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## **Selective Availability, IoT, Suez Canal Visit, Featured at Arab Institute of Navigation Conference**

**BY/ Dana Goward**

**1-3 October 2018**

The recently concluded Arab Institute of Navigation biennial conference in Cairo, “GNSS, the Key to Innovation,” featured a wide variety of presentations of interest to navigators and technologists alike.

Presenters ranged from representatives of the European Space Agency (ESA) and NASA, to those from a transportation company that uses GNSS-enabled tracking while transporting priceless ancient artifacts to the under-construction Grand Egyptian Museum.

Briefing topics included GNSS vulnerabilities as well as GNSS’ roles in Internet of Things (IoT), search and rescue, and smart cities. A challenge mentioned several times was that GNSS services are national systems. While they are now available for use by all, provider nations could degrade or deny service at some point. Selective availability was cited as an example. NASA officials at the conference pointed out that the United States ended selective availability in the year 2000, and that America has pledged it will never be reinstated. Despite this, the possibility of future “selective availability” instances seemed to remain a concern.

The conference was topped off with a technical excursion to the Suez Canal. Conference goers were hosted and briefed by Vice Admiral Mohab Mamish, chairman of the Suez Canal Authority. The briefing included a video detailing how between 2014-15 Egypt built a parallel canal to the original “mother” canal in just under one year. The new canal has allowed simultaneous two-way traffic through the entire length of the waterway. Vessel traffic monitoring and control is based upon the maritime, GNSS-enabled, Automatic Identification System. After sailing on both the old and new Suez canals, conference goers were treated to a fresh seafood dinner sourced from local fish farms that were created when the new canal was built.

# Short shipping as a tool to support integration and economic growth in the Arab region

Prepared by

Dr.Hussien Al-saoub

## Abstract:

Short shipping is a crucial element in the maritime transport industry, contributing significantly to sustained and comprehensive economic growth. However, the sector still faces many challenges that hinder the development of short shipping services around the world in general and in the Arab region in particular.

This research study highlights the concept of short shipping and its importance by identifying the short shipping economics and its legislations in addition to the main problems and obstacles that affect its success. The research also focuses on highlighting the important role of short shipping in promoting Arab regional cooperation to achieve growth and economic integration through the international trade movement using the case study methodology for short shipping operations carried out by the Arab Bridge Company for Navigation between Aqaba in Jordan And Nuweiba in Egypt, The study also summarizes the effects and the positive results whether direct or indirect effects on the economies of both Jordan and Egypt during the period 2009-2013, stressing the fact that short shipping is an effective tool for achieving economic cooperation and integration in the Arab region.

المستخلص:

يعد النقل البحري القصير عنصراً حاسماً في صناعة النقل البحري حيث يساهم بشكل كبير في تحقيق النمو الإقتصادي المستدام والشامل. ومع ذلك، لا يزال هذا القطاع يواجه العديد من التحديات التي تعيق تطوير خدمات النقل البحري القصير في جميع أنحاء العالم بشكل عام وفي المنطقة العربية على وجه التحديد.

يتم تسليط الضوء في هذه الدراسة البحثية على مفهوم النقل البحري القصير وأهميته من خلال التعرف على اقتصاديات النقل البحري القصير والتشريعات الخاصة به بالإضافة إلى أبرز المشاكل والمعوقات التي تؤثر على نجاحه. كما يركز البحث على إبراز الدور الهام للنقل البحري القصير في تعزيز التعاون الإقليمي العربي لتحقيق النمو والتكامل الاقتصادي من خلال حركة التجارة الدولية، وذلك باستخدام منهجية دراسة واقع الحال (case study) لعمليات النقل البحري القصير التي تقوم بها شركة الجسر العربي للملاحة بين العقبة في الأردن ونوبيع في مصر، حيث يلخص البحث إلى الآثار والنتائج الإيجابية الكبيرة سواء كانت آثاره مباشرة أو غير مباشرة على اقتصاديات كلاً من الأردن ومصر خلال الفترة 2009:2013، مؤكداً حقيقة مفادها أن النقل البحري القصير هو أداة فعالة لتحقيق التعاون والتكامل الاقتصادي في المنطقة العربية.

## 1. Introduction

Maritime Transport is considered the spine of worldwide trade, which accounts for 70% of transportation demand worldwide, and is of a crucial importance to any economy, and different maritime activities generate many benefits to the people forming a main stimulant for socio-economic development and international competitiveness (Maritime's Strategic Economic Importance, 2013).

The ultimate target of a regional economic cooperation which includes different shapes and levels among countries in the same geographic territory, is to enhance cross border connectivity and gain mutual economic welfare. (United Nations Conference on Trade and Development, "Trade and Development Report, (2007).

The process of creating constant and distinguished maritime services between EU member states, will present short sea shipping (SSS) as a genuine substitute for crowded road networks (European Commission, DG Energy and Transport, 2006).

## 2. Short Sea Shipping and its Main Characteristics

### 2.1 Short Sea Shipping (SSS) Definition

There is no public acceptance for a certain definition. Douet and Cappuccilli, (2011) stated that: "Defining SSS is not an easy task since there is no general agreement on the concept". Many international associations defined SSS as follows:

### 2.1.1. European Commission Definition

EU defined SSS as: "The movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports and ports situated in the non-European countries having a coastline on the enclosed seas bordering Europe". European Commission, (1999), OECD, (2003).

That is, SSS includes domestic and international maritime transport, including feeder services, along the coast and to and from the islands, rivers and lakes.

### 2.1.2 The US Department of Transportation Maritime Administration Definition.

The US Department defined SSS as: "Coast-wise waterborne transportation of freight and/or passengers by navigable waterways without crossing an ocean". U.S. Army Corps of Engineers, (2009).

### 2.1.3. The Canadian Definition.

Transport Canada defines SSS as: "Multimodal concept involving the marine transportation of passengers and goods that does not cross oceans and takes place within and among Canada, the United States and Mexico". (Transport Canada, 2006).

### 2.1.4. The IMO Recommended Definition.

IMO promotes SSS as: "Short sea shipping (SSS) is defined as the commercial shipment of cargo or passengers by domestic and international maritime transport. In general, this subsector of marine transportation operates in coastal and inland waterways, does not cross an ocean and often is in competition with road and rail networks" (CSL Group, Research and Traffic Group, 2013).

The above mentioned definition has broad, global application and is the most precise definition matching ABM's case

## **2.2 Economics of Short Sea Shipping (SSS)**

### **2.2.1 Energy Saving and its influence on the Environment**

The amount of fuel consumed per unit of cargo carried by SSS vessel is less than the amount consumed per unit of cargo by road transport. (Casaca & Marlow, 2007). This means that the resulting emissions from SSS operations are less than emissions caused by road transport.

### **2.2.2 Capacity**

SSS vessels can carry larger amounts of cargo than other competitive modes of transport, bearing in mind that RoRo short sea vessels have less capacity than regular container vessels. Hence, RoRo short sea shipping costs three times more than regular container vessels of the same size. (Casaca & Marlow, 2007).

### **2.2.3 Infrastructure**

Efficient and adequate infrastructure is needed for SSS to increase its competitiveness. Consequently, RoRo short sea shipping can satisfy the needs of international business and trade, if the port has sufficient flexibility and efficient connectivity to intermodal transport (Casaca & Marlow, 2007).

### **2.2.4 Short Sea Shipping Competitiveness**

The SSS competitiveness based on the theoretical framework formulated by (Musso, E. et. al., 2010) depends on the availability of five conditions simultaneously: (Cargo volumes, origin-destination should not be multiple, location of single shipments should allow unification of parcels, the direct cost derived from transshipment should be less than the direct cost of using best transport mode and the higher ratio of maritime distance to inland distances).

## **2.2.5 Economic Benefits of Short Sea Shipping**

SSS has many economic benefits, that is without the Canadian Great Lakes fleet and the Seaway, it would not be economically possible to deliver iron ore from Quebec/Labrador to Canadian and U.S. steel mills along the Lakes. The EU is the largest trading bloc in the world and 2% of its GDP comes from the maritime cluster, representing 350,000 jobs. Also Japan's Cabotage market is closed to all but Japanese flag vessels. This sector carried 35.9% of Japanese domestic cargo. (CSL Group, Research and Traffic Group, 2013).

## **2.3 Regulations of SSS**

The European Union (EU) have laid out specific standards to promote SSS and enhance its competitiveness, which is considered as a model for regulation in this regard, where the EU efforts have continued since the 1990's to regulate the operations of SSS to ease the congestion and eliminate emissions on roads and rail through shifting to SSS.

