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Contents

The History of GPS

GPS, originally designed for military and intelligence applications at the height of the Cold War in the 1960s, with inspiration coming from the launch of the Soviet spacecraft Sputnik in 1957, the Global Positioning System (GPS) - is a network of satellites that orbit the earth at fixed points above the planet and beam down signals to anyone on the earth with a GPS receiver. These signals carry a time code and geographical data point that allows the users to pinpoint their exact position, speed and time anywhere on the planet.

Transit was the first satellite system launched by the USA and tested by the US Navy in 1960. Just five satellites orbiting the earth allowed ships to fix their position on the seas once every hour. In 1967 Transit was succeeded by the Timation satellite, which demonstrated that highly accurate atomic clocks could be operated in space. GPS developed quickly for military purposes thereafter with a total of 11 "Block" satellites being launched between 1978 and 1985.

However, it wasn't until the USSR shot down a Korean passenger jet - flight 007 - in 1983 that the Reagan Administration in the US had the incentive to open up GPS for civilian applications so that aircraft, shipping, and transport the world over could fix their positions and avoid straying into restricted foreign territory.

Upgrading the GPS was delayed by NASA space shuttle SS Challenger disaster in 1986 and it was not until 1989 that the first Block II satellites were launched. By the summer of 1993, the US launched their 24th Navistar satellite into orbit, which completed the modern GPS constellation of satellites - a network of 24 - familiar now as the Global Positioning System, or GPS. 21 of the constellation of satellites were active at any one time; the other 3 satellites were spares; in 1995 it was declared fully operational.

The current GPS network has around 30 active satellites in the GPS constellation, Today GPS is used for many of navigation applications, route finding for drivers, map-making, earthquake research, climate studies, and an outdoor treasure-hunting game and many other social application known as geocaching.

Energy efficiency by the real-time energy usage monitoring onboard vessels

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Abstract

The globalized world that we are living in; is heading, and targeting toward developing and improving technologies needed for emissions reduction from ships, which will contribute as an element to reach a bigger and global goal known as Green House Gases (GHG) reduction. Through the International Maritime Organization (IMO) regulations, the shipping industry committed to reducing the emissions of CO_2, SO_x, NO_x and Particular Matter (P.M), which is mainly, caused by the use of the fossil fuel onboard ships. Energy management considered as one of the important tools that assist the organizations to reach their objectives. Which is survival for short-term and success for long-term (Doty & Turner, 2013).

This research explores/Investigate the real-time energy usage monitoring onboard technology to improve vessels' energy efficiency performance, through the new applications and its circumstances, developed by two of the biggest shipbuilding countries; China and Japan. The first step, starting with a major aspect exposes a brief theoretical demonstration and explanation of the specific topic, presenting formal literature, and also the important issues found eventually by researchers. Also, the most recent developments and technologies considered in this study to discuss their existing benefits and applications. Furthermore, the possible future approaches, The second step, presents information concerning strategies/activities. Including services, operation, procedure, and projects applied by the cited countries. Moreover, presenting a critical review of the related portion, that was addressed by both countries around the topic. The third step carrying out a comparative analysis of the application for both countries taking into account the findings in the second step; to identifying the "Best Practices" and lessons learned.

Keywords - Real-time energy usage monitoring, Energy Efficiency, and Shipping

1- Introduction

Global Warming defined as the increase in average temperature near the Earth's surface globally. According to "the U.S. National Oceanic and Atmospheric Administration" Through the last 100 years, the Earth's surface air temperature had increased less than 1.3° Fahrenheit(F) or 1° Celsius(C), causing climate change (Venkataramanan & Smitha, 2011). According to "the U.S. National Oceanic and Atmospheric Administration" Warming is strongest at the poles, moreover, at the last year's temperature increased 9°F/5°C in the Arctic and the Antarctic. Furthermore, it causes hurricanes and changes the frequency of droughts and floods. The reason behind global warming is mainly fossil fuel emissions caused by human activities, which release a high amount of CO2, water vapor, SOx, NOx and P.M. These gasses with other gasses as methane and ozone create Green House Effect, which works on keeping heat radiation inside the atmosphere causing global warming.

Shipping industry share in CO2 global emissions is 3.3% (international shipping 2.7%, domestic shipping and fishing 0.6%), (IMO, 2015). In addition to a share of SOx, and NOx, accordingly the IMO set a regulatory framework to increase and manage energy efficiency to reduce and control air pollutant and GHG through the adoption of MARPOL Annex VI, on 15 July 2011 to set a global cap by introducing technical code to marine engines in phases to reduce the emissions. Moreover, IMO adopted several measures to mitigate and reduce ship emissions through energy management and efficient ships using designing and operating measures (IMO, 2016).

Energy management onboard ships are an important tool to reduce emissions produced by marine engines during ship operation. Energy management onboard ships contribute in applying the IMO regulations and shipping industry commitment in GHG reduction. Moreover, it can be achieved by the development of needed technologies, furthermore, the best operational practices in order to improve ship performance. One of the important elements, that considered as an effective element in energy management is; Real-time energy usage monitoring system which plays an important role in whole energy management.

The paper aims to explore the real-time energy usage monitoring

onboard technology to improve vessels' energy efficiency performance. The applications and its circumstances in China, and Japan will be mentioned and compared as two of the biggest shipbuilding countries (UNCTAD, 2016). Finally, Suggestions will be given based on "best practice" analysis.

2- Analysis

2.1. Real-time Energy Usage Monitoring On-board ships and its importance to improving Energy Efficiency

In the context of international law and the economic pressure point of view, both are pushing the maritime industry to increase energy saving from ships fuel by reduction of energy consumption onboard ships. However, reduction of fuel may not comply with the prediction, due to the real-time conditions as the sea state and changeable weather. The Real-time Energy Usage Monitoring On-board allows, collecting data and measurements from different sensors onboard the ship to be shared between the crew and the shore side, to be analyzed and assist in decision making according to the real-time changes. Moreover, it will lead to the optimal energy use and apply energy efficiency (ARSLAN, BESIKCI, & OLCER, 2014).

Addressing this issue is critical to considering operational measures both onboard and onshore because of the strong link between them to improve the energy usage as energy efficiency. The maritime industry must, therefore, manage these measures properly and implement effective management strategies. These strategies include overall management of energy efficiency, propeller and hull characteristics, the operation of optimal ship systems and the management of voyage performance (IMO, 2011; IMO, 2016).

Real-time energy usage monitoring onboard vessels include part of the Ship Energy Efficiency Management Plan (SEEMP), as a follow-up step to perform energy management monitoring systems (Bännstrand, Jönsson, Johnson, & Karlsson, 2015).

2.2. Literature review

In 2014 the international association of maritime universities (IAMU) sponsored a study based on creating a "mechanism and develop a Decision Support System (DSS), which is to monitor the

energy consumption on a real-time basis" this system considered The Real-time Energy Usage Monitoring on-board Vessels as a part of the operational procedure for making ships more efficient. The study concluded that by obtaining overconsumption data onboard can improve the operational strategy and save fuel which leads to the reduction of GHG emissions. In the DSS allows the decision maker to analyze and use the data and their knowledge to solve onboard energy problems including; the trim optimization, weather routing, use of autopilot, speed, efficient using for the engine, and ship auxiliary systems management (Bännstrand, Jönsson, Johnson, & Karlsson, 2015).

Kai Wang and others in 2015 carried out a research focusing on the important factor onboard for reducing the fuel consumption, which is the optimal speed. This group of researchers proved technologically improved sensors that assist in obtaining accurate real-time data; furthermore, their research defined a "Decision-Making Model to Determine Optimal Engine Speed". The same work concluded that; operating the vessel using recommended speed provided by the model leads to a reduction in fuel consumption, emissions per unit distance, and the shaft power (Wang, Yan, and Yuan, 2015).

Fan and others on their research in 2016, performed a series of system tests onboard a ship in operational mode, after installing of corresponding sensors to construct a multisource information system as a field test. This proved that the sensors monitored all the targeted parameters; moreover, it provided a large quantity of data during the voyage. By analyzing the data suggested that engine speed effects greatly on ships fuel consumption. Furthermore, the voyage environment factors have an impact on ship's fuel consumption. The study provided to ship's crew and shipping companies for monitoring ship operation in addition to providing ship's operation energy efficiency strategy (Fan, Yan, & Yin, 2016).

2.3. Recent Problems

IMO set the needed rules and regulation to enforce the maritime industry, in particular, the shipping industry to adapt and apply the concept of the energy management (IMO, 2016). Accordingly, the IMO included the monitoring and measurements process in the

SEEMP as persistent fuel efficiency operations (IMO, 2011). While the IMO indicated that there is a defect regarding the calculation of Energy Efficiency Operational Indicator (EEOI) that is because the amount of voyage consumed fuel, not accurate, which considered as the main issue (IMO, 2009). Onboard monitoring by taking into consideration the engine performance management as a concept, is a vital part to estimate/assess the amount of consumed fuel, which lead to energy efficiency and reduction of GHG (Sofras & Prousalidis, 2014).

To achieve mentioned targets, the principle of "Real-time Energy Usage Monitoring onboard Vessels" may consider as a tool for addressing issues concerning monitoring and measuring onboard fuel consumption and saving energy to reduce emissions. At the meanwhile, real-time data collection is not the only problem, but also the calculation of the fuel consumption in real time bases which not depending on the mathematical formula. In that context several solutions were offered as Multiple Linear Regression (MLR), Fuzzy Logic (is used to handle the concept of partial truth, where the truth value may range between completely true and completely false) and Artificial Neural Network (ANN) (ANN is a network inspired by biological neural networks, which are used to estimate or approximate functions that can depend on a large number of inputs that are generally unknown). Regulators and stakeholders have particular concerns regarding Lack of confidence toward technology improvements and reaching better and enhanced ways of operational information to support the process on energy saving regarding decision making. In addition to motive lack for ship-owners and operating companies to collect the needed data and information in real time and determine the accurate amount of fuel consumed.

2.4. Recent technology and developments

Energy efficiency and energy saving, in the maritime industry, especially in the shipping sector is an issue that had become under focus from stakeholders, due to the increase of the requirements of the maritime regulations, the impact of fuel coast on revenue, and the increase of competitive intensity in the Market environment. Accordingly, the topic of real-time

energy usage monitoring onboard vessels became one of the important topics, and in the recent years, several shipping companies assist research institutions or carried out researches concerning the topic. Part of the studies focused on creating software that is capable to interact with the data collected, while other studies concentrated on creating an integrated real-time monitoring system.

- TAO and others in (2008) designed a microcontroller in a single chip form as a real-time remote monitoring system for ships fuel, and the research was carried out to support river shipping companies in the process of managing and controlling river ships fuel consumption during sailing (TAO, FAN, YAN, & TAO, 2008).
- Gonidec & Andreau in (2014), designed a new software named as

E2 software which has three modes. The software was developed to be used the Ship Energy Efficiency Management Plan (SEEMP) process. The first made which are the acquisition mode and its principles shown in figure (1), where the real amount of fuel consumed is recorded and the related fuel Key Performance Indicators (KPI). The other two modes to be used by the ship operator and decision makers where both allowed monitoring the performance of energy efficiency of the ships, through the benchmark mode and the simulation mode (Gonidec & Andreau, 2014).

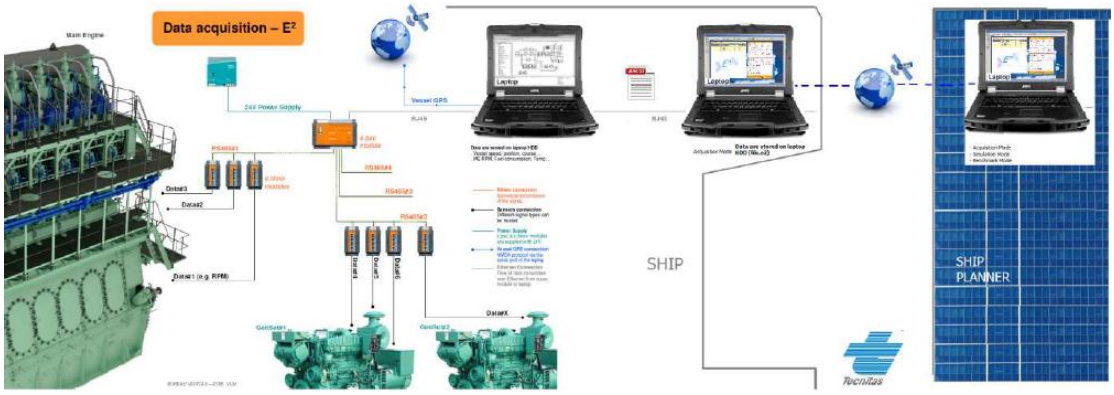

Figure 1: Principle of automatic data acquisition on board coupled with E2 software
Source: Gonidec & Andreau, 2014

Wei and others in (2014) developed a monitoring seamless fuel consumption system for ships fuel in the chines coastal water. This monitoring system based on Geographic Information System (GIS) technology and Bei Dou Satellite navigation system (BDS) short message feature.

In 2015 Bocchetti, and others created a model of multiple linear regression, which present a statistical approach that provided an interval predictions regarding onboard fuel consumption and CO_2 emissions, using the data collected from onboard ship sensors which are available in most modern ships. Moreover, in case of fuel consumption actual value came to be outside the prediction limit, then the management "would be alerted to the possible need for data analysis and/or future remedial actions".

Fan and others in (2016) carried out a study in Yangtze River by selecting a sailing ship in the river, as a target ship, to build a multisource information system by testing and installing corresponding sensors onboard the selected ship. The field tests indicate the success of the sensors in monitoring the parameters by providing large quantities of data. Accordingly, a regional difference analysis and a grey correlation analysis are carried out using the tests provided data. Fan said that "This study not only aids shipping companies and ship officers in monitoring a ship's operations but also provides a high-energy efficiency strategy for a ship's operation."

2.5. Benefits and applications.

Presently several vendors are producing special tools to assist in the ship and fleet monitoring, performance data analysis and reporting. These tools include conducting a voyage as speed optimization, trim optimization, weather routing plan, and monitoring fuel consumption efficiencies for a single vessel or complete fleet. Wide analysis for fleet had provided with helpful proportional performance indicators which, support owners/operators with the necessary data to determine whether the ships have been deployed in the most efficient manner or not (ABS, 2013).

One of the companies which have many real applications on real vessels in the real-time monitoring onboard system is Eniram Company, which produced and developed several applications to reduce gas emissions and increase energy efficiency.

Eniram claiming that their performance optimization combining the knowledge of naval architectural and state-of-the-art machine-learned algorithms, depending on measured data on real-time, furthermore, any artificial counterparts as laboratory tests and/or simulations are not utilized. The system can include fleet component, speed, trim, engine, performance, and Eniram platform modules. Accordingly Ship owner may choose some independent module (ENIRAM, 2014)

Eniram system applied for several types of ships to install and use worldwide. There are examples of benefit in real projects (Eniram, 2017).

Eniram trim assists crews to maintain optimum trim to increase vessel performance. Which used by Hamburg Süd's vessels concluded that Eniram Trim saves real savings of 3-5% on fuel. Return on investment Based on the trial an annual reduction in costs of US $375,000 per vessel can be achieved by actively using Eniram DTA (Businesswire, 2010). Eniram platform is a real-time data collection platform to get vessel performance and fuel consumption which was used by Multi-gas carrier fleet installed both Eniram Platform and Eniram Trim. According to statistics, 2% reduction in fuel consumption has been gained (ENIRAM, 2014).

In summary, there are real applications and benefits, mainly economical and in theoperational decision-making process which improving the efficiency of real-time monitoring onboard and will contribute to improving future perspectives.

2.6. Perspective to the future.

By taking into consideration the Third IMO GHG study 2014, the CO2 emissions from maritime projects will increase by 50% to 250% till 2050 as future scenarios, which speculated on future shipping demand. Consequently, the IMO set the provisions related to energy management standards, which must be compiled by ships (IMO, 2009; IMO, 2011; IMO, 2015; IMO, 2016).

One of the experiments and researches which was recently carried out and found appropriate results in the respect of real-time monitoring to reduce the energy consumption, was carried by Fan & other in (2016), whom carried out a research depending on multisource information system

targeting improvement of energy efficiency onboard, and concluded that reaching the improvement of energy efficiency onboard require the consideration of the voyage environmental factors (i.e. water velocity, depth, and wind) in combination with ship's energy efficiency information as effective strategy To address the current issues the previous considerations are proposed as the short-term future by Maersk aiming to optimize their fleet seeking the energy efficiency through further researches (Fan, Yan, & Yin, 2016). As shown previously external environmental factors as well as operational practices influence ship's fuel consumption. Refinements in the performance of monitoring systems are essential regarding analysis for the process of the decision-making (IMO, 2016). Accordingly, Real-time Energy Usage Monitoring on-board vessels in the Future will be one of the managing tools for onboard energy on both new ships and existing ones, as appropriate measures; moreover, it will produce improved prediction modeling in addition to improvement in decision supporting systems based on ships types (Arslan, Bal Besikci, & Olcer, 2014).

3- Development in Japan and China.

3.1. Japan

A joint project developed by 29 Japanese shipping companies named as The "Smart Shipping Application Platform (SSAP)" project. The project objective was developing a unified data exchange platform. The research funded by 1.2 million US dollars, and a cycle started from December 2012 to March 2015, 50% of the fund supported by Nippon Kaiji Kyokai (ClassNK) and the rest by the participating members (IALA, 2016; Shibata & Ando, 2017).

The technologies of the project tested on Ferry "Sunflower Shiretoko" and Crude-oil Carrier "SHINKYOKUTO MARU" which was a new build (IALA, 2016). Testes results submitted to the International Standard Organization for reviewing whether can become international standardization (Shibata & Ando, 2017). Figure 2 shows the SSAP project Image of onboard application installation.

