

FACTORS AFFECTING SAFE NAVIGATION AND THEIR IMPACTS IN PORT
AREA

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*In the name of Allah, The Most Gracious, The Most Merciful.
To my beloved wife, mother, father, sisters and brothers..*

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In the Name of Allah, The Most Gracious, The Most Merciful.

Praise be to Allah the owner of the World and blessing be upon Prophet Muhammad SAW, his family members, friends and those who follow them until the Day of Judgement.

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May Allah bless us together.

ABSTRACT

Navigation system is designed to guide and control vessel systematically to avoid accident. Navigation system disorder can lead to maritime accidents such as collision, grounding and stranding which could result in significant losses in terms of damage, oil pollution, loss of life and financial losses. As a result, improvement to safety of navigation in ports is increasingly addressed by society, particularly local authorities. This study was conducted to explore the influences of potential factors to the safety of navigation and its impact in port. It has been carried out involving 100 respondents from Johor Port and Port of Tanjung Pelepas. The respondents involved are vessel captain, pilot, and towing captain. Data were collected using questionnaires and were analysed using SPSS program for Win XP. The methods of analysis used in this study are descriptive and inferential. Descriptive analysis is used to determine the safety factors and their impacts, Pearson Correlation method is used to check correlations between factors and impacts, and Analysis of Variance (ANOVA) is used to check dependency of means between groups of respondents. The respondents agree that main factors affecting safe navigation in port are environment, vessel and navigational aid (mean of 1.80, 2.01 and 1.86 respectively), while the failure of navigation in port will contribute to the significant impact to port operations and losses (mean of 1.85 and 2.03 respectively). There are significant correlations between factors and impacts where average r^2 -value is 0.569 between factors elements, 0.503 between impacts elements, and 0.745 between factors and impacts. The result also proved that the answer selection by respondents is not influenced by their working position and experience, where overall p-value is above 0.05.

ABSTRAK

Sistem navigasi adalah perlu untuk memandu dan mengawal kapal secara sistematis bagi mengelakkan kemalangan. Kegagalan sistem navigasi boleh menyebabkan berlakunya kemalangan maritim seperti pelanggaran, terdampar dan terkandas yang mana akan menyebabkan kerugian yang besar sama ada kerosakan, pencemaran, kehilangan nyawa mahupun kerugian kewangan. Oleh sebab itu, penambahbaikan bagi keselamatan navigasi di pelabuhan semakin ditangani masyarakat terutamanya pihak berkuasa tempatan. Kajian ini dijalankan bagi mengkaji pengaruh faktor-faktor berpotensi terhadap keselamatan navigasi dan kesan-kesannya di pelabuhan. Ia telah dijalankan dengan penglibatan seramai 100 orang responden daripada Pelabuhan Johor dan Pelabuhan Tanjung Pelepas. Responden yang terlibat adalah nakhoda kapal, pilot, dan nakhoda kapal penunda. Data dikumpul menggunakan borang selidik dan dianalisis menggunakan perisian SPSS untuk Win XP. Kaedah analisis yang digunakan dalam kajian ini adalah deskriptif dan inferensi. Analisis deskriptif digunakan untuk menentukan faktor keselamatan dan kesannya, Korelasi Pearson pula digunakan untuk membuktikan korelasi di antara faktor dan kesan, dan analisis varians (ANOVA) digunakan untuk menentukan kebergantungan min di antara kumpulan responden. Responden setuju bahawa faktor utama yang mempengaruhi keselamatan navigasi di pelabuhan adalah elemen persekitaran, kapal dan alat bantu navigasi (nilai min masing-masing 1.80, 2.01 dan 1.86), manakala kegagalan navigasi di pelabuhan pula akan menyumbang kepada kesan yang ketara terhadap operasi pelabuhan dan kerugian (nilai min masing-masing 1.85 dan 2.03). Terdapat korelasi yang ketara di antara faktor dan kesan di mana nilai r^2 ialah 0.569 bagi antara faktor, 0.503 bagi antara kesan, dan 0.745 bagi antara faktor dan kesan. Hasil kajian juga membuktikan bahawa pemilihan jawapan oleh responden adalah tidak dipengaruhi oleh pekerjaan dan pengalaman mereka, di mana nilai p keseluruhan adalah melebihi 0.05.