The European Commission (EC) has initiated a communication in 1995 regarding SSS and issued a progress report in 1997. A second progress report on SSS titled "A dynamic alternative in a sustainable transport chain" was submitted in 1999 which investigated the barriers facing the improvement of SSS operations in the EU, and proposed a wide ranged door to door perspective with one stop shops to foster SSS.

In 2011, the EC has underlined its policy and regulations to achieve a competitive and resource efficient transport system emphasizing the importance of utilizing traffic management and ITS systems, advanced logistics, eliminating Cabotage constrains and termination of SSS obstacles. The EC stressed also on developing seaports to accommodate increased volumes of freight by short sea shipping among EU countries and the rest of the world (White Paper, 2011).

## 2.4. Barriers and Obstacles of SSS

Baindur and Viegas (2011) identified four groups of barriers to a successful SSS as follows:

1. **Regulatory barrier:** despite European efforts to standardize and harmonize the regulations concerning SSS operations since the 1990's, there are still inadequate regulations among ports worldwide regarding pollution, safety and security.
2. **Technical barrier:** there is a necessity to unify different freight distribution systems, which implies harmonization between European pallets and ISO containers.
3. **Commercial barrier:** high investment cost of new Ro-Ro ships, may be considered as a barrier for operating SSS, unless there is sufficient and continuous demand.
4. **Environmental barrier:** the SSS may lead to the use of a mix of different types of ships, so the fuel consumption may increase due to using bigger ships and congestion in ports, which will affect the environment badly.

### 3. Maritime Regional Cooperation and its Importance

Economic growth and integration is enhanced through regional cooperation in terms of international trade, where regional infrastructure investments projects are boosted. Simultaneously, the role of regional cooperation is deeply highlighted in order to accommodate the arising international externalities due to cross border trade flow supporting services and to increase social advantages (Trade Facilitation and Regional Cooperation in Asia, 2010).

The maritime sector accounts for 70% of transportation demand worldwide, and is of a crucial importance to any economy, and different maritime activities generate many benefits to the people forming a main stimulant for socio-economic development and international competitiveness (Maritime's Strategic Economic Importance, 2013).

## 4. SSS as an Instrument for Arab Maritime Regional Cooperation (The Case of Arab Bridge Maritime Company)

### 4.1. Introduction

Arab Bridge Maritime (ABM) is the outcome of the regional cooperation between the governments of Jordan, Egypt and Iraq. The establishment of the Company was not based on a political decision only, but on the basis of a comprehensive economic vision and the insight of the decision-makers in connecting the Arab Mashreq with the Maghreb, to achieve comprehensive economic development, and as a replacement of the loss of Palestine in 1948 which was the bridge linking the East and West of the Arab region.

Thus this cooperation supports the economic integration and growth between the three countries (Iraq, Jordan and Egypt) in terms of GDP increment through the value added generated from maritime activities, governments' revenues and employment opportunities.

So this research will analyze and measure the economic effects on the Jordanian and Egyptian economies on the macro level during the period 2009-2013 where the next period faced the effects of the so called Arab Spring.

### 4.2. ABM Business Generation Contribution to the Economy

ABM's contribution as a stream of direct business generation is accounted for a total of USD 325 million during the period 2009-2013 (192 USD million into Jordan's economy, and 125 USD million into Egypt's economy) as shown in table 4.1. Also ABM's intermediate consumption of local third parties worth a total of USD 103 million in Jordan, and USD 60 million in Egypt as shown in Figures 4.1, 4.2:

Table 4.1 ABM Company Revenue, 2009-2013

In (000s)	Unit	2009	2010	2011	2012	2013	Cumulative sum
<b>Quantities</b>							
Departing passengers	# of passengers	444	419	378	412	266	1,919
Arriving passengers	# of passengers	398	357	335	358	233	1,681
Outward vehicles	# of Vehicles	49	49	45	77	42	262
Inward vehicles	# of Vehicles	40	40	35	39	34	188
Cargo exports	Tons	461	624	867	695	639	3,286
Cargo imports	Tons	797	945	988	1,030	998	4,758
<b>Values</b>							
Jordan	USD	41,751	41,322	38,036	48,063	22,411	192,214
Egypt	USD	26,865	28,824	27,308	25,967	15,519	124,483
KSA	USD	617	4,951	2,630	-	-	8,198
<b>Total Direct impact</b>	<b>USD</b>	<b>69,233</b>	<b>75,697</b>	<b>67,973</b>	<b>74,031</b>	<b>37,940</b>	<b>324,804</b>

Source: ABM Data 2013, Researcher Analysis

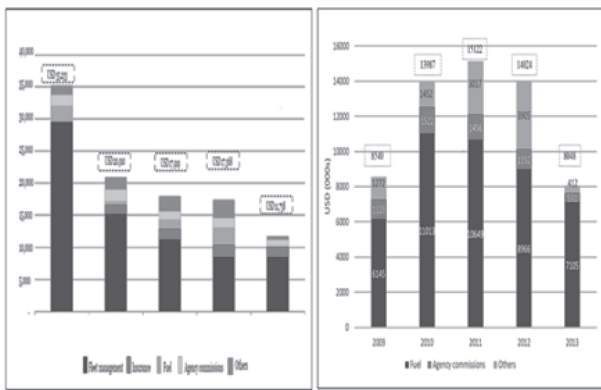
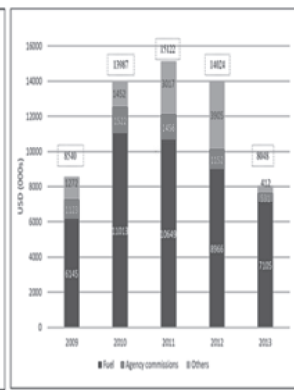


Figure 4.1  
ABM's Local Intermediate Consumption in Jordan



4.2 Figure  
ABM's Intermediate Consumption in Egypt

### 4.3. The Effect of ABM Operations on the GDP

The GVA from the water transport sector in Jordan during the period 2009-2013, contributed by an average of 2.5% to the GVA from the transport and storage sector. Cumulatively, the water transport sector generated a GVA of USD 279 million during the period 2009-2013 as shown in Table 4.2, where on average, ABM directly contributed to 44% of Jordan's water transport sector.

Table 4.2 Jordan's Transport and Storage Sector Contribution to Total GVA

In million USD	2009	2010	2011	2012	2013
Land Transport; transport via pipelines	1,013	1,228	1,262	1,363	1,518
Maritime Transport	46	56	55	58	64
Air Transport	185	217	216	228	250
Supporting and auxiliary transport activities	516	613	642	725	813
<b>Total GVA transport and storage</b>	<b>1,760</b>	<b>2,114</b>	<b>2,175</b>	<b>2,374</b>	<b>2,645</b>
Transport and storage GVA as a % of Jordan's total GVA	8.3%	9%	8.6%	8.7%	8.9%
Water transport GVA as a % of transport and storage GVA	2.6%	2.6%	2.5%	2.4%	2.4%

Source: Euro monitor, Researcher Analysis

Egypt's transport and storage sector contribution to the total GVA is calculated as shown in Table 4.3:

Table No 4.3 Egypt's Transport and Storage Sector Contribution to GVA

In million USD	2009	2010	2011	2012	2013
GVA from Transport and Storage	12	13	14	15	14
Egypt's total GVA	179	204	220	243	243
Transport and storage GVA as a % of Egypt's Total GVA	6.7%	6.4%	6.4%	6.2%	5.8%

Source: Euro monitor 2013, Researcher Analysis

### 4.4. The Effect of ABM Operations on Governments' Revenues

ABM contributes to the government revenues in Jordan by USD 68.6 million through different sources, where the most important source is departure tax, followed by Aqaba port fees, dividend payout and employees' income tax, where ABM's contributes to the government revenues in Egypt by USD 45.8 million including dividend payout, departure taxes, sales taxes, Nuweiba port fees and employee income tax as shown in Figures 4.4, 4.5:

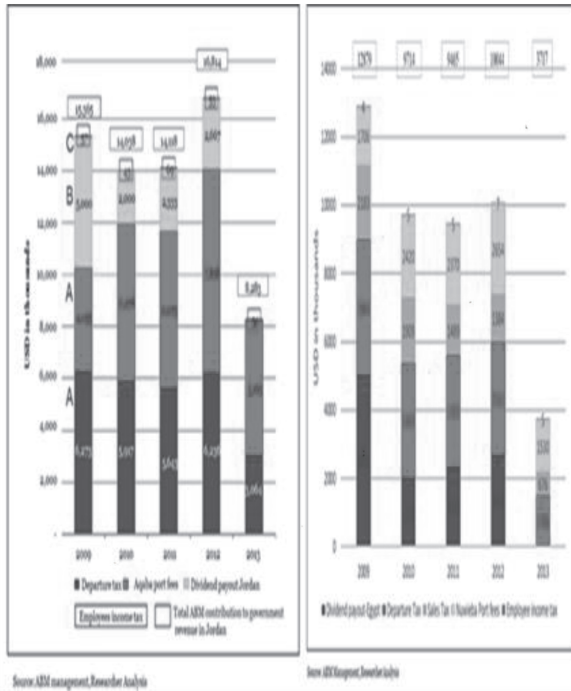


Figure 4.4 ABM's Contribution to the Government's Revenues in Jordan

Figure 4.5 ABM's Contribution to the Government Revenue in Egypt

#### 4.5. The Effect of ABM Operations on Employment

ABM currently supports an approximate of 462 Jordanians and 90 Egyptians (including ABM employees and their direct families), where ABM has paid a total of USD 14.7 million to its direct employees in Jordan during 2009-2013.

