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Shipboard security analysis for safety of navigation using the Automatic Identification System (AIS) : a practical view from some maritime administrations of the European Union countries

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SHIPBOARD SECURITY ANALYSIS FOR SAFETY OF NAVIGATION USING AUTOMATIC IDENTIFICATION SYSTEM (AIS): A PRACTICAL VIEW OF SOME MARITIME ADMINISTRATIONS OF THE EUROPEAN UNION

BY

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Acknowledgement

Declaration

This dissertation is submitted to the World Maritime University (WMU) Malmö Sweden, in partial fulfilment for the award of a Master's of Science Degree (MSc) in Maritime Affairs, specialising in Maritime Administration in 2006.

No portion of this work has been submitted in support of an application of similar nature or any other institution of learning.

Signed: _____   Place/Date: Malmö, Sweden,_____

Abstract

Shipping is considered as carrier of world trade and it is estimated that 93% of the world trade is carried by sea. But the safety of the world trade carriers and the impact they might have on the lives of those who depend on it is a call for concern. This dissertation tries to determine how effective the Automatic Identification System (AIS) can and or is used onboard ships especially in providing safety of navigation. This has been realised through gathering information from some five Maritime Administrations of the European Union (EU), Sweden, Malta, Denmark, Luxemburg, and Germany through questionnaires sent to them.

It was found that the AIS can have a big impact on safety of navigation either through;

❖ Using it in combination with other aids to navigation such as AIS/ECDIS or AIS/ECDIS/DGPS. This is due to the shortcomings of the RADAR, paper chats, and ARPA which were first used for navigation. The shortcomings of the previous aids to navigation were poor metrological conditions such as rain and snow or in areas were they are obstacles such as bends and bridges.

❖ Collision avoidance is possible with the AIS especially as ships are able to identify each other and avoid the time wasting calling on the VHF. The event of any collision on the lives of people using the coastline cannot be over emphasised here, considering the loss of businesses due to pollution of the coastline and beaches and the effect on aquatic life.

❖ Using the LRIT coastal authorities will be able to monitor ships on the high seas even before they enter their waterways. The AIS can help in fighting certain crimes at sea such as piracy and be used for SAR operations, since shore authorities can easily identify vessels that may be in need of assistance.

However, mariners should not see the AIS as the end of the problem, but should consider it as a means to an end, for any decision taken should be based on the use of two or more aids to navigation than totally relying on the AIS.

Table of content

CHAPTER ONE

Introduction and Research Statement

1.1 Introduction

Maritime security issues and unsafe acts disrupting safety of navigation are not that new in the maritime world. The story dates as far back as in the years of piracy, hijackings and stowaways. The International Maritime Organisation (IMO) in finding ways of improving navigation of ships has produced number of conventions including the Suppression of Unlawful Acts (SUA) against the safety of maritime navigation in 1988. This convention came up at the heels of the Achille Lauro incident in 1985. Prior to this convention, the IMO has come up with a good number of other conventions to secure safety of navigation and to fight maritime security and related problems. These include:

- SOLAS 74 Chapter V, as amended to carter for Safety of Navigation
- SOLAS 74 Chapter XI as amended to take care of Special Measures to enhance Maritime security,
- SOLAS 74 Chapter XI-2 as amended for Special Measures to Enhance Maritime Security
- The ISPS Code

To make matters worse, the turn of events of the September 11, 2001 brought about a total revolution in Security issues with the adoption of the adoption of the International Ship and Port Facility Security (ISPS) Code. This created doubts as many people were asking what connection had incidents that happened in the aviation industry had to do with maritime industry. However, the IMO looked at this issue from a different perspective, to safeguard against these incidents transferring into the maritime sector. But the question of whether security on board ships, safety of navigation and related issues has been totally catered for still lingers in the corridors of the IMO.

Maritime security issues for safe navigation of ships in waterways today have taken a different dimension, though it is not that new. In 2000, IMO adopted a new carriage requirement (as part of a revised new Chapter V of SOLAS) for all ships of more than 300 gross tonnage to carry Automatic Identification Systems (AIS) capable of providing information about the ship to other ships and to coastal authorities automatically.[1] This was expected to come into force in July 2004. Numerous regulations and rules have been adopted by the IMO and the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) and others in this effect to cover the use of the AIS.[2] These include:

- IMO Performance standard for AIS (MSC.74 (69)) Annex 3
- IMO Carriage requirements for AIS within SOLAS Chapter V, Regulation 19
- ITU-R.M 1371-1 Technical Recommendations on AIS
- IALA Technical clarification on ITU-R M 1371-1
- IEC 61993-2 Test Standard for Class A AIS Transponders
- IEC 62287 Test Standard for Class B AIS Transponders
- IALA Technical Guidelines for AIS

The AIS is to be carried on board ships with the Global Maritime and Distress System (GMDSS) and the Vessel Traffic Services (VTS) which is expected to provide basic information about a ship on a radar screen, such as ship's name, call sign, and IMO number[3] to other ships and coastal authorities.

AIS is not a new navigational aid. Others have existed before it and as a good navigational aid, seafarers require aids that will efficiently and effectively provide them with long range visibility, adequate meteorological and hydrographic conditions, long interaction with other traffic systems in communication of information, and effective shore based controllability. Navigation aids such as the

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[1] http://www.imo.org/Safety/mainframe.asp?topic_id=754
[2] IMO/IALA Seminar on AIS, session N° 3, paper N° 2
[3] Jens-Uwe Schröder (WMU 2004), Contemporary issues in maritime Security, pg 102.

Radio Directing and Ranging (RADAR), Automatic Radar Plotting Aid (ARPA) and Electronic Chart Display and Information Systems (ECDIS) were all used, but with little consequences to safe navigation and all these paved the way to the Vessel Traffic Services Systems (VTS) to increase interaction with the shore based maritime stations.

The proper use of AIS is required to enhance the safety of life at sea, the safety and efficiency of navigation, and the protection of the marine environment [4] from pollution in case of collision According to IMO Assembly Resolution A.857(20), Guidelines for Vessel Traffic Service, establishes the following tasks to be performed by a VTS:

> A VTS should at all times be capable of generating a comprehensive overview of the traffic in its service area combined with all traffic influencing factors. The VTS should be able to compile the traffic image, which is the basis for the VTS capability to respond to traffic situations developing in the VTS area. The traffic image allows the VTS operator to evaluate situations and make decisions accordingly. Data should be collected to compile the image…………...

According to IALA guidelines, the VTS authorities stand a better chance of achieving the above tasks through the AIS.

1.2 Research Question

Just more one year after coming into force of the AIS as a navigational aid, what do Maritime Administrations of the European Union (EU) think of the AIS as a possible practical tool in meeting the shortcomings of previous aids to navigation such as the RADAR, ARPA, and ECDIS?

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[4] IALA Guidelines on AIS as a VTS tool, December 2001, pg 3

1.3 Objectives

This dissertation has as main objective to determine how effective the AIS can and or is used onboard ships especially in providing safety of navigation. This will be possible through an analysis and investigation from five Maritime Administrations of the EU, namely, Sweden, Denmark, Malta, Germany and Luxemburg.

Other objectives will include:
- ❖ Evaluate how useful AIS information can be of use to maritime administrations
- ❖ Identify the potentials of the AIS as a tool for safety of navigation
- ❖ Find out what these maritime authorities are doing with the data they collect
- ❖ Evaluate how beneficial the AIS is viewed by the maritime authorities to increase safety of navigation in their water ways
- ❖ Evaluate the usefulness of the AIS as a measure to fight maritime security as a whole
- ❖ Determine the weaknesses of the AIS in fighting maritime security especially in navigation
- ❖ Propose recommendations on the use of the AIS alongside other security measures on-board ships as a security measure

1.4 Limitations and Demarcations

Here, limitation is considered in relation to why the study is limited to only five maritime administrations. Shipping is reaching and having an impact on millions of people, predominantly shippers and ship owners, but the boundaries of who benefits from the safe navigation of ships can reach, and in what ways are still unclear. Despite all the conventions and inventions to provide safety of navigation, there are still a number of vital questions that continue to worry users of the shipping industry and those who support it. The maritime industry is an old industry and most regulated, but the level of incidences that occur in the provision of the services are still far from reduced. This dissertation was initially planned to cover seven Maritime Administrations of the EU, but finally was limited to only five maritime

administrations of the EU because the Norwegian MA refused to answer to the questionnaire for they believed the information required in the questionnaire was so sensitive; the United Kingdom did not respond at all. Taking into consideration the case of the Baltic States, which include Sweden, Denmark, Finland and Germany, who have given the responsibility to the Helsinki Commission (HELCOM) to gather information on incidences that happen in the Baltic Sea, Malta and Luxemburg apart may have their own view of safety, and not leaving out the time factor issue that was required to gather all the necessary questionnaires that were sent out to respondents, in this case the maritime administration.

1.5 Definitions

Automatic Identification System (AIS): According to the Wikipedia, AIS is a system used by ships and vessel traffic systems (VTS) principally for identification of vessels at sea. AIS helps to resolve the difficulty of identifying ships when not in sight (e.g. at night, in radar blind arcs or shadows or at distance) by providing a means for ships to exchange ID, position, course, speed and other ship data with all other nearby ships and VTS stations. It works by integrating a standardized VHF transponder system with a GPS receiver and other navigational equipment on board ship (Gyro compass, Rate of turn indicator, etc.).[5]

Transponder: This is a radio or radar transmitter/receiver activated for transmission by reception of a predetermined signal.[6]

GPS: A system of satellites, computers, and receivers used by ships to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver.

