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Contents

Australia Has Moved Five Feet in 22 Years and Satnavs Are Struggling to Keep Up

Ben Griffin

Australia has moved so much in the last 22 years the government needs to update its latitude and longitude co-ordinates or face increasingly inaccurate GPS data.

Tectonic activity is to blame for Australia moving at a rate of 7cm (2.8 inches) per year and so an update to the country's co-ordinates has been scheduled for January 2017. As of then, Australia will be 1.8 meters (nearly six feet) to the north of where it is officially located now. The reason for overcompensating the distance is so that Australia should be in the exact position it should be in 2020, giving the co-ordinates a bit of breathing space. Until then, maps will remain out.

The problem with Australia moving at such a pace is the difference it creates between local co-ordinates and those of global navigation satellite systems (GNSS), which affects map information accuracy. It helps little that the Australian Geocentric Datum of Australia last updated the co-ordinates in 1994, although a smartphone GPS system can be out by around 16 to 32 feet so you could, in theory, never notice the difference.

But for some navigation systems that rely on really accurate GPS data, such as fully autonomous vehicles, a deviation of a few feet out could mean the vehicle is on the opposite side of the road and heading into incoming traffic.

After 2020, Australia will switch to a new system that can account for changes over time, meaning the 2017 adjustment should be the last manual one. "If the lines are fixed, you can put a mark in the ground, measure its co-ordinate, and it will be the same co-ordinate in 20 years. It's the classical way of doing it. We used the old plate fixed system to make life simple, but we don't want to do this adjustment every so often," he added.

Australia was once connected to Antarctica and India around 100 million years ago and split up over the next 55 million years so the movement is nothing new. Maths geeks can run the numbers on how long it will be before Australia and Asia hook up.

Challenges of Maritime Security with Special Reference to (Malacca Strait)

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Abstract

Maritime piracy and armed robbery against ship are one of the contemporary challenges of the maritime industry, especially after the terrorist attacks of September 2001 and even more recently. There are a number of maritime security challenges facing the maritime industry including: illegal immigration by sea; smuggling and drug trafficking; terrorism; and piracy and armed robbery at sea. Maritime is considered a sensitive and of high-risk transport sector, in terms of security. Moreover, topics related to safety and security in maritime transport have become very important over the past decades mostly because of the numerous maritime accidents putting in danger both human lives and the environment. This paper provides an overview of the issue of maritime safety and security in South East of Asia especially Malacca Strait and present solutions to these challenges facing maritime industry. Furthermore, a number of recommendations aiming to enhance the existing levels of safety and security in maritime transport in the examined area provided.

Keywords: Maritime Safety and Security, Maritime Threat, South East Asia.

1. Introduction

Shipping is considered the main element affect the international trade, and the global economy. Until the end of the 1980s security issues in the maritime sector were not covered by specific international conventions as a unique regime or agreement. Recognizing that the United Nations Convention on the Law of the Sea (UNCLOS) held at Geneva from 24 February to 27 April 1958 adopted a number of provisions that generally established principles of international law and regulations. They were kept to national regulations and limited bilateral agreements. The exploitation of the seas for human trade and for transport of illegal drugs ،weapons and endangered species has grown exponentially during the past 20 years. These illegal activities have a negative impact on the shipping industry and port facilities. **(Velez, 2005)**

Maritime piracy and armed robbery against ships are one of the contemporary challenges of the maritime industry. These two phenomena have a global impact on maritime trade and security. From isolated acts of piracy, crime has evolved to become extremely well prepared activities by organized crime. Recently, the maritime industry has also been affected by international terrorist activities . Traditionally, port facilities were not regulated by the International Maritime Organization (IMO) with the exception of the interaction of ships with port facilities. However, according to the International Maritime Bureau (IMB), most pirate attacks occur while ships are at anchor or at berth **(Liss, 2014)**. This has led the IMO to develop a series of recommendations, directives, and resolutions aimed at improving ships and port facilities ’safety and security measures. The mandatory security measures, adopted in December 2002, include a number of amendments to the 1974 Safety of Life at sea convention (SOLAS) the most far-reaching of which enshrines the new International Ship and Port Facility Security Code (ISPS Code).

2. Safety and Security Measures in Maritime Transport

Due to the international character of the shipping industry, the regulation of maritime safety mostly takes place at an international level, within the framework of the United Nations and its (IMO). The structure of the global marketplace requires that goods and materials be delivered not only to the geographical location where they are required but also within a very precise timeframe. Maritime security is an integral part of IMO's responsibilities. A comprehensive security regime for international shipping entered into force on 1 July 2004. ISPS Code contains detailed security-related requirements for Governments, port authorities and shipping companies in a mandatory section together with a series of guidelines about how to meet these requirements which is non-mandatory section. However it must be mentioned that there are also other associations involved in this field such as the International Labour Organization (ILO), International Organization for Standardization (ISO), Secure Trade in APEC Region (STAR), United Nations Economic Commission for Europe (UN-ECE), Container Security Initiative (CSI), Custom-Trade Partnership against Terrorism (C-TPAT) and Smart and Secure Trade lanes (SST).

3. Maritime piracy and armed robbery

The word "pirate" has its root from the Latin word "pīrāta" where the notion of 'sea robber' originated and from the Greek word "peirātés" which means 'attacker' or 'marauder' as a noun originating from the verb "peiran" signifying 'attempt' or 'attack' (Ayto, 2005). Therefore, a pirate is etymologically a person who undertakes an attempt of attack or an actual attack on someone. The definition of the word "Piracy", which is the acts committed by pirates, has evolved throughout the history depending on the occurrence of the act itself and the modus operandi of the perpetrator as well as the era. If for a long time the notion of piracy has only been related to the sea transportation and maritime activities, the usage of this word has extended to the air transportation sector, to the domain of intellectual property and other fields such as broadcasting.

Maritime piracy and armed robbery against ships have thrived and regained its status as amongst the number one threats and contemporary challenges of the international community and coastal States since few decades. Their occurrence varies slightly from a region to another but their impacts are national, regional and global. According to the International Chamber of Commerce (ICC), the statistic shows that the total number of incidents per region in 2014 has reached in South East of Asia to 141 incidents while in Americas were 5 incidents only (Fig. 1).

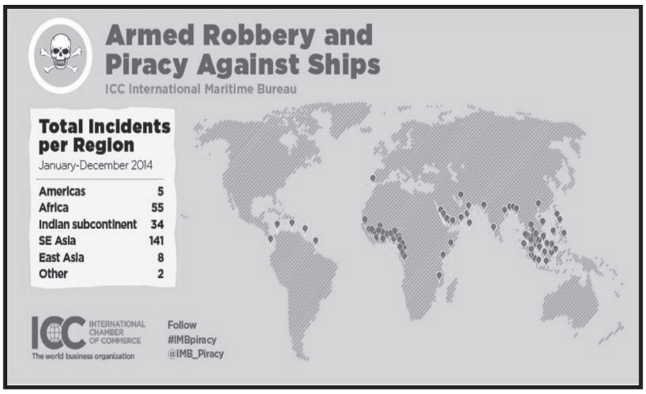

Figure.1: Armed Robbery and Piracy against Ships
Source: ICC, 2015

At some stage, each and everyone bears the consequences of their outbreak in a close or remote manner if they are not prevented or combated. Pirates are not fish; they don't live in the sea, they live in the cities **(Hirsi, 2011)**. This statement seems to indicate that maritime piracy and armed robbery against ships problems are primarily a land problem and should be solved on land before solving it at sea.

3.1 Forms of modern piracy

The International Chamber of Shipping (ICS) classified pirate attacks into three basic categories:

3.1.1 Low-Level Armed Robbery (LLAR)

Attack with the intention of stealing usually under cover of darkness. The culprits take whatever they can carry from the deck and the hold. Violence only occurs when the crew tries to stop them.

3.1.2 Medium-Level Armed Assault and Robbery (MLAAR)

Armed assault with violence or threats of violence. The pirates usually come on board unnoticed and force the crew to hand over their cash and valuables. Cargo is also stolen if possible. Each raid is over in less than an hour.

3.1.3 Major Criminal Hijack (MCHJ)

Carefully planned theft of the entire cargo. The pirates know every detail of the cargo and the ship's stowage plan. While some of the attackers hold the crew captive below deck, others transfer the cargo to another ship. When the raid is over, the ship drifts in the ocean with the bridge unmanned. This type of attack usually results in a double-digit million dollar loss. **(Christian & Pottengal, 2006)**

4. The Challenges and Risks faced South East Asia

Piracy is a worldwide phenomenon and may concentrate in a region rather than the others, but fundamentally attacks are possible on any shipping route. Any incidents will normally involve the responsibility of several states and actors. Maritime transportation is one of the drivers of globalization, the shipping industry and the complex web of the sea routes until recently attracted scant attention compared to other transport sectors. The impact of piracy on maritime trade only came under scrutiny after the increases in pirate attacks and armed robberies of merchant vessels in the world especially in Southeast Asia.

Southeast Asia consists of eleven countries that reach from eastern India to China, and is generally divided into "mainland" and "island" zones. The geography of Southeast Asia is a blessing for trade and a curse for security. On the one hand, the countries benefit from being at the intersection of some of the world's major sea lanes, such as the Strait of Malacca, the Singapore Strait, the Sunda Strait, and the Lombok Strait. On the other hand this high volume of cargo places additional responsibility on governments to adequately control the flow of goods through their ports to make sure they do not become transit safe havens for smuggled sensitive goods.

4.1 Strait of Malacca

Strait of Malacca in Southeast Asia is among the world's most strategic waterways for international oil and gas trade. The Strait extend to 500 nautical miles long just nine nautical miles wide at their narrowest point, and only 30 meters deep in some places. It is one of the most highly frequented waterways in the world. Between 60,000 to 94,000 shipping vessels pass through the Straits annually, carrying about a third of global trade. Indeed, the Straits see three times more general traffic than the Panama Canal and twice as much as the Suez Canal **(Umana, 2012)**.

It serves as a key global distribution route for energy resources from the Arabian Gulf on which the energy security of the regional economic powerhouses heavily depends. Hence, the security of this specific sea-lane is crucial for Asian economies as well as for those extra-regional powers, such as the USA and the European Union, whose economies are increasingly intertwined with that of Asia **(Kovács, 2005)**.

Figure 2: Strait of Malacca
Source: www.welt-atlas.de, 2015.

The Strait considered a focal point of legal and political issues, such as the sovereignty of territorial waters and the responsibility to secure the waterway. Likewise, the waterway is a source of environmental concern for the littoral countries of Indonesia, Malaysia, and Singapore (Fig.2).

The security of the Straits of Malacca is a global economic priority for various reasons. Any acts of terrorism that would cause the closure of the Straits would be catastrophic for the global economy, as the Strait is one of the most important chokepoints in the world for international trade.

Unfortunately Malacca Strait have become notorious for maritime robbery and pirate attacks, as well as for being a transit hub for myriad black markets and a haven for belligerent non-state actors. Indeed, in the area around the Straits of Malacca, porous borders and poorly monitored ports allow these threats to infiltrate the coastal nations. A lack of strong government control pervades in certain pockets and gives rise to corruption. In this governmental blind spot, crimes burgeon and flourish, and due to economic marginalization, individuals frequently turn to a life of crime, fueling hidden, black market economies. Strait of Malacca faces multiple security issues that affect the three littoral states and the Straits' user nations. In fact, its geographical position makes it not only valuable to the states that border the waterway but also an intensely critical region for foreign countries dependent on trade passing between the Pacific and Indian Oceans. **(Umana, 2012)**.

4.2 Maritime threat in Strait of Malacca

The threat of using ships as a target or a medium for terrorist attack is a risk that should be taken into consideration in the South East Asia Region. Cargoes are transported in large amounts in this area and therefore many ships could also be potential and attractive targets for attack. The ever-increasing amount of traffic through the Strait creates a number of challenges for the three littoral states in charge of maintaining security in the region.

Despite the recognized significance of the Straits of Malacca several threats and risks still prevail in the maritime security environment of Southeast Asia. Armed robberies against commercial vessels frequently disturb the security of international shipping activities in the regional waters and various transnational terrorist groups are suspected to be associated with pirate activities. This situation raises the alarm of a potential act of maritime terrorism against vessels and other sea-borne facilities in the Strait of Malacca. **(Kovács, 2005)**.

The causes of piracy in Strait of Malacca are dire economic and social conditions as well as poor security, fragile states and the effects of political transformation.

The situation became worse in the 1990s and the International Maritime Bureau established a 24-hour Piracy Reporting Center (IMB-PRC) in Kuala Lumpur, Malaysia, in 1992 to provide the first point of contact for shipmasters to report any incident of piracy.

Table 1.1: Types of vessels attacked

Ship's Type	2010	2011	2012	2013	2014	2015	Total
Bulk Carrier	80	100	66	53	55	86	440
Container	74	62	39	30	20	30	255
General Cargo	63	35	15	17	14	15	159
RORO	6	3	2	1	2	-	14
Tankers	149	168	122	133	130	87	789
Tug	20	32	23	18	7	10	110
Total	392	400	267	252	228	228	1767

Source ICC IMB, 2016

Piracy attacks in the Strait of Malacca reached a peak in 2011 with 400 attacks on different types of ships, while the attacked were the highest on tankers. The total number of attacked vessels in the period of six years reached to 1767 attacks, Tanker ships took about 45% while the number of attacks on bulk carriers increased to 86 in 2015. It can be seen in the last two years that the total number of attacked vessels remains constant of 228 attacks (Table 1).

There are many suggestions for combating the challenges in maritime security in Strait of Malacca including gaining consensus between affected nations and regional cooperation, tackling the root causes ashore, enforcing legislation among many other factors. Arguable the advanced use of Vessel Traffic Services (VTS) in tracking the ships will enhance efforts at bringing down the maritime security threats or crime in the Strait of Malacca.

5. Safety and Security distinct aspect in Vessel Traffic Services (VTS)

Vessel Traffic Systems (VTS) are the technology that enable efficient tracking, monitoring, management, recording and analysis of vessel movements in a particular area, such as a port or confined waterway. VTS comprise a set of sensors (most commonly radar, radio based Automatic Identification Systems (AIS) and CCTV, often also tide gauges and meteorological stations), signal processing and storage servers and any number of co-located or distributed VTS operator stations. It presents real-time navigational data overlaid on an Electronic Chart System (ECS) display. VTS around the world improves the safety and efficiency of navigation, safety of life at sea and the protection of the marine environment and or the adjacent shore area, worksites and offshore installations from maritime security threats and adverse effects of maritime traffic.

There are three distinct aspects associated with security in the VTS environment. Firstly, there is the need to ensure that the operation of a VTS is not exposed to, or susceptible to, the risk of terrorist attack. Secondly, there is the potential for VTS to obtain information that may aid or assist security agencies in counter-terrorist activities. However, this situation will normally only apply when a VTS authority enters into specific agreement with national authorities. Finally, although VTS is not by definition a security-related system, the integrity of VTS data and systems must be protected and security assessments should be considered. It is necessary to prevent unwanted and unauthorized access to the VTS system. These systems are used in ports and confined waterways to monitor and control vessels for navigational safety and operational efficiency, and ensure vessels follow designated routes. Currently vessel tracking systems largely rely on radar signals and present a two dimensional picture of vessels moving within the designated area on an electronic chart, displayed on computer screens. They allow port operators or Coastguards to see the vessels and monitor and to control their progress. But these systems have significant limitations. They do not identify individual vessels, and the performance of radar systems can be adversely affected by weather, furthermore when vessels are close together, their radar blips can merge.