In 2012, ABM employed 8 direct employees and 847 indirect employees in Egypt, where ABM has paid a total salaries of USD 255 thousands during 2009-2013.

ABM's normal course of business entails the continuous out-sourcing services which is considered as the indirect employment involving local third parties, where ABM indirectly led to the employment of a total of 491 employees in Jordan at Arab Marine Services Company, Aqaba Port, Farah Catering Company, Arab Ship Management Company and the cleaning Staff.

Also, ABM indirectly led to the employment of a total of 770 employees at Nuweiba Port in 2012, as well as 70 employees at Canal Shipping Agencies Company and 7 employees at Mega Water services which provides maintenance services to ABM's water desalination station in Nuweiba.

#### 5. Conclusions

ABM Company has formed an excellent real-life model of a successful maritime regional cooperation between three Arab countries (Iraq, Jordan and Egypt) as a liner operator specialized in SSS services between Aqaba-Nuweiba ports for both passengers and cargo. In doing so it is acknowledged that the basis of a comprehensive economic vision and insight of the decision-makers in connecting the Arab Mashreq with the Maghreb was the driving force of such a cooperation. Hence, this research concludes the following:

1. There is a great potential of using SSS in the Arab region to shift freight transport from congested roads and rail, which will reduce emissions and facilitate trade within neighboring countries.
2. Maritime Policies should be designed to encourage SSS in the Arab region due to the comparative advantages in operating vessels in SSS, in order to reduce road congestions and oil subsidies. Consequently, the policy maker in the Arab region has to adopt SSS as an instrument for maritime regional cooperation, based on the European success stories as well as ABM experience, to boost trade and development through achieving externalities and socioeconomic welfare.
3. SSS has a great influence on economic growth and integration through regional cooperation in terms of international trade, where regional infrastructure investment projects are boosted and where SSS supports regional cooperation which accommodates the arising international externalities due to cross border trade flow supporting services.



4. ABM operations have yielded huge benefits for both Jordanian and Egyptian economies in terms of direct and indirect generation of business, direct and indirect cumulative contribution to government revenue, employment opportunities, contribution to GDP and improving the balance of payment, whereas the Jordanian economy has benefited relatively higher than the Egyptian economy, due to the existence of ABM's headquarters in Jordan and the huge size of Egypt's economy.

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## Intention towards Risk Assessment Management of Oil Transportation in the Maritime Sector

Prepared by

Capt. Yasser El-Haridi

### Abstract:

The purpose of this paper is to discuss the intention towards risk assessment and management of oil transportation to prevent oil spilling and accidents arising from human errors. The model used is based on theory of planned behavior, where it was found that human behavior could be changed according to officers' attitude and perceived behavior control, while it is not affected by officers' subjective norms. This research gives insight to the importance of controlling human attitude and behavior to be able to increase the intention towards risk assessment and management and also to have better behavior when dealing with oil transportation in the maritime sector.

Keywords: Risk Assessment, Oil Spilling, Attitude, Theory of Planed Behavior, Theory of Reasoned Action.

### المستخلص:

الغرض من هذه الورقة هو مناقشة مراجعة تقييم المخاطر لإدارة النقل النفطي لمنع تسرب النفط والحوادث الناشئة عن الأخطاء البشرية. ويستند النموذج المستخدم إلى نظرية السلوك المخطط ، حيث وجد أن السلوك البشري يمكن أن يتغير وفقا لموقف وادراك الضباط والتحكم في مدى قدره على التصرف ، في حين أنه لا يتأثر بمعايير الضباط الشخصية. يعطي هذا البحث نظرة ثاقبة لأهمية التحكم في وعى الإنسان ليتمكن من زيادة الإدراك فى تقييم المخاطر وإدارتها وأيضاً لتحسين الوعى عند التعامل مع النقل النفطي في القطاع البحري.

## 1. Introduction

Human error is cited as the predominant cause of transportation accidents. Thus, human error is the primary cause of most transportation related accidents according to all research studies and investigation reports (Harrald et al., 1998). Prevention programs must, therefore, effectively reduce the incidence of human error, but where should these programs be targeted, how effective will they be, how much do we know about the types and causes of human error that result in maritime accidents, are considered as some important questions to be answered (Wiegmann and Shappell, 2017).

Risk assessment is a well-developed field which many operators are currently applying to improve their operations and reduce their risk exposure (Mousavi et al., 2016).

Significant modeling assumptions and a great deal of skill and effort in obtaining relevant data are required to portray human error in a manner that produces useful and accurate results. Risk managers and other stakeholders must pay attention to the hidden assumptions and selected data that drives the risk models (Grabowski et al., 2000).

On the other hand, oil spill is a great challenge nowadays in the maritime sector. It is detected by remote sensing as an essential component. Oil spills are one of the major sources of marine pollution. About 87 million barrels of oil are developed globally every day, which are then transported by pipelines and via marine vessels. Leakage may occur during the process of transporting oil, which will result in environmental pollution. Thus, reducing the risk of oil spill disasters is essential for protecting the environment and reducing economic losses. Oil spill surveillance constitutes an important component of oil spill disaster management. The public expectation is that oil spill extent and location are precisely mapped. Response personnel can use this location information to implement countermeasures to minimize the effect of pollution. Remote sensing is used to check for illegal discharges from ships.

This paper describes the modeling of human error related accident event sequences in a risk assessment of maritime oil transportation through examining the officers' attitude and behavior towards risk assessment and management. This research is presented in five main sections; the first is an introduction to the research aim and objectives. The second section displays recent studies about risk assessment in the maritime sector, while the third section represents the research framework and model used. The fourth section presents the results and findings, while the fifth section presents the conclusion derived from this research and recommendations of how to have better behavior.

For historic reasons the size of oil spills have been categorized into three categories, small (< 7 MT/ < 50 bbls), medium (7 – 700 MT/ 50 – 5,000 bbls) and large (> 700 MT/ > 5,000 bbls). It is interesting to note that sea borne trade continues to increase from 1985, which may imply an increased risk. However, the number of spills from tankers over 7 MT shows a steady decline. Interestingly that prior to 1985 the trends in spills seemingly follow the fluctuations in seaborne traded. The divergence after 1985, is possibly related to increased awareness, the international conventions and the joint industry, government efforts through the International Maritime Organization (IMO). The number of large incidents (> 700 MT) has dropped significantly from an average of 25 per year in the 1970's to just over three incidents per year in the past 10 years.

## 2. Literature Review

In any effort to identify hazards and assess their associated risks, there must be full consideration of the interface between the human operators and the systems they operate. Human Factors Engineering (HFE) issues can be integrated into the methods used to identify hazards, assess risks, and determine the reliability of safety measures (Mousavi et al., 2016). The immediate precursor of the accident is termed a triggering incident. Furthermore, accidents and triggering incidents occur within the context of a system state. In terms of accident risk, the system state is defined by combinations of organizational factors (OF) and situational factors (SF) (Merrick et al., 2000). Table 1 shows the human errors, classified as: Diminished Ability, Hazardous shipboard environment, lack of knowledge, skills or experience.