LRIT: In May 2006, the MSC adopted the performance standards and functional requirements for the LRIT. This is a system that will be installed on board ships that

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[5] www.answers.com
[6] www.answers.com

will permit coastal states to receive information at a distance not exceeding 1,000nm. While the AIS is considered a broadcast band, the LRIT data will be available only to specific recipients who are entitled to receive such information and safeguard same data with confidentiality.

ECDIS: This is a computer based information system that can be used in place of paper charts. The system displays information from the Electronic Navigational Charts (ENC) and integrates position information from the GPS and other navigational sensors, such as Radar, AIS and may display additional sailing information such as sailing direction.

1.6 Disposition

Chapter 2: In this chapter, the methodological choice which has been taken, and discussions of the work process of the dissertation and discussions connected to the decisions and choices of way of conducting the research will be discussed.

Chapter 3: This chapter contains some general information about the AIS, development of the AIS, purpose of AIS, presentation of AIS designs and signalling system and use of AIS for safe navigation and transmission of signals to coastal authorities. It also includes a brief literature review on AIS as a VTS service/tool and related issues such as what others think of the AIS, expectations of VTS from the use of AIS. This chapter makes a comparison of other aids navigation used for safety of navigation with the AIS, and concluded with a summary of the whole chapter.

Chapter 4: This chapter is mostly concerned with putting in place data collected and making an analysis of the data. The main concern is presenting the findings after analysis of the data and making some conclusions from the data.

Chapter 5: This chapter is concerned with data analysis and presentation of findings from the questionnaire administered to the maritime administrations. This chapter looks at the impact of the AIS on safety of navigation, individuals and their incomes, shipping companies and seafarers and security that are presented in line with the theoretical framework in trying to answer the research question formulated.

Chapter 6: In this chapter, some recommendations, proposed solutions to problems that arose from the dissertation and from the data gathered are brought out, a conclusions and proposed areas for further research required to better provide better services to the industry are also highlighted.

CHAPTER TWO

Research Methodology

2.1 Scientific Method

In order to enable the reader to understand how and on which basis this research has been conducted, the choices made when working on this research have been motivated. Thus, all issues raised in this chapter, will form the basis for evaluating the results of this research in the light of how the research was planned and carried out.

2.2 Choice of Subject

Since the convention that adopted the International Maritime Organisation (IMO) in 1948, and first meeting in 1959, they have been working under the slogan "Safe, Secure and Efficient Shipping on Clean Oceans". To be able to meet this goal, 40 conventions and protocols and numerous codes and recommendations have been adopted. The IMO has also been working with technology to ensure that this slogan too is met. In this light, numerous aids to navigation have been adopted, but the problems sited still persist with previous navigational aids (RADAR, APAR, ECDIS). In 2000, the IMO adopted a new requirement on navigational aids (AIS) and incorporated the requirement into Chapter V of SOLAS as Regulation 19 for ships of 300 gross tonnage. The diplomatic conference of maritime security in December 2002 later modified this to include ships of 300 gross tonnage and upwards, but less than 50,000gross tonnage stipulating the dates of July 1st 2004 or not later than December 31st 2004 for the AIS to be fitted on board all ships[7].

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[7] http://www.imo.org/Safety/mainframe.asp?topic_id=754

The idea of a Master's Dissertation on the topic of "Onboard ship security analysis for safe navigation using the AIS" is of interest especially as security issues for ships is now the sing song and amplified by the many "unlawful acts" at sea that hinder safety of navigation and threatens the environment. This was further coupled with the fact that, at the moment, IMO is embarking on meeting their objectives of how to eradicate this phenomenon and keep the seas clean especially with the revision of the SUA Convention.

2.3 Perspective

To be able to make things clear to readers of research like this, it is often required that the researcher takes a standpoint as to whether the research is for the shipping industry's advantage or for academic purposes. An academician and business person can often view problems and interpret them differently. In this case, they are two perspectives; that of the navigational safety to the maritime authorities, and that of security to the ship owners who risk their money to carry out the investments for the benefit of shipping transport. To be able to choose this perspective, the main objective "To determine how effective the AIS can and or is used onboard ships especially in providing safety of navigation" has been used. Here therefore, two perspectives, that of the maritime administrators trying to secure the slogan of Safe, Secure and Efficient Shipping on Clean Oceans, and the ship owners waiting for salvation from the administrators so as to help them sail freely without difficulties have been presented.

Looking critically at this problem from the angle of the maritime administrator, the main aim of this dissertation is:
- To see how far the use of AIS can help in navigation,
- What areas can be of importance especially when data is gathered,
- What potentials can this system have to protect the waterways,

- How maritime administrations can benefit using this new technology, and from the angle of ship owners, how the data collected by the authorities will yield results that will leave them sailing without fear of unlawful acts and damage to the environment and

- How the AIS can help them navigate safely through the waters.

2.4 Preconception

According to the Cambridge Advanced Learners dictionary, preconception is an idea or opinion formed before enough information is available to form it correctly[8]. When performing or carrying out an empirical investigation, it is important to understand the point of view on how to see a scientific object. Individual's preconceptions are the ideas that exist regarding different phenomena. This is most often influenced by the person's complex pattern, which in turn is influenced by practical experience, social background, and education. Each and everyone's decisions, values and behaviour are affected by preconceptions they posses. It therefore undermines everyone's complete objectivity especially when making observations. Rather than pursuing complete objectivity, it is nice being aware of such phenomena and let them not interfere in the conclusions arrived at in an unreasonable manner. Preconceptions differ from individual to individual depending on for example experiences, education or previous scientific work. Education on its own forms a strong foundation for understanding preconceptions. Preconceptions are socially founded, subjective opinions on the issues to be studied. The scientist preconceptions vary depending upon the parents, religion conviction, circle, set of acquaintances, working places, and social status. Some are more deeply founded than others and as such are harder to change e.g. faith and politics.

After working in the Ministry in the Department of Maritime Affairs, even though not directly involved with the area of this research, my preconceptions will not only

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[8] Cambridge Advanced Learner's Dictionary, Cambridge University Press 2003

affect the research findings and the conclusions, but the whole research process as a whole as noted earlier. Thus pure objectivity can be very difficult to maintain in such situations and to some extent, the research findings will reflect values. Work is inevitably subjective and that it is important for the reader to have knowledge regarding this and be provided with sufficient information against which the research work can be evaluated and understood.

Preconceptions can therefore be said to be the foundation upon which all following experiences are based and therefore experiences can be coloured by preconceptions. They are not just a built in memory, they actually affect the researcher while he searched for knowledge and decide the approach that he can have on the subject that readers will explore.[9]

2.5 Scientific Ideal

A scientific research is essential to give the reader knowledge on the research and this mostly depends on the way you perceive the reality. This view should follow the theoretical and scientific choices of the study. In most cases, they are two scientific ideals that emerge; the positivism and the hermeneutists. These ideals are two extremes and the researcher may place himself any way along the line.

Hermeneutic researchers are concerned mostly with interpretation of results. Their aim is to "make clear an object of study or area of inquiry that is currently unclear and requires further clarifications"[10]. The positivistic researcher tries to reproduce the reality in such an objective way as possible. While keeping a distance on work and distinguishing between sensibility and sense, the researcher should practice to be neutral and study what is real and obvious.

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[9] Sarita N, and Ulrika Rönnholm (2004). Culture. What are its effects?
[10] Burton,D (2000): Research Training for Social Sciences: A handbook for postgraduate researchers, edited by Dawn Burton. Sage publications Ltd, Great Britain, pg. 21

Because of the nature of the research question, problems and objectives, the positivism research approach will not give the right results to the problems at hand since here in this research, since it is mostly concerned with interpretation of results. Thus trying to determine how effective the AIS can and or is used onboard ships especially in providing safety of navigation, the hermeneutic research approach will be used and the researcher will be concerned mostly with interpretation of results. In this way, an in-depth analysis of the research question will be made and better solutions provided. With known preconceptions and experiences, it will be hard to be completely objective; however, this has already been accounted for above so hopefully the reader is already aware of any impartiality.

2.6 Scientific Approach

Basically, they are two approaches that a researcher can use when setting up and processing scientific research. This is a combination of the more commonly known deductive and inductive ways of approaching reality. If the approach to be followed starts with reality in a deductive way, the process starts with theory and goes on to empirical observations. The researcher can start with a theoretical framework that later can be used to compare and analyse the scientific findings. This approach is characterised by general principles and the researcher's efforts to prove and draw conclusions. The inductive approach, being the reverse, here the researcher studies the object of the research without relating the findings to existing theory and thus it will form its own theoretical framework on the basis of the empirical findings.

In this research, the deductive approach will be used. From existing research and findings about the AIS and other aids to navigation, information will be used to form the basis to compare, analyse and investigate the findings of the research in the EU. The investigation will start from five chosen Maritime Administrations of the EU to approaches of safety of navigation and based on the findings, and will aim at

"determining how effective the AIS can and or is used onboard ships especially in providing safety of navigation", which is the focus of this research.