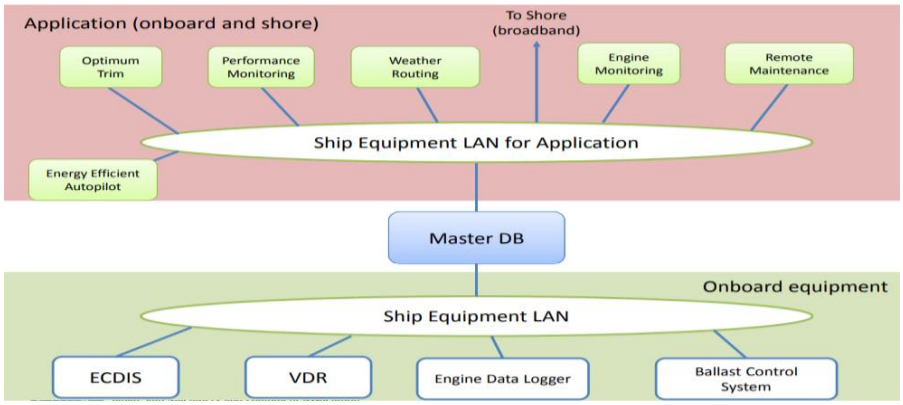

Figure 2: SSAP Image of onboard application installation.
Source: IALA, 2016

The capability of Japan to apply a strategy regarding energy efficiency and emission reduction there was activities needed to be carried out regarding training, equipment, personnel, information, organization, and infrastructure will be discussed in the next few lines.

- Training: for the crew onboard ship to receive the training of IMO course on the energy efficiency of ship operation. (IMO, 2016). Officers and crews on board received training course to use the software.
- Equipment: supporting the vessels with special sensors to measure acceleration data and monitored function, Data analyzing unit, Master database server installed onboard and Communication devices (Shibata & Ando, 2017).
- The personnel are 7 segments: Steering Committee, Application Investigation Working Group, Project Advisory Group, Master Database Development Working Group, Testing on Actual Ship Working Group, International Standardization Working Group, and Ship-Shore Total System Working Group as shown in figure 3

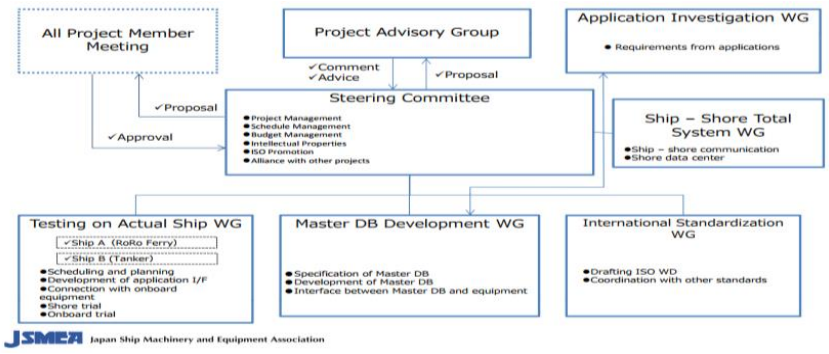

Figure 3: personal groups
Source: Shibata & Ando, 2017

- Information relating to the ship operation such as ship speed and acceleration, fuel consumption, ballast/trim, route, and weather are updated frequently from a reliable source.
- Organization: 29 companies and organizations like Japan Ship Machinery and Equipment Association (JSMEA) and the Nippon Kaiji Kyokai ClassNK.
- Infrastructure preparation and ship data center provided by the experienced organization as ClassNK.

3.2. China

Regarding CO_2 emission reduction from Shipping Industry China has incessant efforts in this issue, as setting a financial support regarding inefficient vessels to assist the shipping companies for scraping, likewise setting tax exemptions concerning new energy inefficient vessels, which leads shipping industry to seek for more energy saving measures (Ministry of Commerce China, 2015; Bay Trade Express, 2015). The capability of China to apply a strategy regarding energy efficiency and emission reduction there was activities needed to be carried out regarding training, equipment, personnel, information, organization, and infrastructure will be discussed in the next few lines.

- Training: The system used by several chines vessels need two end terminal operator, one onboard as a crew and other as a shore side, accordingly, both side need to receive training courses concerning the use of the software. Moreover, there is a need for background knowledge concerning energy management.
- Equipment: in Real-time energy usage monitoring systems the core is the software that carries out the data analyses and the hardware that collect and transfer the data between units which consist of special sensors, Data storage and analyzing center server, Data communication module, and display units.
- Personnel: the need for Onboard, trained Master and crew and onshore, trained officers and managers in Fleet Manage Center.
- Information: an onboard platform to collect real-time output data through sensors and terminal hardware as Global Navigation Satellite System (GNSS) receivers, anemometer, Echo Souder, Electronic Chart Display and Information System (ECDIS) for surface current data, main and auxiliary boiler and blowers operating

parameters, and shaft power. Through the synchronization between onboard and onshore side, the system will be able to implement energy efficiency monitoring and assist in managing in real-time.

- Organization: the project structured by several organizations every in his specialization as system developer, equipment Vendor, shipping company, and verification agency.
- Infrastructure: to apply the project in a wide view to make it effective for multiple shipping companies there is a need for building servers as a data centers and offices to act as shore side.

4- Comparative analysis

The developed countries; China and Japan discussed in this part as countries already implemented some measures in real time energy usage motoring on board vessel. In this context, the analysis is based on the availability of mechanisms that each country flowed and implement.

4.1. China and Japan in respect of Real-time energy usage monitoring onboard vessels.

In China real-time energy usage monitoring system has been applied in two ways depending on the company size. The small companies bought the available modules in the market as the trim optimization module. While the Large size companies targeted the whole energy management system through research process as cooperation between shipping companies and research organizations or university. Accordingly, this will lead to the long lag of time beside the high costs. The previously presented system “Ship Energy Efficiency Online Management System” successfully installed on handymax bulk carrier named “Zhenzhu Hai” by the last quarter of 2015. This project was cooperation between China Classification Society (CCS) and China Ocean Shipping Company (COSCO), furthermore, this system already running 19 vessels and planned for another 35 vessels to install it (Shi, 2015). Japan presented project named "Smart Shipping Application Platform (SSAP)" its objective was developing a unified data exchange platform, aiming to set an internationalized standardization for Real-time energy usage monitoring onboard vessels. Based on this platform in case of being set

as standard patronage that can develop their own applications for energy management (IALA, 2016; Shibata & Ando, 2017).

4.2. Comparison between Japan and China systems.

Both countries have worked on similar projects targeting energy efficiency. To compare between to real monitoring system the comparison carried in respect of training, equipment, personnel, information, organization, and infrastructure.

- Training: Japan SSAP project presently (2017) in phase two which means the project is not done yet, moreover, the collected data related to the ships and its equipment still under review by the ISO. Accordingly, the needed level of training concerning stuff on both ends is not yet been carried out. On the other hand China system installed both onboard ships and on shore. Targeted ends from crew or shoreside have received the needed training.
- Equipment: the core of a monitoring system is the software; accordingly, Equipment is the related hardware. From the hardware perspective, both monitoring systems are the same due to using the same components as database servers, monitors, computers, and sensors.
- Personnel: japan project focusing on a unified standard, not real application based on the users. To develop an application using this platform there is a need for support or maintenance from third-party, mostly the Japanese company. On the other hand China system developed by CCS and COSCO Shipping Corporation, including more practical operation demand referring to real-time energy efficiency management. Timely providing sufficient and capable personnel can be easily ensured.
- Information: Japan developed a standard platform to create application tools this platform combines the present shipboard application system, as GNSS receivers, anemometer, Echo Souder, ECDIS for surface current data, main and auxiliary boiler and blowers operating parameters, and

shaft power data. On the other hand China system based on the IMO requirements regarding energy efficiency management data and targeting to meet requirements of IMO SEEMP.

- Organization: both projects supported by companies and organizations, also have the similar organizational structure, while the Japanese structure more visible and clearer.
- Infrastructure: Japan project targeting the unified standard which demands a high level of infrastructure to verify the validity of standard data, where the data center was supported by Class NK only. While China system considered as practical application project which was supported by shipping companies that provide the needed infrastructure.

According to mentioned above both system have advantage and disadvantage, while from the practical point of view Chinese system is better system, due to it has been applied to several vessels and planned to be applied to more vessels

4.3. Lessons Learned and suggestions

The best energy efficiency practices related to Real-time energy usage monitoring onboard vessels show that the developed countries such as China and Japan have implemented proper tools for monitoring the energy used by ships. Therefore, both countries can contribute with their experiences and practices to accelerate the rate of the research and produce better software and data platform.

Chinese system considered as specific tool has the ability to benefit from historical data support during developing stage, as well as feedback data in operational stage; availability of data of different types of vessels due to different companies based on different data sharing platform, where the communication of practical requisitions might oblige an expansive progress done their advancement cycle, making difficult to commercialize.

The Japanese practices focusing on setting a common platform with bases to be an international standard. The shortage of the available systems is easily noticed however, that will be in the short term. While in the long term more

countries will enter the research race otherwise there will be no place in the shipping market for their energy inefficient vessels and management.

It is recommended for the developing countries to start entering the research race to targeted energy efficiency management system suitable for their own situation and seek the cooperation with several mature research institutions and organizations targeting the same issues to reach optimal modules for energy efficiency management; as well as improvement in energy efficiency management.

5- Conclusions

Climate change as a global challenge and its issues addressed by the IMO through the reduction of emissions from shipping by reducing fuel consumption and improving energy efficiency on board vessels as stated in the SEEMP. Accordingly, one of the important mechanisms to reduce the emissions is real-time energy usage monitoring on board vessels. The global goal of reduction of emissions can be reached in short-term by encouraging/supporting shipowners and shipping companies to implement real-time energy usage with coordination with shore side to support the decision making on real time, in case of applying the system globally.

Presently there are several theoretical developments that have shown positive impact and results by the implementation of real-time energy usage established on combining the new sensing technology and the analytical models that assist in decision making based on accurate data and trusted analyses.

The analysis indicated that China and Japan have developed and tested their effective emission reduction tools by applying real-time energy usage and monitoring onboard their vessels and have resulted for positive results in a reduction in fuel consumption which leads to improvement in energy efficiency. By considering the small size of the merchant fleet of both countries and to reach effective contribution in the IMO goals the project should move from the national level to the regional level as a step to move to the international level.

References

ARSLAN, O., BESIKCI, E. B., & OLCER, A. I. (2014). Improving Energy Efficiency of Ships through Optimisation of Ship Operations. Retrieved April 17, 2017

Bay Trade Express. (2015, May 24). China Exempts New Energy Ships from Tax. Retrieved October 25, 2017, from http://baytradeexpress.com/china-exempts-new-energy-ships-from-tax/

Bännstrand, M., Jönsson, A., Johnson, H., & Karlsson, R. (2015). STUDY ON THE OPTIMIZATION OF ENERGY CONSUMPTION AS PART OF IMPLEMENTATION OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP). Retrieved October 27, 2016

Bocchetti, D., Lepore, A., Palumbo, B., & Vitiello, L. (2015). A Statistical Approach to Ship Fuel Consumption Monitoring. *Journal of Ship Research, 59*(3), 162-171. doi:10.5957/josr.59.3.150012

Businesswire. (2010, May 14). Hamburg Süd Is Reducing Fuel Consumption By Up To 5% With Eniram Dynamic Trimming Assistant. Retrieved May 25, 2017, from http://www.businesswire.com/news/home/20100514005283/en/Hamburg-S%C3%BCd-Reducing-Fuel-Consumption-5-Eniram

DNV-GL. (2014). ENERGY MANAGEMENT STUDY 2014. Retrieved April 17, 2017, from http://www.dnvgl

Doty, S., & Turner, W. C. (2013). *Energy management handbook*. Lilburn: The Fairmont Press.

ENIRAM. (2014). ENIRAM PROVEN FUEL SAVINGS. *Eniram-company-brochure*, 5-8. Retrieved May 24, 2017, from https://www.eniram.fi/wp-content/uploads/2014/09/eniram-company-brochure.pdf

Fan, A., Yan, X., & Yin, Q. (2016). A Multisource Information System for Monitoring and Improving Ship Energy Efficiency. *Journal of Coastal Research, 321*, 1235-1245. doi:10.2112/jcoastres-d-15-00234.1

Gonidec, Y. L., & Andreau, C. (may 2014). E2, an advanced Ship Performance Monitoring tool. *13th International Conference on Computer and IT Applications in the Maritime Industries*. Retrieved February 12, 2017

IALA. (2016, July). SSAP Smart Ship Application. Retrieved October 25, 2017, from http://www.iala-aism.org/products-projects/e-navigation/test-bedsprojects/ssap-smart-ship-application/

IMO. (2009). *Guidelines for Voluntary use of the Ship Energy Efficiency Operational Indicator* [MEPC.1/Circ.684.]. Retrieved October 17, 2016.

IMO. (2011). Ship Energy Efficiency Management Plan (Annex). MEPC 62/INF.10, 1, 37. Retrieved October 18, 2016

IMO. (2014). Third IMO GHG Study 2014 Executive Summary and Final Report. Retrieved October 22, 2016

IMO. (2015). Further technical and operational measures for enhancing the energy efficiency of international shipping. MEPC 69/6. 16. Retrieved September 25, 2016

IMO. (2016). Module 4 – Ship Board Energy Management. IMO Train the Trainer (TTT) Course on Energy Efficient Ship Operation. Retrieved September 14, 2016

Ministry of Commerce china. (2016). Retrieved October 26, 2017, from http://tax.mofcom.gov.cn/tax/taxfront/en/article.jsp?c=30127&tn=1&id=bde8770ac7fb422dbc266ba5cd4583d1

NOAA. (2015). Global Temperature Trends: 2015 Summation. Retrieved January 18, 2017, from https://www.pmel.noaa.gov/arctic-zone/detect/global-temps.shtml

Shi, J. (2015). Intelligent Operation in Green Shipping. *China Ship Survey,* (9), 41-43. Retrieved October 21, 2016

Shibata, J., & Ando, H. (2017, June 13). Smart Ship Application Platform Project. Retrieved October 06, 2017

Sofras, E., & Prousalidis, J. (2014). Developing a new methodology for evaluating dieselâ€ ” electric propulsion. *Journal of Marine Engineering & Technology, 13*(3), 63-92. doi:10.1080/20464177.2014.11658123

TAO, X., FAN, Z., YAN, X., & TAO, J. (2008). Real-time remote monitoring system for ship fuel condition. *SHIP ENGINEERING, 30*(4), 61.

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT. (2017). *REVIEW OF MARITIME TRANSPORT 2016*. S.l.: UNITED NATIONS.

Venkataramanan, M., & Smitha. (2011). Causes and effects of global warming. *Indian Journal of Science and Technology, 4*(3), 226-229. Retrieved September 16, 2016

Wang, K., Yan, X., & Yuan, Y. (2015). Fuzzy Logic Method For Ship Energy Efficiency Decision-Making Model to Determine Optimal Engine Speed. *Sea-Technology Magazine*. Retrieved October 24, 2016.

Wei, Z., Huang, Q., Vehicle, F. G., Wang, A., & Zhuang, S. (2014). Application Research on Dynamic Monitoring of Ship Fuel Consumption Based on BDS. *Information Technology & Standardization, 11*. Retrieved January 20, 2017

The proposed tiers of using ISO 20858:2007 in port facilities

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Abstract

The port facilities' compliance with the international ship and port facility security code (ISPS Code) and other international requirements is verified through periodical verifications and reviews carried out by administrations as well as port facilities' operators. These verifications mainly focus on the documentary requirements of the ISPS Code and pay just little attention to the practical aspects of port facility security plan (PFSP) implementation (Teck& Shah,2008).

In addition, the periodical verifications and reviews are not considered as a clear evidence for port facilities' compliance for the international requirements. Moreover, this is against the spirit of the ISPS code and usage of PFSPs as proactive procedures and measures that could provide instructions for the executing plans in port facilities capable to provide guidance and references in implementing of the security procedures and measures.

having a Statement of Compliance for Port Facility (SoCPF) is not a clear or physical evidence for a port facility to prove its fully compliance with the necessary requirements of the ISPS code and the other mandatory international requirements. The aim of this paper is to offer an instrument tool for port facilities to ensure executing and complying with maritime security requirements. Also, it proposes three tiers for using ISO 20858 to accomplish the aim of the paper and recommends using such tiers in Egyptian port facilities.

Keywords: ISO 20858, maritime security, Port Facility Security Plan, ISPS Code.

1. Introduction

The impact of 9/11 has caused a considerable change in the role of International Maritime Organization (IMO) in dealing with maritime issues from just focusing on “Safer Shipping and Cleaner Oceans” to “Safe, Secure and Efficient Shipping on Clean Oceans” (Gunasekaran,2012). The reformation towards security issues by the IMO reflects its broader and deeper interest in offering a blueprint for better response in the future (IMO, 2010) which eventually caused a positive change of attitude in the international maritime industry stakeholders with the involvement and co-operation of other international organizations such as international labor organization (ILO),world custom organization (WCO) and International Organization for Standardization (ISO) without denying that the influence of some countries either directly or indirectly through these organizations is equally important.

IMO, WCO & ILO issue regulations and requirements. ISO, as a linking instrument, transform those regulations and requirements into industry standards. Then, industry standards are provided to shippers, transporters, ship owners and operators, terminals and port facilities by regulatory bodies as recognized security organizations (RSOs) (Li, 2011).

The ISPS Code is one of the fastest implemented regulations in the entire history of IMO. It took just 18 months from the approval of the amendment to safety of life at sea convention (SOLAS 74) until it entered into force (UNCTAD, 2013). even though, such fast implementation has both advantages and disadvantages; the main advantages of the enforcement of the ISPS code are that maximized the control of access to port facilities and onboard ships. It has also minimized theft and sabotage in port facilities and onboard ships. These advantages offered by the ISPS Code are very important elements to identify risks. Risk identification is very crucial to ensure that the maritime security risk management system functions well.

In addition to the ISPS Code, the Code of Practice on Security in Ports was developed as a result of cooperation between both the IMO and ILO. The guidelines offered by this Code covered a more defined framework for many aspects in the

be voluntary complied in shipyards, assessment of port facilities is given a special concern in this Code where The full methodology suggested go beyond the ISPS Code requirements (Gunasekaran, 2012). This was followed by some other subsequent initiatives such as the ISO Standards like ISO 20858, providing guidelines on maritime port facility security assessment, demanding that the relevant port authority develop a port facility security plan and ensure its application in the case of the critical port facility assets, ISO 28000, providing guidelines on security management supply chains (Bichou, Bell and Evans,2014).