5.1 Use of AIS in VTS Operations

Among the numerous security regulations that came into effect after September 11, 2001 was the requirement for most commercial marine vessels to be fitted with AIS. AIS provides a means for ships to electronically send data including vessel identification, position, speed, and course with VTS stations as well as with other ships. AIS use Global Positioning Systems (GPS) in conjunction with shipboard sensors and digital VHF radio communication equipment to automatically exchange navigation information electronically (Fig.3). Vessel identifiers such as the vessel name and VHF call sign are programmed in during initial equipment installation and are included in the transmittal along with location information originating from the ship's global navigation satellite system receiver and gyrocompass. AIS are used by marine vessels in coordination with VTS to monitor vessel location and movement primarily for traffic management, collision avoidance, and other safety applications **(Heather M. Perez et al, 2012)**.

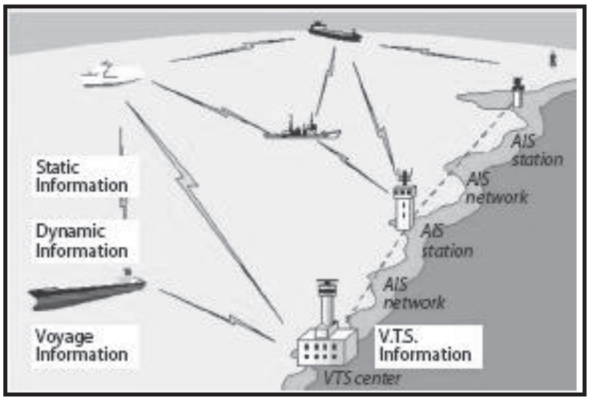

Figure 3: Automatic Identification System data.
Source: www6.kaiho.mlit.go.jp, 2015

AIS is a system that makes it possible to monitor and track ships from suitably equipped ships, and shore stations. AIS transmissions consist of bursts of digital data ‘packets’ from individual stations, according to a pre-determined time sequence. For VTS purposes, an AIS service provides information from one or several AIS base stations to AIS users. The AIS service should provide timely, relevant and accurate information to assist the decision making processes of a VTS. It may also support port operations by providing information to appropriate shore facilities.

The VTS can attach the information of a non-AIS vessel to its radar target and broadcast it as Pseudo AIS target message to other vessels equipped with AIS in the VTS area. Moreover, this function will allow non-radar equipped vessels, which are only equipped with AIS, to view the VTS radar targets, which will increase their situational awareness of all the surrounding traffic, and will enhance the level of safety of navigation in the VTS area.

6. Unmanned Aircraft Systems (UAS) for Malacca Strait

An unmanned aircraft system consists of an unmanned aircraft, its mission payloads, launch and recovery equipment, ground control station, and control and data links. The Coast

Guard is interested in UAS that can remain on station for extended periods, expand maritime domain awareness, and disseminate actionable intelligence on maritime hazards and threats **(USCG, 2015)**. Spain has supplied an unmanned aircraft used in trials of monitoring the Spanish coast, within the remit of the Wide Maritime Area Surveillance (WIMAAS) project, financed by the European Union. This is the first time that an aeroplane of a non-military nature has taken part in controlling European coasts.

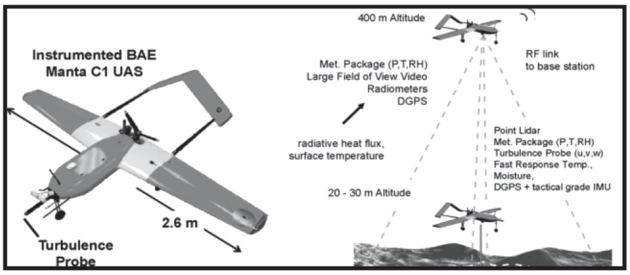

Figure 5.1: Unmanned Aircraft
Source: www.eco.arc.nasa, 2015

The aircraft was commissioned to monitor the Spanish Mediterranean coast at the beginning of July, using a system of radars and cameras installed along the coastline. During the trials, the external monitoring system equipment (SIVE in its Spanish initials) detected a number of ships and small craft at various miles of the coast, and the locations of which were transmitted to the control station from the pilotless aircraft, which flew overhead as indicated by the station in order to identify the vessels through aerial photographs.

The aircraft can carry out a similar demonstration in Malacca Strait for Tele-detection and monitoring, with a capacity for taking and transmitting videos or infrared photographs to a land-based control station.

7. Conclusion

The challenge of providing long-term solutions to the global piracy problem is overwhelming, with a paucity of proactive efforts, especially in terms of tackling the root cause of the issue. As a result of piracy and armed robbery attacks and the increased perception of the threat of such activities, security is a high priority for the maritime community. Maritime transport is one of the forerunners in improving the security of transport. It is essential for Indonesia, Malaysia, and Singapore to gather national and international resources and implement ways to combat the multitude of threats facing the Straits of Malacca. The littoral countries of Indonesia, Malaysia, and Singapore, shipping companies, non-governmental organizations, and other non-state actors with a stake in the Straits should band together and assist their home governments in fostering greater security. Therefore, security in the Malacca Straits must remain on the radar of global actors in order to properly and efficiently protect this very important waterway.

8. Recommendations

- AIS should be implemented on vessels below 300 gross tons and on vessels that are on local voyage.
- Regional countries should share AIS data via the Maritime Safety and Security Information System (MSSIS).
- Unmanned remote-control aircraft system to patrol and monitor threatened sea lanes and to pursue and detect pirate vessels.
- Initiate effective Cooperation between countries like China, India, Japan, and the United States as a vested interest in protecting the valuable trade sea-lanes of the Straits of Malacca.

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Ballast Water Management Technologies

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Abstract - Ballast water discharges have always been a major source of introducing non-indigenous species to the marine environment. Ships use ballast water to provide stability and maneuverability or to be able to ride low enough in the water in order to pass under bridges and other structures. During the ship's voyage, ballast water is loaded in tanks at one port during cargo operation and usually discharged at another port.

The International Maritime Organization (IMO) has actively taken regulatory measures to minimize the species shift by adopting the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) in 2004. In addition, Ballast Water Management for vessels includes all measures that aim at preventing unwanted aquatic species from being transferred between ports in the ballast water as it provided to be a major cause of ecological imbalance.

Nowadays, systems are employed and others are waiting to be used, the current methods are employing physical filtration, while the new methods use physical and chemical disinfection. Unfortunately, no single ballast water treatment technology has been able to remove all organisms or all types of organisms from the ballast tanks. This paper will discuss both the physical and chemical disinfection methods highlighting the most effective method to clean ballast water from invasive species. However, researches are being conducted to find a way to implement this technology because ship owners are understandably reluctant to install such an expensive, unreliable, time-consuming technology and tend to use the effective available method for species filtration.

Keywords: Ballast Water Management, Invasive species, Ballast Water Treatment Technology, Regulation D-2, Physical filtration, Physical and Chemical Disinfection.

1. Introduction

To begin with, Ballast Water (BW) is an amount of seawater pumped in/out in specially made compartments used by oceangoing ships to maintain their stability, balance and structural strength and it is necessary for the ship to sail safely. Ballast seawater is collected and taken to the bottom of the ship while no cargo on board and discharged when ship loads cargo. This water does not only provide stability but it also reduces stress on the hull, improves propulsion efficiencies and maneuverability. Moreover, BW can be used to balance the loss of fuel weight, and fresh water consumption. So BW is an essential source for the safely and efficient operation for oceangoing shipping. The BW transfer across the ocean world have been a major cause of marine ecological imbalance, this transfer had a negative impact on the environment by many ways and in the recent years the movement and the spread of plankton bacteria and other aquatic organisms by ship ballast water has become known as a global problem that negatively effects on the marine ecosystems, fisheries, other industries, as well as the human health (*Sutherland et al, 2001*).

Aquatic organism are discharged while the vessel discharges BW that contains such organisms, or when the vessel loads BW in ballast tanks that contain such organisms in the residual water in the tanks then discharges that mixture in another port. When these organisms in ballast tanks are transported to different water and discharged, these organisms may have a possibility to establish new kind in such type of water, which are not native and can cause significant economic and ecological damage. There are numerous studies and reports that documented the impact of such discharges of BW.Therefore, The International Maritime Organization (IMO) has active regulations and measurements to minimize the species shift through the BW by adopting the International Convention for the Control and Management of Ships Ballast Water and Sediments (BWM) in 2004.Starting from that date vessels began to increase and enhance for practicing in Ballast Water Exchanges (BWE), but BWE seems to be not completely effective method for removing these marine invasive species. To keep up with the IMO requirements, the IMO member states must ratify the treaty of treatment and ships must have an effective way of treatment with a high Tec-system, which is most probably a physical or chemical treatment method.

The purpose of this paper is to present and discuss the available ballast water treatment methods; which are approved or can be approved by the IMO for species reduction. First, the physical methods those have less effect on the marine environment, however they are less effective than the chemical methods. While the second method, the chemical methods, which are effective with high power requirement, remove trace with normal cost but can, cause a great harm to the environment. The points for evaluation ballast water treatment method are a number of factors that must be taken into consideration which are cost, the effectiveness of the method, operation time and the vessel risk, which can affect the human health and the marine environment.

The First important element, the cost which means that new build vessels and exiting vessels must be supplied or fitted with the necessary equipment which may be quite expensive. The second element, the operation time needed for the treatment operation method if it is a long time, the voyage time of the vessel will increase and will causes more in the fuel consumption, which will lead to increasing the voyage cost. The last element, the risk that could face the ship such as losing stability of the ship or the negative impact on the ship's hull which can lead to a disaster for the ship and the marine environment (*Balaji & Yaahob, 2011*).

2. IMO Treatment Regulations

There are many types of technologies which are approved and other waiting to be approved while most of these systems were adapted to meet the requirements of the International Convention for the Control and Management of Ships Ballast Water and Sediments (BWM) 2004,whichrequires ship-specific Ballast Water Management Plan on-board that is approved by the administration, Ballast Water record book on-board, The D-1 regulation standard for ballast water exchange, and specifies the volume of water to be replaced, The D-2 regulation standard covers approved ballast water treatment systems, and specifies the amount of viable organisms left in water after treatment, and International Ballast Water Management Certificate (BWMC) (*DNV.GL,2015*). The IMO established the D-1 regulation standard BWE which take place at least 200 nautical miles from the nearest land and in water depth of 200 m and must change at least 300% of total tank capacity or at least 95% of tank capacity. The D-2 regulation standard approved Ballast Water Treatment Systems (BWTS), which the IMO made an implementation schedule for the BWM as shown in table 1 (ABS, 2011).

Ballast Cpty (m3)	Build Date	First Intermediate or Renewal Survey, whichever occurs first, after the anniversary date of delivery in the respective year								
		2009	2010	2011	2012	2013	2014	2015	2016	2017
< 1,500	< 2009	**D-1** or **D-2**								**D-2***
	in 2009	Note: **D-1**; **D-2** by 2nd Annual but not beyond 31 Dec. 2011 or EIF, whichever is later								
	> 2009	**D-2** (at delivery or EIF, whichever is later)								
≥ 1,500 or ≤ 5,000	< 2009	**D-1** or**D-2**						**D-2***		
	in 2009	Note: **D-1**; **D-2** by 2nd Annual but not beyond 31 Dec. 2011 or EIF, whichever is later								
	> 2009	**D-2** (at delivery or EIF, whichever is later)								
≥ 5,000	< 2012	**D-1** or**D-2**								**D-2***
	≥ 2012	N/A			**D-2** (at delivery or EIF, whichever is later)					

Note: EIF = Entry into force

Table 1. IMO BWM Convention Implementation Schedule Revised per Resolution A.1005 (25) &MEPC.188 (60) Source: ABS (2011).

Following the Implementation Schedule for the BWM Convention, came the Guidelines for Approval of Ballast Water Management Systems (BWMS)(G8) MEPC.125 (53) Rev. MEPC.174 (58), then the Approval of BWMS that make use of the Active Substances (G9) MEPC.126(53)Revised in MEPC.169(57), and also the Guidelines for BWE Design and Construction Standard (G11) MEPC.149(55) (*ABS, 2011*).

3. Ballast Water Treatment System Design

The treatment of BW can take place either onboard the vessel or can be discharged to a land-based reception facility. The treatment systems onboard vessels that discharge the ballast water directly to the seawater were the center of great attention of those meant with technology development. BWTS are based on four main processes: physical separation such as electric pulses, Biocide Treatment such as bleach that kills the main organisms, the magnetic treatment and the chemical treatment that destroys the cell membrane through oxidization, while some BWTS incorporate a combination of these processes.

Ballast water exchange system can be simply produced by ships using the existing resources; it can remove organisms but with a low efficiency, leaving behind the sediments in the ballast-water tanks. To achieve the exchange system criteria set by IMO, at least 95% of the BW usually exchanged in the open ocean by this method, which is effective because organisms from coastal waters are unlikely to survive in the open ocean and vice versa. Figure 1 - shows BWE of a ship departing a port in the Indian Ocean (1), sailing through the Suez Canal, discharging cargo in the Mediterranean (2) and loading ballast water to cross the Atlantic Ocean (3). BWE would occur in the Atlantic prior the ship entering the Great Lakes to pick up cargo (4).

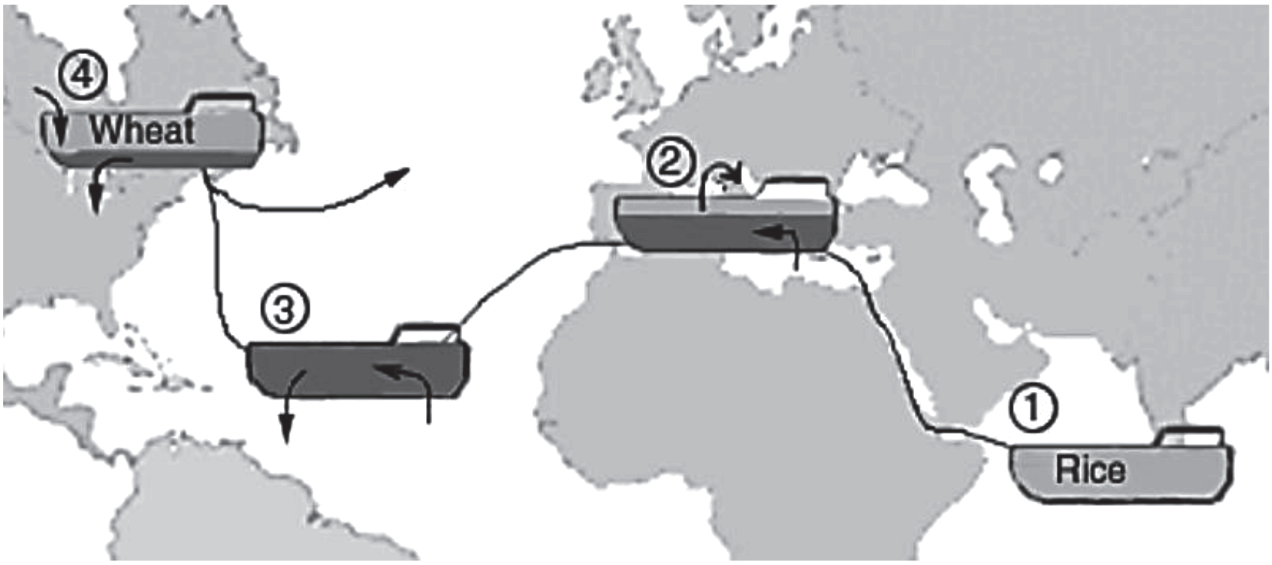

Figure 1.Ballast Water mid Ocean Exchange
Source: Corrina, Reilly, Pederson (2002).