2.7 Research Method

Basically, they are two main research methods and each method is employed and used depending on the research question at hand. The first method, the qualitative method where the goal is to widen the knowledge and the whole pre-understanding through field observations or in laboratories. The weakness of this method is the effect from the control of the phenomena, which will continue to change because of the scientific process. During the oral method, the interviewer should guide the conversation as little as possible. Through the language, the scientist and respondents could take part of each others thoughts by their own valuations and experiences, for it becomes easier for the scientist to gather information from the respondents. Qualitative research is by no means a new strategy or framework for doing research (Hamilton, 1994; Vidich and Lyman, 1994)[11]. Nonetheless, there has been a very considerable growth in the use and popularity of qualitative research since the early 1960s, which can easily convey the impression that it is of more recent origin that is in fact the case. It seems to imply any approach, which does not entail the collection and analysis of qualitative data. This view is generally regarded as unhelpful though it does have some currency, largely because for most writers and practitioners, it is viewed as being more than the mere absence of qualitative data.

Quantitative methods on the other hand are based on already decided and well structured questions, which all the respondents will be asked. The information is reduced to a certain area of interest and respondents will be repeated the same questions. This can be combined with open questions, which give the respondents flexibility to answer from different perspectives. Quantitative aspects may also be combined in the same study. They can compliment each other by bringing width and

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[11] Allan Byman and Robert G. Bmguess (1999): Qualitative research.

depth into the research. A mix of qualitative and quantitative studies is chosen as the best ideal to follow as questionnaires were mailed to some actors.

With the main objective being to achieve a deeper understanding of the chosen subject, this research will place more emphasis on the quantitative research method, though at some level, a bit of qualitative methods from what others might have said about the subject will be used. This combined approach is the most meaningful way to probe into the subject and determine how effective the AIS can and or is used onboard ships especially in providing safety of navigation.

CHAPTER THREE

Theoretical Framework

3.0 Introduction

In this chapter, two types of approaches for the use of maritime authorities and the ship owners will be discussed while all the approaches are very much feasible, the problem lies on their level of outreach to the different strata of users and the degree of accessibility by clients and the alternate objectives of the shippers and ship owners.

In the first approach, coastal states who are solely concerned with the protection of the coastal areas against pollution, conservation of natural resources, vessel traffic management, maritime security, and law enforcement are interested in vessel identification as well as in monitoring certain vessel activities and movements. Before the technology of AIS, this was mostly done through surveillance and ships expected to voluntarily report in case of accidents, use of radar equipment, or through physical sighting of vessels in the waters[12].

On the other hand, the other theory is supported by ship owners, seafarers and mariners who are very much in need of an efficient, reliable and effective means for them to be able to identify vessels. The proponents of this theory believe that, this new technology should help them to eliminate the need to blindly call a vessel on VHF with a message seeking, to identify another vessel (e.g., "northbound ship on my port bow"), to eliminate or reduce the hazard of collision arrangements with other vessels, and to identify a rogue ship holding on in contravention of the rules of the road[13].

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[12] Ship board AIS, meeting the needs of mariners, Transportation research Board of National Academies, Special report 273, Washington DC, 2003

[13] Ship board AIS, meeting the needs of mariners, Transportation research Board of National Academies, Special report 273, Washington DC, 2003

According to the Transportation Board of National Academies, there is a third group of people with commercial interest who have motivated the development of the AIS. This group include port authorities, vessel operators, and pilots all of whom seek to improve safety and facilitate commerce through improvements in the availability and timeliness of the information available to mariners. This group thinks that with the AIS, the reliance on voice communication as in the past will be limited[14].

3.1 General Information on the AIS

According to SOLAS Chapter V, Regulation 19, all ships with gross tonnage of 300 and above but less than 50,000gross tonnage were required to carry on board the AIS by December 31, 2004.

The AIS is a system intended to allow the passage of information between ships and the shore. In the past ships could identify themselves, work out if they are the ones at risk of collision, and this has always posed a danger. According to an article published in the SIRC column of the Sea by Phil Belcher, "….we live in the real world where compliance with the collision regulations is less than full. Furthermore, according to the US Vessel Bridge – to – Bridge Radiotelephone Act (1971), ships should as a matter of routine, contact other ships in order to seek clarification of their actions"[15]. He went further to accept the fact that the AIS has that potential to revolutionise collision avoidance and rather than calling everyone on VHF.

The AIS system consists of the following;
- ❖ One multi-channel VHF transmitter
- ❖ Two multi-channel VHF receivers
- ❖ A central processing unit (CPU)
- ❖ An internal GNSS receiver for timing purposes and position redundancy

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[14] Ship board AIS, meeting the needs of mariners, Transportation research Board of National Academies, Special report 273, Washington DC, 2003

[15] Phil Belcher, SIRC Column Journal the Sea, May – June 04, pg. 4

- ❖ Interfaces to navigation EPFS receiver, gyro and log and to other board sensors
- ❖ Interfaces to radar/ARPA, ECS/ECDIS, integrated navigation systems and dedicated AIS display
- ❖ A BIIT (Built in Integrity Test)[16]
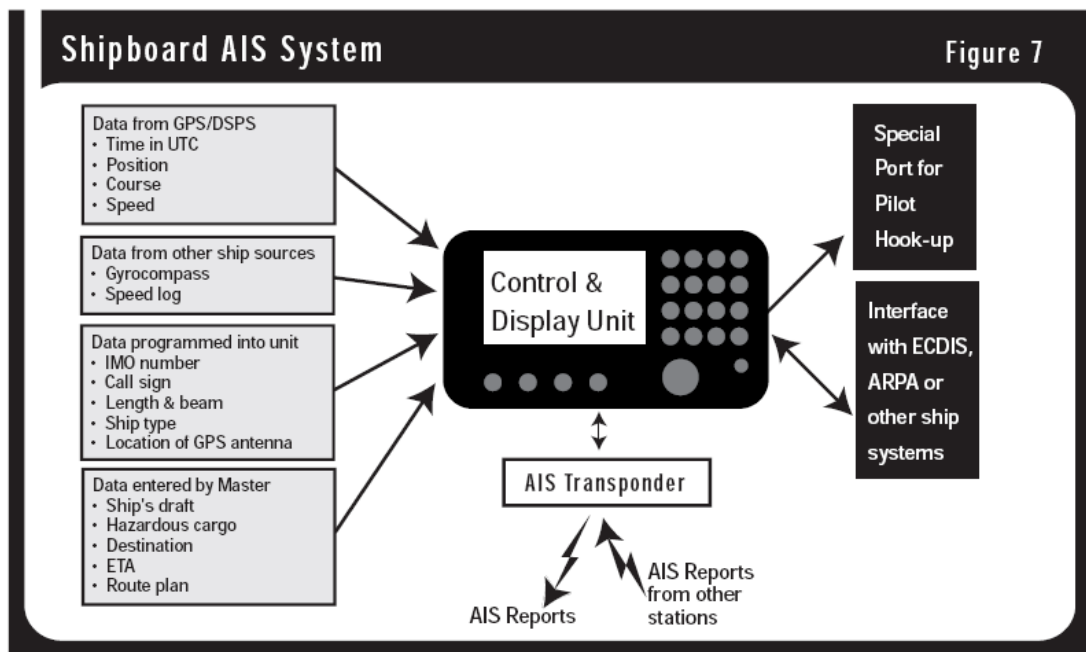
Figure 1

Source: Marine GPS; A complete guide to AIS

According to IALA publication, the AIS operates on the VHF maritime band and sends out ship information as identification, position, course, speed, ship dimensions, draught, ship type and cargo information, to other ships and to shore. The timing of information is derived from an integral global navigation satellite system, e.g. GPS receiver and if integrated into other devices such as the electronic chart system (ECS)/electronic chart display and information system (ECDIS) or a radar/automatic radar plotting aid (ARPA), the effectiveness will be significantly increased.

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[16] Guidelines on AIS as a VTS tool, IALA publication, December 2001, pg. 4

It is worth noting that the AIS station operates in an autonomous and continuous mode, regardless of whether it is operating in the open seas or in coastal or inland waters, and uses both the 25kHz and 12.5kHz simplex channel band width, with each of these bandwidths having a capacity of 2,250 slots/minute at a transmission rate of 9,600 bits/second, and when both channels (AIS 1, AIS 2) are used, the reporting capacity doubles, i.e. 2 times 2,250 to give 4,500.[17] Therefore, in case where the AIS station gets overloaded, the SOTDMA algorithm and the GMSK/FM modulation ensure effective communication from stations far away gets reduced giving priority to close receiving stations.

Reporting rates too differ from ship to ship. Table 1 shows the rates of communication for various manoeuvring ships:

Table 1

Serial Nᵒ	Ships manoeuvring condition	Reporting interval
1	Ship at anchor or moored and not moving faster than 3 knots	3 minutes
2	Ship at anchor or moored and moving faster than 3 knots	10 seconds
3	Ships of 0 – 14 knots	10 seconds
4	Ships of 0 – 14 knots and changing course	$3^{1/3}$ seconds
5	Ships of 14 – 23 knots	6 seconds
6	Ships of 14 – 23 knots and changing course	2 seconds
7	Ships of >23 knots	2 seconds
8	Ships of >23 knots and changing course	2 seconds

Source: IALA Guidelines on AIS as a VTS Tool

Table 1 shows that all precautionary measures have been taken to avoid any incidents that will hinder navigation by fast sailing ships having higher rate of reporting time and slow ships almost mooring, less reporting time.