Failure to such comply with the international maritime security requirements would result in failure to obtain national and international recognitions that could lead to degrade commercial competitiveness of those ports which presents the main problem for this paper. consequently, the shipping companies, shippers and freight forwarders could switch to other compliance ports.

2. (ISO) standard regarding to maritime security

Ports are considered as hubs for the security of port facilities. The risk shall be operated efficiently and effectively. This concept shall be completely applied on port security processes and operations. While laws and regulations mandate certain security standards, total quality management (TQM) and other quality standards. The quality standards such as ISO certification criteria require specific improvements in processes to enhance productivity and profitability of port operations. Security is a critical issue of each of these elements. For that reason, this section of paper briefly displays ISO standards regarding to maritime security (Abdel Fattah,2015).

ISO has issued many of maritime and supply chain standards that are replacing the originally published Publicly Available Specifications (PAS) documents such as ISO 28000 and ISO 20858.

2.1. ISO (28000:2007): It specifies the requirements for a security management system, including those aspects that are critical to security assurance of the supply chain. Security management is linked to many other aspects of business management.

international trade, therefor they

These aspects include all activities controlled and influenced by organizations that have an impact on supply chain security. Other aspects should be considered directly, where and when they have an impact on security management, including transporting the cargoes along the supply chain. ISO (28000:2007) is applicable to all sizes of organizations, from small to multinational in manufacturing, service, storage or transportation at any stage of the supply chain (UNCTAD, 2016).

2.2. ISO (20858:2007): It establishes a framework to assist marine port facilities in specifying the necessary competence of personnel to conduct a marine port facility security assessment and to develop a security plan as required by the ISPS Code. ISO (20858:2007) assists marine port facilities in conducting the marine port facility security assessment, and drafting or implementing a port facility security plan (PFSP). In addition, ISO (20858:2007) establishes certain documentation requirements designed to ensure that the process used in performing the responsibilities and duties manner that would allow independent verification by a qualified and authorized agency if the port facility has agreed to such review (UNCTAD, 2016).

2.3. ISO (27000 series): These standards have been specifically reserved by ISO for information security issues. Finally, all these ISO Standards listed above, align with a number of other topics, including ISO (9001) (quality management) and ISO (14001) (environmental management) (Abdel Fattah,2015).

3. ISO (20858:2007) requirements, limitations and structure

After the adoption of the ISPS Code, the ISO Technical Committee ISO/TC 8 issued the ISO 20858:2007, concerning Ships and Marine Technologies – Maritime Port Facility Security Assessment and Security Plan Development. ISO 20858:2007 published in 2007. It replaces the PAS which had been previously issued on 1 July 2004, the same day the ISPS Code “entered into force”, and is designed to assist in the uniform industry implementation of

described above were recorded in a the ISPS Code (Chacon, 2016).

It is not an objective of ISO 20858 to set requirements for a contracting government (CG) or designated authority in designating a Recognized Security Organization (RSO), or to oblige the use of an outside service provider or other third party to conduct the marine port facility security assessment or develop security plan if the port facility personnel have the necessary expertise outlined in this specification. Ship operators and ships' masters should be informed that marine port facilities that use and apply this document meet an industry-determined level of compliance with the ISPS Code (ISO,2007).

3.1. Performance of the security assessment

The port facility that is implementing this International Standard, ISO (20858:2007), shall conduct a security assessment or depend upon existing security assessments that are valid, documented and meet the necessary requirements of this International Standard. The port facility security assessment shall consider all security threat potential successful attacks on the port facility, and the likelihood of each security threat scenario being successful given the security procedures measures in place. Based on these considerations, a determination shall be made if additional security countermeasures are needed. The personnel who are conducting PFSA shall have the necessary experiences as required in the ISPS Code.

3.2. Security assessment procedures

A port facility security assessment provides the basis for developing the Marine Port Facility Security Plan. the methodology used in the assessment shall meet the requirements of ISO 20858. The scope of the assessment extends to those port facilities and port infrastructures that could be threatened or be used to threaten maritime trade. The port facility security assessment shall include, at least, all these areas:

- where port facility/ship operations are conducted within the port facility,
- where cargoes are staged, stowed or handled

scenarios, consequences of before/following marine transportation in the port facility,

- where cargoes documentations for marine transportation are handled/accessible in the port facility,
- attached to the port facility without an intervening security perimeter,
- including ship anchorage areas/ channels used to approach the port facility.

The PFSA shall include all areas interfacing between ships and port facilities. The personnel who are conducting the assessment shall review all existing security operations and contingency plans in the port facility. These personnel shall also conduct on-scene security survey in the port facility, examine and document all important operations during such assessment. The PFSA shall identify all crucial assets and infrastructure in the port facility. Besides, the personnel conducting PFSA shall communicate with and consult the local law enforcement and all other appropriate government officials responsible of securing the port facility against documented and considered (ISO,2007).

The methodology used to conduct a security assessment shall, at least, identify the security threat scenarios documented in ISO 20858. A thorough evaluation of consequences shall be conducted and carefully consider potential the loss of lives, economic losses and environmental pollution. The consequences of each security incident evaluated at a port facility shall be classified as high, medium, or low. In case of using the numerical system in the security assessment process, the numerical results shall be converted into a qualitative system. Rationales for the classifications of consequences for each security incident shall be documented. The values of “high”, “medium” and “low” consequences shall be thoroughly determined. The likelihood of each security scenarios becoming a security incident should be classified as high, medium and low (ISO,2007).

The rationale for the classification of likelihood that is assigned to every security scenario shall be documented. the security scenarios scoring chart shall be utilized to know exactly when

any potential threat. All information received shall be scenarios. The person who is assessing the security shall document every single security scenario required to be considered for countermeasures. When utilizing the methods specified in ISO 20858, each countermeasure shall be assessed for influence in countermeasures must be considered for specific security lowering the likelihood or /and consequences until the security scenario no longer needs that countermeasures be considered. The countermeasure accomplishing this is considered to be efficient and shall be documented in the PFSP. Figure.1 Evaluating the security process (ISO Focus ,2006).

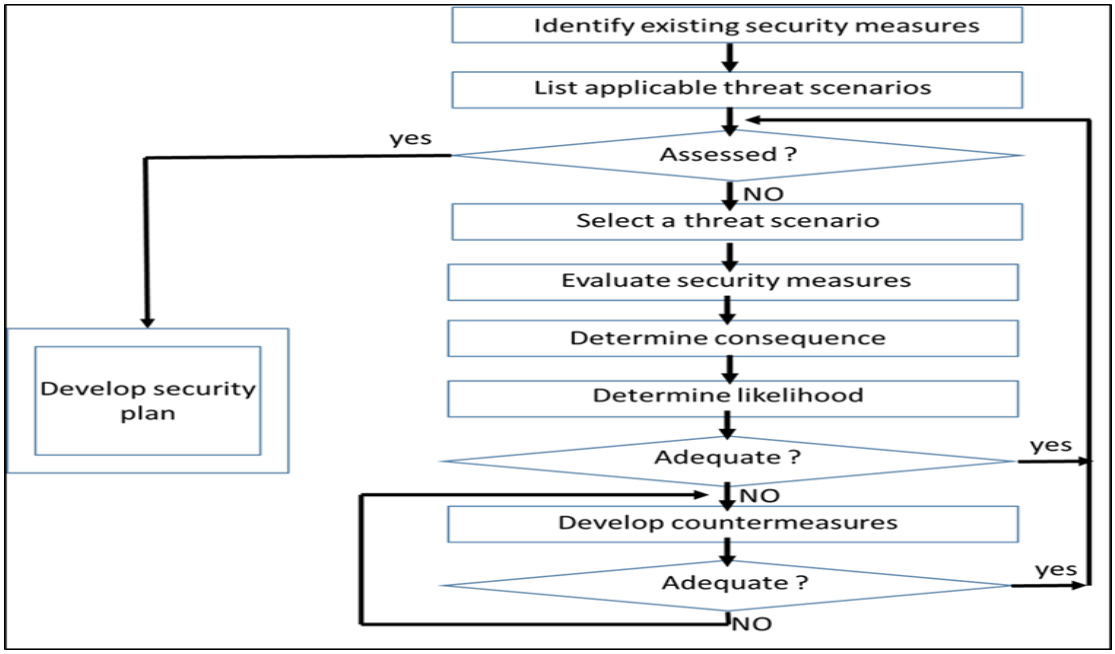

Figure.1 Evaluating the security process. Source: ISO Focus ,2006

3.3. Port Facility Security Plan (PFSP)

A PFSP shall be developed to ensure the implementation of measures assigned to secure the personnel, port facility, ships, cargoes, cargo transport units and ships' stores in the port facility against all potential risks of any implemented, in such order, to maximize benefits as assessed unless the CGs set other concepts. Countermeasures determined to be implemented shall be incorporated into the PFSP in the appropriate section (ISO,2007). **Contents of the port facility plan:**

- The port facility (PF)

security incident. The countermeasures shall be

perimeters or areas covered by the PFSP are as follows:

- All exits, gates and access points, all restricted areas in the port facility including jetties, ship berths, emergency equipment, emergency shutdown controls, parking spaces, security checkpoints, vital buildings, emergency vehicle lanes, storage spaces especially for dangerous materials and all port facility assets.
- A description of the security organizational structure, including an explanation of duties and responsibilities of every person in the security organizational structure shall be documented.
- The Security organizational structural of the PF, document the name of the PFSO and all of his contact details.
- Changes in security levels and document different procedures and measures related to each security level.
- Document all security procedures and measures for interfacing with ships related completing a Declaration of Security (DOS).
- Define the means by which the PFSO shall follow to inform PF personnel of changes in security Procedures and measures. The security system shall allow continuous effective and efficient communications among all PF security personnel, ships, the PFSO and national and local authorities that have security duties or responsibilities.
- All security systems and equipment.
- Security procedures and measures for access control, Access to restricted areas, handling cargo, delivery of ship's stores, spare parts and bunkers.
- Security incident reporting procedures.
- Any other additional requirements necessary for cruise ship, passenger and ferry port facilities.
- Periodical security audits and

to each security level.

- Document procedures for

implementing security plan amendments.

- Security training, drills and exercises.
- Security Skills, knowledge and competencies necessary of all PF personnel.
- Implementing the supply chain security plan, the organization shall establish and use an existing management system to allow all of its specific port facility security processes to be effectively and efficiently executed.

3.4. Documentation

The documents developed to meet ISO 20858 shall be maintained and secured to prevent unauthorized disclosures. Define the plans that will be used to maintain and secure all the documents listed in this clause (ISO,2007).

3.4.1. The PFSA report shall contain, at least, all of the following:

– PFSP table of contents.

– The name and location of the PF.

verifications.

- Procedures for

survey and developing security assessment.

– The date when the PFSA was accomplished and revised.

– The date when the PFSA shall be reviewed.

– an explanation of the port facility security assessment methodology applied, including, at least, a description of the threat scenarios that were considered, the methods applied to classify consequences and likelihood, how risks were evaluated and the methods that were applied to determine the necessary countermeasures.

– The detailed maps or charts of the areas that were assessed with scales should

identify the following:

- Accesses, exits, gates, approaches, and areas of anchorages, maneuvering and berthing;
- Cargo warehouse, storage spaces, terminals, and cargo handling equipment;
- Systems such as electricity supplies, Power plants, distribution, substations,

– The persons' names and qualifications who were conducting on-scene security

radio, and telecommunication systems;
- Computer systems and networks;

- PF or ship traffic-management systems and to navigational aids;
- Cargo transfer piping, and fresh water supplies and all piping systems;
- Railways and roads Bridges;
- PF service supply boats, including pilot boats, tugs, lighters, etc.;
- Security and surveillance equipment, devices and systems;
- Waters adjacent to the PF.

- A detailed description of the current state of security in the PF including

the accomplished performance review list.

– A detailed description of the nature of the PF being assessed.

– A prioritized listing of potential risks to be addressed.

It shall be advised that the PF operators have to ensure that the original security assessment is revised to take into account any changes concerning its operations, as well as changes in the PF

3.4.2. Security operations and security training records

The following additional records shall be maintained as the following:

– Training records: For every security training session, the date of every session, duration of the

session, a description of the training and a list of attendees' names.

– Drills and exercises records: For every security drill or exercise, the date held, description of

drill or exercise, list of participants' names and any best practices or lessons learned that could

improve the PFSP.

– Security incidents and breaches records: For each security incident or breach, the date and time

of occurrence, location in the PF, description of incident or breaches, to whom it was reported,

and a description of the response.

– Changes in security levels

structures or in the vicinities around the port facilities. A copy of this statement shall be enclosed in each PFSA report.

compliance with additional requirements.

– Records of maintenance, calibration and testing of security equipment: For each occurrence of

maintenance, calibrations and testing, the date and time and the specific security equipment

involved.

– Records of security threats: For each security threat, the date and time of occurrence, how the

threat was happened, who received or identified the threat, description of such threat, to whom

it was reported and a description of the response.

– Records of Declaration of Security (DoS): A copy of every DoS for at least 90 days after its

starting date.

– Records of the annual PFSP audit: For each annual audit, a letter certified by the PFSO

documented the date such accomplished audit.

records: For each change in security level, the date and time of

notification received and time of

Unless otherwise specified in this document, all other records required in ISO 20858 shall be maintained for at least 2 years. Records could be kept in an electronic format. If so, they shall be secured against unauthorized disclosure, deletion, destruction or amendment.

4. The Proposed tiers of using ISO 20858 by port facilities

ISO 20858 directly concerns PFSAs& PFSPs development. It is designed to facilitate a consistent implementation of the ISPS code worldwide such a way creating a safe and secure international maritime shipping system. In addition, it is designed to ensure that the completed work meets the requirements of IMO and the appropriate maritime security practices that can be verified by an outside auditor. It is a unique standard when compared with other ISO standards as it focuses only on the marine PF. This standard addresses the execution of marine PFSAs, marine PFSPs as well as the skills and knowledge necessary for the personnel involved in

3.4.3. Retention of records

All records concerning the PFSA and PFSP shall be maintained until a new security assessment or security plan is accomplished.

implementation of the ISPS Code (Teck& Shah, 2008).

The vital importance of PFs makes them a vulnerable node as a port-related disruption can generate domino effect on a network of supply chains (Loh&Thai,2014).

The port facilities' failure to show an evidence of complying to ISPS code and other international necessary requirements could resulted in losing their commercial confidence among the shipping companies, ships operators, charterers, freight forwarders and other international industry players involving in maritime trade. Such failure could finally lead to lose the ports' competitiveness. It is the responsibility of port facilities to maintain their continuous compliance to the necessary international requirements and also port facilities had better display an evidence for the effectiveness of security procedures and measures implemented through a proved port facility security plan.

This Paper suggests that using ISO 20858: 2007 is a clear evidence for those port facilities executing an approved PFSP and emphasizing their compliance with the ISPS to use ISO 20858 fully meet the international mandatory industry-determined level of compliance with all needed requirements.

The critical importance of port facilities in the international trade operations makes them a vulnerable link in the supply chains because a disruption in port facilities' activities could generate a domino effect on the network of supply chains causing a profound negative effect on the entire global economy. The vulnerability of port facilities needs to ensure having an evidence of executing of an approved PFSP implementing all necessary international requirements to secure that vital link, port facilities, in the supply chains and as a result secure the global maritime trade. **Applying the three tiers in using ISO 20858 as:**

- The First Tier is a first party audit which is the self-verification of conformance by the port facility itself.
- The Second Tier is a second

code as well as the other international necessary requirements. Accordingly, the Ships' masters and operators, shipping companies, charterers and freight forwarders will be sure that port facilities voluntary determine

- The Third Tier is a third party audit which is the verification of conformance to agreed criteria by an entity independent of all parties of the port facility.

party audit which is the verification of a port facility's conformance to agreed criteria by another entity, agency or body which has a vested interest in the port facility's operations in the supply chain.

Figure 2. indicates Three tiers using ISO 20858.

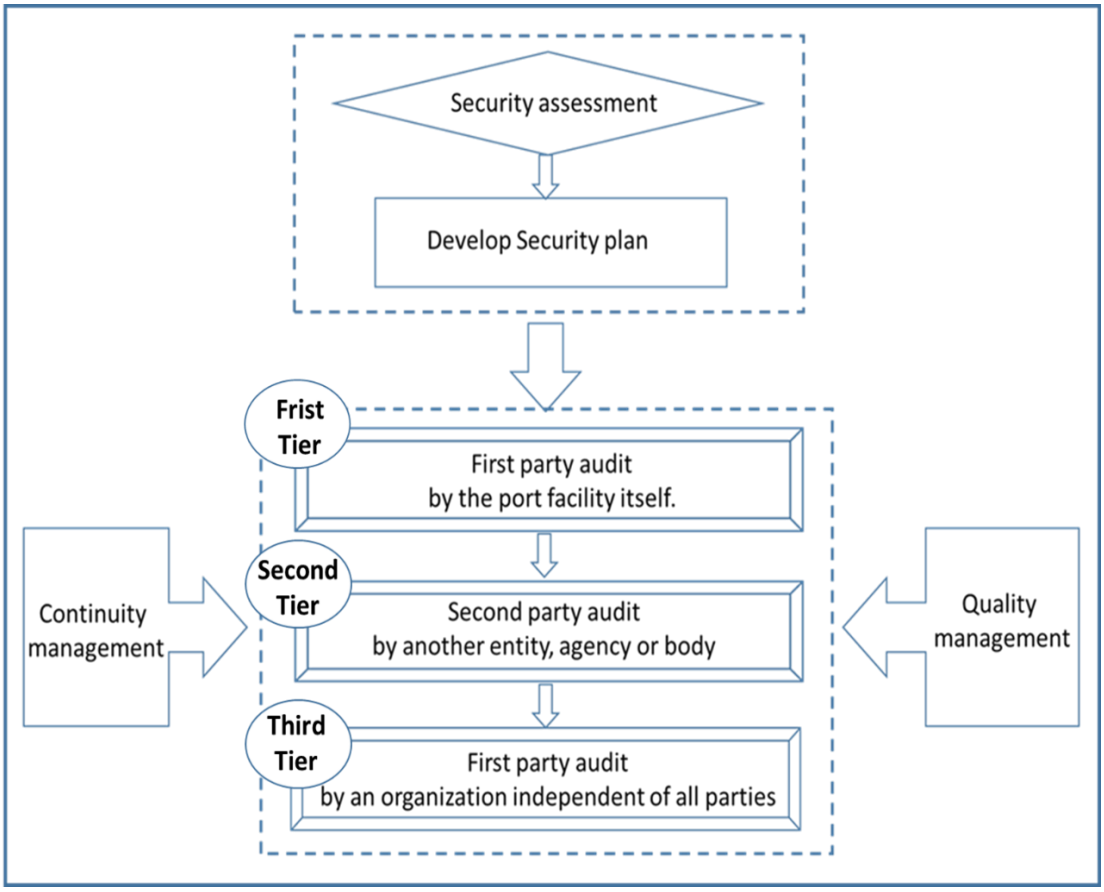

Figure 2. Three tiers using ISO 20858. Source: Prepared by authors

Port facilities that are intending to implement ISO 20858 are not obliged to obtain such services by an external consultant. In case of

However, it is the responsibility of the port facility seeking such consultant to completely verify the competence of consultants offering

any port facility decides that it is necessary to have advice or consultant to conduct port facility security assessments, develop port facility security plans or implement the necessary requirements, it may seek external consulting services.

the advisory services.