The advantage of this method is that the BWE is done while the ship is in her route without losing time during the voyage. In addition, there is no additional equipment or operator training needed and that leads to low cost and a simple process. (*Corrina et al, 2002*). The disadvantage of this method is the difficulty of removing residual water from the bottom of the ballast tanks completely, the organisms which are stuck to the tank side or structure will not be easily removed, besides, during the stormy weather or rough seas it will be unsafe for a ship to do the BWE and that will lead to keeping the organisms inside the ballast tanks and may be discharged at a later time. Moreover, because of such emergency, higher ship stresses, damage risk of the ship hull BWE is not always possible in such weather conditions. Also, some reports concluded that insufficient exchange is a reason for the presence of 87% to 48% species in the seawater, BWE is considered as an operative measure till effective treatment systems are developed and regulations are implemented.

3.1 Physical Filtration Technologies

Most of the solutions used as pre-treatment are filtration followed by a form of disinfection. The efficiency of such physical filtration solutions is more than 91%. Physical separation technologies of filtration are the easiest for removing organism with sizes ranging from 25to 50micrometerthat lives below 18m depth, for that combination filtration systems the Lloyds' Register reported that their efficiency is 95% (*Murphy et al, 2002*).However, a filtration system in combination with heat treatment is the best option to treat ballast water. There is another method of filtration technology called Hydro-cloning method, that method is more cost effective and alternative to filtration, this method removes organism same as filtration but its efficiency is much lower(*Taylor& Rigby, 2001*). In addition, there are De-oxygenation systems that use the oxygen, nitrogen, chemicals and venture oxygen stripping. The advantage of this technology is low corrosion due to reduced oxygen used in the removal process, while its disadvantage is that this treatment process requires a long time range from one to four days (*Lloyds' Register, 2010*).The Physical disinfection methods have disadvantages same as the chemical methods on kind and variety for removal, but their intensities are reasonably less.

3.2 Chemical Disinfection Technologies

The effectiveness of chemicals is classified according to their results. The chemical disinfection methods such as chlorination are the most preferred, the efficiency of Chlorine depends on temperature, reaction time and the Chlorine residual (*Zhang et al, 2003*). The use of chemicals raises an important question, which is; will it harm the marine environment and human health on the long term. The answer is that disinfection by-products such as Trihalomethanes could cause environmental and health harm, while some chemicals like Chlorine dioxide require time to be discharged in a safe state, for example chlorites and chlorates are potentially toxic and they require some form of control during discharging BW (*Tsolaki & Diamadopolulos, 2009*).

There is a heat treatment solution that is projected by the Lloyds' Report, which seems that it is an effective method for treatment. Heat treatment technologies alone and in combination with microwave and ultrasound were tested with various organisms and they proved to be 100% effective (*Tsolaki & Diamadopolulos, 2009*). The costs of energy for heating must be taken to consideration while the solution provided by the Lloyds' Report was nil. For that reason, the heat treatment technology availability might be an economical choice. Moreover, the operational costs in general relate to the installed power and the consumption and the cost has been a projected by the manufacturer in a comparison based on the different in technologies.

3.3 Other Treatment Technologies

The technologies that are used for treating BW are generally two generic types namely; solid liquid separation and disinfection. Solid liquid separation is simply the separation of suspended microorganisms from the BW, either by sedimentation, which is allowing the solids to settle out by virtue of their own weight, or by surface filtration, which is removal by straining. This process produces a waste stream that contains the backwash water from filtering operations or the underflow from hydro-cyclone separation and they can be safely discharged during ballasting. On de-ballasting the solid liquid separation operation generally removes inactivates micro-organisms by using one or more methods such as chemical inactivation, oxidizing biocides or non-oxidizing biocides and physic-chemical inactivation such as Ultra Violet light (UV), and heat cavitation's (*MEPC, 2011*).

Treatment systems involving the active substances are required to obtain initial and final approvals after being reviewed for environmental impact, also a land-based testing and the sea-based testing for type approvals for not involve in an extended period. The system that does not involve active substances would require land and sea trial validations and can obtain the type approval from Flag State. For the IMO requirements, it may be said that treatment technologies available for the industry in a filtration to be the favored as a primary treatment, while the chemical methods are a slightly preferred over the physical disinfection methods. The chemical solutions appear promising in the long term, environmental harm might be important, and the costs expensive. Waste heat from ship's engines seems to be a favorable option and especially for ships on voyages more than 10 days, but there is only a single heat treatment option available and hopefully would be ready for use by the deadline set by the IMO in 2016.

4. The Cost of the Treatment Methods

The analyses of the costs that is based on the technology suppliers is for average operating costs around $30 per 1000 m3/hour of treated water, about $130 for operational costs of chemical systems and for physical disinfection systems might be better on the long term. Consequently, the electric pulse, heat treatment and de-oxygenation as treatment solutions might be high for ship capital costs, but it may be expected to decrease in the coming marine organisms to the ship ballast tanks and installation of these treatment systems will increase on board in the future. For the terms of ship capital costs the power requirements, and chemical solutions appear to be better, while for the industry preference shows a greater number of chemical systems installations with economics of energy and cost, an effective design with easy installation. Treatments designed to be carried out during ballasting or de-ballasting or during voyages, the manufacturers design listed 63 treatments systems which are single or in combination treatment, 36 treatment systems during ballasting the ship tanks, 21treatment systems for de-ballasting the ship tanks and 6 treatment systems during the sea passage. For the systems that employ filtration, they are used during the de-ballasting as a general rule, but it may be safe that the treatment takes place prior loading the seawater into the tanks as this is the preferred mode to overcome the organism retention problems in the tank sediments. Almost all the approved systems and those who are waiting to be approved are employing combinations of technologies, all the methods have similar efficiencies in terms of organism and species elimination without baseline data on actually harm for marine organisms and organisms that may be considered for testing treatment solutions.

All of these methods have been useful to BWT and are comprised in two or more stages of treatment with a solid liquid separation stage that differ in employed products and different unit processes. Figure 2showsthe commercial systems which are comprised into two or more stages of treatment with a solid liquid separation stage.

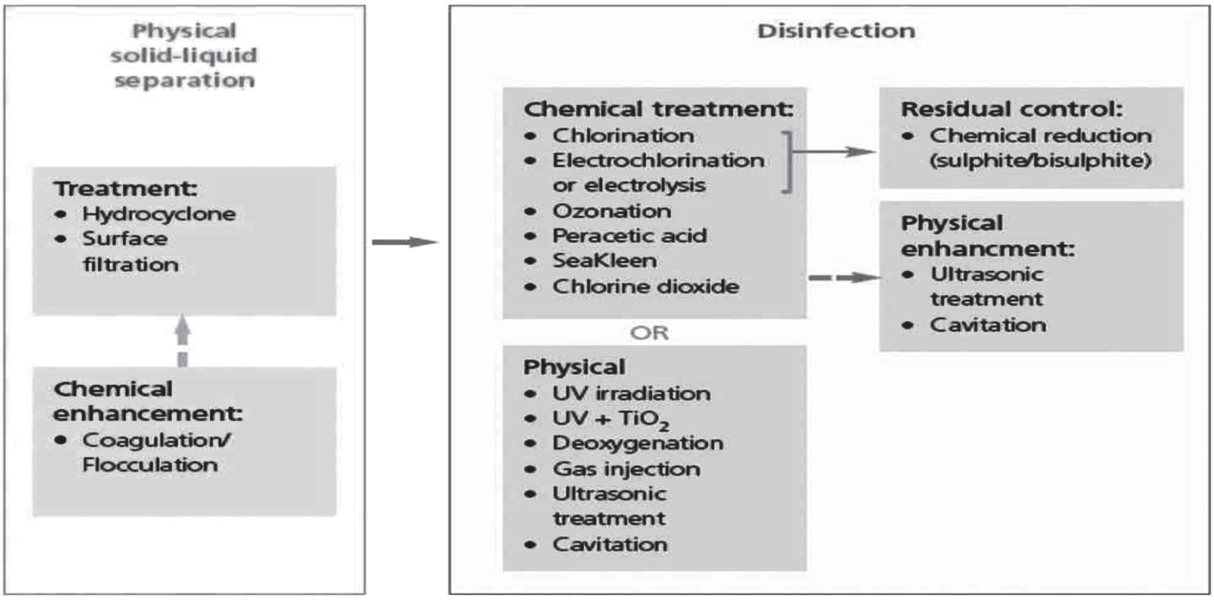

Figure 2.Ballast Water Treatment Technology process options
Source: Lloyd's Register Report, April 2015.

5. Conclusion

Reference to the ABS last report in July 2014, about 40 countries with total world merchant shipping tonnage of 30.25 % have ratified the BWM Convention. Although the BWM Convention has more than the required number of states to ratify the convention, it will not enter into force until after the percentage of world merchant shipping tonnage increase by at least 4.75 %. The status of the BWM Convention and Parties to the Convention is listed in Table 2.

States	% Tonnage	Parties to the Convention
Needed: 30	Needed: 35%	Albania, Antigua and Barbuda, Barbados, Brazil, Canada, Congo, Cook Islands, Croatia, Denmark, Egypt, France, Germany, Iran, Kenya, Kiribati, Lebanon, Liberia, Malaysia, Maldives, Marshall Islands, Mexico, Mongolia, Montenegro, Netherlands, Nigeria, Niue, Norway, Palau, Republic of Korea, Russian Federation, Saint Kitts and Nevis, Sierra Leone, South Africa, Spain, Sweden, Switzerland, Syrian Arab Republic, Tonga, Trinidad and Tobago and Tuvalu.
Currently: 40	Currently: 30.25%	

Table 2. Status of Ratification of the IMO BWM Convention
Source: ABS (2014).

The ratification of the BWM Convention by Morocco, Indonesia and Ghana in November 2015 has brought the convention closer to meet the requirements for entering into force. Till now 47 countries have ratified the convention, and this number is more than the 30 country required for the convention to enter into force, but the requirement for Parties to hold 35% of the world's tonnage has been met is still being calculated. The Convention will enter into force twelve months after the tonnage requirement are met (IMO, 2015).

The transfer of invasive species into new environment via BW was identified as one of the top four threats to the world's oceans, due to its negative impact on both the environment and human life. BW as one of this biological invasion means can shift from the exchange of practices to treatment ways by removing organisms from ballast water that cause ecological and economic harm. Because there is no one method has yet been proven to remove all organisms from ballast water, more research must be conducted and new methods to be developed to determine the effectiveness of combining ballast water treatment methods. An approach of optimizing a ballast management system by combining technologies such as heat treatment that is harmless and easily available on-board, resources combined with another physical disinfection method such as filtration or de-oxygenation can be worked on.

Technologies that comply with regulation D-2 performance standards began to be put into operation and proved to be effective. Costs would be the major determinants of that choice and the high costs of these technologies will increase freight costs, for example, the cost of retrofitting vessels to use ballast water treatment has been estimated between $200,000 and $310,000 per vessel for physical treatment and around $300,000 for chemical treatment. Ship owners are reluctant to use a new technology unless it is proven effective and they will have a number of options until the effective methods are determined. Research must be pursued on no-ballast ships, shore-based treatments, because installing new technologies or retrofitting ships is expensive, an estimates costs of $400,000 per vessel for modification of container/bulk vessels to use onshore ballast water treatment facilities at California ports.

In order to select a suitable system, ship operators have to consider the requirements of the BWMC with a work plan for ship supplier, treatment system installation, training requirements and commissioning. In addition, the ship operators if they decided to use the chemicals treatment systems have to look at their consumption rates, ways of handling and storage of the used chemicals, as well as health and safety considerations in terms of protecting the environment, during normal and emergency operation, in addition to being the most cost effective method.

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Smart Identification Systems is an Important Element for Monitoring, Tracking, and aids to Navigation in the Smart Ports

Refaat Rashad

Abstract

Ports were described by several names and titles. In terms of size there are small, medium, Large and mega ports, in term of ages, they were specifies as old, modern or new ports. In terms of generation, they have named themselves accordingly 1st, 2nd, 3rd and the 4th generations. For the goods operation there are centralport, and hub ports and so on it is endless chain of names aiming at obtaining a market place in the expanded maritime transportation. Smart ports, intelligent ports and Information ports are the new version of theadvertising of thisnonstop progress. However, smart ports have received a sound acceptance in the freight business; leading ports such as Rotterdam, Singapore and Vancouver have already declared themselves as Smart Ports.

Smart ports necessitate that every single component in the port operation to be functioning in smart way. Smartness may be defined that a processes of less paper, less time, less effort, manpower and less cost with maximum turnover and value added benefits. Increasing the gap between the lessees and the maximums denotes the smartness of the port.

Monitoring and tracking systems in smart ports add to the smart operation. Efficient tracking system helps the management tolocate the position of every single mobile target in and near by the port. Incoming trucks fitted with smart tracking deviseshelps to allocate proper loading/unloading slots in the port. Port navigation with smart identification system facilitatespiloting, minimize the berthing time and assure the required safety. Smart port is a comprehensive integration of all operation in the port and in its affiliated hinterlands.

The objective of this paper is toreview the requirements of the smart ports with analytical thoughtstaking into account the identification systems operated in the other leading ports and the potential capabilities of the ports in developing countries.The analyticalreview may draw a Road Map for the existing ports to be converted to smart ports in terms of locating the position of vehiclesand improving the traffic management of trucks, and sorting the containers allocation and their security. Virtual aids to navigation and berthing also benefit from the identification system based on new technology of GNSS positioning and GSM communication systems provide an essential means to assure safe navigation in ports.

However in order to become a member of exclusive club of the smart ports, the country and the administration, should also move toward the smartness with utmost development of intelligent management and human resources.

1- Introduction

Identification of moving targets in ports is important element to monitor tracking and assure safe navigation in the smart ports.Marine ports are the gate way in the international trade driving of the economic growth of the country. Any type of port can be seen as the initial interface between a country and the trade partners with whom the country does business.

Some ports have declared themselves smart ports; many other are performing their operation with high efficiencywithout declaring themselves smart ports.Rotterdam Port Authority, Singapore and Vancouver are among those ports that declared the smartness of their operation. Each of those ports has its own features and capabilities with some common factors between themselves but not identical.

Investigating the operation of other well advanced ports around the world, and analyzing the number of shipping of their turnaround time, number of ships, number of TEUs handling, well draw the road map for the developing to push forward towards the smartness.

2- Common features of smart Ports

- **Simplicity of operation**

One of the main issue of simplicity and efficiency of the port operation is well implemented in the maritime port logistic clusters, and absolute need to improve the level of automation in relationship between port operators and in the management of the document flows, where date and information need to be disseminated among stake holder parties in the port.