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[17] Guidelines on AIS as a VTS tool, IALA publication, December 2001, pg. 4

3.2 Development of the AIS

The quest to keep the oceans clean of navigation problems and pollution is not a new concept. Previous aids to navigation consisted of beacons, light houses and later followed by buoys, but the search for a perfect and safe aid to navigation still continued. The post World War II saw considerable pressure from environmental groups especially after the accidents of Torrey Canyon, Amoco Cadiz and many others for the protection of the environment. Poor visibility considerably affected traffic management that further impeded full utilisation of Port facilities. The VTS came in when congestion in ports and increasingly the carriage of hazardous goods was taking an increase effect on the environment and others saw the VTS to be the solution, but today the AIS is now coming into central stage.

With the introduction of the GDMSS and the Search And Rescue Transponder (SART) used in identifying the position of survival crafts, to the Emergency Position Indicating Radio Beacon (EPIRB), which normally indicates the position of a distress craft via the VHF or satellites such as International Mobile Satellite Organisation (INMARSAT), to the Digital Selective Calling (DSC) that allows ships and shore stations to identify other ships when receiving their Mobile Service Identity number (MMSI)[18], especially ships in distress, navigation has been of great importance.

However, in the real world, where compliance with collision regulations are less than full (Phil Belcher, 2004), the AIS should come into play to bring its own impact as to revolutionise collision avoidance.

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[18] Ehab Ibrahim Othman, Vessel traffic services (VTS): The management and monitoring of maritime traffic in light of the new technology of the automatic identification system (AIS), 2004, (Dissertation),

3.3 Purpose of the AIS

The AIS is not only expected to revolutionise the collision avoidance, but also has the potential to aid navigators on board ships and certainly play a role in safety of navigation.

In IMO Resolution MSC.74 (69) Annex 3, Recommendation on performance standards for AIS, it is clearly stated that:

> The AIS should improve the safety of navigation by assisting in the efficient navigation of ships, protection of the environment, and operation of Vessel Traffic Services (VTS), by satisfying the following functional requirements:
> - In a ship-to-ship mode for collision avoidance;
> - As a means for littoral States to obtain information about a ship and its cargo; and
> - As a VTS tool, i.e. ship-to-shore (traffic management).

> The AIS should be capable of providing to ships and to competent authorities, information from the ship, automatically and with the required accuracy and frequency, to facilitate accurate tracking. Transmission of the data should be with the minimum involvement of ship's personnel and with a high level of availability[19].

3.3.1 AIS and Safety of Navigation

The risk of collision depends on two factors, namely the navigator's assessment of the risk itself and the knowledge of the motion of the ship and other ships. Assessment of the motion of other ships can be achieved through visual sighting, radar, ARPA, AIS and voice communication with other ships. Visual sighting, radar and communication are real information, but it is difficult for the navigator to predict

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[19] IMO Resolution MSC.74(69) Annex 3, Recommendation on performance standards for AIS

the situation well ahead of time especially as safety margins are small in congested waters[20]. But ARPA and AIS information is easy to interpret if displayed graphically, making it easy to predict other ship's motion. It can be deduced here that, AIS has an added advantage over other aids to navigation in as much as safety of navigation is concerned.

Bridge layouts have in the past been a cause of concern, whereby mariners have to constantly draw and correlate data from a number of independent sources to develop information for decision making—typically a combination of visual cues, one or more radars, paper and electronic charts (ECDIS or ECS), conventional instruments such as compass, speed log, communications, machinery, instrumentation, and alarm panels. Mariners must not only correlate the data provided by these diverse sources but also resolve the differences between the various inputs and determine what is valid within a safety- and time-critical period[21].

Take the case whereby a mariner has to run left and right collecting such data, and by the time a decision is drawn, anything can happen. Therefore, AIS will be beneficial in such instances whereby the mariner will no longer have to consult all shipboard equipment to determine the position of another ship or a reef.

An example of such situations whereby mariners in the course of collecting data and having to analyse, results into a collision is the "LADY SANDALS," in 2000 where the Officer On Watch (OOW) focused on the apparently precise representation of the area provided by the ECS system, and did not appreciate the variance between its representation and the visual cues"[22] and collided with another ship in Canadian waters.

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[20] Hans Ramsvik, AIS as a tool for safety of navigation and security – Improvement or not?, Det Norske Veritas
[21] Shipboard Automatic Identification System Display, Meeting the needs of mariners, Transportation Research Board of National Academies, Special report 273, pg 52.
[22] Shipboard Automatic Identification System Display, Meeting the needs of mariners, Transportation Research Board of National Academies, Special report 273, pg 52.

3.3.2 AIS and Security in Navigation

The term security in relation to navigation has not had a clear cut definition. To quote Mr. Maximo Q. Mejia, "Maritime Security are those measures employed by owners, operators, and administrators of vessels, port facilities, offshore installations, and other marine organisations or establishments to protect against seizure, sabotage, piracy, pilferage, annoyance, or surprise"[23].

Maritime security issues are hot topics at the IMO. In a key note address at the International Symposium on Contemporary Issues in Maritime Security held at WMU from 11 – 15 August 2003, the IMO Secretary General, Efthimios Mitropoulos said, "…the IMO's work in the realm of maritime Security provides support for its objectives in enhancing safety and also preventing pollution of the marine environment" [24] . Security issues have no doubt become of immense importance at the IMO since the late 1970's with studies about barratry against ships, seizure of ships and many other maritime crimes. The peak of security issues came especially after the attacks of September 11, 2001 with the adoption of the ISPS Code in 2002 and the revision of the SUA Convention and its protocols in 2005.

The SUA Convention covers maritime crimes, such as seizure of ships by force, acts of violence against persons on board ships and placing of devices on ships with the intention of destroying or causing harm (E. Mitropoulos, WMU 2005). According to the Mr. Mitropoulos, the revision of the SUA Convention will go a long way to cover crimes, such as piracy and armed robbery, which the IMO started monitoring as far back as 1984; considering the harm that these issues can cause to the environment in case of any single attack. But to what extent will the problem of maritime security stop or at least reduce being a concern to safety of navigation?

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[23] Maximo Q. Mejia, Maritime violence and other security issues at sea, (2002) WMU, pg. 27-38
[24] E. Mitropoulos. Contemporary Issues in Maritime Security, (2005) WMU, pg 154

SOLAS Chapter V, Regulation 19, establishment and operation of aids to navigation states, "Each contracting government undertakes to provide, as it deems practical and necessary, either individually or in co-operation with other contracting governments, such aids to navigation as the volume of traffic justifies and the degree of risk requires". Contracting governments are therefore expected to provide such measures so as to ensure proper navigation in their waterways. According to IALA Guidelines on AIS as a VTS tool, the AIS will certainly have an impact on the security issues since it is expected to:

- Provide automatically to appropriately equipped shore stations, other ships and aircraft information, including ship's identity, type, position, course, speed, navigational status and other safety-related information;
- Receive automatically such information from similar fitted ships;
- Monitor and track ships;
- Exchange data with shore-based facilities,

It is clear that if contracting states are able to put in place such shore stations, security issues will be stepped up since vessels will be easily monitored from shore by authorities.

But according to Hans Ramsvik, of Det Norske Veritas, even though AIS has been identified as a tool to increase security, the output is highly dependent on the sensors and open settings, thereby giving a lee way for easy falsification of AIS data for onboard, and may be setting up of "ghost AIS" for sending of false information. He further feared that AIS information will publicly be available to pirates, terrorists and all others with an AIS receiver and may even serve as a tool for them to selectively choose their targets.

3.3.3 Other Purposes of AIS

AIS should not only be limited for the purpose of safety and security of navigation, but has other purposes. IALA Guidelines on AIS as a VTS tool identifies some other uses of the AIS, such as:

- Use in vessel automatic identification, whereby there is an immediate and automatic provision of vessel identify (MMSI, call sign and others) thereby cutting down on time wastage usually encountered through voice communication and the reliance of vessels having to report to the VTS authorities when she is in their waters, which solely depended on the ship reporting through the VHF and shore authorities having to correlate the identity with the radar track through DF.

- AIS will improve vessel tracking through the following

  • A wider geographical coverage as VTS organisations fitted with AIS will be capable of receiving both identity and precise location of a vessel at maximum VHF radio communication frequency.

  • Positional accuracy of more than 10 metres will be achieved when associated with DGNSS correlated signals, which is more than the radar which was limited to an accuracy range of between 30 to 50 metres.

  • The issue of "shadow" areas that has often caused problems to the VTS especially in areas with proximity to buildings and land will be resolved by the use of AIS which will avoid a greater majority of these areas.

  • The problem with track transferring or "swapping" of identities by ships passing just close to each other resulting to inaccuracy in vessel traffic image witnessed with the VTS that caused problems if not rectified by VTS operators will be reduced as the AIS has been proven to prevent this problem occurring.

  • Real time manoeuvring data such as ships' heading and rate of turn will be derived directly from the vessels with AIS navigation systems

as they are included automatically in the Dynamic Message broadcasted rather than being calculated as was the case with radar based VTS systems.

- AIS will also be used in
  - ➢ Electronic transfer of sailing plan information
  - ➢ Electronic transfer of safety messages
  - ➢ Automatic indication of voyage related information (cargoes, dangerous goods, etc)
  - ➢ Impact on VHF communications
  - ➢ Archiving data
  - ➢ System redundancy
  - ➢ Potential for interaction with regional AIS networks
  - ➢ Improved SAR management

3.4 AIS Signalling System/Transmission of Data to Coastal Authorities

Nations world wide have drawn experience from the lastest major maritime accidents and their consequences on their environment, and are now striving at keeping their waterways safe, protecting their environment and, at the same time, trying to provide the most economical and effective environment for ship traffic.