Finally, consultants who offer such services to a port facility shall be excluded from participating in third party audits of the same port facility. Using ISO 20858 through the first and the second tier, a first party audit and a second part audit, will not cost any financial burdens on the port facilities. However, if having a document of compliance with ISO 20858 from a third party audit process is a target then the port facility seeking certification should consider selecting a third party certification body accredited by a competent accreditation body, such as a distinguished Recognized Security Organization (ISO,2007).

There are many port facilities using ISO 20858 as a clear and physical evidence to prove their compliance with the necessary requirement of the ISPS code. The first example, Arab Shipbuilding and Repair Yard (ASRY) has complied with ISO 20858 since 2010. ASRY has had maritime business since 1977. Beginning with the dry-dock, followed by the floating docks, slipways, and over 4km of alongside berth space, ASRY now has a leading variety of facilities to repair any size and type of vessel. The yard is trusted by some of the chemical carriers, and more (ASRY, 2015). The second example, Dubai Port (DP) World has already conformed ISO 20858 - at its all terminals throughout the company's network of 77 operating marine and inland terminals supported by over 50 related businesses in 40 countries across six continents (DP World,2016,2017). Maritime Security Committee (MSC) 83 noted that ISO PAS 20858 was issued to uniform the implementation of the ISPS Code and It is considered as a full ISO standard (IMO,2008).

5.Conclusion and Recommendations

There is an urgent need for complying with the international maritime security standards. it is required an international support in dealing with necessary maritime security indicating that this is an international problem and national solutions or unilateral government

most prestigious names in the global shipping industry and is capable of repairing any type and size of marine vessel, from workboats, to containerships, VLCCs, cargo vessels, ro-ro vessels, bulk and cargo carriers,

actions would not work. There is an urgent need for complying with the international maritime security standards. it is required an international support in dealing with necessary maritime security indicating that this is considered as international problem. So, national solutions or unilateral government actions would not work effectively. ISO 20858 is a requirements standard intended to help port facilities executing an PFSPs to establish and demonstrate their compliance with the IMO regulations and ISPS code requirements in a manner that can be verified by an outside auditor.

Therefore, having a certificate of using ISO 20858 shall eliminate any doubt against the effectiveness and efficient of executing the port facility Security Plan. This research is to propose three tiers to use ISO 20858 and highlight the importance of having a certificate of ISO 20858 as a clear evidence of complying with the necessary international requirements through executing a proved PFSP. So, Ships' masters, operators and all maritime industry parties will be sure that such port facilities using ISO 20858 meet the international mandatory industry-determined increase their competitiveness, ensure preventing any attempt to breach the security of the port facilities.

References

1- Arab Shipbuilding & Repair Yard (ASRY), (2015), ASRY- Brochure, https://www.asry.net/wp - content/uploads/2015/08/ASRY-Brochure-Dec14-low-res.pdf (Accessed MAR 21, 2017).
2- CRISP (Evaluation and Certification Schemes for Security Products) project, (2014). Consolidated report on security standards, certification and accreditation – best practice and lessons learnt, http://crisppproject.eu/ (Accessed MAR 26, 2017).
3- Chacon, H, Victor, (2016). "The Due Diligence in Maritime Transportation in the Technological Era", PHD Dissertation, Faculty of Law, the University of Hamburg.
4- DP World Corporate Brochure, (2016). http://web.dpworld.com/wp-content/uploads/2014/01/DPW_Corporate-Brochure_A03.pdf (Accessed MAR 20, 2017).
5- DP World, (2017). ttp://dpworld.ae/uploads/Download/English/56962015114925PM845-DP%20World%20UAE%20Region

level of compliance with the ISPS Code.

This paper recommends applying the three proposed tires of using ISO 20858:2007 in the Egyptian port facilities to have a clear evidence of their compliance to the international security requirements,

%20Handbook%20English.pdf (Accessed MAR 11, 2017).

6- Hui, Shan, Loh. Vinh, Van, Thai, (2014). Managing Port-Related Supply Chain disruptions: A Conceptual Paper. The Asian Journal of Shipping and Logistics. Volume 30 (1) pp. (097-116).

7- International Organization for Standardization(ISO), (2007). ISO 20858:2007 Ships and marine technology – Maritime port facility security assessments and security plan development, Geneva.

8- International Labor Organization, (2004). ILO and IMO code of practice Security in ports. Geneva.

9- International Maritime Organization, (2008). MARITIME SAFETY COMMITTEE, 83th session, MSC 83/4, MEASURES TO ENHANCE MARITIME SECURITY, London.

10- Khalid, Bichou. Michael, G, H. Bell and Andrew, Evans, (2014). RISK MANAGEMENT IN PORT OPERATIONS, LOGISTICS AND SUPPLY-CHAIN SECURITY Routledge, New York, ,10017, USA.

11- Lee, Ghim, Teck. Muhammad, Zaly, Shah, (2008). SUPPLY CHAIN SECURITY FOR PORT FACILITY IN COMPLIANCE WITH ISPS CODE. EASTS International Symposium on Sustainable Transportation incorporating Malaysian Universities Transport Research Forum Conference 2008 (MUTRFC08).

12- Li, Yanqing, (2011). ISO/TC8 Bridge with IMO, http://www.asef2015.com/asef2007/PDF/1.%20ISO-IMO%20by%20Mr.Li%20(China)-

14- Periasamy, Gunasekaran, (2012). PORT SECURITY IN A DEVELOPING COUNTRY – PRE AND POST 9/11 TERRORIST ATTACKS: A CASE STUDY ON PORT KLANG IN MALAYSIA, PHD Thesis, Greenwich Maritime Institute, University of Greenwich, London.

15- ISO Focus ,(2006). Maritime security, The Magazine of International Organization for Standardization, Volume 3, Nos. 7/8, July/August 2006, ISSN 1729-8709, Genève, Switzerland.

16- UNCTAD, (2013). Review of Maritime Transport 2013., United Nation, Geneva.

17- UNCTAD, (2016). Review of Maritime Transport 2016., United Nation, Geneva.

1.pdf (Accessed Mar 19, 2017).
13- Mohamed, M, Abdel Fattah, (2015). PROPOSED INTEGRETED MODEL TO PORT FACILITY SECURITY MANAGEMENT AND PERFORMANCE MEASUREMENT. MASTER DEGREE Dissertation. Maritime Post graduate studies Institute. AASTMT. Egypt. Alexandria.

The Need for Developing Nile River Transport to Apply Multimodal Transportation System

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Abstract

Domestic trade is the Backbone of the national economy. Egypt has a volume of domestic freight, half billion tons (ministry of transport), which refers to the large size of the market and number of consumers comparing to the neighboring countries, and according to the World Economic Forum which, Indicated that Egypt Population 86.7 (millions), GDP 286.4US$ billion, GDP per capital (US$) 3,304, and GDP (PPP) as share of world total is 0.87%. While Egypt multiple transportation modes suffer from an imbalance between modes, where 95% of Egypt freight moved through Roads, 4% moved by railways and 1% moved by Nile river transport.

To restore the balance between the modes there is a need to Apply Multimodal Transportation System in Egypt and apply the optimal integration between the different modes. This paper aims to present the significance of the multimodal transportation concept and transportation mode integration. Moreover, reviewing the transportation system in Egypt and its status, especially Nile river transportation system, to discuss the level of integration between the different modes, moreover to identify the factors that lead the system to success and factors that hold it back.

1. Introduction

The economic growth and potential development in Africa are quite promising. Several African countries are expanding in their external trade such as Egypt and that had and impact of increasing demand for the effective and efficient transportation system. Moreover, the expansion in the internal trade has increased the demand for a better transportation system with the best utilization for all available modes. Transportation considered as the milestone for

socioeconomic interaction. It became paramount for human activities.

Physical issues, as, untrained transport supervisors/managers and planners, fund/investment restructuring, bureaucracies, inadequate traffic regulations, Lack of multimodal transportation management and the unavailability of the integration between transportation modes. Roads with bad condition and lack of maintenance, inadequate trains with low connectivity, and inadequate fleets of vehicles, are common features of developing countries. All these factors often hold back the economy development of the country.

Domestic trade is the mainstay of the national economy, as it represents a reflection of the economic interaction between producers, distributors, and consumers. The importance of the Egyptian domestic trade refers to the large size of the market and number of consumers comparing to the neighboring countries. The Egyptian domestic trade depends on road transportation. However, road transportation generates several issues as; increasing of traffic density on some roads, exceeding permissible loads for freight vehicles, increase in accident rates on some intersections and increase in traffic congestion especially at the entrances and exits of major cities. Accordingly, these factors lead to an increase in the cost of transport, which negatively affect the competitiveness of exported goods and increase the cost of imports.

Egypt had several types of transportation modes for cargo transportation as the sea, roads, rails, inland waterways, airways, and pipelines. This research aims to review the transportation system in Egypt and its status. To discuss the level of integration between the different modes, moreover to identify the factors that lead the system to success and factors that hold it back.

2. Integrated Transport & Multimodal transportation Significance

Governmental success in providing efficient transportation system is vital for the growth of the economy and securing better life standard for the next generations. Integrated transport system provides goods free movement within the country.it

focuses on harmonization of rules and interoperability of transportation modes, nodes, and networks (European Commission, 2010). To reach the integration between transportation modes there is a need for clear understanding of modern transportation modes and the relation between it and the nodes. Moreover, the need for specialized logistics management complying with the country needs and status, to deliver reliable, safe, and cost-effective service.

The terms "Intermodal Transport" and "Multimodal Transport" are used in a very similar meaning for cargo movement, from origin to destination. However, the United Nations defined[1] doth differently in the Multimodal Transport Handbook (1995).

Multimodal transport is a concept which makes multimodal transport operator (MTO) responsible and liable for all transport activates by coordinating and managing the operation from shipper's door to consignee's door, to guarantee continuous cargo movement using best routes, efficient, and cost-effective. To apply that concept there is a need for simplified

3. Egypt in Brief

The Arab Republic of Egypt located in north-east Africa, bordered by Sudan from South, Libya from West, the Mediterranean Sea from the north, and the Red Sea from the East. Egypt populated area 55367 km², which present 5.5% of the total area (total area 1,002,000 m²). Egypt climate influenced by several factors, the low-pressure areas, the location, and the landscape, all works on dividing Egypt to distinguished climatic regions. Accordingly, that makes Egypt a dry arid region in general, while the north coast preserved by the

[1] Intermodal Transport: The transportation of goods by several modes of transport where one carrier organizes the whole transport from one point or port of origin via one or more interface points to a final port or point. Multimodal Transport: Where the carrier organizing the transport takes responsibility for the entire door-to-door transport and issues a multimodal transport document.

documentation[1], commercial practices, transport infrastructure, and local legislation emanated from related conventions[1].

Mediterranean climate. Climate mainly in Egypt is two seasons: a moderate winter, and a hot summer from May to October ("Location and Climate").

According to "World Economic Forum[2]." Indicated that Population 86.7 (millions), GDP 286.4US$ billion(B), GDP per capita (US$)3,304, and GDP(PPP) as a share of world total is 0.87%. Moreover, the country ranking out of 140 countries for elements that have a direct or indirect influence on the transportation system and its integration shown in Table(1). In addition to the most problematic factors for doing business which shown in figure(1).

Element	Rank out of 140
Quality of overall infrastructure	114
Quality of roads	110
Quality of railroad infrastructure	70
Quality of port infrastructure	55
Quality of air transport infrastructure	53
Quality of electricity supply	101
Government budget balance, % GDP	139
Inflation, annual % change	133
Quality of primary education	139
Quality of the education system	139
Quality of math and science education	131
Quality of management schools	139
Internet access in schools	132
Availability of specialized training services	139
Extent of staff training	139
Intensity of local competition	128
Capacity for innovation	133
Quality of scientific research institutions	128

Table 1: Ranking of Egypt
Source: The Global Competitiveness Report 2015–2016

[2] Simplified documentation can be carried out by electronic means such as electronic data interchange (EDI).
[3] Related conventions as United Nations Convention on International Multimodal Transport of Goods
[4]World Economic Forum Global Competitiveness report indicators 2015–2016.

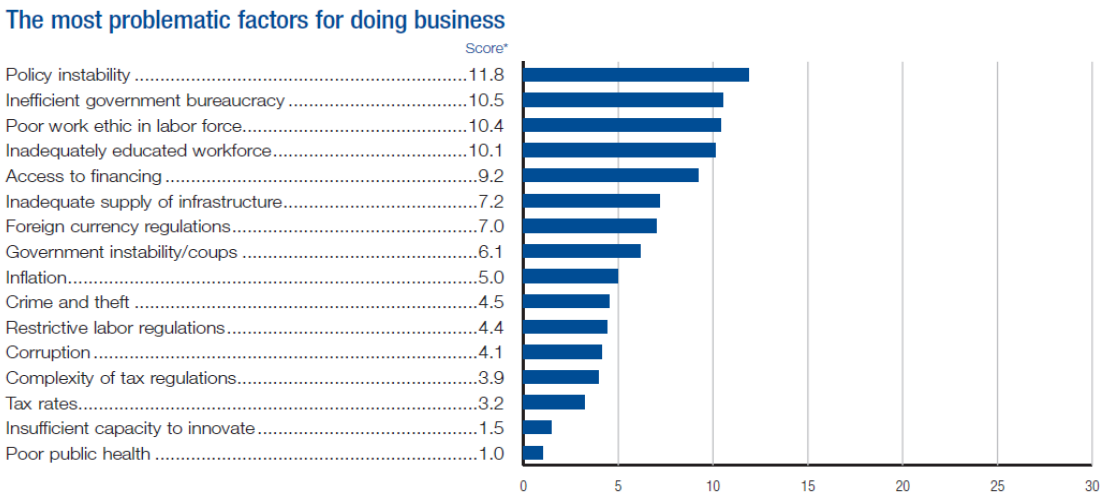


Figure 1: The Most Problematic Factors For Doing Business
Source: Source: The Global Competitiveness Report 2015–2016

The World Bank Logistics Performance Index (LPI), rank the countries from the perspective of logistic performance, this ranking depends mainly on combining data on six core[3] performance components using the qualitative analyses to produce a single aggregate measure. According to this index, Egypt ranked 49 in 2016 while it was 62 in 2014, which means that the logistic performance is improving. However, there is still a wide gap need to be covered and improvement needed in different contexts ("World Bank Group").

Egypt has a trade deficit for a long period, from 2006 the gap between import and export increased continuously as shown in figure(2). Egypt ranked 62 as exporting economy and 71 as a complex economy, according to " (ECI[4])." In 2014, Egypt exported $33.2B and imported $82.4B. Table(2) show top commodities for Egypt trade.

[3] The core six components are; the efficiency of border clearance and customs, quality of trade and transport infrastructure, quality and competence of logistics, ability to trace and track consignments; those components rated from "very low" to "very high". Then The ease of arranging competitively priced shipments, rated from "very difficult" to "very easy.", Moreover, the frequency of shipments reaches consignees within expected delivery times or scheduled, rated from "hardly ever" to "nearly always.".

[4] "the Economic Complexity Index (ECI)"

NO	Export	Value in USD	Import	Value in B USD
1	Crude Petroleum	6.84 B	Refined Petroleum	7.47B
2	Refined Petroleum	1.34 B	($), Wheat	5.36 B
3	Insulated Wire	996 Million (M)	Semi-Finished Iron	2.9 B
4	Video Displays	757 M	Crude Petroleum	2.79 B
5	Gold	667 M	Cars	2.27 B

Table 2: Top Commodities For Egypt Trade 2014
Source: OEC

Figure 2: Egypt Trades Import & Export Trend
Source: OEC: "The Observatory of Economic Complexity."

"United Nations Convention on International Multimodal Transport of Goods" is not ratified by the Egyptian administration ("Multimodal Transport Systems," 2013), which considered as a factor that holds the country from applying the rules and Laws that assist in activating successful multimodal transportation system.

Egypt own the resources of the success of the multimodal transportation system, by owning the main components as sea ports, airports, rails, roads and Suez canal in addition to the availability of the cheap labor. While every country is unique in its needs and has its characteristics and capabilities, that need a different way of managing to integrate its transportation system.

4. Egypt transport system

Egypt has a volume of domestic freight, half billion tons (ministry of Transport (MOT)). While this volume suffers from an imbalance between import and export which makes the amount of the empty modes back to ports is high. Moreover, the unloaded ships which departure without cargo,

Year	Cargo Volume (1000 tons)				Modal Share (%)			
	Road	Railway	IWT	Total	Road	Railway	IWT	Total
1979	73,700	5,000	4,300	83,000	88.7	6.1	5.2	100.0
1992	165,495	9,642 0	3,214	178,351	92.8	5.4	1.8	100
2000	242,000	11,812	2,161 0	256,000	94.5	4.6	0.8	100
2010	433,361	4,042	2,226	439,630	98. 6	0.9	0.5	100.0

Table 3: Annual Modal Share for Egyptian Freight Movement
Source: JICA, 2014

which has a negative impact on the transport cost.