The Electronic Data Interchange EDI is capable of establishing advancedtechnology integrated with the Intelligent Transport (IT) system. Computerize and automation would simplify, standardize, render more efficiency and accelerate themovement towards theeconomy. Interaction between operators in different port communities, national and international communities would be sound good and also is important.

- **Maximize resources utilization and the turnaround time**

Competition among ports continuous increase as the differentiation of hub and mega ports progress. Smart ports should plan to introduce high technology services in theircontainer terminals to maximize the terminals capacity.

Trucks automated and guided vehicles or straddles are the equipment used in shifting the container from one place to another.Container terminal operator should challenge to minimize the operational cost while trying to maintain excellent service quality and to maximize operational effectiveness.

- **Communication and accessibility to information**

The communications in the smart port is the heart of the connectivity required between the ports, its clients, its vendors, security, and others who play a role in the desired secure and profitable trade relations. Extensive array of communications and events management capabilities can be configure to smart port operational requirements, traffic management, board and assembly meetings, conference calls, project updating, asset reservations, and much more. These capabilities include, telephony – phone and fax, Email notifications - triggered by events, text messaging and instant response forinteroperable IP-based communications.

Smart ports should have a legal and constitution framework to govern, approve and organize electronic documentation. Electronic documents may include all shippingdocumentsaffiliated tomaritime transportation such as Bill of Lading, charter agreement, cargo manifest, payment invoices and receipts, cargo insurance, and customs clearance.

In the quest to improve vessel turnaround times, smart portsshould more rely on wireless technologies to enhance the flexibility ofoperations and improve efficiency, not only the concerned departments inside the port but also to be connected to the other ports in the vicinity and to the regular shipping liners.

In 1970's the world largest container ports was New York followed by Rotterdam , 45 years later the largest and the second largest ports in the world were Shanghai and Singapore respectively. It is clearly show that the weight of the shipping industry and the maritime business has shifted toward the South East Asian region. The tentop ports in the last three years were designated as Smart ports based on the use of o new technologies of communications, computerization in addition tracking and monitoring of cargo and the containers movements.

3- Smart Containers

Containers that are using sensors and systems to track and report data on their contents, unauthorized access and physical location hold huge promise for improving supply chain efficiencies and strengthening security.

Once port declared itself as smart port, then information about the location and the cargo contents should be disseminated to other components and stake holders of the port. Since decades ago, many containers were fitted with sensors and communication systems. Shipping management companies, liners and cargo owners were able to real time monitor their container, and their cargo inside the containers in port, at the roads or even at sea.

Container tracking and monitoring, are essential for the smart ports, special sensors mounted in each container can provide in real time the condition of the internal space of the containers. Information about temperature, humidity, time of open or seal the container even more unauthorized movement or opening of the container can be instantly sensed, whereas owner and other concerned parties of the cargo can be notified.

Smart ports have a driving mission to move cargo quickly and safely through the port. To accomplish this mission, a reliable, flexible, and secure flow of information is vital. Therefor complete control and management of the smart ports containers should be an active part of the monitoring and tracking system.

4- Elements of Monitoring and Tracking Systems

Monitoring and tracking process requires two important information of the tracked object, which are the accurate position and the real time of such position.A tracking unit is the device, normally carried by the moving vehicle or container, that uses the GPS to determine and track its precise location, and hence that of its carrier, at a periodical intervals.

The recorded location data can be stored within the tracking unit, or it may be transmitted to a central location data base or Internet-connected computer, using a cellular (GPRS or SMS), radio or satellite modem embedded in the unit. This allows the asset's location to be displayed against a map backdrop either in real time or when analyzingthe track later, using **GPS tracking software**. Data tracking software is available for smart devices with GPS capability. Typical GPS tracking systems used in commercial fleet management have two core parts: location hardware and tracking software. Other devices known as a GPS beacon, this kind sends the position as well as other information like speed or internal situation of containers such bas temperature, and humidity at regular intervals, to a determined server, that can store and instantly analyze the data.In all cases tracking requires a system or means to radio and electronic transfer the information to the chancels and port management centers. The efficiency of the identificationsystem depends upon the following parameters of the positioning and timing availability;

Availability: To assure proper tracking the former information, position and time must be available 24/7 end-to-end real-time container tracking and securitymonitoring services optimize supply chain security management, uninterrupted flow of date.

Accuracy: Position and time accuracy are important factors for the management of movement trucks in or near by the port area, position accuracy within the range of sub meter can be achievedby Global Navigation Satellite System GNSS, time accuracy is required for the communication .GNSS are able to provide time accuracy of the range of 50n. Second.

Reliability: Monitoring and tracking depend on comprehensive closed loop system include, positioning and timing. Communications system based on GSM or VHF will assure the continuity of the tracking process.

Continuity: Continuous flow of information should be maintained. Satellite signals are usually weak and subject to the intentional and unintentional interference. To assure that position and time are available, backup system should be envisaged to maintain the tracking operation.

Accessibility: Port operation is like a bee network, where are many internal movement of targets, such as containers trucks, private or port operation vehicles, or even ships and boats exist the port or in the near by the approaches or already committed into the approach navigational channel.Then accessibility means that the possibility of target when inters the tracking zone of a port, the tracking system should be able to acquire the necessary information of such movements.

Integrity: Integrity of the tracking system means that, in case a malfunction takes place in the tracking system. The control operation should be identifying, the outage of the system must be contained and be able to restore the operation in short time. These operations necessitate continuous observation of the performance of the monitor and tracking system.

Trust-ability: Once the monitor and tracking system is operated all users should be able to trust the information provided by the system, the trust of the system will eliminate the doubt about the information and will help to provide instant decision in the right time.

5- Monitoring and Tracking systems in Ports

Many tracking systems are available worldwide; the competition between the manufactures of the equipment, the dealers of the producers and the services providers enhances the tracking technology and brought the cost down to a reasonable level. The systems are able to be integrated into the Intelligent Transport system, IT of ports. This Integrationcreates a comprehensive all function integrated systems, operated by centralized control mainframe.Trucks and fleet management system cannot be effectively operated without a mean of tracking and monitory system in the smart ports. To achieve the monitoring and tracking of ships at sea or trucks on the roads away from the shore GSM coverage out of VHF range an extra service in required based on communication satellites, the Geostationary INMARSAT or the low orbit IRIDIUM communication satellites providing information.

The Automatic Identification System (AIS) is a ship-borne transponder system designed in the first instance for maritime safety and in particular collision avoidance. It consists of a transponder unit including GPS, VHF transmitter / receiver and display / terminal. The unit broadcasts a message at regular intervals containing its identification, position, speed, course plus a number of detailed items about the ship and its cargo such as ship length, draft, cargo type, ports of providence and destination.The range of coastal range of AIS receivers is typically 40 nm. The range but can considerably be longer if the receiver is installed on an elevated position, and also during the preferable atmospheric conditions.

Information updates depend upon frequent of movements of the object. The transmission unit can be manually or automatically activated depends upon the situation.Inside the port area, at the check points the transmitted information can betriggered by the control center.

Ships, boats and Tugsinside the harbor and at the approach channel are guided in their updating their data by the use of AIS depends on the speed and the course alteration of each moving ship. The AIS system is based on transponders located on board ships. VTS and port management center can also be supplied with AIS units to be enabled to receive information from ship boats and tugs as a part of the comprehensive tracing and monitoring system at the AIS dedicated VHF frequencies. Once set up for a voyage, information is transmitted continuously from each vessel without requiring attention from the mariner. The introduction of AIS provides an alternative way of obtaining information for better traffic management in ports.

AIS helps in ship to shore and shore to ship, communication a VTS tool for traffic management, help identify vessels, assist in target tracking, simplify information exchange (reduce verbal communication), and provide additional information to assist situation awareness and safety.Incoming truck to the portat the connecting road will be assigned to the system at the first crossing of the triggering devices at the toll station.

6- Type of information

Identification varies according to the tracked target. For trucks and port operation vehicle the registration and plate number are essential information, type of vehicle and properly name of driver or authorized person for the vehicle may be included if available. Container data includes number, type and capacity. Ships data include information about the arrival of vessels, information about berthing plan, customs manifests, crew and passenger lists for passenger ships, information about dangerous goods if carried.The static data for ships and boats include ships, MMSI, Call sign and name IMO Number, type of ship, and, flag.Dynamic data of ships boats and tugs include real time positioning, heading and other navigation information. Ship’s dynamic date are based on the onboard sensors and transmitted to the smart port control center through the VHF, AIS systems.

Targets dynamic positioning and timing are based on any of the GNSS GPS or GLONASS, supported by ground or satellite augmentation to provide higher accuracy and secure integrity. The smart identification and tracking system monitors and tracks trucks, service vehicles, mobile cranes, container and other mobile equipment using the local (GSM) network. The rate of updating of the dynamic data depend the movement speed of each target connected to the monitoring and tracking system.

A virtual Aid to Navigation (AtoN) can be used in situations when it is impractical to equip or time does not allow the equipping of navigation buoys with an AIS transceiver. In this case, AISof the port monitoring system can configure any changes or shift in the position of the buoys which will be displayed on an electronic chart or mimic display system.

7- Conclusions and the recommendation

Smart ports operations is active and pay back its investment cost when it is affiliated with smart cities as well intelligent management system. The back bone of the smart port is computerization, automation and communication networks. Transparencies of information, centralization process (one window) clearance; add to the feature of the smart ports. Smart ships, smart cities and smart legislation environment will enhance the smart ports. Accurate positioning; reliable communication and fast flow of information have made it possible to monitor containers and its valuable cargo, improvement supply chain efficiency andreduce costs.

Conventional ports are invited to join the smart ports exclusive club, regardless their size of the port, the internal operation process are counted improving the individual platforms in the port will create a smart port.Identification and monitoring systems for vehicles, containers and ships are available in the global market with modern technologies.

Government should enhance the transformation of the conventional ports to the updated smart ports by mandate the best strategies for securing, directives and compliance requirements to protect the handling of the electronic documents of the smart ports.

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Ship Owners Anonymity as Security Risk

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Abstract

Flag States are responsible for ensuring that their vessels act in conformity with applicable rules of international law wherever their vessels are located and consequently Flag States play a particularly important role in ensuring maritime safety, security and the protection of marine environment. Hence, they are required to exercise effective jurisdiction and control in administrative, technical and social matters over ships flying their flag. Unfortunately, there are clear indications that a number of flag States regularly fail to comply with the United Nations Convention on the Law of the Seas (UNCLOS), and other relevant international instruments and agreements, while some other flag States fail to exercise effective jurisdiction and control over vessels flying their flag. The reasons for that arethe various flag states which are known as the open registry states, who market their registry systems to attract ship owners and shipping companies to fly their flags by offering lax registration requirements, procedures and poor control. Inaddition, they provide various options to attract ship owners, one of them which of this paper concern, the ownership anonymity that expose the marine community to various security and safety threats.

The paper is discussing the security threats that might be initiated from the anonymity of ship owners which is given as a positive option by the open registry system. Also, discusses how such an option raises the potential use of vessels in criminal and terrorist acts under the legitimate umbrella of the open registry system and why hiding the owner identity is considered as security breach.

1. Introduction

International shipping is a unique sector that has special features due to the various international actors involved, as a result the sector faces number of challenges. One of these challenges concerned with ships nationality, where all vessels must possess a national character in-order to be managed and controlled under the jurisdictions and laws of the national identity and it provides the legal bases for giving a specific name to the vessel for trade, legal and navigation purposes. Every state therefore under the international law has the rights to establish the national laws and standards for granting nationality to vessels that require flying its flag. So there is an agreement between the flag state and the ship owner on the required conditions to grant the flag to the ship, consequently both the flag state and the ship owner enjoys the privileges of the agreement. Some flag states known as open registry states provide lax registration systems and lesser control over their flag ships beside generally characterized by the country of registry that permits ownerships of its ships by non-nationals condition in order to grant the flag to the ship. Therefore, the open registry system attract most of the ship owners as it fulfills their different objectives and motivations, the choice of options is wide and each register may offer its own legal and commercial benefits. The permission to fly the State's flag may be an evidence that a vessel possesses the nationality of that State, but the flag does not proof nationality, the registration is the conclusive evidence of the nationality and ownership. There are features that tend to be common amongst many of the open registers, including low taxation regimes, minimal ownership requirements, and minimum manning requirements, inadequate or absent maritime administration, and a general absence of regulatory observance (Galley, 2014).The problem with the open registry system lies on the limited link between the flag state and their fleets, the link only through mutual financial benefits rather than a genuine link which is stated specifically and directly by the UNCLOS Article 91 ''*Every State shall fix the conditions for the grant of its nationality to ships, for the registration of ships in its territory, and for the right to fly its flag. Ships have the nationality of the State whose flag they are entitled to fly. There must exist a genuine link between the State and the ship*'' and that ''*Ships shall sail under the flag of one State only and… shall be subject to its exclusive jurisdiction on the high seas*'. Therefore, speaking about open register flag state continuous observance over their fleets or enforcing national and international standards is irrelevant with their policies and registry systems. As a result a huge number of open register ships are characterized by being sub-standard ships and lack the safe operation standards that threaten the maritime safety and the marine environment as well as the maritime security. The port state control reports shows that, most of the detained ships are under open register flag and the marine incidents that influenced the international maritime community and where responsible for the adaptation of new international instruments and regulations were also under open registry flag, the Torrey Canyon accident in 1967, Amoco Cadiz in 1978, Exxon Valdez in 1989, Erika in 1999 and Prestige in 2002 are simple examples.

From security point of view which is of this discussion concern, is about the options given by the open registry states concerning ship owner anonymity, the privilege which encourages and allows them to evade rules and regulations. Some open register states advertise anonymity as one of their registration services and owners who look for hiding their identity could be undertaken for distinctly illegal or even terrorist intent. Flag state generally plays an important role in ensuring maritime security and safety (Gianni, 2008), and the failure to meet their responsibilities and to ensure their ships compliance to the applicable international rules, pose the maritime community to various security and safety threats. From security point of view which is the concern of this discussion, some flag states might facilitate security breaches; specifically the open registry states, where the system provide lax registering requirements and procedures, poor control and anonymity. The service provided by these open register states attracts the ship owners especially for the anonymity offer, including the owners who are involved in illegal activities. Therefore concerns were raised over the potential use of open register ships by terrorist groups and criminal organizations. Another aspect of interest related and serves owners' anonymity is that the open registry states allow financial mechanisms designed specifically to hide owner identity, and hence the liabilities. Allowing registering ownership through offshore corporations, nominees, bearer bonds, shell companies, and the like, have doubtless encouraged many owners, including owners who are involved in illegal acts. Such option and privilege by open registry state has contributed in the prevalence of maritime security and sub-standard shipping where the threats gets high, beside it becomes difficult to prosecute ship-owners involved in these acts because of the anonymity option.

The aim of this discussion is to focus on the anonymity option provided by the open registry system pertaining to security issues; showing how far reached the ownership disclosure requirements mandated by the international maritime community to encounter the anonymity aspect.