AIS in combination with VTS are seen as the most excellent tool over short range/distance provided by the VHF transmission system. But how can traffic at long range be monitored?
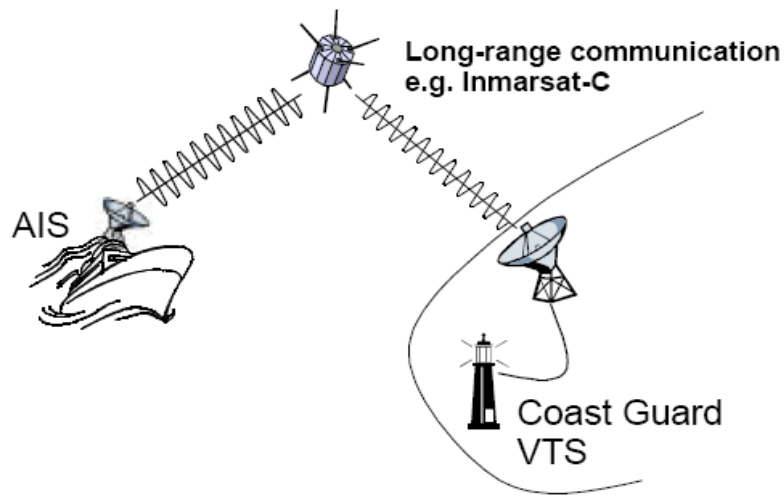
Figure 2

Source: Wim F.M. van der Heijden; IMO/IALA Seminar on AIS paper No 3, session No 4.

According to Wim F.M. van der Heijden of TNO Physics and Electronics Laboratory at the Hague, AIS in combination with a long range communication medium will serve as an excellent tool for tracking ships at long-range and monitoring requirements of the VTS beyond the range of VHF. Since no specific long range medium of communication is provided by the AIS applicable standards, it is left to administrations to choose which cost-effective service to use.

According to the Mariner GPS, coastal authorities stand a better chance of using AIS based stations to monitor ships in their waters. These stations may simply monitor AIS transmissions from passing ships, or may actively poll vessels via the AIS channels, requesting data such as identification, destination, ETA, type of cargo and other types of information. Wide Area Networks (WAN) can be used in cases of wider coverage by different AIS stations in just the same way as the long range system proposed by Wim F.M. van der Heijden.

3.5 AIS and Other Aids to Navigation

The need to bring order to this chaotic condition has long been recognized, but it was not until July 2000 that IMO (2000) moved to establish a work item "to harmonize the presentation of navigational information" in such a way as "to avoid confusion in the display of such information." It is noteworthy that the IMO action was triggered by the new carriage requirement for AIS.[25]

AIS is one of the most recent developments to aids to navigation in the continuous search for better ways of keeping waters safe and secure of collision and other damages. According to the Transportation Research board of National Academies, one of the most frequently cited issues with the coming into force of the use of the AIS is information overload. Mariners are concerned about the sheer volume of data becoming available to them, and the problems of extracting from that data in a timely manner the information needed in a form directly applicable to decision making.
Mariners are increasingly becoming under pressure to choose when to use AIS in combination with other aids to navigation (paper charts, ARPA and radar equipment). The bridge equipment is increasingly pushing the mariners to have to shuttle between various aids to navigation in different circumstances and handle several activities during navigation.

The radar and the Automatic Radar Plotting Aid (ARPA) were thought to be the most effective aids to navigation when they were discovered. But with time, mariners came to realise their short falls especially as they were not more considered to act in avoiding collision.

According to the IALA Guidelines on AIS as a VTS tool, the effectiveness of the AIS may be significantly increased by integrating it into other systems such as the ECS, ECDIS, and ARPA.

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[25] Shipboard Automatic Identification System Display, Meeting the needs of mariners, Transportation Research Board of National Academies, Special report 273, pg 54 - 60

3.5.1 Integrating the AIS into the VTS

IMO Assembly Resolution A.857 (20), Guidelines for Vessel Traffic Services, establishes the tasks to be performed by the VTS:

> A VTS should at all times be capable of generating a comprehensive overview of the traffic in its service area combined with all traffic influencing factors. The VTS should be able to compile the traffic image, which is the basis for the VTS capability to respond to traffic situations developing in the VTS area. The traffic image allows the VTS operator to evaluate situations and make decisions accordingly. Data should be collected to compile the traffic image. This includes:
>
> 1. Data on the fairway situation, such as meteorological and hydrological conditions and the operational status of aids to navigation;
>
> 2. Data on the traffic situation, such as vessel positions, movements, identities and intentions with respect to manoeuvres, destination and routing;
>
> 3. Data of vessels in accordance with the requirements of ship reporting and, if necessary, any additional data required for the effective operations of VTS.

IALA Guidelines on AIS of December 2001 identifies the AIS as being the most appropriate to help achieve the above mentioned task by the VTS, by pointing out the benefits of incorporating the AIS into the VTS will generate to the coastal authorities. Incorporating the AIS into the VTS has been of great value in inland waterways, congested water ways, straits and archipelagos. In the Tokyo Bay, one of the most congested waterways, seven shore based AIS stations were installed in 2003 to help identify vessel identity and position with accuracy[26].

Mr Rainer Strenge and Stephen Bober of the German Traffic Technologies Centre both presented a paper at the 10th International Symposium on VTS held in Hong Kong (2004) on the advantages of AIS in the inland waterways and they believed "It

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[26] Masao Shinozaki, (2004) Report on the 10th International Symposium on Vessel Traffic Services, Hong Kong

is anticipated that AIS will enhance the safety of navigation on inland waterways and improve the quality of the services provided by VTMIS (Vessel Traffic Management Information System) systems, particularly regarding the transport of hazardous cargoes".

Concerning ship safety and pollution measures in the Great Barrier Reef and Torres Strait of Australia, with particular emphasis on the implications for the Ship Reporting System (SRS), presented at the symposium by Mr. Neil Trainor, Nautical Advisor, Australian Maritime Safety Authority Australia, "focussed on the changes that came about when new technologies, such as AIS and Automated Position Reporting via Inmarsat, were introduced into the service to provide Dynamic Ship Traffic Information (DSTI)".

In all, one can rightly deduce that the incorporation of the AIS into the VTS system certainly brings out the most advantages than using VTS alone.

3.6 Summary of Chapter

In this chapter, so far two approaches have been discussed for use in maritime security and safety of navigation by maritime authorities and shipowners.

➢ The first approach concerns maritime authorities (coastal states) who are solely concerned with the protection of the coasts against pollution, conservation of the natural resources found in the coastal waters, vessel traffic control, maritime security, and law enforcement. Here the main focus is bringing out how AIS in combination with other aids to navigation can help to monitor the coastal waters so as to achieve the main concerns mentioned above.

➢ The second approach concerns the shipowners, seafarers and mariners who are solely concerned in an efficient, reliable and effective means for them to be able to meet the said objectives of coastal states and the international community. Here, their main concern is how other ships whether these are on the high seas or in the coastal waters can be identified. AIS here is shown to be effective in other areas such as congested waters and in areas where communication is being perceived as not being able to reach coastal authorities due to barriers such as mountains.

CHAPTER FOUR

Presentation of Empirical Findings

4.1 Introduction

In this chapter, the questionnaire administered to some maritime administrations is analysed. The chapter starts with a brief presentation of the maritime administrations that responded to the questionnaires either as a coastal state, flag state, or port state. The chapter proceeds to looking at the data from the maritime administrations obtained through the questionnaires administered to them and further an analysis of the data and presentation of the findings in a manner that is both fair and accurate from the respondent's point of view, while simultaneously in a way that best meets the objective of this study.

The questionnaire was designed and divided into central themes, each consisting of several questions around the main theme. This chapter works along the main theme to which the respondents expressed their views, experiences and thoughts. However, it should be noted that the division of the topics and questions in the questionnaire does not correspond to the divisions presented in the theoretical framework, but tries to bring out the important areas highlighted in the theoretical elements. A logical approach is maintained applicable to maritime administrations, companies (ship owners) seafarers and mariners.

4.2 Presentation of the Maritime Administrations

4.2.1 Presentation of Malta Maritime Authority, Merchant shipping Directorate

The Maltese archipelago - consisting of the islands of Malta, Gozo and Comino - lies at the cultural, financial and geographical crossroads of the Mediterranean Sea. Strategically located in the centre of the Mediterranean Sea, at the confluence of the major sea lanes linking Europe, North Africa and the Middle East, her position serves an easy access to these markets and beyond.[27]

The Malta Maritime Authority was created by Malta Maritime Act (XVII) of 1991 and has as mission "the attainment of its set objectives, and to the continuing evolution of Malta as a major Maritime Centre. It is the Authority's prime aim to ensure that the services and facilities offered by all the Institutions under its jurisdiction not only meet expectations, but exceed them"[28].

Ship and Yacht Registration and the provision of all ancillary services is the responsibility of the Merchant Shipping Directorate of the Malta Maritime Authority, a body set up by law entrusted with the main function of supervising the organisation and administrative aspects of the primary maritime services.[29]

As of September 2002, the number of vessels registered under Maltese flag stood at 3,143 of the total gross tonnage of 27,064,334 making them the fifth biggest world flag[30].