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LIST OF ABBREVIATIONS

AIS	-	Automatic Identification Systems
ANOVA	-	Analysis of Variance
ARPA	-	Automatic Radar Plotting Aid
ATON	-	Aid to Navigation
COLREG	-	Collision Regulations
DWT	-	Deadweight Tonnage
ECDIS	-	Electronic Chart Display and Information Systems
ECS	-	Electronic Chart Systems
EMSA	-	European Maritime Safety Agency
EU	-	European Union
FSC	-	Flag State Control
FSC	-	Flag State Control
FTZ	-	Free trade Zone
GMDSS	-	The Global Maritime Distress Safety System
GRT	-	Gross Registered Tonnage
IAIN	-	International Association of Institutes of Navigation
IMO	-	International Maritime Organisation
LBP	-	Length between Perpendiculars
MIDAS	-	Maritime Industrial Development Area Scheme
MOU	-	Memorandum of Understanding
PTP	-	Port of Tanjung Pelepas
SAR	-	Search and Rescue
SOLAS	-	The International Convention for the Safety of Life at Sea

SPSS	-	Statistical Package for Social Science
SRS	-	Ship Reporting Systems
STCW	-	Convention on Standards of Training, Certification and Watchkeeping for Seafarers
STRAITREP	-	Ship Reporting System in the Straits of Malacca and Singapore
TCD	-	Turning Circle Diameter
TEU	-	Twenty Foot Equivalent Units
TSS	-	Traffic Separation Schemes
UN	-	United Nation
UNCLOS	-	The United Nations Convention on the Law of the Sea
VHF	-	Very High Frequency
VLCC	-	Very Large Crude Container
VTMS	-	Vessel Traffic Management System
VTS	-	Vessel Traffic Service

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Maritime freight transport has experienced strong growth and profound changes over recent decades. Freight volumes and container traffic in particular have grown with the intensification of global trade and the geographical dispersion of production. The industrial organization of the sector has evolved rapidly.

The rapid expansion of trade has led to fast growth of throughput in many ports. As a result, in many large gateway ports, local communities are increasingly concerned about the negative impacts of port activities, including local pollution and high traffic volume.

Ports only have a limited amount of dockage, and only so many cargo or container cranes. Vehicles that have been moved by ship can only be driven off so fast, and it takes time to do this. Ships usually have to "wait in line" to get to the cranes or the pier because there is a high demand on the limited resources of a port. The high traffic volume can lead to unsafe navigation or navigational failure.

The Lloyd's Register of Shipping Casualty Returns for 1958, the year before the IMO Assembly met for the first time, showed that 16 per cent of the merchant shipping tonnage lost that year (56,000 gt) resulted from collisions and a further 32 per cent (115,000 gt) from groundings or striking wrecks. The vast majority of these casualties, nearly half the total for that year, were thus caused or contributed to by navigational error or deficiency. This proportion was by no means uncommon and indeed many of the worst disasters in shipping history have resulted from collisions and other accidents which can be attributed to navigational errors.

Safety of navigation in port has become an important issue since then. The common maritime accidents to happen due to navigational error are collision, contact or impact between ships with other surface object, grounding and stranding, foundering and flooding, hull and machinery failure, fire and explosion and other miscellaneous. The consequences due to these accidents can be devastating which can cause pollution, economic loss and injury and loss of life.

Over the past two decades, the public reaction to a number of environmental pollution incidents caused by shipping casualties have led to a greater demand for more monitoring of shipping navigation, especially in port. The demands for information from port authorities in regard to ships navigating off their port are increasing with the new emphasis on security and these extra demands must be managed for safe navigation. The situations come worse when the ship rapidly increase over the world every year.

There are many factors which contribute to the accidents risk but, in addition to addressing the safety on navigation system, more effective study and research could play an important role in reducing the accidents risk. Some navigation systems and formulas need to be build base on the parameters of navigation.

In the designing the safety navigation system, many aspect need to be considered especially local port design and early system implemented. Some system like pilotage, towage and equipment implemented for lower accident risk was result in slower port

process. The human factor, including the operation and effect of the technology, should also be taken into account. Therefore an optimization approach is developed to reduce accident risk at port. But higher cost system not usually result for lower accidents risk. What is the parameter that has large influence on ship accidents in port?

With this study entitled 'Factors Affecting Safe Navigation and Their Impacts in Port Area' hopes to find a better solution to that matter above with proper management and system to increase the safety of navigation in port.

1.2 Problem Statements

In port, there are many ships processes involve like charging or discharging process, bunkering, arriving or departing from the port, waiting and so on. These processes are potentially contributed to the accidents when there is no some safety system. Proper navigational system and management will reduce the problems stated thus giving benefits to both ship operator and port operator. In the other hand, the verification of the navigation problem due to the congestion level at port will help port authority and ship master to plan a better navigational management. Identifying factors affecting safe navigation is very important in order to create navigational safety system as well as to reduce navigational error.