Table 1: Human Errors Type and Description

HUMAN/ORGANIZATIONAL ERROR CLASSIFICATION	DESCRIPTION
Diminished ability	Physical, mental, motivational or emotional conditions that degrade performance
Hazardous shipboard environment	Poor ergonomic design, poor maintenance, or poor vessel housekeeping
Lack of knowledge, skills, or experience	Lack of general professional knowledge, ship specific knowledge, knowledge of role responsibility, or language skills
Poor management practices	Poor supervision, faulty management of resources, inadequate policies and procedures
Faulty perceptions or understanding	Inability to correctly perceive or understand external environment

Source: Merrick et al. (2000)

The theory of planned behavior (TPB) is a theory that has been widely used in predicting the intention to perform a behavior or discontinue a behavior. The theory of planned behavior (TPB) constitutes that individuals who believe (or determine) that a selected behavior will result in a positive outcome and is meaningful to other people who are important to them and also perceive the behavior to be within their control, will be more likely to perform the selected behavior than individuals who do not have one or more of these beliefs. The theory of planned behavior (TPB) is based on four general constructs; intention, attitude, subjective norms, and perceived behavioral control. The three latter constructs are used to predict intention to perform a selected behavior (Ajzen, 2008).

Attitudes, which are mostly permanent and stable evaluative summaries about an item, are an imperative psychological construct because they have been found to affect and predict many behaviours (Jalilvand and Samiei, 2012). In Theory of Reasoned Action (TRA), attitude is denoted as the evaluative effect of positive or negative feeling of individuals in carrying out a particular behaviour (Gopi and Ramayah, 2007). The theory of planned behavior (TPB) describes

attitude towards a behaviour as “the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question”. Attitude toward the behaviour relates to the degree to which an individual has a favourable or unfavourable evaluation, or appraisal, of the aimed behaviour. On the whole, the more favourable the attitude toward the behaviour, then the firmer will be an individual’s intention to do the behaviour. Attitude was identified as: “the user’s evaluation of the desirability of his or her using the system,” a function of the subjective probability that the usage behaviour will lead to a specific outcome and a rating of the desirability of the outcome.

The theory of planned behavior (TPB) suggests a second determinant of intention, subjective norm. Within The theory of planned behavior (TPB), subjective norm is identified as “the perceived social pressure to perform or not to perform the behaviour” by the individual. Gopi and Ramayah (2007) also defined it as the individual’s perception of the probability that the potential referent group or individuals approve or disapprove of carrying out the given behaviour. Individuals may be affected by family members, friends, colleagues and relatives (Jain et al., 2017). The theory of planned behavior (TPB) views the role of social pressure to be more vital when the motivation to act in accordance with that pressure is greater. Motivation to comply is the degree to which the person desires to comply with the wishes of the other party. A component of subjective norm is normative belief, or the individual’s perception of a substantial referent other’s opinion about the individual’s performance of the behaviour (Baker et al., 2007; Jalilvand and Samiei, 2012).

The theory of planned behavior (TPB) suggests a third determinant of behavioural intention: perceived behavioural control. Perceived behavioural control (PBC) denotes: “the perceived ease or difficulty of performing the behaviour”. Moreover, Perceived behavioural control (PBC): “is assumed to reflect past experience in addition to anticipated impediments and consequences.” According to the theory of planned behavior (TPB), it is the perception of behavioural control, contrasted with the level of actual behavioural control, that directly influences both intentions to perform a behaviour,

along with the actual performance of that behaviour. The interpretation of Perceived behavioural control (PBC) is like that of perceived self-efficacy, which is “concerned with judgments of how well one can implement courses of action essential to deal with prospective situations”. It was established that people’s behaviour is intensely affected by their confidence in their ability (i.e. perceive behavioural control) to perform that behaviour (Baker et al., 2007; Jalilvand and Samiei, 2012; Gopi and Ramayah, 2007; Jain et al., 2017; Cheng et al., 2015).

The decision to complete a risk assessment is preceded by the individual having the intention to do so. This cognitive process involves understanding multiple constructs in order to comprehend fully the primary factors included with this decision. The theory of planned behavior (TPB) provides a framework to predict multiple attributes of individuals who do and do not intend to complete a risk assessment. In the following section, the research methodology for this paper is determined based on theory of planned behavior.

### 3. Research Methodology

The research framework is illustrated in Figure 1, where it could be observed that the independent variables are Attitude, Subjective Norms and Perceived Behavior Control. The dependent variable is the Behavior and the mediator is the Intention.

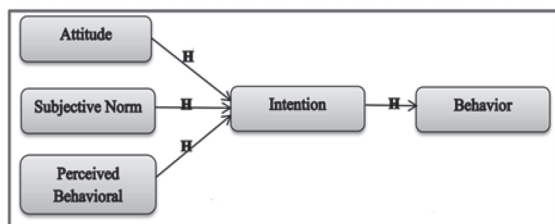


Figure1: The Research Framework  
Source: The Researcher

A questionnaire was adopted from previous studies (Baker, 2007; Sumaedi et al., 2016) and introduced to officers in the maritime sector to evaluate their behavior regarding the risk assessment and management of oil transportation. A number of 400 officers were questioned and results of their responses are shown in the following section.

### 4. Results and Findings

Table 2 shows that all Average Variance Extracted (AVE), Kaiser-Meyer-Olkin (KMO) and factor loadings are beyond the cutoff values, which means that the validity is on the acceptable level. Also, the reliability scale of Cornbrash’s alpha exceeds the cutoff value of 0.7, which means that the data is ready to perform the required analysis.

Table 2: Validity and Reliability Test

Variables	KMO	AVE	Cronbach's Alpha	Items	Factor Loading
Attitude	0.670	72.291 %	0.807	Item 1	0.798
				Item 2	0.593
				Item 3	0.778
Subjective Norms	0.675	68.682 %	0.767	Item 1	0.651
				Item 2	0.649
				Item 3	0.764
Perceived behavior control	0.500	79.474 %	0.739	Item 1	0.795
				Item 2	0.795
				Item 3	Rephrased
Intention	0.500	80.794 %	0.762	Item 1	0.808
				Item 2	Rephrased
				Item 3	0.808
Behavior	0.665	68.579 %	0.768	Item 1	0.651
				Item 2	0.772
				Item 3	0.634

Table 3 shows the frequency tables for the research variables, where it could be observed that responses vary between disagree and agree, which means that not all responses are in the zone of agreement. In other words, the sample under study faces a problem as the respondents’ reactions were not all in the agreement zone thus, in this study testing of hypothesis will be observed to identify which variables direct customers to be in the disagreement zone.

Table 3: Descriptive Analysis for the Research Variables

	N	Mean	Std. Deviation	Frequency				
				1	2	3	4	5
Attitude	400	3.8925	.89046	5	29	65	206	95
Subjective Norms	400	3.7900	.77937	2	22	94	222	60
Perceived behavior control	400	3.3775	.83770	5	40	192	125	38
Intention	400	3.7400	.84806	1	29	116	181	73
Behavior	400	3.8250	.88109	9	22	76	216	77

Table 4 shows the correlation matrix for the relationship between Attitude, Subjective Norms, Perceived behavior control, Intention and Behavior. It was found that the relationship is significant, as the corresponding P-value is less than 0.05 and correlation coefficients are 0.727, 0.275, 0.412 and 0.224 respectively.

Table 4: Correlation Matrix between Research Variables on Behavior

		Attitude	Subjective Norms	Perceived behavior control	Intention	Behavior
Attitude	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	400				
Subjective Norms	Pearson Correlation	.350**	1			
	Sig. (2-tailed)	.000				
	N	400	400			
Perceived behavior control	Pearson Correlation	.421**	.306**	1		
	Sig. (2-tailed)	.000	.000			
	N	400	400	400		
Intention	Pearson Correlation	.165**	.061	.110*	1	
	Sig. (2-tailed)	.001	.221	.027		
	N	400	400	400	400	
Behavior	Pearson Correlation	.727**	.275**	.412**	.224**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	400	400	400	400	400

\*\* Correlation is significant at the 0.01 level (2-tailed).  
\* Correlation is significant at the 0.05 level (2-tailed).

Table 5 shows the regression model fitted for the effect of research variables on Intention. It illustrates that there is a significant positive effect of Attitude on Intention as the regression coefficient is 0.139 and P-value is 0.010. Moreover, it is found that there is insignificant effect of Subjective Norms and Perceived behavior control on Intention as P-values are -0.006 and 0.051 respectively. Besides, the R squared is 0.029, which means 2.9% of the variation of the Intention can be explained by the independent variables together.

Table 5: Regression Model for the Effect of Research Variables on Intention

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	R-Square
	B	Std. Error	Beta			
(Constant)	3.048	.252		12.109	.000	0.029
Attitude	.139	.054	.146	2.585	.010	
Subjective Norms	-.006	.059	-.005	-.098	.922	
Perceived behavior control	.051	.056	.050	.909	.364	

a. Dependent Variable: Intention

Therefore, the first hypothesis of the study are supported, while the second and third hypotheses are not supported.