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[27] http://www.mma.gov.mt/maritimehub_malteseislands.htm
[28] http://www.mma.gov.mt/org_setup_mission_statement.htm
[29] http://www.mma.gov.mt/org_setup_merchant.htm
[30] Malta Maritime Authority Annual report 2001 – 2002 pg 20 - 25

4.2.2 Survey questionnaire administered to Malta Maritime Authority, Merchant shipping Directorate

Responding to the first theme of the questionnaire, the Maltese Maritime Authority incorporated the AIS into their VTS services three years ago. Compliance between the authorities and the shipping companies is said to be effective. But the Maltese authorities on whether they think the AIS is a better aid to navigation compared to the existing ones, they were negative, giving their reason that, every aid to navigation has a different function, and thereby, AIS was not meant to replace the others. They believed that AIS can of course help in fighting crimes, such as piracy, and protection of the marine environment from damage. As to any feedback mechanism within the authority whereby shipping companies can give some feedback from the use of the AIS, they were negative.

The second theme concerning the use of data collected, such data is effectively collected by the Authority and is the responsibility of the Ports Directorate, which is part of the administration. This information is collected by four persons and the data collected helps in addressing port operations, coastal state responsibilities and port state control responsibilities. As to their expectations of the desired results of the data to serve in ship security, they accept short comings of the AIS, but believe that these short comings will be addressed by LRIT.

The third theme on benefits obtained from use of the AIS, the Maltese Authorities believe that it eases their task surveillance by creating a level of proactiveness in their daily operations.

The fourth theme on problems encountered from the use of the AIS, they agree that it was not such a problem to compel their ships to carry the AIS on board. This was accelerated by the fact that most of their ships are involved in long voyages, and had no option than to comply with the existing regulations. But as of now, they have not

encountered any problems from the use of the AIS. As to whether they have so far had any weaknesses after one year of the AIS in force, they thought it was too early to identify any weaknesses.

In conclusion, from the information gathered from the Maltese Maritime Authority, it can be deduced that;

- AIS has a different scope of functioning and cannot replace other aids to navigation since different aids to navigation have different roles to play in the navigation process.
- AIS can effectively help in fighting maritime crimes, such as piracy and help protect the environment from damage such as pollution.
- AIS data can help in addressing issues of port operations, coastal state responsibilities and port state control responsibilities.
- AIS cannot really help in security issues especially out in the high seas, but these shortcomings can be redressed with LRIT
- AIS create a level of proactiveness in daily operations such as surveillance.

4.3 Presentation of Danish Maritime Authority

The Danish Maritime Authority (DMA) is placed under the Ministry of Economic and Business Affairs and represents a small part of a long Danish Shipping Administration founded in 1567.[31]

With the DMA mission being the promotion of safety on clean seas and strengthening effectively competitiveness and employment in the industry, their merchant fleet consists of approximately 500 large commercial ships involved in international voyages, 5,000 fishing vessels, 2,000 other types of vessels and about

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[31] http://www.sofartsstyrelsen.dk/sw278.asp

50,000 pleasure craft.[32] The Danish registry operates three types of ship registries –
Danish registry (mainly for Danish owned ships and ship owners), Danish
International Register (DIS), which is open to foreign ship owners, and the Bareboat
Charter Register.

The Royal Danish Administration of Navigation and Hydrography is responsible for
establishing land based AIS, which is implemented in cooperation with the Danish
Naval Materiel Command and the Admiral Danish Fleet, while The Danish Maritime
Authority is responsible for AIS systems on ships.[33]

4.3.1 Survey questionnaire administered to the Danish Maritime Authority

Responding to questions in the first theme, the DMA incorporated the AIS into their
VTS service two years ago, and compliance by their ships is said to be effective. But
compared to other aids to navigation, they believe that AIS may be good in their own
functions since they have separate functions with other aids to navigation. As to
whether AIS can help in combating crimes, they believe that the most obvious help
can be at the level of pollution damage to the environment. But as to crimes such as
piracy, they think that it may not be very helpful since the master may switch off the
AIS in certain areas where piracy may be expected. However, a feedback mechanism
has been put in place whereby shipping companies can give their ideas from the use
of the AIS.

As for the second theme about data collection using the AIS, the DMA has put in
place an agency in charge of collecting such data. This agency is another
governmental agency. They use such data for accident investigation, and pollution
prevention, and they think that the data so far collected gives them the desired results,
but any such data collected is analysed when there is an accident. Such data

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[32] http://www.sofartsstyrelsen.dk/sw278.asp

according to the DMA give better results than what they used to get with using other aids to navigation.

In the third theme concerning the benefits they get from the use of AIS information, they agreed that it helps them identify ships during surveillance, coupled with safety of navigation in their waterways, pollution prevention and accident investigation.

In the fourth theme concerning any problems encountered with the use of AIS, they had it relatively easy for their ships to comply, especially as it is required by law for ships on international voyages to carry AIS on board. As to any problems they have so far had with analysing the data collected from AIS, the DMA has so far had no problems, likewise, have they seen any weaknesses so far with using AIS as an aid to navigation.

In conclusion, from the information provided by the DMA, it can be observed that:
- AIS has different functions from other aids to navigation,
- Serves the DMA to mitigate damage to the environment such as pollution, and if not switched off by the Master, it can be helpful in crimes as piracy,
- Data collected help them in accident investigation and pollution prevention,
- AIS provides better results and advantages compared to other aids to navigation,
- In surveillance, they can easily identify ships in their waterways, give an added advantage in safety of navigation, as well as in accident investigation and pollution prevention

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[33] http://www.ais.dk/en/index_en.htm

4.4 Presentation of the Swedish Maritime Administration

The Swedish Maritime Administration (SMA) was founded in 1959, and is a self-financing public enterprise, i.e. their activities are, with some exceptions, financed through fees and charges on shipping, outside the government budget. It is governed by Ministry of Industry, Employment and Communications. They cover some seven (7) maritime traffic areas, with three (3) maritime inspectorate areas, and twenty-four (24) pilot stations.[34]

SMA has as mission the safety of navigation in Swedish waters. They are responsible for the supervision of Swedish merchant vessels, fishing vessels and leisure boats, making sure that existing security regulations are being applied. They also ensure that accessibility, safety and environmental consequences at sea satisfy the demands from government, business, merchant shipping, fishing industry and leisure-boat interests.

By December 2004, Swedish-controlled vessels by type of vessel, number and deadweight, gross and net tonnage stood as follows:

Table 6: Swedish-controlled vessels by type of vessel				
		SWEDISH FLAG		
Type	Number	DWT	Gt	Nrt
Bulker	16	67,831	48,186	21,204
Container				
Dry cargo	23	66,248	53,242	25,306
Miscellaneous	17	26,625	34,908	8,291
Offshore	4	5,200	17,941	2,447
Passenger/Ferry	37	134,427	828,711	354,422
Reefer				
RoRo	62	1,016,821	1,954,262	728,237
Tanker	74	640,881	424,950	193,749
Total	**233**	**1,958,033**	**3,362,200**	**1,333,656**

Table 2

Source: The Swedish Maritime Sector – progress report 2004, pg 27

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[34] http://www.shipadm.org/upload/1051/tabla-a-eng.pdf

4.4.1 Survey Questionnaire Administered to Swedish Maritime Administration

From the first theme of the questionnaire, the Swedish Maritime Administration adopted and incorporated the AIS into their VTS service since 1995. Compliance with Swedish flag ships is said to be very effective. But compared to other aids to navigation, the AIS is perceived by the SMA as not the best. This is because, they believe that most ships have the basic AIS installation that provides no graphical presentation of AIS information on ENC or on radar display. In this way, the SMA believes that the full potentials of AIS are not utilised and therefore considered as being less important. The SMA thinks that the AIS will better work in prevention of the environment from damage. As to the existence of any feedback mechanism with the administration between ships and administration, no such mechanism has been put in place.

Responding to the second theme of the questionnaire, the SMA has put in place an agency charged with collection of AIS data. This agency is part of the SMA, but they normally outsource maintenance of the system. Approximately 2 – 3 persons work on the maintenance of the AIS station, communications network, servers and display system. The data collected is used for VTS purposes, accident investigations, planning of pilotage and transportation of pilots, planning of fairways and routing systems, monitoring of ships for environmental protection, and in SAR operations. To be able to serve for security, the LRIT system has to be used, but otherwise, the AIS serves better for safety of navigation. In analysing the data collected, selected data is taken and statistical reports and graphical display are done, even though the SMA has to further develop the tools used for the analyses of such data. As to whether the AIS data gives better advantages over what used to be obtained from other aids to navigation, they think that the AIS provides a unique source of information that comes in the format suitable for computing.

Responding to the third theme about the benefits of AIS, the SMA has benefited a lot by installing AIS coverage over a large portion of their coast. This helps the coast guard's task of surveillance easy since they get all information via the AIS. The areas where they have benefited most are the VTS, SAR and planning operations. As to benefits that shipping companies and seafarers get from the use of AIS, the SMA believes that safety at least is assured, and to some extent, if the company landbase organisation has access to the AIS information, efficiency can be increased.

Responding to the fourth theme on problems from the use of AIS, ships flying Swedish flag were forced to comply since it was a mandatory instrument. Problems encountered from AIS data most often is incorrect or incomplete information transmitted by AIS. This to the SMA is due to incorrect equipment or installation, incorrect configuration at set up and incorrect or missing data input for voyage related data. For the AIS to function better, it is believed that the IMO should use a relevant presentation system for AIS and conduct inspections of installations on board. The weakness of the AIS according to the SMA is the huge amount of data the AIS system gives. This is worsened by the fact that the tools needed to find out the right part of such information are still inexistent.