Although Egypt has multiple transportation modes, however, 94% of Egypt freight moved through Roads and 5% moved by railways and inland waterways. The modes of Egypt transportation system are rails, road network, and inland waterway. Table (3) present Egyptian freight movement.

4.1Egypt road system

The Egyptian road network of 65,050km of roads in addition to 181 bridges stand throughout the country, 36 bridges are passing over the Nile with medium and low altitude, this network handles 94% of the domestic freight transportation (LCA). This network is expanding continually due to the increasing number of vehicles and population which increase road demand. However, the roads characterize by congestion with high accident rate, high level of noise and pollution, lack of a consistent distribution infrastructure, lack of road-based transportation services (Oxford Business Group, 2013). The present freeway in Egypt that has with standard motorway specifications is Ain-Sukhna Hi-way with the length of 110 KM and 28 Km in Alexandria agriculture road (Ragab & Fouad, 2009). Accordingly to integrate this network of roads with other modes of transportations and Egyptian trade demand on transportation, to provide better service many investments is needed, in the form of a group of corridors to serve the process of the integration. Table (4) present the planned corridors in the medium and long term.

NO	Project name	Description	Cost in million LE
1	3rd Cairo Alex Expressway	connects from Cairo to Borg el Arab in desert area by 6-lanes, 120km/h [New Expressway]	2,608
2	Cairo-Alexandria Desert Expressway (Upgrade to 8-lanes)	The committed project is 6-lanes. Upgraded to 8-lanes [Upgrade of Expressway]	1,775
3	3rd Stage Regional Ring Road (Southern Part of Expressway)	forms southern part of Outer Ring Road, 6-lanes, 100km/h [New Expressway]	3,026
4	Alexandria Bypass	forms urban ring road connects the Cairo-Alex desert expressway, 4-lanes, 80km/h [New Art. Road]	1,650
5	Double Tracking of Bypass Line for Cairo - New Alexandria for	freight line (diesel) with local passenger	4,125
6	Cairo-Ismailia Port Said Road (Expressway)	connects from ring road to Port Said, 6-lanes, 100km/h [Upgrade to Expressway]	3,125
7	Cairo Alex Agriculture Bypass Kafr El Zayat - Alexandria	Bypass road for Tanta to Alex. in south side of agricultural road in 6-lanes [New Art. Road]	1,759
8	Shubra elkhema - Banha Agriculture Road (Expressway)	bypass road for Cairo to Benha in west side, 6-lanes, 100km/h [Upgrade to Expressway]	2,500
9	Cairo -Suez Road (Expressway)	connects form ring road to Suez, 6-lanes, 100km/h [Upgrade to Expressway]	2,500
10	Ismailia Suez Road (Expressway)	connects from Suez to Ismailia at west side of Suez canal, 6-lanes, 100km/h, connects to upgrade to Expressway from Ismailia to Port Said	1,001
11	Wadi Alnatroum Saloum Road	connects to Libya, in desert area, 4-lanes, 80km/h [New Art. Road]	3,599

Table 4: Egypt road projects
Source: JICA, 2014

For the present road developments, several projects are under construction[5] to upgrade the network by 3000Km. In addition to three tunnels underneath the Suez Canal, as a part of Sinai-Peninsula development plan. Figure (4) present the short term corridors developments.

[5]The under construction projects include Safaga to El-Quseir road, Marsa-Alam road, Ras Sudr to Sharm El-Sheikh road, and Alexandria to Abu Simbel road.

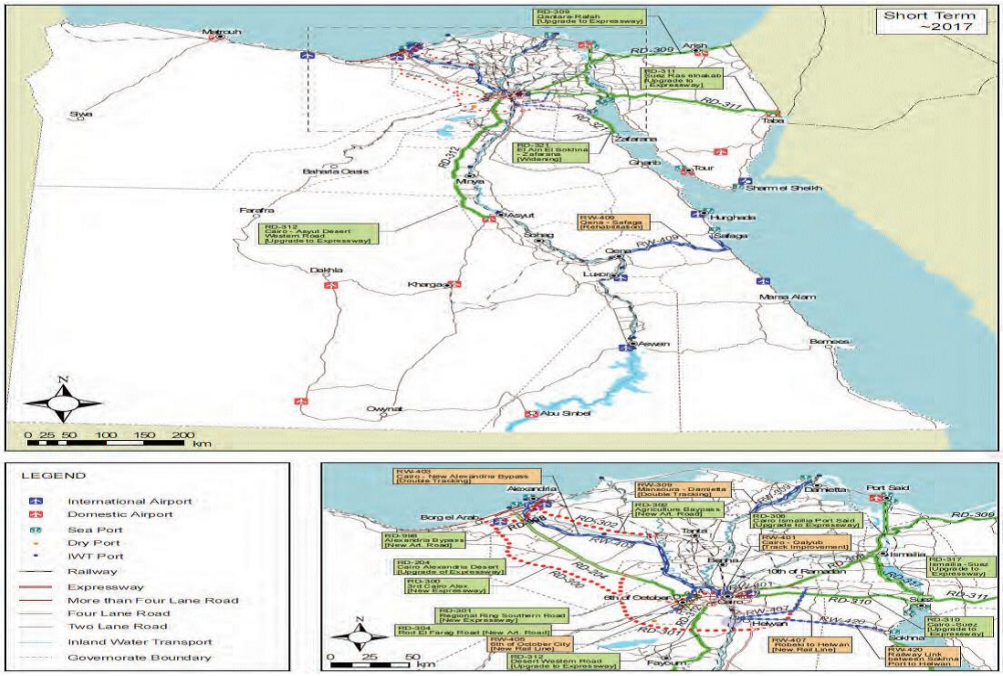


Figure 3: Road projects of short-term
Source: JICA, 2014

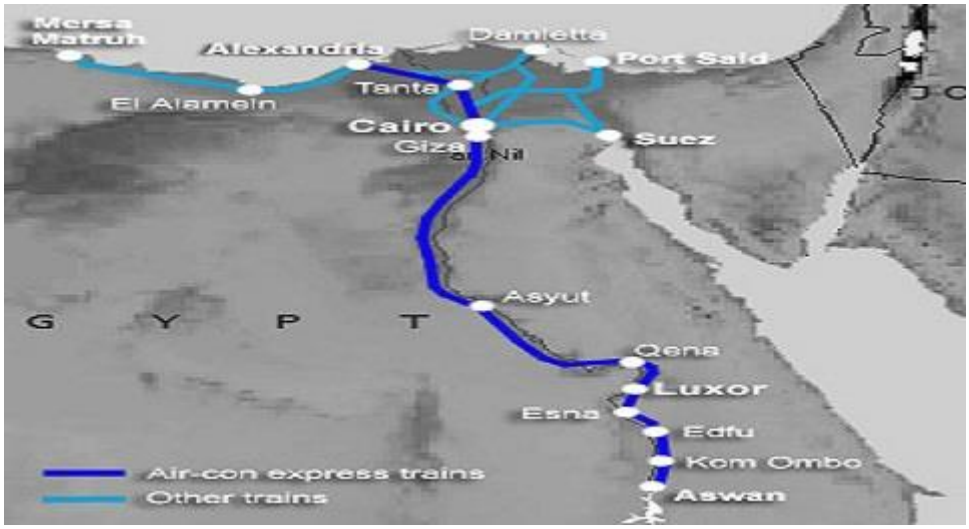


Figure 4: Egypt railways map
Source: Egyptian Railway Authority

4.2 Egypt rail system

Egypt railways one of the oldest railways in the world since the eighteenth century, extended from north to south Egypt linking all main cities and the three main ports with the length of 5,083 km as shown in figure(5).

The share for Egyptian freight movement decline to reach 0.9% in 2010 (JICA). Cairo, and Alexandria the only distribution center that has a container freight station linked with the railways, while the other main cities do not, while these cities considered as distribution centers.

Rail transport is under-utilized and is suffering from the lack of consideration as a serious transport alternative. This relative neglect has hindered modernization, and a lack of investments underpins the gradual deterioration of the competitive strength as compared to road transport. Recently the government set a plan to improve the railway services by investing in projects presented in Table (5).

NO	Project name	Description	Cost in million LE
1	Railway Link for 6th of October VAL (Value Added Logistics) Center at 6th of October City	City connects from Baharia line via L-1 [New Rail Line] New VAL/ Distribution Center	2,400 1,000
2	Railway Link between Robeki to Helwan	forms a part of south ring railway route [New Rail Line]	2,100
3	Improvement of Station Facilities for Freight Services (2stations)	Good intermodal connection & facilities, railway layout/arrangement, warehouse and station office at Qabbary and other station.	1,025
4	Railway Link between Sokhna Port to Helwan	New freight railway line for direct link from Sokhna port to 6th of October [New Rail Line]	3,750
5	Inland Water Transport port for ITC	connects to south ring railway route around Helwan, Tebbin port improvement, includes waterway, navigation and lock operation improvement.	1,000
6	Railway Link for 10th of Ramadhan City	connects between Tel el Kebir to Robeki through Logistics Center [New Rail Line]	2,295
7	Improvement of Signaling System for Increase of Freight Trains	connects for Tanta - Mansoura - Damietta [Signal Improvement]	875
8	Double Tracking for Ain Shams - Robeki	from Cairo - Robekki along Cairo - Suez line [Double Tracking]	625
9	Improvement of Station Facilities for Freight Services (6 stations)	Good intermodal connection & facilities, railway layout/arrangement, warehouse and station office at stations of Imbaba, Beni Suef, Minya, Asyut, Qena and Aswan	2,813

Table 5: Egypt Railway Future Projects
Source: JICA 2014

4.3 Inland waterway transport (IWT)

Inland waterways in Egypt are significant and unique, where it consists of Lake Nasser, Nile River, Alexandria-Cairo Waterway, small canals, and Suez Canal which presently offers depth more than 20 m, Egyptian inland waterways have a total of 3,500 km (Gray, Fattah, & Cullinane, 1998).

River navigation has a length of 3136 km, with 44 river ports most of the ports connected to roads while only two ports connected to the railway, at Alexandria and Aswan. Raw material as: Molasses, petroleum products, phosphates, and stones are the main freight transported by the river which presents 80% of total river freight.

ITW share decline to 0.5% in 2010 due to; lack of government subsidization, lack of support to river transport activities, and low coordination in assigning specific volumes of freight. Moreover, lack of maintenance and developing, micronizing the proper river infrastructure (Korkor, 2012).

4.3.1 River characteristics

The routes of navigation in the river Nile consist of three main parts. The first part starts in Aswan and extends with the river rapid till Cairo. The second and third parts start from Cairo but extend in two directions, one toward Damietta and the other toward Rashid. The three main parts are divided into sectors by low bridges and locks as well. Table (6) presents the discerption of the main three parts of the river.

	From – To	Length (km)	Width (m)
First part (Aswan – Cairo)			
1st Navigational Channel	Aswan High Dam - Esna	169	639
2nd Navigational Channel	Esna rapids – Naga Hamadi rapids	190	570
3rd Navigational Channel	Naga Hamadi rapids - Asyut	187	1060
4th Navigational Channel	Asyut – Cairo	414	533 – 1150
Second part (Cairo – Damietta)			
1st Navigational Channel	Delta rapids - Damietta	228	217
Third part (Cairo – Rosetta)			
1st Navigational Channel	Delta rapids - Rosetta	200	n/a

Table 6: the discerption of the main three parts of the river

Source: El-Nakib, 2011

4.3.2 Nile fleet and ports transportation capacity

The Nile transportation network in Egypt contain a sum of 1850 KM of waterways suitable for navigation: which include 44 river ports which import and export different types of goods as shown in Table (7), in addition to 10 anchorages, including the 8 berths for loading and discharging of different types of cargo (MOT, 2009).

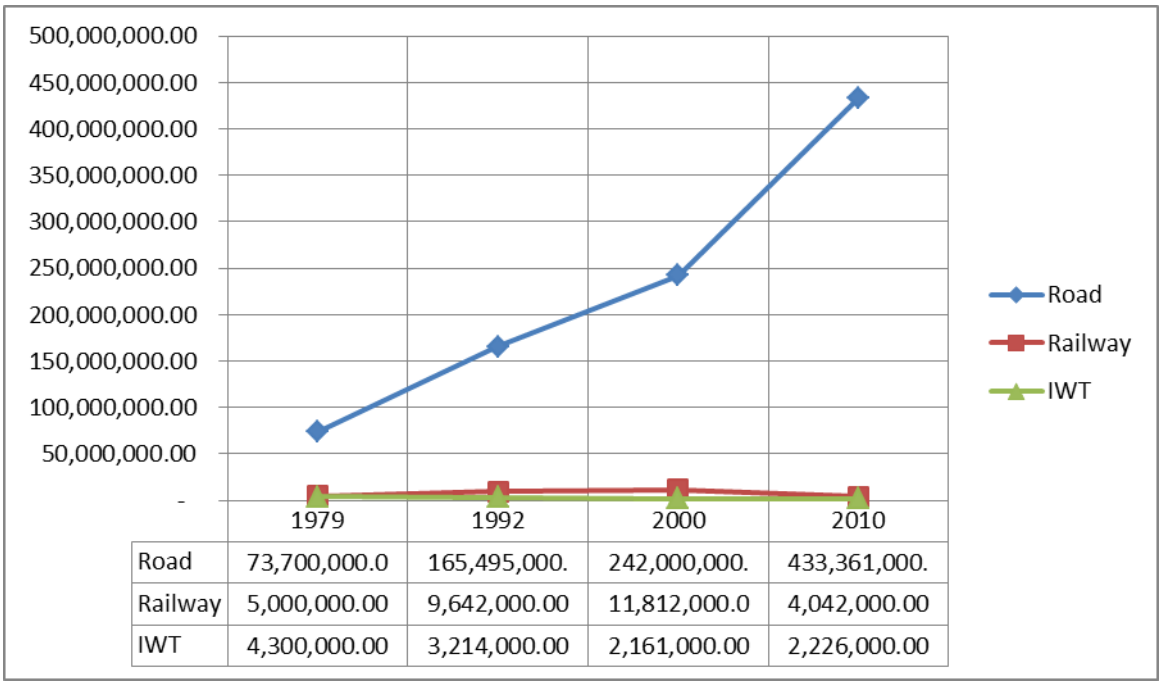
No	River port name	Storage in Tons	Throughput	
			Exports	Imports
1	Iron and Steel	3000	-	Petroleum
2	Abu Zaabal Fertilizers	15000	-	Phosphate
3	Kima	2000	Fertilizers	Fertilizers
4	Tanash	2000	Aswan mud	Aswan mud
5	Al Jazeera	3000	Mud	-
6	Al Shima	1000	Mud	-
7	Al Nasrab	1500	Phosphate	Phosphate
8	Aqaba 1	2000	Mud	-
9	Aqaba 2	3000	Mud	-
10	Al Biyara	15000	Molasses	Chemicals – sugar
11	Edfu Sugar	2000	Molasses – Sugar	Fuel – limestone
12	Al Mowareda	180	Phosphate	Phosphate
13	Ferrosilicon plant	500	Ferrosilicon	products Coal
14	Al Sabaiaa	30000	Crude phosphate	-
15	Armant Sugar	30000	Molasses – Sugar – Sugar Cane	Fuel – sugar – limestone
16	Qaws Sugar	50000	Molasses – Sugar	Production equipment
17	Dishna Suger	10000	Sugar	Sugar
18	Nag Hammadi Sugar	50000	Molasses – Sugar	Sulphurs – limestone – spear parts
19	Aluminum River	60000	Brick – Aluminium	Brick – Aluminium – coal
20	Al Belina	10000	Passengers – Vehicle	Passengers - Vehicle
21	Gerga Sugar	40000	Molasses	Stones - fuel
22	Assiut Thermal Station	35000	-	Petroleum
23	Petroleum Port	Tanks	Solar – ceresin – petroleum	-
24	Assiut Cement 1	20000	-	Petroleum
25	Assiut Cement 2	60000	Fertilizers	Petroleum
26	Bmnaqbad Fertilizer plant	50000	Fertilizers	Phosphate - sulphur
27	Nile Cotton Ginning	7000	Cotton	Cotton
28	Bani Khalid Samalout	10000	Limestone	-
29	Tipin Limestone	70000	Iron products	Limestone
30	Al Tebeen El Nahry	17750	-	-
31	Tipin for coke	125000	Cook	cook - limestone
32	Kawneya Cement	7000	Bulk Cement	Packaged Cement
33	Nile cement	9000	Packaged Cement	-
34	Wosol Samalout	7000	-	Limestone
35	Hawamdya Sugar factory	1000	Molasses – Sugar - spare parts	Fuel – molasses - sugar
36	Moedat factory	7000	Equipment Raw	materials
37	Al Masara	4000	Aluminium Products	Aluminium Products
38	Tora	5000	Cement	-

39	Ether ElNaby	20000	-	stones - powders
40	Imbaba Silos	60000	Wheat	-
41	Sulphur	40000	Sulphur	-
42	Phosphate - Ismailia Canal	60000	-	Phosphate
43	43 Renaissance - Nubariya Canal	80000	Sulphur	Sulphur
44	Barricade - Nubariya Canal	5000	Aluminum Products	Production equipment

Table 7: Egyptian Nile ports with cargo type in throughput

Source: GRTA (2007)

Egypt river fleet consist of a group of overage vessels which cannot support modern transport, this fleet needs refurbishment as soon as possible and also may need replacement in many cases. The fleet productivity is declining year after anther as in 1979 it presents 5.2% of the cargo transport in Egypt while in 2010 it dropped to 0.5% (JICA 2014).



	1979	1992	2000	2010
Road	73,700,000.0	165,495,000.	242,000,000.	433,361,000.
Railway	5,000,000.00	9,642,000.00	11,812,000.0	4,042,000.00
IWT	4,300,000.00	3,214,000.00	2,161,000.00	2,226,000.00

Figure 5: Modes of transportation share in ton from 1979 till 2010
Source: author

Accordingly, as shown in figure (5) it's noticeable the declining of the tonnage transported by the river where it reaches 2.2 million tons of cargo in 2010. For the future, long term planning in river transport the projects presented in table (8).