Table 6 shows the regression model fitted for the effect of Attitude, Subjective Norms, Perceived behavior control on Behavior. It illustrates that there is a significant positive effect of Attitude and perceived behavior control on Behavior, as the regression coefficients are 0.665 and 0.136 and P-values are 0.000 ,0.001 respectively. Moreover, the R square is 0.542 which means 54.2% of the variation of the Behavior can be explained by the independent variables together.

Table 6: Regression Model of Behavior Dimension on Officers Intention

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	R-Square
	B	Std. Error	Beta			
(Constant)	.777	.180		4.323	.000	0.542
Attitude	.665	.038	.672	17.329	.000	
Subjective Norms	.000	.042	.000	-.006	.995	
Perceived behavior control	.136	.040	.130	3.394	.001	
a. Dependent Variable: Behavior						

As it was shown in Table 5 above that there is a positive significant effect of Attitude on Intention, as the corresponding P-value is less than 0.05. Moreover, there is a significant effect of Attitude, Perceived behavior control and Intention on Behavior as Table 7 below depicts. Therefore, there is a partial mediation role between Attitude, Subjective Norms, Perceived behavior control and Intention.

Table 7: Regression model of the Mediation Role of Intention between Research Variables and Behavior

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	R-Square
	B	Std. Error	Beta			
(Constant)	.455	.208		2.184	.030	0.552
Attitude	.650	.038	.657	16.971	.000	
Subjective Norms	.000	.041	.000	.009	.993	
Perceived behavior control	.131	.040	.124	3.288	.001	
Intention	.106	.036	.102	2.972	.003	
a. Dependent Variable: Behavior						

#### 4. Discussion and Conclusion

The research findings shows that it is important to improve the attitude towards the oil spilling behavior as well as the perceived behavior control and intention. The mentioned variables show a significant effect of officers behavior to improve. Therefore, the policies and procedures introduced should enhance such factors to be able to have better officers behavior. Oil spills constitute a serious distortion of marine life's animals and their habitat.

Oil spill thus, surveillance is an important part of oil spill contingency planning. To limit the damage by a spill and facilitate containment and cleanup efforts, researchers, and emergency managers must obtain real-time remote sensing information on spill location, size and extent of the spill, direction and speed of oil movement by using right sensor devices for the missions. For such risk assessment to happen, officers should alter their behavior and intention towards risk assessment by improving their attitude and intention towards oil transportation risk assessment. This might happen through incentives for this or certain penalties that could control the risk assessment process.

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## The proposed protecting measures against pirates attacks

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### Abstract

Maritime piracy and armed robbery against ships are of the challenges the maritime industry currently faces. These two phenomena negatively impact maritime trade and security on a global level. Nowadays, vast areas of the world's seas and oceans such as the Gulf of Aden and the Indian Ocean are considered high risk areas in terms of piracy and armed robbery against ships' activities. Both personal property and human lives are threatened by piracy. In this respect, the international community and the coastal states of the region have exerted every effort possible to try to find ways to address the problem .

Paper includes available literature and quantitative approach to pirate attacks and measures against them with reviews the definition of maritime piracy and armed robbery according to the IMO, the emergence of piracy, statistics of piracy acts, affected areas around the world, suggested preventative measures and recommendations on using technological methods of non-lethal anti-piracy weapons. Also, the paper aims to explore the precautionary measures to be taken to improve the maritime security and the actions made by the different maritime organization against piracy.

### Key words

Maritime piracy, non-lethal weapons, maritime security, armed robbery against ships

### المستخلص

القرصنة البحرية والسطو المسلح ضد السفن هي من التحديات التي تواجهها الصناعة البحرية حالياً مما يؤثر سلباً على التجارة البحرية والأمن على المستوى العالمي. وفي الوقت الحاضر، تعتبر المناطق الشاسعة من بحار العالم ومحيطاته مثل خليج عدن والمحيط الهندي هي مناطق شديدة الخطورة فيما يتعلق بالقرصنة والسطو المسلح ضد أنشطة السفن. كل من الممتلكات الشخصية والأرواح البشرية مهددة بالقرصنة. وفي هذا الصدد، بذل المجتمع الدولي والدول الساحلية في المنطقة كل جهد ممكن لمحاولة إيجاد طرق لمعالجة المشكلة.

تتضمن منهجية الورقة بعض الأدبيات والنهج الكمي المتاح لهجمات القرصنة والتدابير ضدهم بإستعراض تعريف القرصنة البحرية والسطو المسلح وفقاً للمنظمة البحرية الدولية، ظهور

القرصنة، إحصائيات أعمال القرصنة، المناطق المتأثرة في جميع أنحاء العالم، إقتراح تدابير وقائية وتوصيات بشأن استخدام الأساليب التكنولوجية للأسلحة غير القاتلة لمكافحة القرصنة. كما تهدف الورقة إلى استكشاف التدابير الاحترازية الواجب اتخاذها لتحسين الأمن البحري والإجراءات التي تتخذها مختلف المنظمات البحرية لمكافحة القرصنة.

## 1. Introduction

The word “pirate” is derived from the Latin word “pīrāta”, where the idea of ‘sea robber’ originated and from the Greek word “peirātés” which means ‘attacker’ or ‘marauder’ as a noun originating from the verb “peiran” denoting ‘attempt’ or ‘attack’. In this sense, a pirate is, etymologically, a person who undertakes an attempt of attack or an actual attack on someone (Randrianantenaina, 2013).

Piracy seems to have been, for many centuries, a way of life for many. As a result, for a long time it has been an omnipresent danger, plaguing the world oceans and seas. That was true in the past and still is true today. Recorded history shows that since the days of ancient Greece and the Roman Empire, piracy has been an impediment to maritime trade, spreading across every maritime region of the world, from the Mediterranean and Northern European seas, to Asia, the Middle East and Africa and the Americas. It is believed that even the great Julius Caesar, while still young, was taken hostage by pirates in the year 78 BC, only to be liberated after a considerable payment to the pirates (Jesus, 2003).

The number of pirate attacks against ships has risen every year between 2006 to 2011, Ships reported 445 attacks in 2010, up 10% from 2009. While 188 crew members were taken hostage in 2006, 1050 were taken in 2009 and 1181 in 2010 (ICC, 2011).

According to IMB, hijackings off the coast of Somalia accounted for 92% of all ship seizures in 2009 with 49 vessels hijacked and 1016 crew members taken hostage. A total of 28 vessels and 638 hostages were still being held for ransom by Somali pirates as of 31 December 2010 (ICC, 2011).

Piracy is not only a major issue to the shipping industry, but also to any companies that manufacture goods and transport them to different countries around the world. Pirates use the modern technology to target ships in highly trafficked waters. Gulf of Aden, Arabian Sea, Coast of Somalia and the Horn of Africa are sailed by many ships and are frequently attacked by the Somali pirates. In most of these attacks, the pirates hold victims hostage with guns but do not actually kill them showing that they are driven by monetary reasons, not violence.

According to Thomas Friedman, globalization could be traced back to 1492 (Friedman, 2005). It gained popularity as technology increased during the late 20th century. As the piracy problem continues to grow, its impact on the global supply chain will be more severe. Companies that currently conduct or are looking forward to conducting international business in the future must be aware of piracy threat and what action must be taken to address it. (Sullivan, 2010).

## 2. Definition of Piracy

“Piracy” is defined, in article 101 of the 1982 United Nations Convention on the Law of the Sea (UNCLOS), as follows:

Piracy consists of any of the following acts:

(a) Any illegal acts of violence or detention, or any act of depredation, committed for private ends by the crew or the passengers of a private ship or a private aircraft, and directed:

(i) On the high seas, against another ship or aircraft, or against persons or property on board such ship or aircraft;

(ii) Against a ship, aircraft, persons or property in a place outside the jurisdiction of any State;

(b) Any act of voluntary participation in the operation of a ship or of an aircraft with knowledge of facts making it a pirate ship or aircraft;

(c) Any act inciting or of intentionally facilitating an act described in sub- paragraph (a) or (b).

The International Maritime Organization (IMO) defines armed robbery as follows:

“Armed robbery against ships” means any of the following acts:

1. Any illegal act of violence or detention or any act of depredation, or threat thereof, other than an act of piracy, committed for private ends and directed against a ship or against persons or property on board such a ship, within a State’s internal waters, archipelagic waters and territorial sea;

2. Any act of inciting or of intentionally facilitating an act described above. This distinction between piracy and armed robbery based on the location of the activity complicates both the reporting and the prosecution of maritime piracy. However, because most attack statistics do not distinguish piracy from armed robbery based on the definitions above (Helmick, 2014).