2. Security and Anonymity

After September 11th, 2001 maritime security concerns kept growing by national and international maritime regulatory bodies and the ship owner anonymity issue started to be dealt with in more persistent manner, where more demands for greater transparency of ships ownership been pushed strongly. More worries starts to rise about the probability of using ships in terroristic attacks and also from being used by some terrorist and criminal organizations in funding their criminal acts, the lack of ship ownership transparency increased the threat and risks to maritime security. Several approved reports such as OECD report in July 2003 assured that some terrorist organizations were being funded by legitimate corporations owned by terrorist individuals enjoying the hidden identity option provided by the open registry states systems. The mask that is used to cover ship ownership identity and the security threats from such veil revealed the fact that it is difficult now a day to know who owns and control number of open registry flag ships, this fact was clearly stated by the Organization for Economic Co-operation and Development OECD report in July 2003.

Hiding the identity of ownership may be undertaken for valid commercial reasons, it protects owners who have a bad history in ship detentions or bad reputation with crew poorly supported, even provide cover for those who might have illegal or terrorist intent. The lax registration procedures by the open registry states might provide the legal cover to ship owners which might use their ships for committing unlawful act; or use their ships in lawful trade for funding unlawful acts; even use the ship as weapon in a terrorist act, beside it give no possibility for authorities to prosecute ship owners when their ship gets involved in any unlawful acts. As a result the maritime community dealt with the alert seriously and started to regulate certain laws and regulations to encounter such threat and faces the challenges raised by such condition granted by the open registry states.

2-1 Law and regulations statues concerned with ownership disclosure

The September 11th attacks led the international maritime regime to take an immediate action concerning the maritime security. Most of the new legislations and regulations where aiming greater maritime safety and security and focusing on the lack of adequate tracking of crew, cargo and vessels in addition to extra port security. The IMO through the maritime safety committee and its maritime security working group in December 2002 in the conference of the International Convention for the Safety of Life at Sea,1974 (SOLAS1974)adopted the International ship and port facility security code (ISPS code) which became mandatory in July 2004.

The ISPS code main objective is to enhance the security measures to detect and deter terrorist acts that threaten the security of passengers and crews and the safety of ships. SOLAS 1974 amendments added chapter XI-2 for special measures to enhance maritime security, which include only the mandatory part of the ISPS code. While further more amendments to SOLAS chapter V for safe navigation; addressing in Regulation 5 the Continuous Synopsis Record requirements and specifying in 5.3.6 that it shall contain the name of the registered owner(s) and their registered address(s). In addition, regulation 5.3.8 ensured that the name of the company and its registered address shall be contained in the record, as well as from where it carries out the safety management activities. Moreover regulation 5.4 ensured that any changes to entries shall be recorded in the Continuous Synopsis Record and the administration shall revise and approve the changes. According to regulation 5 the IMO tried to address the ownership anonymity in some way but practical speaking owners who are involved in any illegal activities or has terrorist intents will never place their names in any vessel or administration records.

The September 11th attack investigations led to the fact that terrorists where funded from several maritime corporations worldwide and no terrorists names were listed in the ownership records of these corporations (fox, Bennett.).There are plenty of ways to hide ownership identities which is actually offered by the administrations of the open registry states, and allows them to conceal ownership identities. The international maritime community continued tracking the problem and kept trying to contain such threat via additional laws and regulations to contain the flag states failure to carry their responsibilities as in the United Nations Convention on the Law of the Sea (UNCLOS) whom specifies flag state responsibilities in various articles. The UNCLOS Article 91, article 94, 1 and 94.2 concerning rights and duties of flag states, besides Article 217.8 that requires compliance to international standards and rules by flag ships and prohibit sailing unless flag state approval. Moreover the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (SUA) which covers the unlawful acts by ships and the expected threats. Even though, the International Labor Organization (ILO) convention governs the working conditions, rest hours and crew affairs which is extremely violated by the open registry system and pose various threats to maritime security directly and indirectly.

3. Anonymity Threats

Owners can easily establish complex webs of corporate entities which are freely available in many jurisdictions. The open registry states facilitate registration of corporation as vessels owners as well as several other mechanisms that provide further effective anonymity. Bearer shares is the popular and the most effective cloaking method, where no owner name, can be easily transferred from person to person without many changing hands. Thus, facilitate a high level of anonymity. At the same time, many of the traditional jurisdictions will allow local subsidiaries of foreign corporations to register their vessels under their flags, thereby allowing ownership to be concealed(Galley, 2014).Therefore, Terrorist groups can easily operate single vessels or entire fleets in order to generate funds and support their logistics operations, in fact, one terrorist group's. The Liberation Tigers of Tamil Eelam (LTTE), have developed and operated an extensive and profitable network of freight forwarders and ship operators (OECD, 2003) and that is a perfect example of ownership anonymity that might lead to a catastrophic consequences over the maritime security. The group was operating a shipping fleet bearing Panamanian, Honduran or Liberian flags, and the vessels crew were Tamils while the vessels where owned by front companies in Asia (OECD, 2003). The vessels were operated openly in the world shipping market carrying legitimate cargos an definitely, the vessel operations and profits where used in order to generate funds and support their logistics operations. It is doubtless that other criminal or terrorist groups are using the same approach and might already control a fleet of cargo vessels in order to generate revenue. Finally, the maritime transport sector, largely because of the availability of opaque ownership disclosure requirements can provide an attractive option for groups seeking to combine legitimate revenue-generating businesses with a more sinister global logistics.

From a different angle, in some open registry ships, crew might be problematic, since they have little connection to either the shipping company or vessel owner other than that they were hired to work on the ship. Consequently, they could have control of the ship and may be involved in various illegal activities. The prevalence of cases of unpaid wages, poor salaries and late payments, in addition to the crew rights violation because of the opaque shipping company and vessel owners, led some crew members, including officers, to be involved in illegal activities and taking illicit cargo. Illegal activities such as Human smuggling, human trafficking, drugs and weapons smuggling is very popular especially upon the open register ships and by their crews. Such activities by crews are mainly due to the loss of the genuine link and the opaque identity of the owners, therefore the lack of loyalty and connection. Containers for example are being popularly used to hide stowaways and it is a well-established trick in human smuggling (Tina & Ellen, n.d.) and it could easily be loaded with explosives. The minimum possibility to verify container contents beside the lack of proper inspection over them raised the possibility of the use of them in human smuggling, transport of weapons or loaded with explosives for terror acts and even transfers terrorists to circumvent immigration control. Such opportunities cannot be done unless ship crews are being involved either by agreement or unintentionally. Crew incompetency is one of the reasons for risks being augmented and security being diminished as most of them lack the adequate security standards and the main reason for that is lax registration conditions and the low wages scales in open register ships due to lack of the owner control and company connection. the lax crewing requirements and the ability to employ cheaper foreign crew and lower minimum manning levels, resulting in lower operational costs, higher work-load, more pressure, inadequate resources for on-going ship maintenance and questionable attention to security matter(Gianni, 2008). The sub-standard working conditions in the open registry flag ships which doesn’t comply with international standards encourages crews to find other ways to support their income and therefore to get involved in such illegal activities. This problem mainly found to be as a response to the lack of the genuine link and the owner ship anonymity, which requires serious attention and active actions, where the probability for using this weak point is relatively high and threatens the maritime community directly now a day.

4. Ownership Anonymity

Ship owners are given so many attracting offers by the open registry system; the economic attraction is a major motivating factor; minimum operating costs due to lower crew wages and maximization of revenue and turnovers. In other hand non-economic advantages include transparency of ownership, which means the ability to hide ship-owners identity. From economical angle, all the open registry states that provide anonymity services benefit financially from the system, they earn registry fees, maintenance and tax fees and expending little to ensure that their ships that fly their flags meet international standards and laws. The lax registration procedures and requirements in addition to the provided offers led most of the world fleets to prefer registering in these states, therefore earn large profits and bear very little costs.

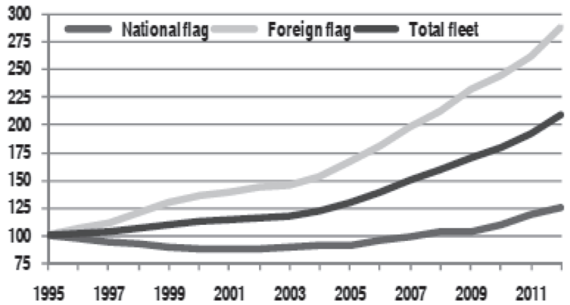

Figure (1) world merchant fleet by national and foreign from 1995- 2012
Source: (ISL, 2012)

Now the owner of the ship change opinion about the registries flag, thus they are choosing the open register flag. Figure (1) illustrates the world merchant fleet by national and open register flag. The number of merchant fleet and foreign flag equal 100 million dwt in 1995, But the foreign flag increased dramatically at (300 million dwt) in 2012. In addition, the national flag increased slowly at (125 million dwt).

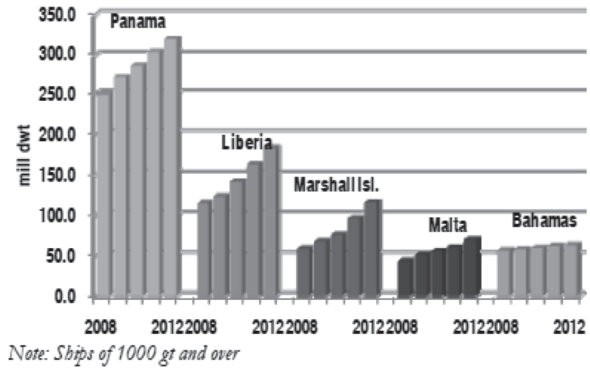

Figure (2) The tonnage development of major open registry flag.
Source: (ISL, 2012)

Figure (2) illustrates the tonnage development of major open registry flags. Panama flag was the highest value (320 million dwt), was double Liberia flag (120 million dwt). The Malta flag and Bahamas flag were the almost equal (60 million dwt).

Rank	Flag	Number of merchant vessels ≥ 1000 GT	Rank	Flag	Number of merchant vessels ≥ 1000 GT
1	Panama	5,764	32	Belize	261
2	Liberia	1,948	33	Gibraltar	216
3	China	1,775	34	Georgia	209
4	Malta	1,281	35	Sweden	194
5	Bahamas	1,213	36	Ukraine	193
6	Singapore	1,131	37	Canada	171
7	Russia	1,130	38	Korea, North	171
8	Antigua & Barbuda	1,059	39	Spain	167
9	Hong Kong	1,009	40	Comoros	144
10	Indonesia	965	41	France	141
11	Marshall Islands	902	42	Netherlands Antilles	138
13	Greece	824	43	Brazil	135
14	Korea, South	738	44	Bermuda	133
15	Norway	715	45	Iran	131
16	Japan	676	46	Honduras	126
17	Italy	604	47	Cayman Islands	124
19	Saint Vincent & Grenadines	582	48	Portugal	117
20	Netherlands	566	49	Sierra Leone	113
21	Turkey	565	50	Saint Kitts and Nevis	104
22	India	477	51	Taiwan	102
23	United Kingdom	474	52	Syria	96
24	United States	446	53	Finland	92
25	Thailand	405	54	Azerbaijan	86
26	Philippines	383	55	Egypt	77
27	Germany	382	56	Croatia	75
28	Vietnam	314	57	Tuvalu	74
29	Malaysia	304	58	Mongolia	73
30	Denmark	299	59	Barbados	71
31	Isle of Man	297	60	Bulgaria	71

Table (1) Top 60 flags based on numbers of merchant vessels on registry > 1000GT
Source CIA World Factbook. November 2007

The lax procedures no doubt attracted terrorist and criminal groups to benefit the cover given to their identity under legitimate umbrella and enjoy anonymity as long as they keep paying the required registration fees and tonnage tax. In the other hand, through anonymous ownership, passive investors limit their liabilities to the amount of their investments and for this purpose investors were encouraged to invest in the maritime industry. Anonymity provides investors with limited liabilities, and any increase in their liability will be opposed by a rise in the costs within the maritime industry through increasing the insurance costs, operational costs and the legal expenses. The rise in costs will be reflected on the consumer and they will bear the brunt of the rise of liability and that would have a negative impact on the shipping industry and the global economy as a whole, where 90% of the world trade is being carried by ships. Therefore, the idea behind not taking a sever action against the open registry anonymity option has an economical background that makes the hand of the international maritime community tied up despite the security threats. Beside, that it is not yet proven that requiring disclosure could prevent terrorist and criminal organizations from funding their acts. The terrorists in such open registry system have plenty of choice to fund their activities and use the ship for terrorist purposes. Moreover it becomes even difficult to detect potential security risks and terrorist groups under this system; they can easily own fleets and benefit the cover given to their identity as long as they keep paying the required registration fees and tonnage tax (Tina & Ellen, n.d). So, it not wise to have rules and regulations that might lead investments to be minimized or the costs to be raised for one single option given to investors to encourage investments in the maritime sector.

After September 11th new security regulations put in place which added financial burden on ship owners which was not actually opposed because of the understanding to secure shipping and to protect investments. Ship owners agreed on the new security measures as it will improve maritime security and assist in preventing vessels from being used in maritime attacks or in unlawful acts. Unlike the new security measures, the requiring disclosure of ship owners would not prevent funding the terrorist and criminal organizations or even identify them because definitely will not place their names in any records. Moreover the costs to investigate the destination of fund of all these ship-owners records will be extremely costly to any security agency with little to be gained. Requiring transparency will negatively affect investors and yet terrorist will still not be detected, investigations should be conducted through the use of international cooperation between governments' intelligence to share information to track and seize funds transfer worldwide. The situation is a serious security breach and threatens the maritime security in a way that could lead to unbearable consequences and could not be confined by political boundaries (Tina & Ellen, n.d.).

The continuous failure of open registry states to meet their responsibilities and to discharge their duties under international laws raises questions about international maritime standards goals as well as actions required for the integrity of the current system for registering ships (Gianni, 2008).

5. Conclusion & Recommendation

As seaborne trade increased internationally, the number of ships started to increase as well, and the use of open registry flag by ship owners found to be preferable. The continuous failure of open registry states to meet their responsibilities and to discharge their duties under international laws raises questions about international maritime standards goals as well as actions required for the integrity of the current system for registering ships. The lack of the genuine link plays role in posing the maritime community to various threats and requires strict compliance to activate UNCLOS requirements and further control over this aspect. Also the fact that the maritime legal regime created by UNCLOS does not apply to non-state actors, such as cargo owners and ship owners must be revised as their contribution to the security breach is undeniable.

The Open registry system advantages regarding the lax registration policies, not requiring the disclosure of beneficial ownership and the anonymity is a crucial security aspect and need to be dealt with by the international community in legal framework and rules. Allowing of corporations to be registered as beneficial owner in open registry system must be revised as it facilitates identity cover to ship owner in a way that threatens the maritime security directly. The corporate mechanisms allow terrorist groups and other crime organizations easily fund their illegal or terrorist activities beside they can legally possess their own fleets. Moreover the anonymity option given by the open registry flag to ship owners makes it more difficult to prosecute them if the ship is being stopped for illegal activities. In other hand, because of the opaque shipping company and vessel owners, with the lack of the genuine link could push shipping crews to get involved in illegal acts and pose the maritime security to high risks.

The international maritime sector should consider the economic benefit behind the anonymity option in parallel with the security needs, and to target the ship operators rather than beneficial owners who might have no involvement to the operation of the ships they own.