NO	Project name	Description	Cost in million LE
1	IWT port for ITC	connects to south ring railway route around Helwan, Tebbin port improvement, includes waterway, navigation and lock operation improvement.	1,000
2	Waterway Improvement on Cairo-Alexandria	aims to dredging for safe navigability preventing from sedimentation (width 40m x dredging depth 1.5m x203km).	500

3	Waterway Improvement on Cairo – Damietta	Aims to dredging for safe navigability preventing from sedimentation (width 40m x dredging depth 2m x200km).	600
4	IWT port improvement for Upper Egypt	Connects roads/ railway smoothly, Asyut and Quena ports port improvement, includes waterway, navigation and lock operation improvement.	1,000
5	Lock Expansion with Comprehensive Lock Operation Improvement	upgrades the present capacity of Asyut Barrage Lock by expansion and improves operation of other locks.	290
6	Waterway Improvement on Cairo – Asyut	aims to dredging for safe navigability preventing from sedimentation (width 40m x dredging depth 2m x200km).	650

Table 8: Inland Waterways Transport projects
Source: JICA 2014

5.Transportation system performance and level of integration

To analyze the Egyptian transportation system performance and level of integration, there is a need to analyze it from the perspective of three elements; these elements are the hardware, human-ware, and a software element.

5.1 The Hardware Element

The growing dominance of road cargo transport makes road infrastructure receives the highest investment priority which leads to stagnation in the other transport sectors.

It obliges other modes to use old infrastructure and rolling stock/fleets. However, the utilization of this valuable asset is weak due to less-than-optimum management and policing as well as poor transport equipment[6] and abysmal safety practices in addition to roads congestion and low level of maintenance

Rail transport is under-utilized and suffers from the lack of consideration as a serious alternative. Lack of modernization and investments underpins the gradual deterioration of the competitive strength as compared to road transport. Operational efficiency and available capacity of railway transport is low, which leads to continued and possibly irreversible structural deterioration of the sector due to high maintenance and operating costs in addition to non-readiness for container freight[7].

[6] Motorists frequently lack the capacity to maintain their vehicles or modernize their operations (logistics, intermodality, loading/usage practices), which leads to highly unsafe and inefficient traffic conditions. Shippers prefer using road because it offers higher flexibility and lower prices.

[7] Container shipments are, at present, not a priority for the rail sector due to a lack of infrastructure both for handling and transporting of this growing cargo potential. Controlled tariffs do not increase sector competitiveness and operational sustainability but only consolidate the downwards trend. To be competitive, the sector is in urgent need of adequate infrastructure, new equipment, but most of all a new operational and management philosophy.

IWT is unpretentious because of impediments in river infrastructure[8] and operational inconsistencies. River vessels are over-aged and not adapted for modern cargo transport. This requires refurbishment/replacement to increase its role in the transportation system. River ports suffer a lack of equipment as well as professionalism to efficiently accommodate cargo, in particular, containers.

5.2 Software Element

Lack of modernization of the transport sector caused low performance and poor capacity utilization. Some one-half of trucks, travel empty suggesting considerable logistics shortfalls. The IWT and railway sectors barely generate cargo by the sector itself. Several factors[9] encourage shippers to use predominately road transport for their cargoes.

A sustainable regulatory framework for the transport sector as a whole requires adapting the legislation to the needs of modern transport, with a predominant aim to facilitate market-responsive, customer-oriented and private sector involvement. Cargo consolidation is hindered by the absence of management and operational know-how.

Integration of river and railway transport into the Egyptian transport system(multi-modal dimension) is therefore very low to non-existent[10].
Technological innovation is a driving force in modern logistics and defines the competitiveness of the transport system and of logistics and transport services. There is a pressing need for the introducing of modern technology and logistics strategies into the Egyptian transport market.

5.3 Human-ware element

The sector suffers from a severe shortage of qualified staff. There is a lack of training programs and human resource development, in particular, related to modern technologies in the sector. Qualified personnel and a unified data system[11] encompassing all transport modes are both lacking. Which seen as an urgent prerequisite for efficient transport planning.

Coordination between Ministries and organizations is complex and time-consuming. Approaches to transport planning, implementation and operations are currently fragmented among a myriad of organizations. Human resource responsibilities for transport activities are fragmented.

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[8] Available locks on the river with old design, low bridges, unavailable fairways and lack of navigational aids.

[9] Factors as, externalities related to market access, administrative practices, lack of intermodal systems, regulatory frameworks and inability to operate in a competitive market

[10] According to the study that was carried out at 2014 between MOT and JICA that low level of integration was caused by unfair competition by road transport that benefits from rules and subsidy mechanisms interfering in free market principles and allowing market prices that do not reflect true operating costs.

[11] ideally computerized and/or GIS friendly

6.The importance of the role of river transport and its impact on economic development in Egypt

As previously presented, domestic cargo transport in Egypt dominant by road transport, which Results from it several issues, including pollution, where statistics have proven that traffic causes 75% of urban noise as well as traffic congestion. The of traffic problem is cause other dangerous effects especially on the development of the society, in addition to the harmful effects in terms of health which caused by air and noise pollution and the consequences of road accidents. Which here shows the role of the Nile River in the Renaissance interior trade effectively as an alternative to road transport.

River transport is one of the most important alternatives to solve the problem of land transport and the ideal means of linking between seaports and river ports. River transport is an effective means and tool that has an impact on social, urban and industrial development. River navigation is an important factor in the prosperity of trade. River transport contributes to the transfer of goods between the production areas and the consumption areas within the country especially in upper Egypt. River transport characterized by several features that make it strong competitor compared to other means of transport, moreover, the most important feature is the extension from the south to the north of Egypt, passing through most of the governorates of Egypt. Accordingly, the Nile river in its pass cover the most places of raw material extraction, manufacturing areas of population areas, which may assist in transporting raw and manufacture good outside the country. the Nile River is a natural watercourse available without any effort in the establishment.

River transport is characterized by the availability of infrastructure (Nile River and its branches and navigational channels) at no cost compared to the high cost of the infrastructure of the road and railways. The river transport is characterized by a high capacity to transport equipment with length exceeds 30 meters, and weighs more than 400 tons such as grain, Construction materials, mining extracts, molasses, petroleum products and industrial products such as cement, fertilizers, and others that are transported in large quantities and for long distance.

Furthermore, The river unit's load reaches 900 tons, equivalent to the load of 40 trucks of 24 tons. Which distinguishes river transport by reducing the operational cost of river vessels. The river ship, with a capacity of 900 tons, is powered by two engines, 460 hp. Compared to other transport, this load is equivalent to the cargo of a cargo train consisting of 23 vehicles, each with 40 tons, And is also equivalent to the load of 30 truckloads of 30 tons, which requires a driving force 7200 horsepower (the power of the truck 240 HP). Therefore, the average consumption of fuel for the river ship/unit is much lower than the consumption of fuel for other means of transport. River transport is also characterized by lower investment cost for river transport compared to other means. Similarly, the Nile River is used for transporting containers by using the largest number of containers at a lower cost By other means (Abdul Khaliq, 2007).

Increasing river transport share in Egypt will have an impact on; reduction of total transport freight, reduce road traffic and its related issues, reduce the annual cost of road network maintenance, decrease the produced amount of greenhouse gasses and noise pollution. These factors have a positive effect on the economic development of Egypt.

Conclusion

In a globalized world, Countries tend to work on the prosperity of trade, increase the efficiency of the economy and expand the scope of trade to reach remote/distant places, through applying the application and exploitation of multimodal transport by all available means of transportation to reach their goals, which Egypt lack. Egypt relies on a single mode of transport and the exploitation of road transport in transporting 95% of the domestic trade, which Leads to depletion of road network infrastructure, the lack of optimal use of the railway network and Nile river waterways. This, in turn, led to ignore these resources and lack of interest in the importance of utilizing it, similar to other countries that seek to exploit all available means, as a concept to increase the efficiency of internal transport.

To build a world class integrated multimodal transport infrastructure and services which satisfy people and business needs and demand as well as enabling economic growth

and sustainable development in Egypt. several strategies is needed as Maximize the economic returns of state from the transport sector, Promote National, and International Investments, Build Knowledge to the Transport sector and transfer know-how, Adopt new policies and legislation that grovel transport system obstacles.

Egypt Inhabited area mainly on the side of the Nile which indicate the need for the integration of IWT and railway with the roads with the support of the modern transport system and equipment, and innovative ideas, to create the perfect integrated transport system for Egypt.

Egypt needs a positive way for transportation planning as the integrated approach for planning to influence the system toward sustainable patterns. Moreover, integrated transport planning built on the key issues for transportation, as transport safety, travel demand management and accessibility, transport system interdependencies, interactions between transport and land use, and traffic congestion. Integrated transport plans capable of identifying and prioritizing transport infrastructure and service improvements to satisfy community and government objectives.

Recommendations

- Egypt authorities should ratify multimodal transportation related conventions with implementing the rules of it and modify needed domestic law to comply with the rules. Moreover, developing a legal frame to cover the multimodal transport.
- Transportation system planning should depend on the integrated approach planning.
- Planning on benefiting from the Nile River and its exploitation as a key factor in the process of transporting exports and imports.
- The establishment of an integrated system for transporting the domestic trade through establishing an integrated logistics loops by connecting the three main modes of transportation.
- To activate and exploit the link between sea ports and the Nile River and connecting river ports and sea ports
- Linking between river ports and dry ports and exploit dry ports in the proper and optimal way to serve river ports.

- Establishing specialized companies in multi-modal transport in Egypt, encouraging local and foreign investment and providing facilities to achieve the multi-modal transport system in Egypt.
- Increase and integrate IWT utilization by renewing of the present river fleet to be suitable for containerized cargo, apply fairways in the river for the safety of navigation, modify river locks, preparing the river ports with modern equipment, and increase level and budget of specialized training from simple worker to managers.
- Encourage private sector participation in all river transport activities, river ship owning and floating facilities, which leads to increased employment opportunities. Choose the most suitable river ports on the river transport network to offer it to investors from the private sector, according to specific criteria to be developed, utilized optimally, and take advantage of their idle or unexploited capabilities to be points of exchange of goods with other means of transport to reduce shipping freights.
- The establishment of companies for river transportation and the exploitation of some river ports to serve as a container.
- Increase and integrate railway utilization by building specialized trains, linking the rail system to all ports either sea port or river port, increase the level and budget of specialized training from simple worker to managers, increase marketing for the system, and developing a computerized system to monitor, control and carry out the documentation process.
- The need to use electronic documentation instead of a paper document in all modes, and also in customs process and decrease the level of physical inspection to a minimum. Moreover, the need for Developing single window system to control and solve several problems as port custom and gate congestion.

References

- Abd El Khaliq, Said (2007) - The Future of River Transport in Egypt Review of the Potential and

Capacities Available in Light of the State's Pursuing Market Economics Policy - Alexandria: The Academy Library

- Banomyong, R. (2012). MULTIMODAL TRANSPORT: ITS EVOLUTION & APPLICATION. Retrieved September 9, 2016, from http://www.bus.tu.ac.th/usr/ruth/thesis/chapter2.pdf

- El-Nakib, I. (2011). Examining the Status of Egypt's River Transport System. Alexandria Faculty of Commerce Journal for Scientific Researches, 48(02), 112-123.
- European commission. (2010). • TOWARDS AN INTEGRATED TRANSPORT SYSTEM – FREIGHT FOCUS. Retrieved September 10, 2016,
- Gray, R., Fattah, N. A., & Cullinane, S. (1998). Road freight privatisation in Egypt: Is big beautiful? Journal of Transport Geography, 6(1), 33-41. doi:10.1016/s0966-6923(97)00028-8
- JICA. (2014). ARAB REPUBLIC OF EGYPT. *International Law Reports*, 288-316. doi:10.1017/cbo9781316152201.017
- Korkor, H. (2012). EGYPT POLICY REFORMS TO PROMOTE ENERGY EFFICIENCY IN THE TRANSPORTATION SECTOR. 2-3. Retrieved September 12, 2016
- Ministry Of Petroleum Egypt | Investment Elements. (2015). Retrieved September 19, 2016, from http://www.petroleum.gov.eg/en/Investment/InvestmentElements/Pages/default.aspx
- OEC: The Observatory of Economic Complexity. (n.d.). Retrieved September 10, 2016, from http://atlas.media.mit.edu/en/
- Oxford Economics. (2011). The Wider Economic Benefits of Transport. *ITF Round Tables*. doi:10.1787/9789282101834-en
- Ragab, A., & Fouad, H. (2009). ROADS ANDHIGHWAYS IN EGYPT REFORM FOR ENHANCING EFFICIENCY. *The Egyptian Center of Economic Studies*, 152nd ser. doi:10.1007/springerreference_64829
- Multimodal Transport Systems. (2013). doi:10.1002/9781118577202
- Oxford Business Group. (2013, November 13). The Report: Egypt 2013. Retrieved September 14, 2016
- Digital Logistics Capacity Assessments. (2013, November 19). Retrieved September 13, 2016, from http://dlca.logcluster.org/display/public/DLCA/2.3+Egypt+Road+Network
- World Bank Group. (2016). Retrieved September 09, 2016, from http://www.worldbank.org/
- Maritime Transport Sector. (2014). Retrieved September 10, 2016, from http://www.emdb.gov.eg/en

- MINISTRY OF CIVIL AVIATION. (2016). Retrieved September 19, 2016, from http://www.civilaviation.gov.eg/

Ship scraping-recycling industries and its environmental impact on marine Life

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Abstract

Ship scraping-recycling industry is an important source for developing countries especially in south Asia for supply row materials, re-use of machinery and recycle fuels residuals. It is also offers a plenty of jobs opportunity for thousands of people and necessary for recycling the ships that are represents the best choice for reaching their end of operational life.

The result of this method in the dismantling of ships are commonly represent high levels of hazards and reflected negatively on the marine environment and adversely affect the communities which are often rely on agriculture and fishing for survival.

As for each year a number of ships have been dismantling contain large amounts of toxic and hazardous materials in developing nations in a present of lack in restrictions for environmental and short in implementation convention, the aim of this paper is to help to overcome the challenges involved in ship scraping-recycling industry and how can be minimize the environmental impact on marine Life.

Keywords: Recycling, Scraping, Convention, Environmental hazards

1-Introduction

In simple terms, ship scrapping (breaking or recycling) is to carry out or take to pieces an obsolete vessel for scrapping or disposal at the end of their economic lives or to their final destination. That process is done out at a pier, dry-dock, beach or dismantling slip, including a wide range of undertakings such as removing all equipment and furnishings, cutting and recycling the ship's hull. (Stuer, 2007)

Ships are very complex in structures and consist of a variety

of material types, and their breaking procedure is hardly and dangerous since it mostly relies on human power and labor while this industry has been playing a great role in the economy for some nation through providing some raw materials as steel industry, shipbuilding industry and some other industries which also generate a number of employment opportunities.

Ship scraping risk environment by hazardous such as asbestos, lead and affect the environmental for worker health by work in bilge and tank cleaning. Ship-recycling drawing negative picture and need more measures by the relevant bodies such as International Maritime Organization (IMO) and International Labour Organization (ILO). (Metin, 2013)

While on the other hand ship breaking in order to recover components and materials for reprocessing and to re-use is the most important output of the ship breaking industry, as for example it need less energy for taking out a tons of steel due to less times need for production from scrap if compared to steel production from iron ore. (Naser, 2008)

Ship-recycling have some disadvantage and sustainable way which represent as for some materials such as steel, machines, auxiliaries and furnishings they are dispose in economically integrate life chains with appropriate integrated system for recycling or reusing of ship.

In 2016 there is about 668 of ships are scraping in the marine world (ship dismantling records, 2016). Most of this ship breaking takes place in India, China, Bangladesh and Pakistan under low conditions in terms of workers health and environmental protection, the number of the related accidents and deadly diseases are relatively high and in addition the environment is severely polluted by hazardous material from dismantled ships where the beaching method is present and the mostly used that countries.

Turkey has also been involved in ship breaking activities since 1976 with a small capacity if compared to the leading nations. Turkey offers a good geographical as an alternative to European countries within the region. Furthermore the adoption of Hong-Kong Convention and amendment to

Basel Convention leaded Turkey towards the legislated of the national ship breaking regulation in the direction of green ship breaking.

So it seems that the process of ship recycling happened on developing countries to avoid the burden of high cost, environmental hazards, safety and health issues and also in order to manage the hazardous wastes involved in that process.

2-Methods of recycling ships

The way and method is different in developed than the developing countries. Both start with a quotation for which the highest contract will win for how many dollars per ton and not as good for the environmental legislation. Then the ship is taken to the scraping location either under its own power or with the use of tugs.

There are two famous ways of methods for preparing the ship for recycling which are beaching and Dry-docking. In developing countries and mainly in Indian region, ships are run ashore on gently sloping sandy tidal beaches at high tide so labors can be accessed for disassembly. While in European Union nations they use slipway or docking method other than Beaching and that because of strict environment regulations.

Beaching methods is successful for the area that has a very high tidal variation. As at high tide ship with its full thrust is allowed to approach for the shore of the recycling yard or can be pulled by winches if the ship has no propulsion or thrust. Sometimes winches are also used to pull ships further more inside even if the ship operating by its propulsion. After that ships anchor is dropped to steady the ship and the engine is shut down.

At high tide and when the water recedes, the ship settles down and dismantling began manually from top to bottom symmetrically. It takes about three months to break down a handy sized cargo vessel for about 40,000 tones with around 50 laborers working in that process. While in the other method they mostly use either at afloat or at dry-dock for safe recycling of ships and it consider as environment friendly than beaching method.

Fig (1): Beaching methods on the developing countries, Source: Bacigalupi, November 2016

In developed countries the dismantling process done with Recycling rates of 98% achieved and reflects the technical guidelines for the environmentally management that published by Basel Convention in 2003 which demands that all yards must have separate hazardous, non-hazardous waste and appropriate storage units that must be done before dismantling.(Gwin,2016)

Moreover before dismantling an inventory of dangerous substances should be compiled and all hazardous materials and liquids such as bilge water must be removed. The Holes should be bored for ventilation and all flammable vapours should be extracted.