### **3. The Emergence of Piracy**

The extensive piracy studies provide a good understanding of the factors triggering the spread of piracy. Studies on the root causes of piracy and on the regional variations of piracy operations have elaborated several factors. There are five factors behind the outbreak of piracy. Those factors are Geography, weak law enforcement, maritime insecurity, economic dislocation, and cultural acceptability (Bueger, 2015).

#### **3.1 Geography**

Geography firstly refers to the fact that regions with close proximity to waterways tend to have piracy. Proximity to major lanes of transportation and major ports makes piracy more profitable and therefore increases the possibility of piracy. Secondly, geography refers

To the existence of hideouts that is coastal strips or islands are difficult to reach or control. Pirate's dens are necessary for preparing a piracy operation. In case of ransom, pirates shall anchor the vessel. Pirate's dens require basic infrastructure, such as roads or nearby villages to provide the logistics needed for such operations. Piracy operations can also be launched from ports, especially if they are not properly governed. In geographical terms, Somalia's coastline is 3,025 km. The Gulf of Aden, the southern gateway to the Suez Canal is one of the main trading routes with a number of ships exceeding 20,000 annually including a substantial amount of the world's crude oil navigating through it. A significant number of remote coastal villages provide dens and a sufficient infrastructure for kidnap and ransom (Vrey, 2015). In addition Indonesia, Philippines, Gulf of Guinea and Venezuela are affected by piracy.

#### **3.2. Weak Law Enforcement**

The weak law enforcement factor stresses that the lower the risk of getting caught and punished pirates, the higher the likelihood that piracy occurs. This has to do with various levels of law enforcement stretching from coast guard and naval capabilities by which coastlines and the sea are patrolled for policing, intelligence and reaching the efficiency of the judicial sector allowing prosecuting pirates. In addition, the quality of regional inter-state collaboration in maritime security matters has to be considered. Pirates operate across maritime borders; so efficient collaboration mechanisms are needed to allow for hot pursuit of perpetrators as well as sharing of intelligence and evidence between national agencies.

After years of civil conflict, Somalia's maritime, coastal and territorial law enforcement has been weak. Yet, Somalia has never been in a state of lawlessness. Basic law enforcement is provided through the rudimentary policing and judicial capacities of the regional governments. Yet, as a form of law based on compensations, crimes such as piracy are not subject to it if members of

Somali clans are not involved as victims. Clearly, there was and is a lack of capacities to effectively police the Somali coast and the sea or prosecute suspects in Somalia as well as littoral countries. Moreover, there have been accusations that some parts of Somali governmental elites benefit from or even take part in piracy operations, which shows that corruption is endemic (Vrey, 2015).

### **3.3. Maritime Insecurity**

A factor closely linked to weak law enforcement is the level at which the maritime environment of a region is insecure and susceptible to violence. Piracy tends to take place in seas where there is a host of other illegal activities, such as trafficking, smuggling and illegal fishing. Not only is it relevant to the question of coast guarding and law enforcement at sea, but also in how far violence and insecurity at sea has come to be the norm.

### **3.4. Economic Dislocation**

Piracy has often been described as a business model and seen as an activity that is economically profitable. While piracy promises considerable revenues, a direct causal link between poverty or lack of employment opportunities and piracy cannot be constructed. Rather than poverty per se, the crucial factor is economic dislocation. Communities that tend to engage in piracy are those which have been economically marginalized, deprived of the advantages of economic developments and globalization processes or are not allowed to participate in sources of wealth.

Economic dislocation is elaborated in Somalia in at least two senses. On the one hand, with the end of the UN intervention in the 1990s, Somalia became a territory that received only scant attention from the international community. While humanitarian aid continued to flow, Somalia has neither benefitted from large scale international development support, nor gained a fair share of globalization-induced economic wealth (Bueger, 2015).

On the other hand, coastal communities belong to the marginalized parts of the population within Somalia. Such communities which mainly rely on fishing have lower status in a pastoral society where cattle imply prestige. With maritime insecurity and foreign fishing exploitation increasing from 1995, coastal communities have been disadvantaged and threatened in their livelihood (Weir, 2009).

### **3.5. Cultural Acceptability and Skills**

Piracy has a cultural dimension. In order for piracy to prevail, it requires some sense of legitimacy. Soldiers have to be recruited and convinced that to engage in piracy is a legitimate activity. The majority of piracy operations are dependent on support from local communities which provide shelter, food and other supplies.

Another cultural dimension is the availability of skills required for piracy among the populace. Such skills include navigation, boarding, weapon handling or negotiation skills. Skills necessary to perform piracy are widespread in Somalia and form part of a traditional cultural repertoire. This includes the navigation skills of fishermen and dhow traders, or the negotiation skills provided by a society governed by customary law and informal governance processes. Decades of civil war have taught Somalis skills such as the handling of weapons. Other skills such as the handling of navigation devices or boarding skills have been trained in attempts of setting up coast guards (Beuger, 2015).

## **4. Piracy Statistics**

According to the International Maritime Bureau of the International Chamber of Commerce (ICC), there were 264 pirate attacks reported worldwide in 2013 (ICC, 2013).

Somali piracy, including attacks on vessels plying the Gulf of Aden, Red Sea, Arabian Sea, Gulf of Oman, and in the Western Indian Ocean, has been the center of attention of the maritime industry in recent years. The aggressive hijacking of merchant ships and the holding of

Their crews for ransom climaxed in late 2010; when about 700 mariners were being held off the coast of Somalia aboard 30 merchant ships. The phenomenon of Somali piracy was highlighted for the general public with the release of the film “Captain Phillips,” in 2013 which portrayed the story (Helmick, 2014).

In 2013, there were 23 reported attacks on commercial vessels, none of which were successful. At the same time, there has been a surge in the number of completed piracy attacks on vessels along the West African coast. There were almost 100 such incidents in 2013 (Madsen et al, 2014). During the first quarter of 2014, maritime piracy incident statistics indicate that there were 22 attacks in the Gulf of Guinea/West Africa region, 15 attacks in the Horn of Africa/Western Indian Ocean region, and 31 events in the waters off Southeast Asia (MAREX, 2014).

The accuracy of the statistics cited is quite questionable. Vessel owners and ship masters may be disinclined to report attacks to authorities. The investigation may delay the ship, which is commercially undesirable (Helmick, 2014).

### 5. Maritime Piracy Affected Areas around the World

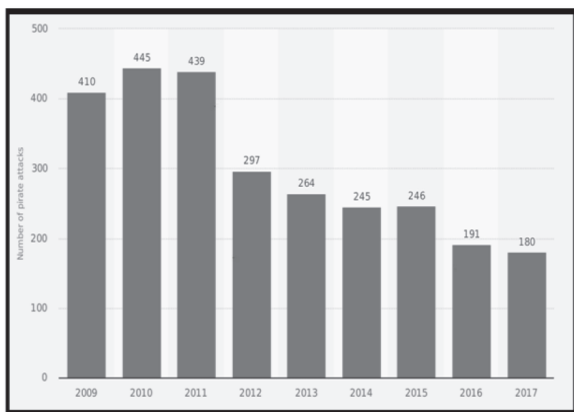


Figure 1. Number of pirate attacks against ships worldwide from 2009 to 2017  
Source: ICC, IMB, Hellenic Shipping News, 2018

The figure shown above depicts the number of pirate attacks against ships worldwide from 2009 through 2017. Declined from 445 attacks in 2010 to 180 in 2017.

Recently Worldwide in the first three months of 2018, 100 crew were taken hostage and 14 kidnapped from their vessels. A total of 39 vessels were boarded, 11 fired upon and four vessels hijacked. By ending the second quarter of 2018 there have been 107 attempted and actual attacks by pirates globally, up from 87 in the same time span in 2017 (ICC, 2018).

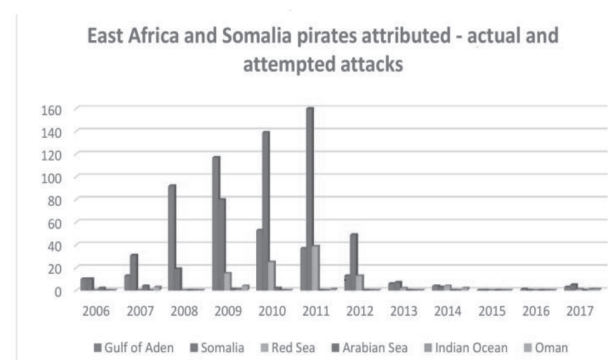


Figure 2. East Africa and Somalia pirates attributed – actual and attempted attacks  
Source: (ICC, IMB, 2018).