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IMO Benefits of Implementing the Hong Kong Convention for Recycling of Ships

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Abstract

Ship recycling became an important element in the shipping industry, as some countries depend on that element economically in order to make maximum use of the materials, substances and equipment coming out from the demolition of ships. The International Maritime Organization (IMO) noticed that the ship scrap has harmful impact on the marine environment and human health in the form of noise and hazardous materials. Therefore, the first agreement for recycling appeared in 1989, namely BASEL Convention then the IMO adopted The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC) 2009. This convention developed a prior plan for the ship recycling process in order to protect people who work in that field and to issue certificates and inventories for the ships that will go through the recycling process.

This paper will discuss The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships 2009, highlighting the main points required performing safe recycling. In addition, the paper will analyze the economic benefits resulting from implementing and applying the convention in a way to encourage the coastal states to invest in the recycling business while maintaining harmless for human and marine life cycle.

Keywords: Ship Recycling, the Hong Kong International Convention, Ship Recycling Facility, Ship Recycling Facility Plan, Hazardous Materials.

1. Introduction

Ship life cycle at sea is considered as a long one that could extend to 25 years, the recycling process starts at the end of this life cycle, which is an economic and commercial operation that is beneficial to both the owner of the ship and the entity responsible for recycling the ship. The ship is cut into parts then these parts are reused as well as the operative equipment. However, these parts have some hazardous materials, during the cutting process some welding parts and some paints fall in the water, resulting in the pollution of the marine environment in addition to harming human life. So the first glance to the convention was The Basel Convention on the Control of Trans boundary movements of hazardous waste and their Disposal (Basel Convention) in 1989, which was adopted in 1989 and entered into force on May 1992 and the last glance in the ship's life cycle which is the recycling process and the risks arising from hazardous materials and waste. (Bhattasharjee, 2009).

Among the objectives of Basel Convention was the reduction of damages resulting from hazardous waste and waste production in terms of quantity and potential danger on the human health. Also, the convention presented some means of treatment for the occupational health, disposal of hazardous wastes and other wastes as soon as possible and recycling it properly as well as reducing wastes to the minimum, which is consistent with the safety of the marine environment. In May 2009, the IMO paid attention to the gravity of these materials on the marine environment and on the health of those working in that field. Therefore, the IMO adopted The Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships (HKC) in 2004, the HKC has developed some regulations to ensure and improve the basic standards for ship recycling, developed standards inventories to be given to the scraping yards while recycling process, and the required equipment for cutting ships. (Mikelis, 2012)

This paper will discuss The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships 2009, highlighting the main points required performing safe recycling. In addition, it will analyze the economic benefits resulting from implementing and applying the convention in a way to encourage the coastal states to invest in the recycling business while maintaining harmless for human and marine life cycle. The structure of this paper consists of a back ground introduction about the recycling regulations, the implementation role of the HKC for the different parities of the convention, the economic benefit of the recycling process, and examples for implementing the (HKC) in China and EU countries, finally comes the conclusion & recommendations for this paper.

2. Implementation of Hong Kong Convention

The HKC must be applied on all ships more than 500Gross Tons (GT), while it will not be applied on governmental and warships. In order for HKC to be applied, all parties, the convention states, whose ships are flying their flag and the authorities meant by the HKC should apply the regulations of this convention, as the convention states should make an Inventory of Hazardous Materials (IHM) and submit it to the maritime administration before entering the scraping yards. This inventory includes four lists. Firstly, a list of hazardous materials such as asbestos, ozone, depleting substances and Anti-fouling systems containing organot in compounds as a biocide in terms of ship construction and ship equipment in terms of its locations and number and this list is mandatory for all ships. Secondly, a list of hazardous materials such as lead compounds, mercury compounds and radioactive substances which result from the operation of waste processes and this list are mandatory for new ships, new installations and voluntary for existing ships. Thirdly, a list that contains potentially hazardous items such as kerosene, waste oil, acetylene and nitrous oxide mentioning the stores locations for such substance in the ship, this list is mandatory for new ships, new installations and voluntary for existing ships. Finally, a list of regular consumable goods potentially containing hazardous materials such as computers, refrigerators and fluorescent lamps, this list is mandatory for new ships, new installations and voluntary for existing ships (Joinet al, 2013), figure (1) shows the processes of completing the inventory of hazardous materials by the ship owner to submit it to the flag state.

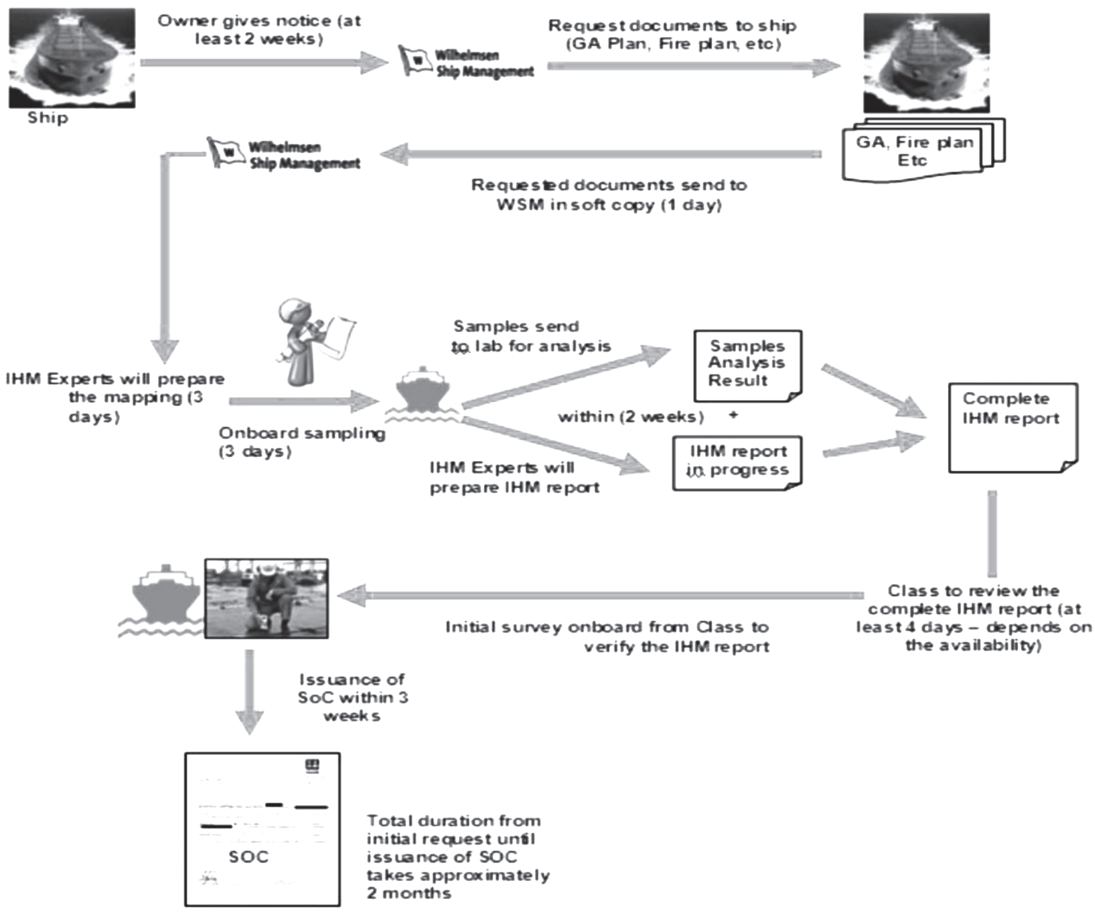

Figure 1. Inventory of Hazardous Materials Processes
Source: Wilhelmsen Ship Management, (2010).

After receiving (IHM) the flag state must issue the certificate of International Circulation on Inventory of Hazardous Materials (ICIHM). This certificate is renewed every five years and any modification in the construction of the ship will incline the ship owner to make a comprehensive inspection for his ship (ABS, 2011), then the ship owner must submit the ICIHM and the recycling plan of the ship before the ship enters the scraping dock, which identify all about the hazardous materials and waste, and after necessary examinations, the flag state must give the ship owner the following certificate, which is called The International Relay for Recycling Certificate (IRRC) (HKC, 2009).

2.1The Role of Ship Owner

Ship-owners who want to recycle their ships have either to contact with a recycling facility directly or to use the service of a shipbroker. However the way used for recycling, the main requirement that a ship-owner should do to recycle his ship is to develop a Ship Recycling Plan (SRP). In order to make such plan, ship-owner should provide a completed IHM, including ship stores, generated wastes that will be present at the time of delivery of the ship, copies of plans and ships drawings. Also, ship-owners are required to ensure that the recycled ship is 'Safe for Entry' and 'Safe for Hot Work, which means that all cargo holds and bunker tanks will be gas free especially chemical and oil tankers, which allow the recycling facility to do hot work during the cutting process and these activities have to be mentioned in the S R P (ICS, 2016).In addition, ship owner must inform his maritime administration and flag state about the locations of the remaining fuel and oil in the ship. Also, pointing out the location of the hazard materials help in the recycling process and enable the recycling facilities to avoid such hazardous materials and to perform the recycling process in a correct and safe manner.

2.2 The Role of Recycling State and Port State Control

Countries on which the recycling and cutting process takes place must be sure that the ship to be recycled was built and designed in a safe manner that protects the marine environment. These countries must receive the recycling plan and the International Relay for Recycling Certificate and make sure that all the hazardous materials and equipment are posted in the recycling plan before starting the recycling process (Mikelis, 2012).Port State control, should visit the recycled ship before entering the recycling process and be sure of the presence of the ICIHM and IRRC certificates as well as surveying the ship wastes and the hazardous materials locations. The Port State must suspend and detain the ship if it notices any change in the locations or quantities of wastes or the hazardous materials (Rossi, 2011).

2.3 The Role of Ship Recycling Facility

The ship recycling facility is the specialized and responsible authority for the recycling process, the used type of the recycling method and the steps to be followed during the cutting operation. It must be sure of the presence of the Ship Recycling Certification (SRC) and the Ship Recycling Facility Plan (SRFP) which should include the developing management methods of the recycling process to achieve the convention requirements, developing a system to record all the recycling processes, set the laws and responsibilities for the staff and workers during the recycling process, setting the instructions of the occupational safety and protection of the people and the marine environment, developing a surveillance system during the recycling process, developing a contingency plan and identifying the individuals responsibilities in case of emergency, ensuring writing detailed reports in any case of incidents that may occur during the recycling process that might harm health, environment and these reports must be published and finally developing systems for raising the levels of the workers responsible for recycling process by conducting training programs (IMO, 2009).

3. The Economic Benefits of the Recycling Process

- world economy has witnessed a significant decline as well as an increase in the cost of the ship voyage and decrease in cargo freights, these changes forced ship owners who own over 15 years ship to starts ending their ships to recycle in case of getting more benefits of the recycling money instead of spending money on the running cost of the ships, some countries began to take the advantage of doing the recycling process on their land to boost their economy by entering the recycling business within the calculation of their Gross Domestic Product (GDP) (Mikelis, 2007). Figure (2) illustrates the development of ship recycling industry between the periods of 1979 to 2010. In 2010, the figure shows that Bangladesh had the highest volume of recycling tonnage; namely around 18 million GT, followed by India which scores around 14 million GT, which was double the number of China that recycled around 7 million GT, and finally Pakistan had the lowest volume of recycled tonnage with 4 million GT.

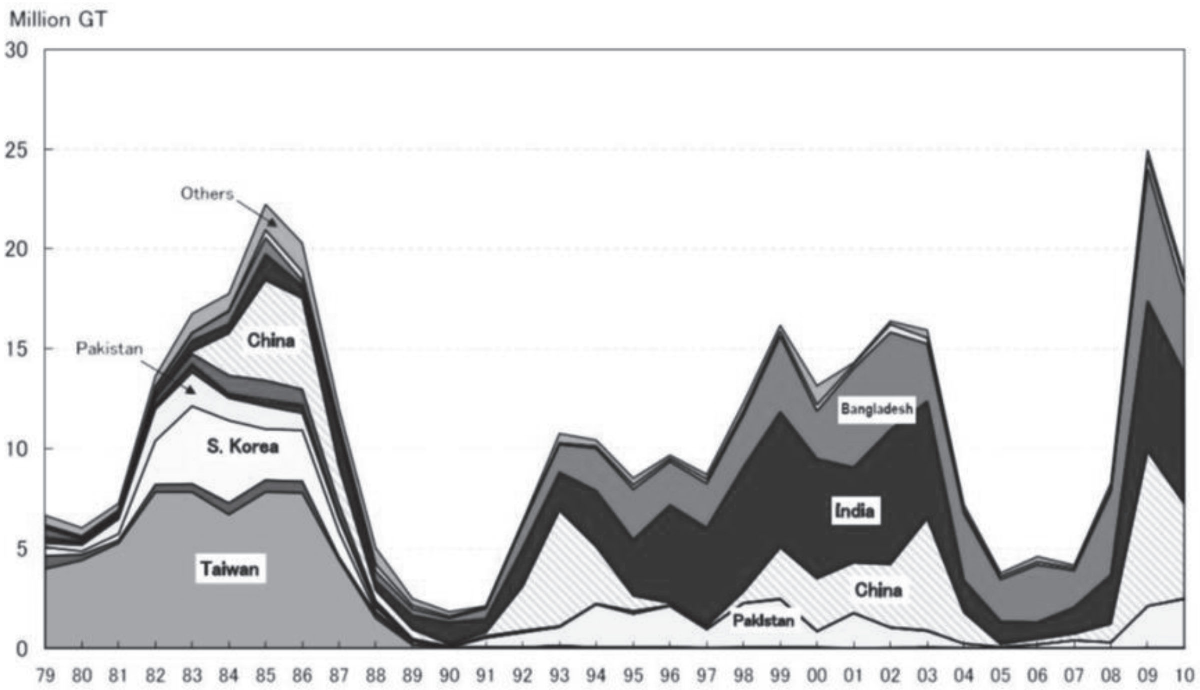

Figure 2. Development of Ship Recycling Industry
Source: Vuori, (2013)

Later in 2012, about 57.5 million Dead weight Tonnage (DWT) of the world cargo ships went through scraping processes. Figure (3) illustrates the highest percentage of cargo ships that have been scrapped. The ranking of the scraping countries have witnessed slight change than in 2010, India came first by 34% of the total scrapped tonnage represented by around 19millionDWT, followed by Bangladesh 24% which is equal to around 13 million DWT then China by 19%which is equal to around 11 million DWT, then Pakistan in the same rank as year 2010 by 17% which represent around 10million DWT and remaining 6% for the rest of the world, while Turkey takes a high percentage of that amount by 40% of the remaining international percentage which is approximately half the remaining percentage (HSN, 2013). Moreover, to show the benefits of this statistics these percentages have to be converted into income, as mentioned before, the scrapping market prices in the end of 2011 was500 US dollar per light displacement ton (ldt), which means a very huge income for these countries that were interested in the recycling business, which raise the importance of implementing the HKC to preserve the marine environment and maintain safety of human health during the recycling process.