1.3 Objectives of the Project

- i) To determine the factors affecting safe navigation in port.
- ii) To determine impacts of unsafe navigation in port.

1.4 Scopes of the Study

This project will be carried out under these scopes;

- i) Study about safe navigation for ship in restricted area especially in port which has more constraints.
- ii) Identify possible factors affecting safe navigation in port.
- iii) Identify possible impacts of unsafe navigation in port.
- iv) Verify all elements using statistical method.
- v) Test the validity by getting verification from experts.

1.5 Research Questions

Accordingly, the questions that will be studied in more detail in this research are as follows:

- i) What are the domains and dominant factors affecting safe navigation in port?
- ii) What are the domains and dominant impacts of unsafe navigation in port?
- iii) Is there a significant difference in the selection of answer by working position and working experience in maritime field?
- iv) Is there a significant correlation between factors affecting safe navigation in port and impacts of unsafe navigation in port?

1.6 Research Importance

The study conducted is to get clear information whether safety for vessel navigation in port is influenced by many factors. This also has to consider the impacts of unsafe navigation in port like grounding, capsizing, contact, damage, injury, schedule delay and so on. In addition, this study will be used as a guide for port authority to build or implement new system regarding port safety. This study also has some interest as follows:

- i) To help port authority develop safety navigation system in port.
- ii) To create awareness to vessel master and port authority about factors of safe navigation and its impact.
- iii) To provide information to academicians about most factors that contribute to the safe navigation in port.

1.7 Research Hypotheses

To be more focused on the objectives, research hypothesis is needed. Some hypotheses are made to test every variable.

H₀₁: Water current is not a factor affecting safe navigation in port.

H₀₂: Wind speed is not a factor affecting safe navigation in port.

H₀₃: Wave height is not a factor affecting safe navigation in port.

H₀₄: Low visibility is not a factor affecting safe navigation in port.

H₀₅: Narrowness of area is not a factor affecting safe navigation in port.

H₀₆: Depth of water is not a factor affecting safe navigation in port.

H₀₇: Water tidal is not a factor affecting safe navigation in port.

H₀₈: Other port activity is not a factor affecting safe navigation in port.

H₀₉: Number of vessel is not a factor affecting safe navigation in port.

H₀₁₀: Distance between vessels is not a factor affecting safe navigation in port.

H₀₁₁: Vessel size is not a factor affecting safe navigation in port.

H₀₁₂: Loading condition of vessel is not a factor affecting safe navigation in port.

H₀₁₃: Ballast condition of vessel is not a factor affecting safe navigation in port.

H_{O14}: Vessel turning circle is not a factor affecting safe navigation in port.

H_{O15}: Draught of vessel is not a factor affecting safe navigation in port.

H_{O16}: Speed of vessel is not a factor affecting safe navigation in port.

H_{O17}: Pilot on board is not a factor affecting safe navigation in port.

H_{O18}: Experience of vessel captain is not a factor affecting safe navigation in port.

H_{O19}: Towing is not a factor affecting safe navigation in port.

H_{O20}: Buoy is not a factor affecting safe navigation in port.

H_{O21}: Radar is not a factor affecting safe navigation in port.

H_{O22}: Pilot experience is not a factor affecting safe navigation in port.

H_{O23}: Number of tugboat is not a factor affecting safe navigation in port.

H_{O24}: Continuous communication is not a factor affecting safe navigation in port.

H_{O25}: Port schedule delay is not an impact of unsafe navigation in port.

H_{O26}: Transportation efficiency is not an impact of unsafe navigation in port.

H_{O27}: Port traffic is not an impact of unsafe navigation in port.

H_{O28}: Environment safety is not an impact of unsafe navigation in port.

H_{O29}: Access to the port is not an impact of unsafe navigation in port.

H_{O30}: Loading and unloading of cargo is not an impact of unsafe navigation in port.

H_{O31}: Berth availability is not an impact of unsafe navigation in port.

H_{O32}: Cargo handling process is not an impact of unsafe navigation in port.

H_{O33}: Capsize is not an impact of unsafe navigation in port.

H_{O34}: Fire is not an impact of unsafe navigation in port.

H_{O35}: Breakdown is not an impact of unsafe navigation in port.

H_{O36}: Grounding is not an impact of unsafe navigation in port.

H_{O37}: Threat marine life is not an impact of unsafe navigation in port.

H_{O38}: Fatality is not an impact of unsafe navigation in port.

H_{O39}: Injury is not an impact of unsafe navigation in port.

H_{O40}: Damage to port structure is not an impact of unsafe navigation in port.

H_{O41}: There is no significant difference to the environment related factors affecting safe navigation in port by working position in maritime field.