The problem of Somali piracy has led to a fundamental re-evaluation of the importance of maritime security for the African continent, and indeed there is a strong international consensus to act and support regional actors to tackle maritime security challenges. In this sense, piracy has opened a window of opportunity to re-organize maritime security governance and build sustainable institutions. With the decline of Somali piracy as shown in figure 2 there is however also the risk that the “momentum” could get lost soon and that the window of opportunity closes.

Table 1. Location of actual and attempted attack, January - December 2014 – 2018

Location	2014	2015	2016	2017	2018
SE ASIA - Indonesia	100	108	49	43	36
Malaysia	24	13	7	7	11
Philippines	6	11	10	22	10
INDIAN - Bangladesh	21	11	3	11	12
AFRICA - Ghana	4	2	3	1	10
Nigeria	18	14	36	33	48
SOUTH AMERICA - Venezuela	1	1	5	12	11
Total at end of year	174	160	113	129	138

Source: ICC, IMB Piracy and Armed Robbery against Ships Report, 2019

Table 1 depicts a decreasing of the attacks in Indonesia while a significant increase in Ghana and Nigeria, Figure 3 shows a seven location recorded around 69% attacks globally from a total of 201 reported attacks for the period of 2018, also the figure shows much attacks in Nigeria than the other areas (ICC, IMB, 2019)

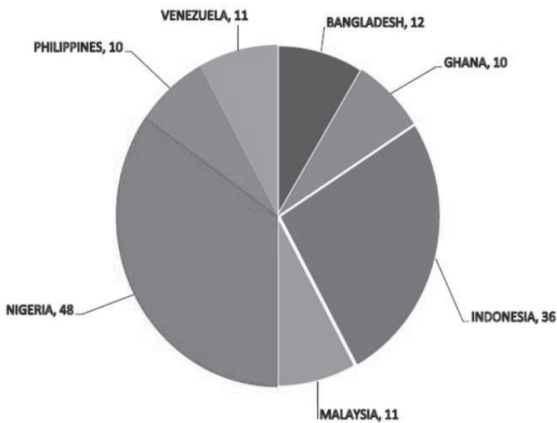


Figure 3. Location of actual and attempted attack in 2018

Source: ICC, IMB Piracy and Armed Robbery against Ships Report, 2019

In the past few years, the menace of maritime piracy has noticeably mushroomed. The spread of sea piracy now is not restricted to one particular area. It has become rampant in almost every part of the world. Detailed below are 10 piracy-affected areas:

### 5.1. Malacca Straits

The Strait of Malacca, which is connecting Indian Ocean and Pacific Ocean, has been an endangered marine piracy area. Since the Strait forms a commercial gateway for the Suez Canal, Egypt and Europe, in addition to being one of the most important Indo-Sino marine navigation routes; the area is susceptible to high occurrences of maritime piracy. Nonetheless, collaborated efforts amongst the Indonesian, Malaysian and Singaporean authorities are being exerted to keep the piracy incidents in this part of the world to the minimum (MI News Network, 2016).

### 5.2. South China Sea

The marine pirates, mostly Malaysians or Indonesians, in the South China Sea are considered to be among the most dangerous pirates.

### 5.3. Gulf of Aden

The Gulf of Aden is another affected piracy sea area at the entrance to the Red Sea. The Gulf forms an important trading route leading into the Suez Canal and geographically well-positioned with the anarchic Somalia.

### 5.4. Gulf of Guinea

The Gulf of Guinea stretches along a major portion of North-Western and Southern Africa (Angola). It is a vital trade route for crude oil tankers to the European and American continents, making it a suitable target for the transgressors. As per the International Maritime Bureau (IMB) statistics, so far there have been 27 reported attacks, though it has been speculated that many incidents may have gone unreported (MI News Network, 2016).

### 5.5. Benin

Benin, in Africa, is another area infested with marine pirates. In terms of marine shipping, Benin has been listed as one of the high risk areas. The IMO has taken pains to counter maritime piracy in this area, though positive results are yet to be seen.

### **5.6. Nigeria**

Located in the Western part of Africa, Nigeria is regarded as a hive for piracy activities. The threat of piracy is so high in the region that it has been rated as one of the most risky areas for marine cargo transportation. Moreover, the security cover provided by the Nigerian naval authorities is lacking, resulting in an increase in sea piracy in the area. Due to the extensive piracy threat, shipping through the entire marine belt of West Africa requires a high insurance cover for the goods being transported.

### **5.7. Somalia**

The major cause of marine piracy occurring in Somalia is because of abject poverty in the region due to civil war, government ineffectualness and the vast toxic-in-nature marine wastes dumped in the Somali sea-waters. Because of piracy, there have been other problems in the form of fast-increasing premium rates for insurance policies. Maritime piracy in Somalia is a cause of international concern as the country people hold the belief that piracy is the only option available to them to ward off poverty and other constraints plaguing them.

### **5.8. Indonesia**

Amongst the affected piracy areas in the world is Indonesia. The areas that are targeted by the sea pirates include the Anambas, Natuna and the Merundung Islands. The Indonesian authorities' punitive response to the captured pirates in the country is also very listless, raising major concerns across the world.

### **5.9. Arabian Sea**

Lying in the Arabian Sea, the Gulf of Oman is one of the areas which have been repeatedly targeted by sea pirates. International organizations and authorities, however, have de-emphasized the importance of providing a security cover in these areas, as compared to that offered in piracy infected areas such as the Gulf of Aden and the Somali coasts. This is mainly because of the limited available naval resources to act as an effective cover and because of the position of the area geographically.

### **5.10. Indian Ocean**

The waters of the Indian Ocean are also falling prey to the acts of sea pirates. The Indian Ocean is an inevitable marine navigation route, highlighting the nature of the problem more starkly (MI News Network, 2016).

## **6. Preventative Measures**

Some of the most effective countermeasures to pirate attacks in the Horn of Africa include rerouting, arming ships with unconventional, nonlethal weapons, and arming ships with security teams. Each of these methods can be effective but comes with consequences that must be considered prior to implementation.

### **6.1 Rerouting East – West Trade to Cape of Good Hope**

Shipping companies may choose to reroute their ships because of Somali piracy to avoid the Gulf of Aden area. This way allows ships to avoid hazardous areas, protecting the crew as well as the cargo on board. Companies will as well pay lower insurance premiums than if they were to travel through the Suez Canal and have a higher likelihood of a safe voyage.

Although the Suez Canal is a convenient route for many international voyages, rerouting oftentimes forces a ship to take a more indirect route. This way is far more expensive and time-consuming. Rerouting to avoid the Suez Canal adds 23–86% more distance onto a voyage. For instance, rerouting a ship from Saudi Arabia to the United States around the Cape of Good Hope can add \$3.5 million in annual fuel costs per ship. Rerouting also forces a ship to use different ports and waterways (Aden, 2013).

### **6.2 Arm Ships with Unconventional Weapons**

Another method would be that shipping companies arm their ships with nonlethal weapons, such as long-range audio devices (L-RAD), magnetic acoustic devices (MAD), electric fences, and holographic radars. Since the crew can use these devices themselves, there is no need for security teams. Calling for additional security takes time but when the crew is armed with non-lethal weapons, they can immediately

Attack when in danger. It is, however, expensive because the shipping company must purchase the weapons and train its crews to use them properly. L-RAD costs approximately \$175,000 and MAD costs \$6,000 to \$150,000 (Cowhig, 2010).

Although sound weapons create loud, uncomfortable noises, pirates are not deterred by them. For example, the pirates that carried out the second attack on the Maersk Alabama in November 2009 seemed to ignore the painful screeching sounds from the ship's L-RAD system. They were only driven away by gunshots fired by an onboard security team. Since pirates carry lethal weapons themselves, trying to counter them with nonlethal weapons is rather inadequate (Thompson, 2009).

### **6.3 Arm Ships with Security Teams**

Shipping companies may arm their ships with security teams. Hiring private security is now considered a common practice for many companies. Advanced economies like the United States have started to recommend that ships embark with private security guards on board, so as to prevent pirates from attacking (Miller 2010). This approach is money-consuming and it is considered as a permanent burden to always have security teams stationed on board especially on routine shipments. Arming ships with security teams is the most effective option, especially for vessels that carry valuable goods. (Sullivan, 2010).

## **7. Anti-Piracy Weapons for Ships to Fight Pirates**

The Israeli-based cargo ship MV Africa Star was attacked by nine pirates in 2009. The ship's crew made use of barbed wire to prevent pirates from climbing on board the ship. A major piracy attempt was thus avoided using a non-lethal anti-piracy method (Raunek, 2017).