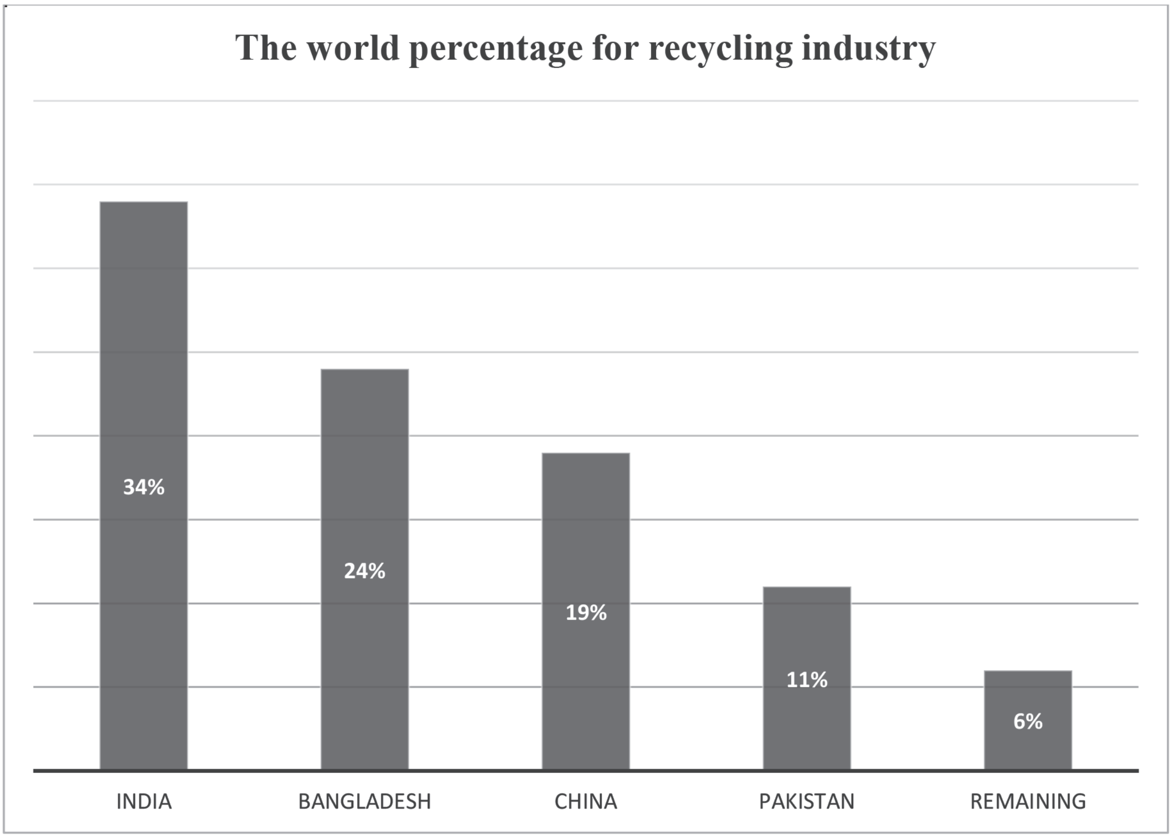

Figure 3. The World Percentage for RecyclingIndustry
Source: HSN, (2013)

4. Implementation of the HKC in China & Turkey

On one hand, as it was mentioned before that about 19% of the ships were recycled in China, therefore the Chinese government has begun to develop the standards that should be used for recycling to protect the marine environment and safety of human health during the recycling process (Puthucherril, 2010). These standards are between the ship and land facilities where a Recycling Plan must be developed through the International Ship Recycling Association (ISRA), so the recycling state can make sure of all the required standards and be sure of the locations of hazardous materials and waste, before starting the recycling process and entering to the scraping yards (Lloyd's, 2011). Among the characteristics of the recycling process in China, the Chinese craping yards makes a full use of all the parts and equipment's of the ship, as China was one of the first IMO member states that applied the HKC and actually began auditing all ships that subject to the recycling process.

One other way of implementing the convention, is the way adopted by Turkey, which occupies a large percentage of the ships scrapping business in the Mediterranean, as mentioned above around 40% of the reaming percentage of the shipping cargoes in the world, therefore, the Turkish government has made the promotion of this industry and push it forward to support its local economy. Turkey is one of the first countries that have ratified and supported the HKC for the protection of the environment and maritime safety, the Turkish government has started to apply the convention on all ships flying the Turkish flag and on all docks and scraping yards in its ports. As mentioned before, the Turkish government implemented the HKC and identified some requirements, such as that the recycled ship must present the ship recycling plan and the list of all the hazardous materials and waste while entering to the scrapping places. Also, the government set strict penalties for ship owners that breach the treaty's requirements and commit them to prove that their ships are green (Vuori, 2013).

5. Implementation of the HKC in the European Union (EU)

According to the statistics of 2011, about 278 million DWT ship flying the flag of the European Union countries, which present around 20.6% of the world tonnage, about 10% of these DWT capacity are subject to recycling inside the EU countries and the rest of these percentage go for scrapping in India and China, That is because of the high level of safety and security requirements enforced by the EU as well as the cost of the working force in these states (McCarthy, 2012).

The EU countries were among the first member states of the IMO to ratify and apply the HKC, as they began developing their required standards for ships that need to be recycled in any country of the EU countries. The EU started implementing the HKC and established special requirement, such as all ships flying the flag of EU countries must acquire the required certificates for recycling; all hazardous materials and waste must be controlled inside the scraping docks in which the cutting process takes place, the scraping yards, which will perform the recycling process and not a member in the EU but scraping ships flying the flag of the EU country must apply all the requirements of the convention, all ship owners that fly the flag of EU must inform their flag state with the cutting schedules and finally they developed deterrent and severe penalties for ship owners who violate any of the EU or the convention requirements (European Commission, 2012). Based on the above information, it is clear that the EU countries have imposed laws on the ships flying their flag as well as the docks in which the cutting process will take place, to ensure that these docks implement the convention requirements in a way that protects the environment and people health.

6. Conclusion & Recommendation

The average age of ships dismantled has been increasing for the last 10 years from 25 years to 34 years. Moreover, in the coming 10 years it is expected that the scrapped ships will be approximately around 30 million DWT, which equivalent to around 6 million tons of steel will exit from the shipping market. There are great expectations on the future of green ship recycling industry. The public opinion and awareness of the industry’s character puts the stakeholders of ship recycling under constant pressure to improve the business to be eco-friendly. The shipping companies concerned about the environmental values have made a competition factor for themselves, such as Maersk Group which is already supporting the HKC even though it is not entered into force yet and the company started using IHM since 2007. As noticed, there are two main factors that control the development of ship recycling volumes. Firstly, the global trends in the economy which sets the demand of the freight markets which determines the need for an actively operated fleet. Secondly, the domestic demand for steel which guides the ship recycling industry in the countries involved in that industry. However, the domestic need for scrap steel mainly affects the balance where the ships are broken within the industry rather than the total global volumes. India and China might be gaining some increase in the recycling market share due to the economic growth in other business sectors. Also, it is expected that there will be some regulations related to the rise of recycling volumes of the ship recycling markets in 2016 when the transition period of the IMO regulation that interdicts single-hull tankers comes to an end. It is estimated that 1300 single-hull tankers will be going for scrapping by the year 2016; a great number of these vessels has already been gone for cutting that indicates an increase in the demand of ship recycling facilities.

Finally, the recommendations is to encourage the IMO member states to ratify the HKC and entering the convention into force in order to make the IHM compulsory for all the ships which will reduce the risk for the crew and will protect the marine environment. Also, the IMO have to raise the number of the recycling areas all over the world in order to facilitate the recycling process and to reduce the hazard materials and waste coming out from the recycled ships. To wrap up Egypt, as an IMO member state, have to build up recycling yard and recycling facilities to support the recycling industry, which will help in increasing the national income and raise the Egyptian economical level. In addition, it is recommended that these recycling facilities take place in the area between Port Said and Damietta port because of their strategic location and logistics facilities, also this location will prevent the ships that need to be recycled from passing the Suez Canal and that will reduce the cost of the recycling voyage.

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Full Parameters Calibration for Low Cost Depth Sensors

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Abstract

Recently, the availability of the RGB-D sensor in commercial market with reasonable price and its high potential to be integrated with different navigation and 3D modeling systems, this is placed navigation and 3D modeling by low cost depth sensor in top of surveying topics. Structure sensor is one of latest RGB-D sensors released in the market. The structure sensor is mainly based on IR sensors and structured light principal to produce the depth information. Unlikely KINECT sensor, structure sensor does not have RGB camera and it is designed to be attached with mobile devices which have RGB camera. To achieve high accuracy depth measurement from such sensors, a rigorous calibration for manufacture parameters as well as the distortion model and the systematic error for depth sensor must be precisely handled. The calibration issue is the master key to adopt these sensors to be applied in surveying application alongside the gaming purpose. In this research a new methodology for depth sensors calibration and a new distortion model were introduced. The distortion model is presented to replace the traditional distortion correction concepts. After applying the distortion model and manufacture calibrated parameters, the system can improve the depth precision by 80% for near and far range and by 20% for normal working range.

Keywords: RGB-D sensor, 3D indoor modeling, indoor navigation, low cost depth sensor, calibration

1. Introduction

Indoor 3D modeling and navigation become a serious research topic when the application area is related to Building Information Modeling (BIM) and Smart city. As the indoor environments have very complex structure and narrow spaces, special sensors are nominated to be used to achieve the application requirements. Consumer-grade RGB-D sensors are assumed to be one of the most attractive sensors to be applied in indoor applications. However, RGB-D sensors have the ability to be adopted in real time for 3D reconstruction and integrated with several navigation systems as constraint, the crucial issue faced these sensors is the reported depth accuracy (Khoshelham & Elberink, 2012), (Yamazoe, Habe, Mitsugami, & Yagi, 2012), (Mallick, Das, & Majumdar, 2014), and (Camplani, Mantecón, & Salgado, 2013).

Two main concepts have been implemented in RGB-D sensors, the first is the structured light concept, in which the depth sensor is combined from two Infrared (IR) sensors, one is IR projector which emits a structured light pattern and another is IR camera which receives the IR pattern reflected by the objects in the camera field of view (Haggag, Hossny, Filippidisy, Creighton, Nahavandi, & Puriy, 2013). The second is the time of flight (ToF) concept, in which the depth sensor uses the time difference between the projected pattern and the received pattern from both IR sensors (Gokturk, Yalcin,

& Bamji, 2004). KINECT version two (v2) is based on the concept of ToF, and KINECT version one (v1) is based on first concept (Microsoft, 2016).

Dealing with the first concept, the depth for each pixel in the image is computed based on the difference between the IR standard pattern emitted by IR projector and the IR pattern returned by the object; both patterns are collected on IR camera space. The difference between both patterns is called disparity. By knowing the baseline between IR projector and IR camera and the projected depth for standard pattern as well as the disparity value, the manufacturer demonstrated the main principal in only one simple equation which called manufacture equation for the depth sensor. One reason which called this sensor is RGB-D sensor was the first sensor released on the commercial market was KINECT sensor in 2010 (Microsoft, 2016), however this sensor reported the depth based only on both IR sensors and color information is optional, the manufacturer illustrated RGB sensor to produce ordinary images in the same time with depth images.

A new depth sensor was released on the market called Structure sensor (occipital, 2015), this sensor is only dealing with the depth information as it is combined from IR camera and IR projector. Structure sensor is based on the disparity concept to deliver the depth information similar to KINECT v1. Although the same manufacturer concept; a lot of operational and physical differences between structure and KINECT sensors, these differences placed structure sensor in a grand position compared with KINECT. Structure sensor is designed to be attached to any mobile device with different operating system (IOS, Android, and Windows), the size and weight as well as the internal battery of the sensor give it the chance to be the first fully mobile depth sensor released in the market.

The common issue between the structure and KINECT sensors is the accuracy of the delivered depth alongside the calibration of the manufacture parameters. In this paper, we proposed a new methodology for low cost depth sensor calibration and introduced a novel distortion model for depth sensor which deals with both IR sensors.

This paper is divided to seven sections. First section is the introduction for the main concepts of low cost depth sensors and differences between the current types in the commercial market. Second section illustrated the concept of low cost depth sensors based on the structured light, also this section mentioned the current procedures for calibration and error modeling for RGB-D sensors. In the third section, the proposed calibration methodology and the distortion model were mentioned. Fourth and fifth sections show the experimental design and the results of calibration and the distortion model, respectively. Before conclusion and future work, examination and validation of the proposed methodology and distortion model were carried out on data samples collected by structure sensor.

2. RGB-D Sensors Structured Light Concept and Current Calibration Procedures

RGB-D sensors which based on structured light concept have attracted the researchers from computer vision, robotics, augmented reality, and indoor navigation and 3D modeling. When the KINECT v1 was released in 2010 a lot of researchers suggested and presented several calibration methodologies to calibrate the sensor to be adopted in the precise applications besides the gaming purposes (Khoshelham & Elberink, 2012). The principal of RGB-D structured light sensor is illustrated in the following figure (figure 1).

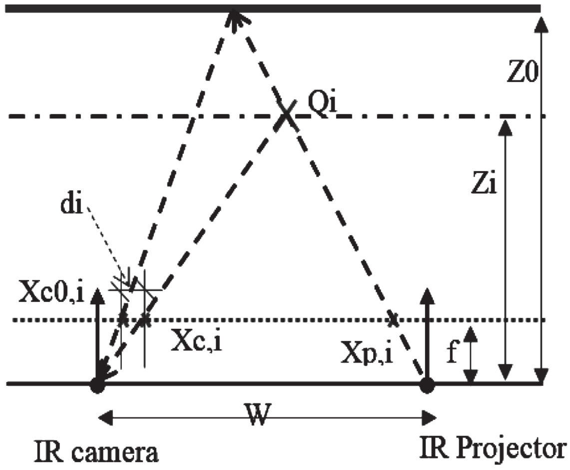

Figure 1: Structured light low cost depth sensor main concept

The manufacturers design the low cost depth sensor based on three main parameters which are, the baseline between IR sensors (W), standard projection depth (Z0), and focal length (f). The three main parameters are collaborated with the measurement disparity (di) to deliver the pixel depth (Zi). By triangulation, the sensor firmware can compute the depth information based on the measured disparity as follow

$$Z_i = \frac{f.w}{f.w/Z_0 + d_i} \quad \textbf{(1)}$$

Where (di) is the measured disparity in pixels, as the structure sensor normally normalized this value to be within range 0 to 2047. The reported disparity, which called normal disparity (d_i^n), has a relationship with the measured one as follow:

$$d_i^n = \frac{1}{\alpha}(d_i - \beta) \quad \textbf{(2)}$$

Where α and β are the normalization factors to be assigned by the sensor firmware. Applying equation (2) in equation (1), we can realize that:

$$Z_i = \frac{f.w}{f.w/Z_0 + d_i} = \frac{f.w}{f.w/Z_0 + (\alpha.d_i^n + \beta)} = \frac{1}{1/Z_0 + (\alpha.d_i^n + \beta)/f.w} = \frac{1}{a + b.d_i^n} \quad \textbf{(3)}$$

Equation (3) is considered as the manufacture equation for any RGB-D sensor based on structured light principal. a and b values are considered as the manufacture parameters which take in account all the designed parameters in depth sensors.

$$a = 1/Z_0 + \beta/f.w \qquad b = \alpha/f.w \quad \textbf{(4)}$$

In context of RGB-D sensors calibration, there are two main philosophies to calibrate the sensor designed parameters, the first one assumed that both IR sensors have the same behavior of lens camera and applied the pinhole camera model to both sensors then computed the internal and external parameters for each sensor (CHOW & LICHTI, 2013). This method utilized the photogrammetric bundle adjustment for the sensor and recovered the baseline and distortion models for each sensors. Bundle adjustment for IR projector has to work with the standard projected IR pattern, however this pattern is unknown and still manufacturer's secret, the authors computed the IR projector data based on the reported disparity and initial manufacturer parameters. This leads to have some limitation on IR projector data independency and reliability (CHOW & LICHTI, 2013). Applying the proposed method in real time as well as the distortion model was not clearly stated. The calibration procedure was based on three sensors as the color camera was integrated to the system, and consequently, this method may need another extension to be applied to structure sensor.