Vessels which are taken to a dry dock or a pier is considered more environmentally friendly and that due to most of the spillage is contained and can be easily for cleaned up. The propeller is removed beforehand to allow the water-craft to be moved into discharge facilities and that can stop an overflow of toxic liquid into the waterways. Ship cut down using saws, grinders, abrasive cutting wheels and gas torches.

A ship recycling yard which are follow the beaching method or dry-docking is as an open space that will exposed the materials which are result from recycling. Recycling yards in China employ afloat method and are being able to capture maximum market share of ship recycling industry. A large number of items generated from ship recycling yard can be directly utilized by bare minimum value such as anchors, chain, wires, pulley, iron and steel items, steel, glass containers, etc.

The advantage of beaching method is not only in saving cost but also offer a smooth facilitates for recycling while in the Afloat method have some technical difficulty as for example balancing the ship parts and maintaining gravity in all the time of the process. Also the waste water generated from hot work will directly find its way into the sea while in afloat method wastes are make their way into the basin of the port if they are not carefully dealt with. The beaching method has more amount of control that can be exercised during cutting operations while it is advisable to create more infrastructures.

3-Uses of recycled items

The dismantling by Beaching methods in developing countries it begins with draining of fuel and liquid of firefighting which is sold to the trade while the reusable items as electric wiring, furniture and machinery are sent to local markets. The unwanted materials become inputs to their relevant waste streams as for example the toxic insulation is usually burnt off copper wire to access the metal.

A ship has several cargo handling equipments on board and those items need not be recycled fully. They would need to be refurbished and repaired to extend their operation life and performance. The material handling equipments such as cranes, cargo gears, davits, pulleys, etc can be used for wide range of applications both in marine and non-marine sector.

Pieces of the hull simply fall off and are dragged inland with a winch or bulldozer then cutting into smaller pieces away from the coast where about 90% of the steel is re-rollable scrap while higher quality plates that are heated and reused as reinforcement bar for construction. The rest is melted down for re-rolling in electric arc furnaces or mills in a steel plate shape. (Gwin, 2014)

Furthermore items extracted from ship at the time of recycling could be used in existing ship and that because of that the marine equipments are highly robust and have a very long lifespan. Many shipping companies lead to be depending on these equipments from ship recycling yard and that will be due to immediate availability with lower cost of acquisition and sometimes lower downtime. Items generated from ship recycling yard can be reduced a large extent and save more time consuming and costly. Items in the engine room are most preferred items looked for by ship repair yards and for the shipping companies as replacement in their own ship or as spare parts.

Recyclable materials which obtained from ships are classified **as shown in Table 1**.

As a result the ship operation is in a very harsh weather condition so all items on board a ship are very robust and have a longer lifespan. Due to this, the demand for such items from the consumer industry is very high and sometimes they are sold in the open market at a premium compared to the existing items locally made.

Material Type	Destination
Metals (ferreous /non-ferreous)	Recycle
Non-hazardous waste	Municipal landfill
Chemicals and paints	Energy generation
Bunker/Oils/Slops	Energy generation
Electronics and batteries	Recycle
Asbestos and toxic waste	Industrial landfill
Equipment	Re-use/sale

Table1. Type of waste from ships

Source: Metin, 2013

4-Hazards of ship-breaking industry:

Generally the hazards which are related connected to ship breaking are dividing into two categories; the first one is intoxication by hazardous substances and the accidents that happened during the process. The intoxication ship breaking industry has some problems that impact and create environmental pollution with a lot of health and human hazards. Explosions of available gas and smoke in the tanks are the major reason of accidents in the yards. The second one is the accident of staff falling from the vessels high as they are operational with no security harness.

Also the size and function of ships play a main role as represent a huge amount of ton for waste, asbestos and thousand litters of oils resources that defined as unsafe waste organization practice and a threat for both public health and marine environment. Asbestos as a heat insulators found in disposal procedure while during dismantling the labors are surrounded by is very harmful and may cause death through cancer.

Persistent Organic Pollutants (POP's) Persistent Organic Pollutants are harmful for the environment, population and wildlife. It is a highly toxic and remains for a long time where it is a widely distributed biologically and accumulates in a fat tissue of living organism and can cause adverse effects on human body and also increased cancer probability.

Oil residues are much harmful for the environment and marine life and it may cause serious damages in different ways and reason of death for fishes, mollusks, mammals, crabs and other water organisms. The toxic concentration of ammonia in marine organism is found with a huge floatable materials is also causes bird reduction in coastal areas.

5-International Structure under UNEP, IMO, ILO

The International Labour Organization (ILO), the United Nations Environment Program (UNEP) and the International Maritime Organization (IMO) have provided regulation and provide guidance regarding environmental and labour conditions in ship breaking.

The United Nations Environmental Program (UNEP) adopted the Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal in 1992 following numerous hazardous waste trafficking scandals in the late 1980s.

5.1-Basel Convention

The Basel Convention with ratified by 166 countries is set a requirements for Control of Trans boundary movements of hazardous wastes and their Disposal wastes for the environmentally. The Convention also combines several concepts to protect and minimize hazardous to human health and the dangers hazardous from waste.

The Basel Convention aims to stop the transportation of dangerous substances and remains the only international regulations that protect developing countries from the dumping of toxic wastes exported from industrialized countries. In 1995 the Basel Convention adopted an amendment for prohibition export of wastes intended for recovery and recycling to developing countries while on the European level the amendment has been incorporated into the European waste shipment Regulation (WSR) which means that EU Member States are not allowed to export hazardous wastes to developing countries.

In 2002, the Basel Convention adopted the Technical Guidelines for the (ESM) which is state for Environmentally Sound Management for a Full or Partial Dismantling of Ships with a document for countries that already has or establishing ship dismantling facilities. The Guidelines provide

information and recommendations on procedures that must be implemented for achieving safe and environmentally in ship dismantling.

In 2007, Basel Convention launched the Global Program for Sustainable Ship Recycling in order to encourage collaboration in health and safety and environmental conditions and also offered a variety of technical method for beaching which can be a guidance to make ship breaking yards more compliant.

5.2-Hong Kong Convention

The Hong Kong Convention was adopted in May 2009 with few countries signing for that agreement. The Hong Kong Convention is for allows ships to be exported for recycling as long as various conditions are meet with an inventory for all water craft and every shipyard needs to publish a recycling plan to protect the environment.

Guidelines supporting the Convention have recently been developed by the IMO while the Hong Kong Convention is not expected to enter into force before many years unless flag states, ship owners and ship recyclers can struggle for an early compliance. The preparation of Inventory for Hazardous Materials (IHM) are one of the main item which is in most of cases not provide by ship owners for safe handling, storage and disposal of all hazardous materials present on board ships while Ship Recycling Plan for recycling yards is missing in many recycling yards.(Kanwar, 2013)

The Hong Kong Convention does not provide an equivalent level of protection for developing countries from hazardous waste coming from industrialized countries and does not rule out the beaching method as non-compliant as for so far Chinese recycling yards are awaiting and complain.

The Convention comprises requirements for ships having an (IHM) prior to recycling and for ship recycling facilities to have reporting requirements authorized by the authorities. Also the facilities are required to implement a Ship Recycling Plan (SRFP) that covers worker safety and training, protection of human health and the environment, roles and responsibilities of personnel, emergency response, and systems for monitoring, reporting and records.

5.3-The European Union (EU) Regulation on Ship Recycling

In March 2012 the European Commission proposed strong regulations to ensure that if a vessel has a European flag it must be disposed of in a shipyard on a European Union (EU) green list and the facilities must be compliant and regulated internationally.

In June 2013, the European Union agreed on a new Ship Recycling Regulation and will be applicable between 2016 and 2019. The regulation applies on large number of vessels flying the flag of EU Member. The objective of the Regulation is to reduce the negative impacts from the recycling of EU-flagged ships and considered as an early implementation of the Hong Kong Convention.

The Regulation sets a number of requirements for the facilities to recycle European ships and requirements stricter than Hong Kong Convention while beaching facilities will not be able to meet them. Ship owners will have to ensure that each ship prepared for recycling provide by the necessary information for the recycling facility, also provide with an updated IHM, and minimise the amount of cargo residues, remaining fuel oil and generated wastes remaining on board. Finally, they will have to provide ready for recycling certificate.

It is important to Basel Convention to be apply for ships less than 500 GWT, government and territory ships and that because they are barred from the Hong Kong regime. therefore the Waste Shipment Regulation (Basel) and the future Ship Recycling Regulation (Hong Kong) will apply in the EU and will not be applicable to the same ship at the same time.

6-Global perspective

The global ship breaking industry scrapes more than thousand large oceangoing vessels in different types annually. Almost all ship recycling activities done in five countries which are India, Bangladesh, Pakistan, China, and Turkey and at present, South Asia is the global centre for shipbreaking.

A 68% of these vessels were broken in South Asian yards where China attracted 17% of the ship recycling market whereas Turkey covered 12%. Around 3% recycled somewhere else and The EU represented 2.2%. (Kanwar, 2013)

Table 2 show when each Convention and associated EU legislation will apply:

Hong Kong Convention Application (future Ship Recycling Regulation)	Basel Convention (OECD Decision) Application (Waste Shipment Regulation)
a. Ships flying EU flag located anywhere in the world	a. Ships containing hazardous materials flying EU flag less that 500 GWT
	b. Government ships of an EU country containing hazardous materials
	c. Ships containing hazardous materials of any flag or size in a port or territorial waters of an EU country when its intent to be disposed is known (hazardous waste under Basel)

Source: NGO, November2012

The growth of the shipbreaking sector in South Asia is linked to the growing demand for steel and depending on local and global steel prices. The scrap steel recovered in the shipbreaking yards is sold on the domestic markets and can also be re-exported to the European Union. The main reason for the current global distribution of shipbreaking is related to low labour and compliance costs for environmental protection, hazardous waste management and workers' health and safety in South Asia.

A number of factors have led to increase the number of vessels dismantled every year. One of the main factors is single hull oil tankers, which is to be completed by 2015. Also ship owners modernize their fleets in order to comply with environmental standards and to increase the operating efficiency.

7-Green Ship Design and Building

EU not allowed the ships to derogate from Basel Convention, veto obligations, commitments and can be directed to the EU List of green ship recyclers if fall under administration. The new built ships that do not contain hazardous wastes upon arrival in the ship recycling state have the exception of readily removable residual oils, fuels, and safety equipment necessary to make a final voyage, and will be allowed to be received in non-OECD/EU green facilities.

All ships carrying hazardous materials that would qualify as hazardous waste under Basel must only be allowed to be received in OECD/EU located recyclers on the EU List as set forth in Art.12 of the Commission Proposal.

The European List divides into two sub-lists:

List A: OECD/EU green ship recycling and pre-cleaning facilities authorized to handle hazardous ships and non-hazardous ships.

List B: non-OECD/EU green ship recycling and pre-cleaning facilities authorized by EU to handle non-hazardous ships.(NGO,2012)

The Government with the relevant provincial authorities should develop and implement a "Green Ship Recycling Strategy" to allow the needed transition towards clean and safe ship recycling compliant with international and domestic law and based on guidance offered by the Basel Convention Secretariat, the ILO and the IMO.

8-Conclusion and Recommendations

The convention for ship re-cycling has not yet been implemented while the re-cycling process can assist in reducing the waste and lower the principle cost of a ship. In order to make ship recycling clean and safe globally, all parties including governments in ship-owning, ship recycling states and their service providers need to ensure that their end-of-life vessels are pre-cleaned to the extent possible and hold a proper IHM as a basis for a ship recycling plan.

Difficulties and problems encountered in shipbreaking industry Due to its intrinsic nature and associated environmental concerns there are only a few countries in the world which are engaged in shipbreaking sector.

The Hong Kong International Convention on the Safe and Environmentally Sound Recycling of Ships (Ship Recycling Convention), adopted on May 2009 and there are some interim measures are imperative until the early implementation of the convention becomes effective.

Workers in shipbuilding industry need to demand clean and safe recycling and prevent ship dismantling at locations with substandard environmental protection and to encourage

recipient countries to create environmental regulations and improvement workers rights, health and safety and living conditions.

Relevant authorities should develop and implement a "Green Ship Recycling Strategy" with international and domestic law based on guidance of Conventions and to monitor the implementation.

Reference

Bacigalupi, Paolo, November, 2016, Ship breaker novel.

Imrul Jobaid, Moniruzzaman Khan, A.K.M Kamrul Haque, Istiaque Ahmed Shawon. Oct. 2014, Ship Recycling and Its Environmental Impact: A Brief Overview of Bangladesh, IOSR Journal of Business and Management (IOSR-JBM).Volume 16, Issue 10.Ver. I, PP 31-37.

Gwin, Peter (May 2014)."The Ship Breakers".ngm.nationalgeographic.com .National Geographic Society. Retrieved 2015-08-03.

Kanwar Muhammad, Javed Iqbal, Patrizia Heidegger.Brussels / Islamabad October (2013) Pakistan Shipbreaking Outlook:

The Way Forward for a Green Ship Recycling Industry – Environmental, Health and Safety Conditions 1st Edition

Metin Taylan. Spoudai, Journal of Economics and Business, (2013) an Insight into Ship Recycling: Facts and Figures, Vol. 63, Issue 3-4, pp. 5-14

Nanda Gopal K. Reddy and N.Manoharan. Indian Journal of Science and Technology, October 2014.Ship Recycling: An Important Mile Stone for India Vol. 7(S6), 15–21,

Naser G, Unsalan D, Tekigul N, Stuer-Lauridsen F. (2008), the ship breaking industry in Turkey: Environmental, safety and health issues, J. Cleaner Production, Vol. 16, No. , pp.350-358.Shipbuilders' association of Japan, (2011): Shipbuilding Statistics.

NGO, 12 November2012, Shipbreaking Platform and Greenpeace Position on the European Commission Proposal for a Regulation of the European Parliament and of the Council on Ship Recycling (COM 2012/118) a principled and practical solution for ship recycling

Stuer-Lauridsen, F. Jensen, M. P., Odgaard, Th., Husum, H., Olsen, D. and Ringgaard, K. W.,
(June 2007). Ship Dismantling and Pre-cleaning of Ships, Final Report, and European Commission Directorate General Environment.

Ship dismantling record, (20160.list of ships dismantled worldwide in 2016

LIST OF ABBREVIATION

ESM: Environmentally Sound Management
EU: European Union
IHM: Inventory Hazardous Materials
ILO: International Labour Organization
IMO: International Maritime Organization
OECD: Organisation Economic Co-operation Development
PIC: Prior Informed Consent
POP: persistent Organic Pollutants
UNEP: United Nations Environment Program

Integrated MOB search and rescue system (IMOB - SARS) – An Overview

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Abstract

Man overboard (MOB) is defined a person who has fallen to the sea from a boat or a vessel in the water and needing to rescue; this person may be crew member of coast gourd, merchant ship or fisher. According to previous studies, international maritime conventions such as SOLAS, MLC, and STCW covered emergency procedures of MOB accident. There are two gaps; first, there is no any automatic systems needed to be onboard to detect MOB at the moment of falling overboard, where statistics illustrate that up to 75% of MOB finally died or missed due to nobody saw them at the moment of falling, especially if the ship steaming high speed. The second gap is that the smoke life buoy is not effective to rescue the victim due to ship's movement away from him, especially in the presence of white horse in rough sea, and if he doesn't wear life jacket. Therefore, drones equipped with smoke life buoy, GPS, and thermal camera will be effective more than traditional equipment.

The research discusses and analyses the extremely useful of implementation an integrated MOB rescue system onboard ship for monitoring, tracking and rescuing. These systems use an infrared human motion detector or wrest band which transmit signal for bridge receiver to give alarm once person fall in water; this is called automatic MOB detection system, ECDIS built-in SAR software and drones for quick response to arrive accurate position of victim. Research aims to improve rescue operation of MOB to reduce loss of life at sea, through the amendment of current international maritime convention related to MOB emergency procedures.

Keywords: Man overboard, MOB detection system, SAR operation software, SAR Drones,

1. Introduction

There are many risks of MOB accidents; the most important risk is the non-detection of the drowning at the moment of fall. Statistics showed that most of these accidents ended in drowning or missing, hens detecting device is required to give immediate alarmed on bridge. This problem has been discussed in a previous research paper by the author; it will be briefly mentioned in this research. It will also discuss new detecting technology **(**infrared human motion detector). Other hazards include drowning, hypothermia which can lead to death within 20 minutes in cold water and the loss of MOB between propeller wake, high waves, poor visibility and the speed of the ship, usually those who fell in the sea did not wear lifejacket causality in passenger ship. Using a marker life buoy is not adequate to save the drowning, also the delay time to prepare crew emergency team and rescue boat. Therefore, the MOB victim needs a quick response to rescue them. It is also possible to use the drones' technology to drop life buoy accurately and quickly to the MOB position. It can help in search and rescue operation if MOB lost, through an integrated system to detecting, planning, monitoring, and tracking and rescuing to avoid the risks mentioned above.