From the above discussion, it can be concluded that for the SMA,

- AIS on board ships is simply basic since there is no graphical presentation of AIS information on the ECN or radar display, making it less important,
- AIS is best suited for prevention or protection of the marine environment against damage,
- AIS data serves in accident investigation, planning of pilotage, planning of fairways and routing system, monitoring of ships for environmental protection and SAR operations,
- AIS compared to other aids to navigation, has a unique source of information that comes in the format that is suitable for computing,

- If shipping companies'/landbased stations get access to AIS information, efficiency will increase coupled with safety part,
- AIS provides incomplete or incorrect data due to problems of configuration or installation on board ships,
- To help in safety and security issues, the IMO should do relevant presentations and carry out better inspections installations on board,
- Data collected from AIS still lacks the necessary tools to analyse and get the correct information required for use.

4.5 Presentation of the German Maritime Authority

Bundesamt für Seeschifffahrt und Hydrographie, BSH, (Federal Maritime and Hydrographic Agency), is the German government's agency responsible for safety of navigation and maritime security, the provision of nautical and hydrographic information services, administration of the German flag and marine environmental protection. It is the lead agency responsible for shipping and maritime affairs in Germany and is placed under the jurisdiction of the Federal Ministry of Transport, Building and Urban Development.[35]

As of 1st July 1985, Germany had a total of 6,953,607 gross tonnage registered ships of above 500grt (consisting of German Democratic and German Federal) under her flag.[36] According to the BSH Annual Report of 2004, more than 2,100 ships are registered under the German flag as seagoing ships.

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[35] http://www.independent.com.mt/news.asp?newsitemid=33490
[36] UNCROS, Annex III

4.5.1 Survey questionnaire administered to the German Maritime Authority

The questionnaire administered the German Maritime Administration was as the others, divided into central themes with a series of questions around the theme.

Responding to questions in the first theme, the German Maritime Administration (GMA) has been using the AIS since December 2004 and its use is said to be effective. Compared to other aids to navigation, they believe the AIS is a better choice and could serve in combating crimes such as piracy, ship deviations, and prevention of environmental damage through collisions. The GMA has a system of feedback between their administration and the shipping companies flying their flag.

As to the second theme concerning the use of the AIS, an agency, which is part of the administration, has been put in place to collect relevant data. This information serves the GMA for safety of navigation, efficiency of traffic and environmental protection. Analysis of such data is done manually and automatically. This information gives the GMA better results than what they got through the use of other aids to navigation.

Responding to questions on the third theme concerning benefits from use of AIS, they believe that the AIS has helped in increased their surveillance functions. Their benefit covers all the German territorial waters and the EEZ in securing safety. As to feedback from seafarers and shipping companies, there is a positive response as to the benefit from the use of the AIS.

In the fourth theme of questions, the GMA accepted that making ships under their flag comply with the provision of the international instrument was not difficult as it is mandatory to all sea going ships, which their ships are. The greatest problem they face with handling AIS information is how such information is handled on board.

The weakness they find with this information is how this information can be used statistically since no better means of analysing the information is yet made available. The following can be said from the responses from the GMA:

- The AIS gives better results compared to other aids to navigation,
- AIS can serve in combating crimes at sea such as piracy, deviations and help in environmental protection from pollution,
- A central agency which is part of the GMA is in place to collect information from the use of AIS and this information serves for safety and efficiency of traffic,
- Such data collected is analysed manually and automatically and gives better advantages than information of the same nature formerly collected from the use of other aids to navigation,
- As to the benefits, AIS information serves in increasing safety of navigation in all the German territorial waters and the EEZ,
- Problems encountered with the use of AIS information is mostly on handling on board and for statistical reasons.

4.6 Commissariat aux Affaires Maritime – Luxembourg

The Luxembourg Public Maritime Registry was created on November 9, 1990 (by the Maritime Act of 1990), controlled by the Commissariat aux Affaires Maritime and placed under the Ministry of Economy and Public trade since 2004. In April 2000, they were certified under ISO 9001:2000 standards.[37] Their policy is to "contribute to the economical development of the shipping sector as a service industry and the application of national and international instruments"[38]. The commissariat is in charge of shipping companies and their managers, shipping crews and vessels.

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[37] http://www.cam.etat.lu/en/b_iso9000.htm
[38] http://www.cam.etat.lu/en/b_equipe_cam.htm

Although being a landlocked country, Luxembourg operates as a flag state with all types of fleet. As of May 9, 2006, their registry consist of one hundred and thirty-two (132) ships totalling some seven hundred and twenty thousand, seven hundred and seventy-one (720,771) gross tonnage.[39] 7,869 of the total gross tonnage consists of commercial cruise ships and yachts of less than 300 gross tons.

4.6.1 Survey questionnaire administered to Commissariat aux Affaires Maritime, Luxembourg

The questionnaire was divided into main themes with each theme consisting of several questions around the theme.

The first theme was about the use of the AIS. They are not using the AIS as a VTS service and have not adopted the AIS in their administration so far because they are a landlocked country and have no access to the sea, but of course believed that the AIS could be a better aid for navigation compared to others in place so far. They also saw the AIS as being a good tool in fighting maritime crimes, such as piracy, deviations, prevention of the marine environment from pollution. They also pointed out that there is no feedback mechanism in their administration and shipping companies.

The second theme was on how the AIS data collected was used. Since the Commissariat has not adopted the AIS into their administration, there is obviously no central agency in charge of collection such data, but they think that since the AIS is a tool for it to be reliable, it must be properly used by all parties. They believe that the AIS data give more advantages especially as it has been made mandatory. It will help crew in critical situations and obviously put some pressure on the crew on how to behave properly in discharging their duties.

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[39] http://www.cam.etat.lu/en/c_registre_flotte.htm

The third theme was on the benefits derived from the use of the AIS in surveillance of their waterways. The Commissariat had no opinion to this since their country is landlocked and has no access to the sea.

The fourth theme was on the problems encountered from the use of the AIS. The Commissariat agreed that it was easy for them to make their shipping companies accept the use of the AIS on board their ships, but remained neutral as to the type of problems encountered in the use of the data from AIS and to the problems the crew may face with the use of the AIS. But they agreed that in approximately five years to come, if all parties can get a better experience as to the use of the AIS, there will be some positive results. As to any weaknesses their administration might have realised from the use of the AIS, they remained neutral since to my opinion, they have not adopted the tool into their system for the obvious reason of being a landlocked country.

It can therefore be concluded from the above information from the commissariat that:
- The AIS can be a better aids to navigation to the others that have previously existed
- The AIS can effectively help in fighting crimes at sea, prevention of pollution of the marine environment and any other crimes that may be identified by the international community.
- Depending on the proper use by all parties, the AIS can serve in ship security and can be reliable, since it will help the crew in critical situations and force them to behave properly
- Depending on the experience of all parties, the AIS in approximately five years to come will yield positive results.

CHAPTER FIVE

Data Analysis and Interpretation

5.0 Introduction

In light with the discussions and theoretical framework, analysis of the empirical findings is based on the information obtained from the questionnaire. This chapter is divided into different sections and is made from the basis that will be beneficial and a clear consideration that follow between theory, empiricism and analysis.

This analysis is based on reasoning and argumentation and not just statistical relations between the variables involved. Qualitative information will be used here to explain or make sense of a phenomenon. Every hint here is supposed to paint a picture offered as the solution. To better do this, consideration is made to "what do Maritime Administrations of the European Union (EU) think of the AIS as a possible practical tool to serve in meeting the short comings of previous aids such as the RADAR, ARPA, and ECDIS?"

5.1 Impact of AIS on Safety of Navigation

Here, the AIS apparently since coming into force in December 2004 has led to increasing safety of navigation. Four out of the five respondents to the questionnaire affirm how this has either led to safety of navigation or some proactiveness in daily operations by seafarers. This in a nutshell has increased surveillance and eased the job of coastal states in securing their waterways.

It should be noted that one of the objectives of the AIS is to increase safety of navigation.[40] This is achieved through the AIS "position report" transmitted by ships and received both by shore authorities and other ships in the vicinity.

In cases of pseudo AIS targets, information about ships in the coverage area of the VTS not carrying the AIS is tracked and sent to all ships in the area of coverage equipped with the AIS. This leads the proactive ness of the ships around such a ship not carrying the AIS thereby increasing safety of navigation. Therefore, the installation of the AIS on board ships and shore stations has led to safety of navigation and increased and eased surveillance.

5.2 Impact of the AIS on individual incomes and the marine environment

Imagine the aftermath of the Erika or Prestige on individuals around the coasts of France and Spain, both affecting incomes and their lives. Or better still, imagine the effects of the collision of the Baltic Carrier in 2001 and Fu Shan Hai in 2003 which are considered to be the biggest collisions in the Baltic Sea (over 100 tons of pollutants spilled)[41] on the livelihood and incomes of the people around the affected areas. Collisions obviously leads to closure of touristic sites such as beaches, incomes of those offering hotel services; those selling food and stores around the area are also affected. Sea birds and other marine species are affected by any pollution since they are trapped in the pollutants and die.

With this picture in mind, it is clear that with the objective of AIS being collision prevention, there is obviously an impact on those affected. Four out of the five respondents to the questionnaire being coastal states have affirmed that the AIS used within their area has increased the level of pollution prevention, be it through

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[40] Bernhard Berking, Potential and benefits of AIS to ships and Maritime Administrations, WMU Journal of Maritime affairs, (2003), Vol. 2, N° 1, pg 61 -78
[41] Maritime Transport in the Baltic Sea, Draft HELCOM thematic Assessment in 2006

groundings, or collisions. This is done through analysing the data collected from accidents using the AIS, and meaningful conclusions are drawn so that pollution of such nature can be avoided in the future.