The second philosophy (Daniel Herrera, Kannala, & Heikkila, 2012) assumed only one depth sensor combined from two IR sensors, this method is more convenient compared to the previous method as the two IR sensors are working together to produce one measured value which is the disparity. The stated calibration methodology was divided into two stages, the first stage was the manufacture equation calibration with two parameters a and b then, in the second stage, the authors proposed a distortion model which modeled the systematic error and distortion effect for the depth sensor, the distortion model was empirically proposed based on the sensor error behavior. The authors applied an exponential model with two parameters and one spatial reference pattern. The limitation of this method is the mathematical truth of the proposed distortion model, however, the authors stated that the model can work properly with different RGB-D sensors. The similarities between both philosophies are the calibration of RGB camera and the external baseline between the IR camera and RGB camera.

Among both philosophies, a lot of researchers proposed different ways to achieve the depth sensor calibration and depth error modelling. Yamazoe, et al. (Yamazoe, Habe, Mitsugami, & Yagi, 2012) illustrated the distortion model for depth sensor based on the radial distortion function and did not conduct the calibration of the manufacture equation, however the idea of calibration is mathematically valid but the systematic error resulted from manufacturer equation did not be achieved. Another method was introduced by (Raposo, Barreto, & Nunes, 2013), this method completely based on the second calibration philosophy which followed the same models but the authors applied different methodology to achieve fast accurate calibration results, the authors divided the whole methodology into three parts, one was related to the external parameters between the IR and RGB cameras and the second was refinement of the external parameters without distortion effect and finally applying the distortion optimization loop to recover both distortion and external parameters. They assumed that applying the distortion model after refinement of the external parameters will lead to decrease the time of whole calibration process. This method actually presented a way of methodology improvement but did not contribute new knowledge in any of distortion effect or error modelling for delivered depth.

In our work we will deal with the distortion model for only depth sensor without color camera which is the same case for structure sensor, also we will focus on the distortion model and its mathematical truth. We will discuss in details the calibration procedure and the applicability of the proposed distortion and error model to be applied in real time.

3. Methodology and Distortion Mathematical Model

As the current calibration methods are lack of mathematical background or the applicability of the distortion model in real time and/or full parameters calibration for the depth sensor, our methodology was proposed to achieve all of these requirements. The flowchart illustrated in the following figure presents our methodology to calibrate full parameters of low cost depth sensors.

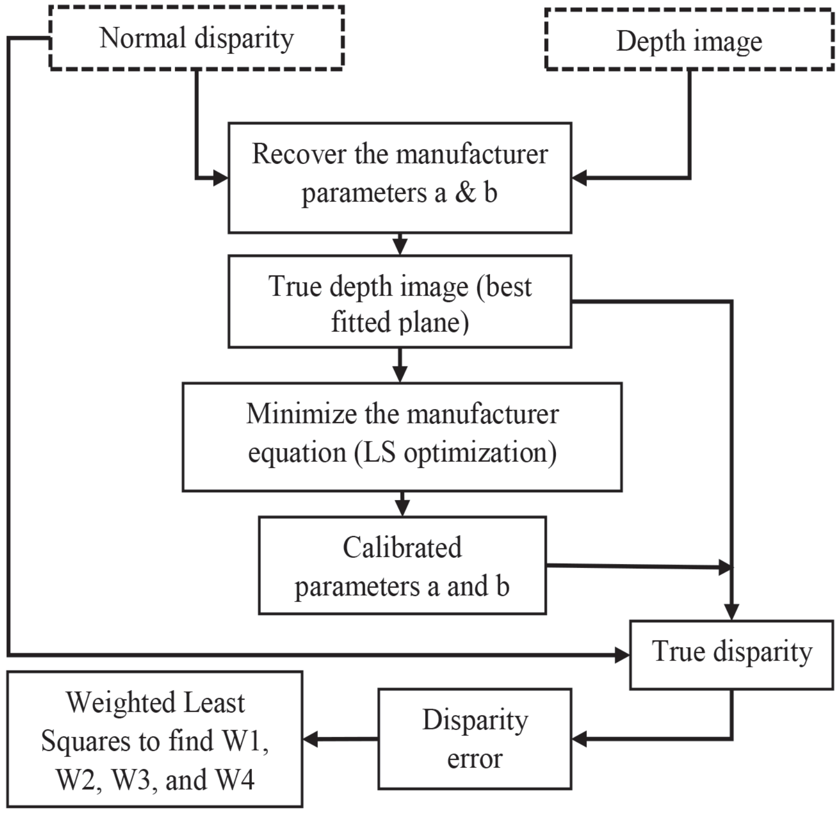

Figure 2: Methodology to calibrate full parameters of low cost depth sensors

Our methodology is based on the normalized disparity reported from the structure sensor and the corresponding depth information. The manufacturer parameters *a* and *b* were calibrated using least square method, consequently, the effect of manufacture constants (Z0, W, and f) on the depth precision was corrected. Then, the proposed distortion model which deals with the systematic and distortion errors was computed after correction of the manufacture constants effect.

The distortion model was demonstrated from the basic concepts of lens distortion, here the systematic error as well as the distortion effect are combined together to follow the general model for distortion effect. The proposed model was delivered mathematically from the general distortion equations for IR camera and IR projectors. Equation (5) presents our distortion model which will be applied to the low cost depth sensors which based on structured light concepts.

$$disp.error_i = \begin{bmatrix} W1 \\ W2 \\ W3 \\ W4 \end{bmatrix}^T \begin{pmatrix} 3*Td_i*(2*x_i - Td_i) \\ 2*y_i*Td_i \\ x_i*\left(Td_i*(2*x_i - Td_i)\right) \\ x_i*\left[(Td_i*(2*x_i - Td_i)+2*(x_i - Td_i)^2)*(Td_i*(2*x_i - Td_i))+2*y_i^2*Td_i*(2*x_i - Td_i)\right] \end{pmatrix} \quad \textbf{(5)}$$

Where, Td is the true disparity reported from depth sensor. x, and y are the pixel location in IR camera frame. W's are the distortion model parameters. Our model is combined from four factors which represent the full effect of distortion effect and systematic error.

4. Data Collection and Experimental Design

The experiments were carried out using Structure sensor which represents the low cost depth sensor. Two different data sets were collected to examine and verify our methodology as well as distortion and error model. Both sets were depth images with corresponding disparity images which captured for planar surfaces. The first set was captured to be utilized in the calibration methodology to construct the distortion model parameters and to calibrate the parameters for manufacture equation. The collected data for calibration and error model reconstruction must be covered at least the proposed working range for surveying application. Also, the collected data is boosted to be collected at different poses with different orientations to enhance the reliability of the distortion model parameters. The second data set was acquired to verify our distortion model and the calibration methodology.

5. Calibration and Error Model Results

The data captured by structure sensor was 108 pairs of images (depth and normal disparity) covered the working range from 0.50 to 3.00 meters. The data was used to be applied in our methodology to recover the calibrated manufacture parameters and the distortion model parameters. The results for manufacture and the distortion model parameters are presented in the following table and figure, respectively. For the calibrated manufacture parameters, there is significant difference between the manufacture parameters used to project the reported disparity to the depth information.

Table 1: The calibrated and the manufacture parameters for structure sensor

Structure Sensor	Manufactured value		Calibrated value	
	a	b	a	b
	-3.38649E-06	3.82538E-03	-3.39008E-06	3.82836E-03

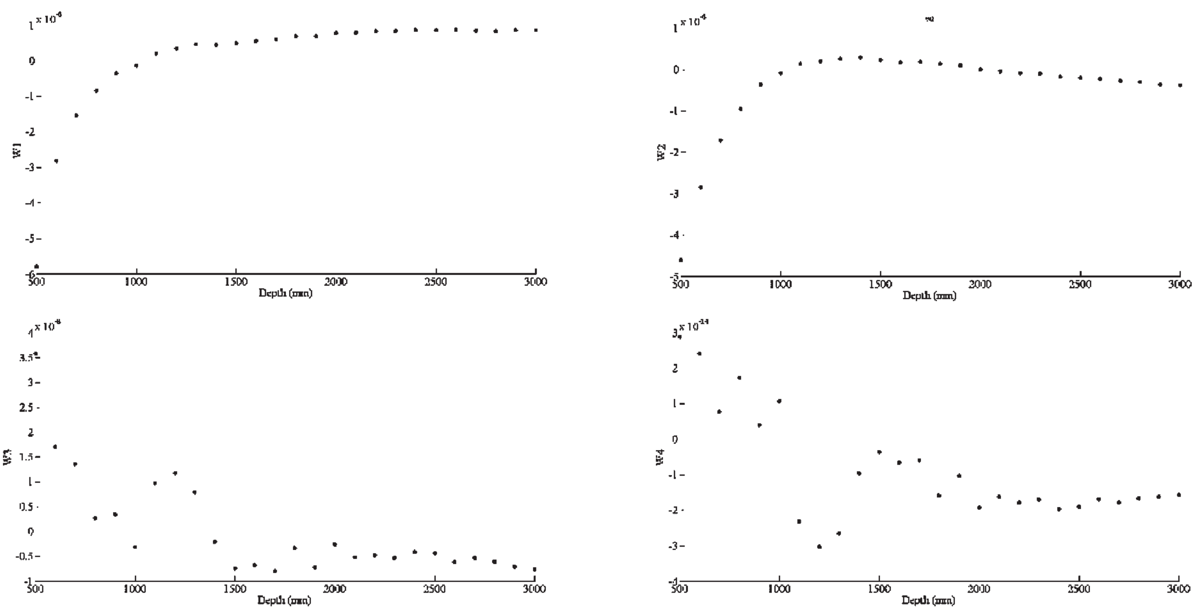

Figure 3: Distortion model parameters resulted from 108 pairs of images

The distortion model parameters were computed out of 108 images and then the results were sampled for each 10 cm. Figure 3 shows that after 2.50 meters the distortion model parameters are become stable and tend to the same value. This is reflect a noticeable procedure for experimental design as it is enough to collect the depth and disparity images between 0.50 and 2.50 meters whatever the application in which the sensor will be used. Also, it is noticed that all parameters tend to be zero around 1.00 meters, this means that the distortion model dose not correct the depth around this working range. Actually, the structure sensor manufacturer company advises the users to operate the sensor for capturing the 3D models around 1.00 meters, which means that the manufacture computed the best design parameters based on the 1.00 meters working range.

6. Verification of Distortion Model and Calibration Methodology

To verify our methodology and the effect of calibrated parameters on the measured depth precision, the second data set was collected. The data captured a plane surface for depth varies between 0.50 and 3.00 meters, the total number of images collected for this experiment was 82 pairs. The results are quantified using the same strategy illustrated in (Daniel Herrera, Kannala, & Heikkila, 2012) and (CHOW & LICHTI, 2013) which is the RMSE of the fitted plane.

The results are illustrated in the following figures, the model reflected a significant improvement in near and far ranges, for the working range, the model can enhance the depth precision by about 20%. This reflected the importance of the calibration and error model of the low cost depth sensors before adopting them in the surveying applications especially when the user is going to extending or reducing the working range which proposed by manufacturer.

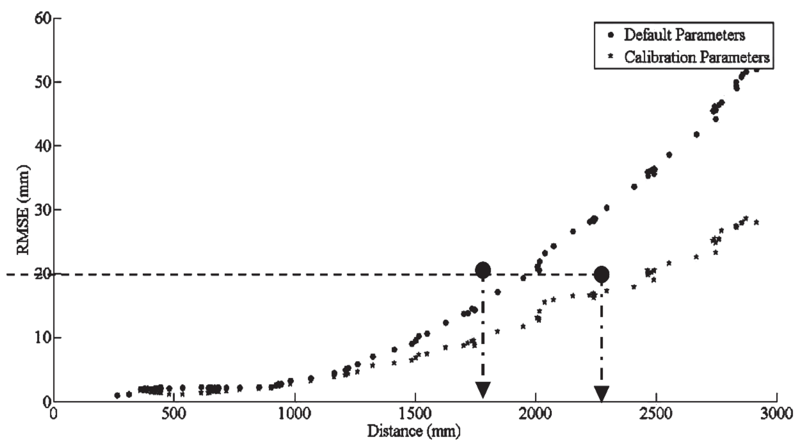

Figure 4: Effect of calibration and error model on the structure sensor

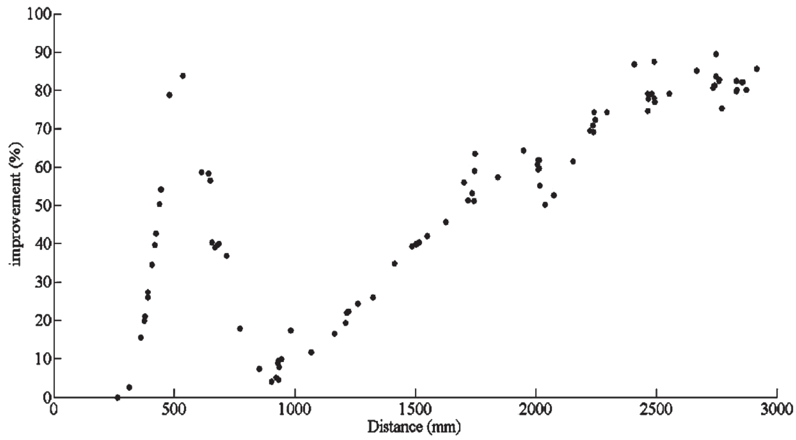

Figure 5: Improvement after applying our calibration procedure

From the illustrated results, if the sensor was adopted for indoor 3D modelling and this application needs accuracy less than 2 cm in depth measurements, the calibration method and error model provided in this research can achieve 2.50 meters working range compared with 2.00 meters for manufacture calibration parameters. This means that the depth error modeling enhanced the working range by 25%. For depth precision, the calibration procedure increased the depth precision away from the normal working range advised by the manufacturer by 70% to 90%. For near working range, the calibration and error model can achieve 20% improvement.

7. Conclusion and Future Work

Low cost depth sensors have attracted broad attention from many disciplines such as computer vision, robotics navigation, surveying, BIM, and smart cities. The accuracy of such sensors is highly depend on the calibration of the manufacture parameters as well as the error model and the distortion of the sensors which implemented in depth sensor. In this research, we proposed and examined a new model for distortion and systematic errors for structure sensor which treated as latest mobile low cost depth sensor released in the commercial market. The results show an effective performance for error model and a significant improvement in depth precision for far and near range (around 80%), and noticeable improvement for normal working range (around 20%).

The extended work for this research will deal with the applicability of the distortion model with other low cost depth sensors released on the market (e.g. KINECT) and check the reliability and stability of the error model.

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