Anti-piracy technology has been greatly developed since then, with the introduction of several powerful non-lethal weapons to be used on ships to hinder piracy attacks. Merchant ships now plying in high piracy-affected areas such as the Gulf of Aden carry armed guards along with a series of non-lethal weaponry to thwart piracy attempts.

Detailed below is a list of some non-lethal anti-piracy weapons that can be used to fight piracy. Yet, not many of them have been used on ships .

### **7.1 Long Range Acoustic Device (LRAD)**

Long range acoustic device is a non-lethal anti-piracy device which uses pain-inducing sound beam to drive away the pirates. The sonic weapon produces high pitched noise that is higher than the tolerance level of an average human being. LRAD has been used on few cargo and cruise ships until now.

### **7.2 Anti-Piracy Laser Device**

The anti-piracy laser device uses non-lethal laser beam to provide a visual warning to pirates and distract them temporarily. The laser device can be used during both day and night, and can be easily operated by the ship's crew.

### **7.3 Water Cannon**

The water cannon is another non-lethal weapon which is widely used on merchant vessels. The device delivers powerful and impenetrable stream of water that blows away pirates trying to board the ship. The cannon can also fill the pirates' boats to slow them down and impede their maneuverability. Most of the water cannon systems can be remotely controlled from a safe position on ships.

### **7.4 Electric Secure Fence**

Electric fence non-lethal system is an electric fence which surrounds the ship and prevents pirates from climbing. The system is a collapsible fence which can be folded and kept safe when not in use.

### **7.5 Nets – Boat Traps**

Boat trap is a type of ballistic net which can be used to stop pirates' boats when they approach a ship. When in water, the net entangles the propellers of the boats which disable the boats, preventing them from moving forward.

### **7.6 Slippery Foam – Mobile Denial System**

Slippery foam is a non-lethal substance which can be used to make the deck or sides of a ship slippery to prevent pirates from climbing it.



The highly viscous substance makes it difficult for pirates to walk or stand.

### **7.7 Foul Smelling liquid – Liquid Deterrent System (or using Stun Gun)**

An anti-piracy technology by the International Maritime Security Network of US involves showering approaching pirates with slick, foul-smelling green liquid, which stinks and burns. The burning sensation and the nasty stink force pirates to jump into the water, stopping a possible pirate attack.

### **7.8 Anti-boarding device – Razor Wire Canister**

Anti-boarding device is an anti-piracy method which uses canisters with sharp razor wires to prevent pirates from boarding the ship. The wires act as a barrier between the pirates and the ship, which hinders forward movement of pirates.

### **7.9 Compressed Air – Ship Bourne Shore Launcher**

The Ship Bourne Shore Launcher is a product of a UK-based company. The Buccaneer Ship Bourne Shore Launcher is a cannon-shaped device which uses compressed air to fire a variety of projectiles. The power and lethality of the projectiles used can vary according to the distance of the pirates from the ship.

### **7.10 P-Trap Anti-Piracy**

P-trap is a non-lethal system which helps prevent pirates from boarding ships. The system carries thin lines which float at the water level around the sides of the vessel. When pirate boats come in contact with the lines, the latter get entangled with the engine and disable the vessel.

### **7.11 Anti-Piracy Curtain**

Anti-piracy curtain is used to stop pirates from climbing the ships. The system consists of a series of hoses dangled on the port and starboard sides of the vessel. Sea water is passed through the nozzles at a force of 0.2 Mega Pascal, which makes the hoses go in unpredictable whirling motion, generating enough force to seriously hurt anyone who gets in the way.

### **7.12 Non-lethal Stun Grenade**

Stun grenade or flash grenade is a non-lethal anti-piracy device which produces a blinding flash of light and loud noise. Stun grenades are

Used to temporarily disorient pirates' senses without causing permanent injury.

### **7.13 Dazzle Gun**

Dazzle gun is a type of laser weapon which uses green light to disorient and temporarily blind the pirates. The concentrated blast of green light can be used during both day and night.

### **7.14 Rubber Ball Grenade**

Rubber ball grenade as a non-lethal weapon sprays rubber bullets on detonation. The anti-piracy grenade also produces light and sound which can be used to deter pirates from coming towards the ship.

### **7.15 Active Denial System – Pain Ray (Electromagnetic wave)**

Officially known as the Active Denial System (ADS), the Pain Ray is a non-lethal weapon which transmits a narrow beam of electromagnetic energy to heat the skin, without causing permanent damage. The wave penetrates beneath the skin which causes unbearable burning sensation, forcing pirates to run away or jump overboard.

### **7.16 Anti-Piracy Fire Hoses**

Ship's fire hoses or special anti-piracy fire hoses are used to fight pirates trying to board the ships. These high pressure water hoses are extremely powerful and effective. Special anti-piracy fire hoses also come with semi-automatic and remote control system.

### **7.17 Molotov Cocktail**

Molotov cocktail can be made on ships using empty glass bottles, a flammable substance such as gasoline, and a source of ignition such as burning cloth wick. It can be thrown on an approaching pirate boat to set it on fire and disturb their maneuverability.

### **7.18 Tasers – Electric Shock**

Tasers are a non-lethal weapon which delivers an electric shock that temporarily causes the pirates to lose neuromuscular control. The device can be used as the last resort to protect the ship's crew from pirates (Raunek, 2017).

## **8. "Citadel" Anti-Piracy Method**

The dictionary definition of citadel is 'A stronghold into which people could go for shelter during a battle.' In terms of ships, a citadel is a room where the crew of the ship can hide in case of a pirate attack. The incorporation of the citadel

Method in ships to protect the ship's crew against maritime piracy has increased in recent times.

There are several aspects that need to be noted about the citadel anti-piracy method. Some of the key points can be listed as follows:

- The citadel anti-piracy method is to be installed in ships as per the regulations of the International Maritime Security Centre.
- The citadel requires having not only food and water supplies but also effective communication channels, a proper ventilation system and a first aid kit.
- The citadel can also be equipped with CCTV Closed-circuit television cameras and should have the control for switching off the engines.

Without proper knowledge on how to use the citadel technique, the method could turn out to be dangerous. The crew of the ship needs to understand how everything operates in the citadel and what the important points that need to be taken into consideration are. If these details are not understood, the citadel could end up being a prison for the crew assembled there for protection.

In addition, constructing a citadel is very costly. This is because the room has to be made to withstand any pirates attack and should have the necessary equipment. Major shipping companies regard the cost of the anti-piracy stronghold as one of the biggest expenditures they need to carry out. The same level of expenditure when compared to the amount of ransom demanded by pirates appears to be very minimal. For this reason, many shipping companies have decided to go for the citadel especially in those ships which have a route that passes through waters where marine piracy abounds (Sharda, 2016).

### **9. Conclusion**

Marine piracy is a crime that needs to be addressed without any delay. The international maritime committees and organizations are doing their share of shouldering the responsibility, but in the absence of a positive and responsible internal government, executing justice, the situation becomes quite difficult. This leads to a greater spread of piracy activities. Since Somalia is still not a stable state, many of

The root causes are still present, and the networks for the piracy operations that have been built up in Somalia have not been dismantled yet. It is, therefore, believed that a minimum amount of foreign-led counter-piracy activities will need to be continued (Science Direct, 2015).

While noting a decrease of piracy rates in Somalia and Gulf of Aden as a result of consolidation the efforts by shipping companies and international community, In addition an increase of that phenomenon in other parts of the world is recorded in Nigeria, Ghana, Venezuela and Philippines.

There are many different methods to combat piracy on board ships using modern and sophisticated mechanisms to repel hacker attacks and avoid the ability to detain the crew by citadel techniques.

### **10. Recommendation**

Fundamental reforms of the maritime security sector are required on national and regional levels. A mainstreaming of maritime security concerns across international policies will be needed. If maritime insecurity breeds threats, then the long term goal has to be taking steps towards :

1. Creating regional maritime security communities.
2. Meet for the need of comprehensive response to prevent and suppress piracy and tackle its underlying causes by the international community in collaboration with authorities of area affected by marine piracy and other relevant actors.
3. Installing of barbed wire and a secure citadel for crew on board ships as well as using of non-lethal anti-piracy methods.
4. Sailing with safe distance from the area affected by marine piracy and at higher speeds with efficient lookout.
5. Solution of piracy threat reasons by shore side law enforcement capacity building, enhanced governmental stability, and the development of viable and attractive economic alternatives for those who engage in piracy.
6. Encourage flag States and port States to further consider the development of safety and security measures on board vessels.

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