H_{O42}: There is no significant difference to the vessel related factors affecting safe navigation in port by working position in maritime field.

H_{O43}: There is no significant difference to the navigational aid related factors affecting safe navigation in port by working position in maritime field.

H_{O44}: There is no significant difference to the impacts of unsafe navigation in port to operation by working position in maritime field.

H_{O45}: There is no significant difference to the impacts of unsafe navigation in port to losses by working position in maritime field.

H_{O46}: There is no significant difference to the environment related factors affecting safe navigation in port by working experience in maritime field.

H_{O47}: There is no significant difference to the vessel related factors affecting safe navigation in port by working experience in maritime field.

H_{O48}: There is no significant difference to the navigational aid related factors affecting safe navigation in port by working experience in maritime field.

H_{O49}: There is no significant difference to the impacts of unsafe navigation in port to operation by working experience in maritime field.

H_{O50}: There is no significant difference to the impacts of unsafe navigation in port to losses by working experience in maritime field.

H_{O51}: There is no significant correlation between environment related factors affecting safe navigation in port and vessel related factors affecting safe navigation in port.

H_{O52}: There is no significant correlation between environment related factors affecting safe navigation in port and navigational aid related factors affecting safe navigation in port.

H_{O53}: There is no significant correlation between environment related factors affecting safe navigation in port and impacts of unsafe navigation in port to operation.

H₀₅₄: There is no significant correlation between environment related factors affecting safe navigation in port and impacts of unsafe navigation in port to losses.

H₀₅₅: There is no significant correlation between vessel related factors affecting safe navigation in port and navigational aid related factors affecting safe navigation in port.

H₀₅₆: There is no significant correlation between vessel related factors affecting safe navigation in port and impacts of unsafe navigation in port to operation.

H₀₅₇: There is no significant correlation between vessel related factors affecting safe navigation in port and impacts of unsafe navigation in port to losses.

H₀₅₈: There is no significant correlation between navigational aid related factors affecting safe navigation in port and impacts of unsafe navigation in port to operation.

H₀₅₉: There is no significant correlation between navigational aid related factors affecting safe navigation in port and impacts of unsafe navigation in port to losses.

H₀₆₀: There is no significant correlation between impacts of unsafe navigation in port to operation and impacts of unsafe navigation in port to losses.

1.8 Expected Outcomes

In completion of this project, safety issue regarding the navigational error in port area will be identified. It is been said that marine traffic control is considerably less sophisticated than is the control of most other form of transport. Ship control is entirely ship based once the ship is outside pilotage waters, and in this respect it is somewhat similar to road vehicle.

The study is about the port area management system on how the related factors can affect the safe navigation of the vessel. With high traffic volume, safety of navigation become the most important issue to minimize any casualty that may happen which the impact can be severe to maritime industry.

It is also to understand the rules and regulation involve in safety of navigation in port in order for further improvement of navigational safety. There are series of measures had been introduced in the form of conventions, recommendations and other instruments.

Lastly, to derive generic model which can be used for further study to determine the infrastructure, equipment and management requirement to be provided and implemented in the port area for safe navigation.

1.9 Definition of Terms

There are so many meaning given by people to the “safety”, “navigation” and “port” according to their background and experience. In this study, these important terms will be defined accordingly to suit with the objectives of study.

1.9.1 Safety

According to Longman Dictionary (2005), “safety” means *“the state of being certain that adverse effects will not be caused by some agent under defined conditions”*. It means that safety is the state of being "safe", the condition of being protected against physical, social, spiritual, financial, political, emotional, occupational, psychological, educational or other types or consequences of failure, damage, error, accidents, harm or any other event which could be considered non-desirable. Safety can also be defined to be the control of recognized hazards to achieve an acceptable level of risk. This can take the form of being protected from the event or from exposure to something that causes health or economical losses. It can include protection of people or of possessions.

1.9.2 Navigation

According to IACS Req. (1992), “navigation” means *“all tasks relevant for deciding, executing and maintaining course and speed in relation to waters and traffic”*.

It means that navigation is the process of monitoring and controlling the movement of a craft or vehicle from one place to another (Bowditch, 2002:799). It is also the term of art used for the specialized knowledge used by navigators to perform navigation tasks. All navigational techniques involve locating the navigator's position compared to known locations or patterns.

1.9.3 Port

According to Code of practice on security in ports (2003), “*port*” means “*The geographic area defined by the member State or the designated authority, including port facilities as defined in the International Ship and Port Facility Security (ISPS) Code, in which maritime and other activities occur.*” It means that port is a location on a coast or shore containing one or more harbors where ships can dock and transfer people or cargo to or from land.

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