2. MOB Emergency procedures

Safety and emergency procedures within the conventions of IMO, international labor organization ILO, **and International Chamber Of Shipping (ICS)** and the last amendments of on SOLAS Chapter III / 17-1 "Recovery Of Persons From The Water" 2014 covers the a contingency plan in the event that someone falls overboard in the time of sight. The plan should take into account the particular characteristics of the ship, the life-saving equipment available, the size of the crew and risk assessment to prevent falling overboard, human errors, crew training and drills to identify the responsibilities of Master and crew during the recovery drills emergency procedures. there are no rules guiding such discuss the use of Integrated MOB rescue system if no body sow the victim at the moment of falling, by other mean These procedures are not effective unless MOB is detected immediately.(IMO, 2014)

3. Integrated MOB search and rescue system (IMOB - SARS)

The system is biased on three main components, MOB detection

system, and SAR operation software for ECDIS and SAR Drones

3.1. MOB detection system

3.1.1. MOB portable detection device

There are many types of MOB portable detection device used different technology, consists of a receiver in the ship's bridge, and a transmitter attached to the crew members such as a wristband or device fitted with life jacket. If MOB fall in the water, the transmitter transmits a signal generating alarm in bridge receiver. The signal can be marked and tracked by ECDIS. It can also be received by satellite and VHF frequencies according detection technology. The technology of this MOB detecting devices depend on different principles and models; the first is working in frequency 406 MHz and 121.5 MHz which is used to connect directly to rescue services through Cospas-Sarsat satellites and aircraft emergency frequency. Second, AIS technology can transmit accurate position. Third, working in DSC on VHF 70 can be used for alerting. Fourth, (IMCA, 2015), wireless sensor networks (WSNs) discovers the Position of a MOB and runs an alarm system on a ship if the victim becomes out of Newark range. (abdullah sevin , cuneyt bayilmis , 2016). There are other technologies that combines two available technologies, positioning by satellite navigation systems, and radio technologies communication is done on one of the common radio channels used at sea when a MOB falls the mobile unit which is separated automatically from the life jacket when it inflates on water impact, it starts transmitting its position to the central unit on the ship. The signal is plotted as a waypoint on the ships ECDIS. The signal is transmitted on an open radio channel so the MOB position can also be picked up by other ships. With a built-in GPS, it transmits an emergency (MOB) AIS-SART signal which triggers an alarm on all AIS enabled chart plotters / ECDIS within range mark position of the victim. The VHF AIS transmitter repeats the message and position several times per minute. This enables victim ship and all vessels within range to assist and rescue MOB. (IMCA, 2015)

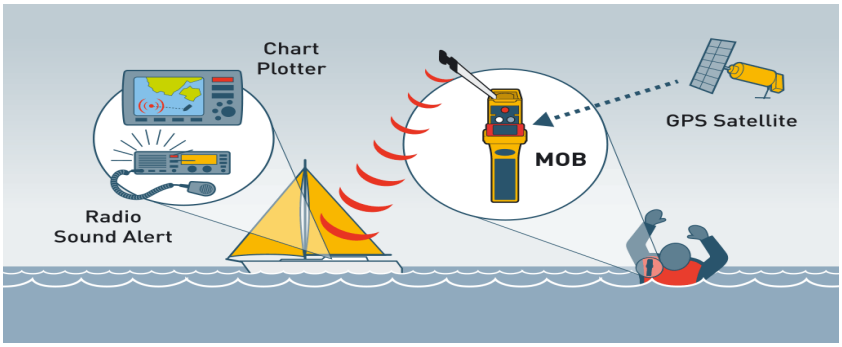

Figure 1: MOB portable detection detector (ocean signal, 2017)

3.1.2. Fixed MOB detection (infrared human motion detector)

The motion detector is not only used as intruder alarm but also used in many applications like border regions, port, security and home gourde automation system; the motion detector will detect the motion of the people and give the appropriate output according to the circuit. In general, motion detector uses different types of sensors like Passive infrared sensor (which will detect the motion of the person using the person body heat), microwave sensor (Microwave sensor will detect the motion of person by measuring the change in frequency from the produced beam), and ultrasonic sensor (It produces acoustic signals which will detect the motion of a person).As the human motion detector is already used in security systems, so it can be used to detect the MOB at the moment of falling into the sea. (Motion Detector Circuit, 2015)

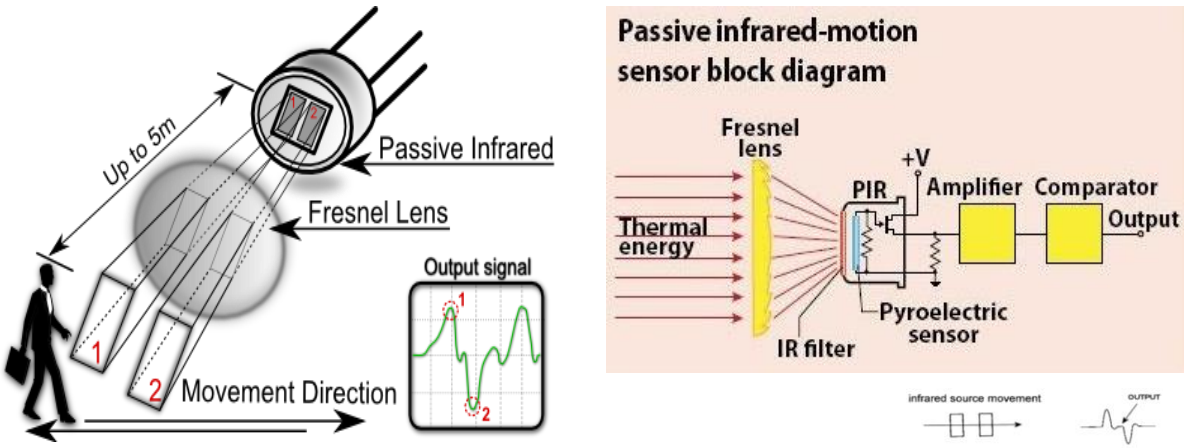

Figure 2: (PIR) sensor used in Infrared human motion detector (Salem toubasi, 2014)

Video camera software, with the proliferation of low-cost digital cameras able to record video, is possible to use the output of such a camera to detect motion (day and night) in its field of view using specific software. Many modern motion detectors use combinations of different technologies while combining multiple sensing technologies into one detector that can help reduce false alarm; for example, many dual-tech sensors combine both a PIR sensor and a microwave sensor into one unit.

The pyroelectric infrared (PIR) sensor has two slots; each slot is made of a special material that is sensitive to IR. When warm bodies like a human or animal passes in front of the sensor, intercepts with first slots, which causes a *positive differential* change between the two slots. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential **resistance** change**, leading to a voltage drop that produces a current that can generate audible and visual alarm.** (Jaeseok Yun, and Sang -Shin Lee, 2014)

Figure 3: Infrared human motion detector System Diagram. (Pure tech, 2015)

3.2. SAR operation software for ECDIS

There are many software packages designed for SAR operation which have several features; Identifying probable location of an accident or lost object, providing rapid predictions of the movement of drifting missing persons or vessels according IAMSAR manual, Storing home base locations of all available Search and Rescue Units using AIS tracking data and Determining search area management. It is also integrated with Environmental Data as weather and oceanographic details which can be displayed on the ECDIS screen (SARMAP, 2017).

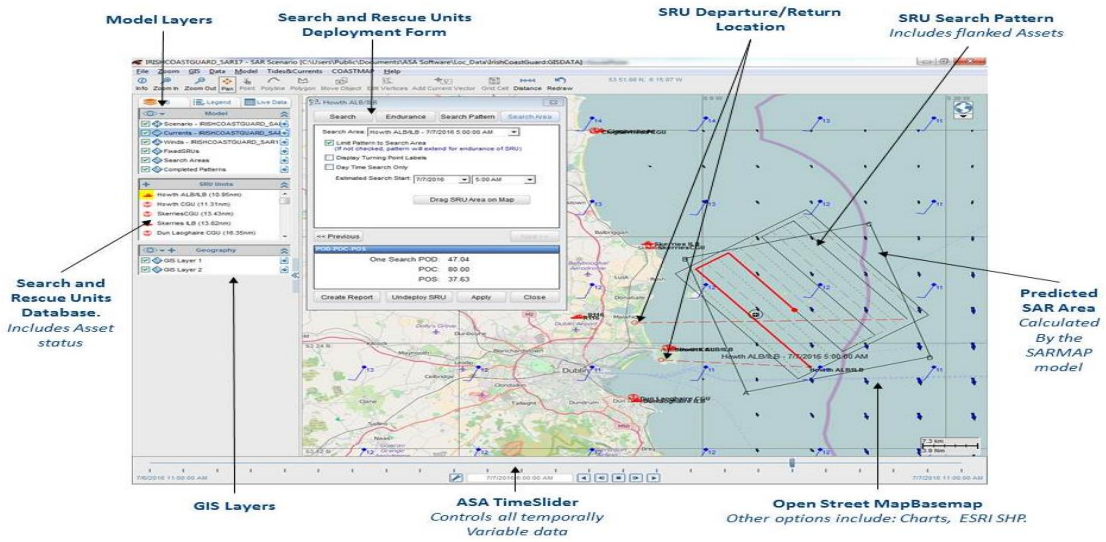

Figure 4: SAR software on ECDIS screen. (SARMAP, 2017)

3.3. SAR Drones

Unmanned aircraft are commonly called unmanned aerial vehicles (UAVs), when it is combined with ground control stations and data links Unmanned Aerial Systems UAS. UAV or UAS have different types (autonomously or remotely piloted) and sizes according to its uses. Small type (limited range) are called drones, these researches recommend using drones to avoid security and privacy problem. The drone can be operated by radio remote control and eight-rotor machine. It is equipped with GPS, IR camera, flight computer**,** lifebuoy and search light. Nowadays drones became advanced and already have a lot of civilian and commercial propose as humanitarian relief operations such as Haiti Hurricane Sandy at 2012, Balkans flooding at 2014 country and Philippines Typhoon Haiyan 2013.The advantage of drone is that it can reach and cover a large area within a short time with quick response because it does not need to pilot and work in difficult atmosphere, dangerous environments for long hours for the survivors rapidly until the arrival of rescue units as well as it can be used to Collect data after marine accident and monitoring the body temperature of survivors at sea by thermal cameras, but it may be used in penetrate of security privacy and spyware. Role of IMO and ICAO for developing of SAR drones through national and international regulations and training also can overcome disadvantages through international cooperation. (S. P.Yeong, L.M.King,S.S. Dol, 2015)

Figure 5 : drone drop life buoy directly over MOB. (Chris Anderson, 2013)

4. MOB Rescue Scenario by (IMOB - SARS)

When person fall in the water and MOB detection system alert alarm, the Initial action by SAR drone drop a lifebuoy to the victim at the same time start Maneuvering to clear MOB away from propeller and also ECDIS Automatically Marking man-overboard position and computing all SAR operation calculation, then commence all MOB Emergency procedures according SOLAS and IAMSAR as per figure (6). During the rescue period MOB position and temperature can be tracked and monitored till the recovery operation of the person in the water end.

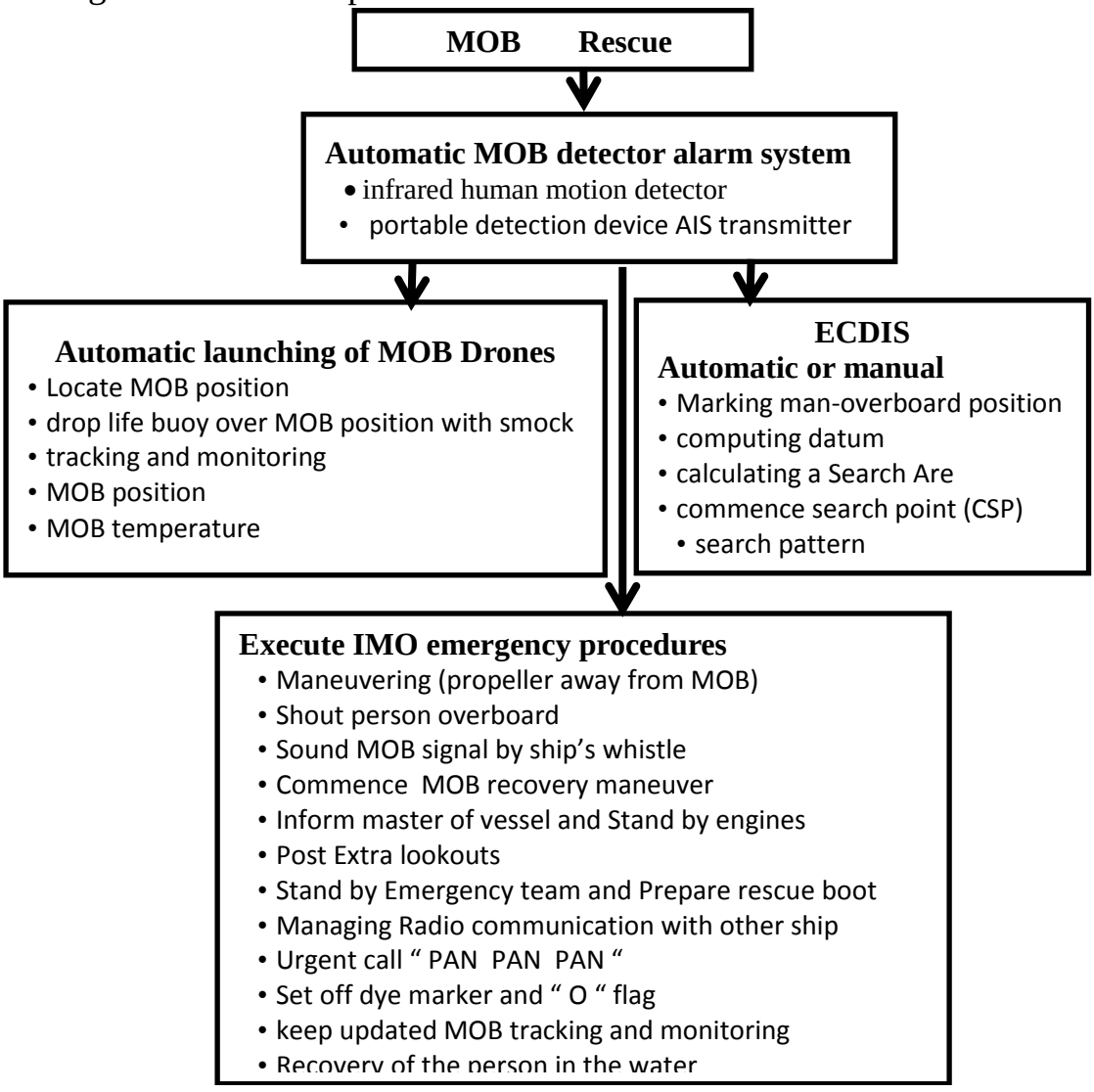

Figure 6 : MOB Rescue Scenario (author, 2017)

4.1. **Detecting system**

Advanced detection system based on the theory of human motion detection by using IR waves which consists of thermal cameras and pyro electric Infrared sensors (PIR), covering all sides of the ship, bow and stern of the ship. These sensors divided the ship sides to area (A) on board and area (B) at sea.

If crew member moved from area (A) to area (B) and fell overboard the detecting system gives audible and visual alarm in the bridge identifying the place of falling and also automatically mark MOB position in ECDIS to start real-time tracking using wind and currents to calculate drift.

Figure 7 : Infrared human motion detector.(Pure tech, 2015)

4.2. Drones

The drone is equipped with GPS and IR camera which is designed to respond automatically, when detecting MOB alarm alerted it drop life buoy directly over the victim accurate position by the new model which can carry three life buoys. It can also Track monitoring the victim through real time IR camera. If the victim goes out of sight, the drone can perform the appropriate search pattern.

4.3. ECDIS

By using special software, ECDIS can mark MOB position manually or automatically in ECDIS screen after detecting MOB Position immediately. Due to prevailing wind and current all SAR calculation according to IAMSAR can be determined in very short time.

5. Conclusion

The contribution of applying MOB detection system make passenger and crew member become safer. ECDIS - SAR software can mark MOB position in screen and perform all SAR calculation according to IAMSAR. There are some advantages and

disadvantages, obvious that an unmanned aircraft should be ideal for MOB Rescue operation, drones can perform all SAR missions also save time and costs, at the same time it may be used in penetrate of security. All previous action can be done in parallel time.

6. Recommendation

IMO needs to adapt developing an Integrated MOB search and rescue system and determine the following:

The utilization technical requirements for MOB detection system to cover all boundary of the vessel and SAR software for ECDIS

- Technical requirements of drones (size, endurance, altitude, flight hours, range, releasing device to drop lifebuoy, communication, thermo-graphic camera)
- Adapt new legislation for drones safety, security and operator training.

7. Future research

Prepare a feasibility study for the possibility of insert this system in SOLAS amendments.

Reference

- Abdullah sevin, cuneyt bayilmis, 2016 "Design and implementation of a man-overboard emergency discovery system based on wireless sensor networks" available at: http://journals.tubitak.gov.tr/elektrik/ accessed at (14th June 2017).
- Chris Anderson, 2013, Rescue drone drops life preservers" Available at: http://diydrones.com/profiles/blogs/rescue-drone-drops-life-preservers# . Accessed at (14th June 2017)
- IMCA, 2015, "Research on Personal Locator Beacons "available at: http://www.wfesafety.com/downloads/3442%5E, accessed at (11th July 2017)
- Julian Turner, 2015"Sound the alarm: should man overboard detection be fitted on cruise ships" available at: http://www.ship-technology.com/features/featuresound-the-alarm-should-man-overboard-detection-tech-be-fitted-on-cruise-ships-4583685/,accessed (11thJuly 2017)
- Kaseko Yun, and Sang-Shin Lee, 2014, "Human Movement Detection and Identification Using Pyroelectric Infrared Sensors", 2014, available at: http://www.mdpi.com/1424-8220/14/5/8057 accessed at (14th June 2017).
- "MOB detection" Available at: http://www.puretechsystems.com/man-overboard-detection.html Accessed at (14th June 2017).
- Motion Detector Circuit, 2015, "Motion Detector Circuit" cruise ships" available at:

http://www.electronicshub.org/motion-detector-circuit/ accessed at (11th July 2017)

- Navigation Dynamics, 2017."Search & Rescue - Sector Search "Available at: http://www.navdynamic.com.au/p_navigator-search-rescue-sector.html. Accessed at (14th June 2017)
- Ocean signal, 2017, "personal locating AIS Man Over Board device with integrated DSC" available at: http://oceansignal.com/products/mob1/ accessed at (14th July 2017)
- *Salem toubasi,2014"Motion Detector Alarm Project"* Available at: https://twinschip.com/index.php?route=pavblog/blog&id=41.Accessed at (14th June 2017).
- SARMAP, 2017. "Search and Rescue Model and Response System" Available at: http://www.asascience.com/software/sarmap/. Accessed at (14th June 2017)

S. P.Yeong, L.M. King, S. S. Dol, 2015, "A Review on Marine Search and Rescue Operations Using Unmanned Aerial Vehicles" International Journal of Mechanical, Aerospace, Industrial, Mechatronic and Manufacturing Engineering Vol:9, No:2, 2015