In another note, two of the five respondents to the questionnaire pointed out that AIS data has served them greater advantages than they used to get from other aids to navigation. This is remarkable in SAR operations, planning of fairways and routing systems, ship monitoring and pilotage reasons, as well as port state and coastal state responsibilities. These services go along way to help prevent the environment from damage by ships.

Therefore, if collision is mitigated through AIS, the lives of users of beaches, such as hotel owners, businesses that flourish around the coast, will greatly increase, thereby changing the lives of those directly concerned. Marine life will be spared, making environment more beautiful and touristic activities will increase further increasing the income level of those around the coast.

5.3 Impact on Shipping Companies and Seafarers

Shipping is an international business and shipping companies are profit making entities, therefore, it is of their utmost interest to see their costs reduced to the lowest to allow them to maximize profits. Ship owners and or companies obviously will be happy if their ships sail on the seas without any meaningful damage to the environment considering the cost that they incur in clean ups. Therefore, they are adversely affected if safety of navigation is compromised.

On the other hand, seafarers stand a better chance to gain should their ships sail safely to their destinations without any harm to the environment since this will cost them their jobs. Seafarers gain a lot in employment on board ships since the money gained will help them change the lives of their families. Their respective countries

benefit from inflow of foreign currency into their various economies. Crew supply countries become internationally known if their seafarers get a good reputation of sailing without incidents. [42]   Therefore, it is of the interest of both shipping companies and seafarers to work for the safety of navigation since navigational errors may also lead to death.

Three out of the five MA in responding to the questionnaire had three different opinions as how beneficial the AIS is to shipping companies and seafarers. While the first MA thinks that such a new technology has created some era of romance between the shipping companies and seafarers positively, in that they are able to safely navigate by creating some proactiveness in seafarers' operation of the ship. Another MA believes that it would have been even better should the land based organisations get access to AIS information. In such a way, there will be increased efficiency and increased safety measures taken by seafarers in the discharge of their duties. Like wise, shipping companies will put in place increased safety nets for the safety of their ships since they too will be exposed to the ordeal the seafarers go through. The third MA believes that the putting the AIS in place has created a positivist notion in the minds of the shipping companies and seafarers make them more cautious of their tasks.

Therefore, the AIS is expected to impact some notion of awareness within the shipping companies and seafarers as to what duties they owe the masses and their clientele whose cargo they carry around the world. If this awareness is taken seriously, a net amelioration in safety of navigation and reduced accidents at sea will be seen.

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[42] This is better elaborated in Mandates in Crew Supply administrations course at WMU by Mr. Maximo Meija. An example of the Philippines is better illustration on how there is a central agency within the administration to carter for foreign employment. This helps the government control her international work force and able to calculate foreign exchange entering the Philippines.

5.4 Security Level Impact

For a long time now, security incidences at sea have been characterised by piratical attacks, hijacking and deviation of ships from their normal routes and names changed. The international community being so concerned by these acts, have amended the SUA Convention giving more responsibility to the ship masters to give accurate reporting on any such incidences at sea.
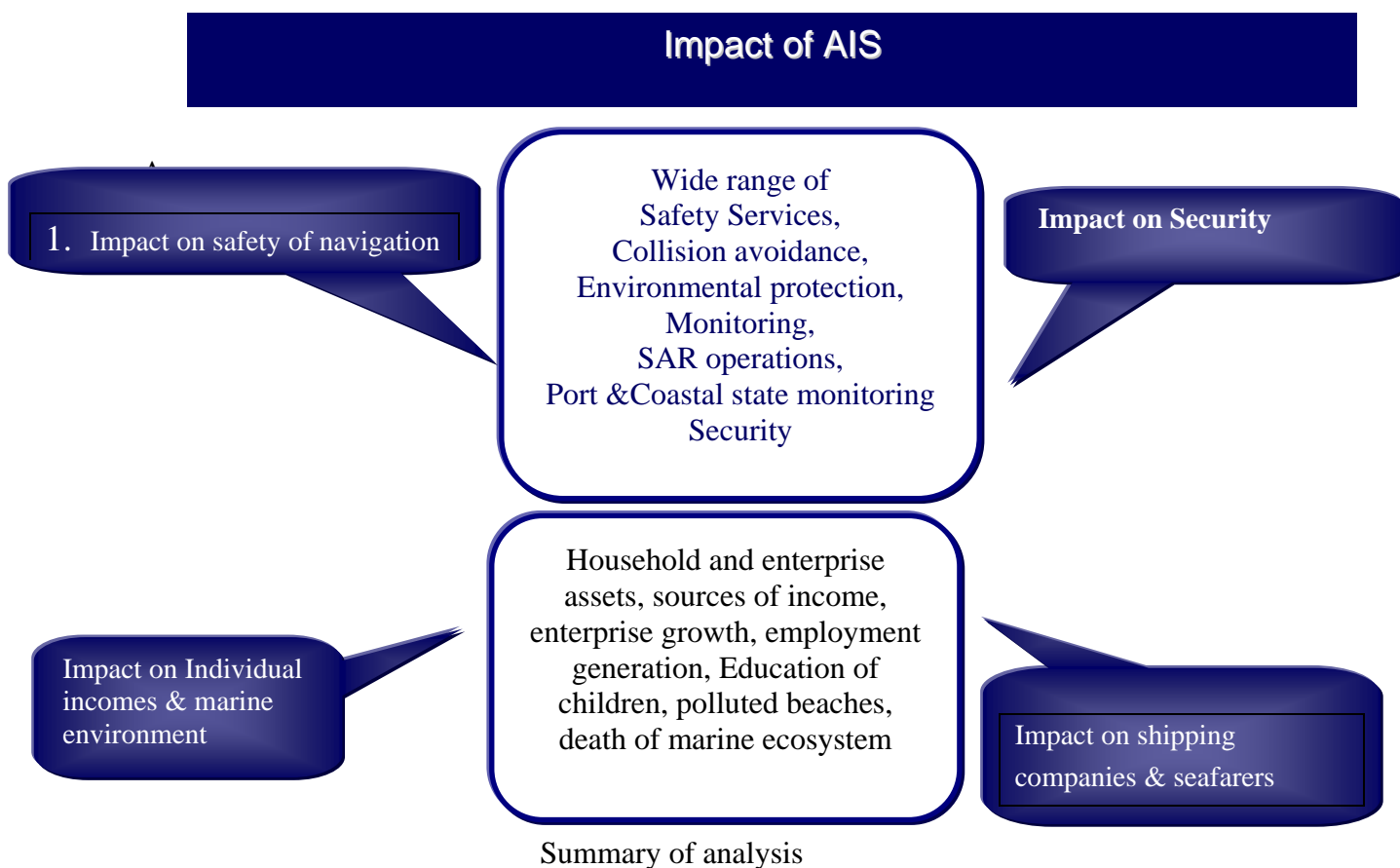
According the first quarter report of 2006 by the International Maritime Bureau (IMB), piratical attacks at sea have witnessed a slight increase of approximately 8% compared to the same period last year. The actual number of reported piracy attacks in the first three months of 2006 was 61, giving an increase of 5 more attacks over the 56 attacks noted in the same period of the 2005.[43] According to Captain Pottengal Mukundan, IMB Director, the dramatical fall in levels of piratical attacks can be attributed to increased law enforcement activities in high risk areas, awareness, and anti-piracy watches by shipmasters in risk prone areas.[44]

In the same connection, the Maritime Administrations who responded to the survey questionnaire believe that with the use of the AIS, the piratical attack levels may even drop further. Thus, three out of the five maritime administrations think that piracy can be monitored should all ships carry the AIS, but one thinks that most masters may switch off the AIS in areas where attacks may be expected. Two of the MAs believe that the AIS too can help in fighting the deviation of ships while on voyage.

But as is the case with every new technology, the AIS too has its shortcomings when it comes to security issues. This is mostly concerned with the range of coverage and data input that may expose ships to potential pirates, since the ship is expected to

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[43] IMB Piracy and armed robbery against ships 1st quarter (1st January – 31st March) 2006, London, April 2006

give her information to all ships around its vicinity to avoid collision. In this way, the pirates may easily know which ship is approaching them and which cargo that particular ship is carrying[45]. As to the range of the AIS coverage, as Wim F.M. van der Heijden of TNO Physics and Electronics Laboratory at The Hague proposes, the Long range INMARSAT transponders (LRIT) will help overcome these shortcomings. This idea was also accepted by one of the MA.

Impact of AIS

1. Impact on safety of navigation

Wide range of
Safety Services,
Collision avoidance,
Environmental protection,
Monitoring,
SAR operations,
Port &Coastal state monitoring
Security

Impact on Security

Impact on Individual incomes & marine environment

Household and enterprise assets, sources of income, enterprise growth, employment generation, Education of children, polluted beaches, death of marine ecosystem

Impact on shipping companies & seafarers

Summary of analysis

Source: Self formulation, June-2006

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[44] http://www.icc-ccs.org/main/news.php?newsid=67

[45] Hans Ramsvik, AIS as a tool for safety of navigation and security – Improvement or not?, Det Norske Veritas

CHAPTER SIX

Summary, Conclusion and Recommendations

6.1 Introduction

This chapter tries to present a summary of ship board security analysis for safe navigation using the AIS; a practical view of some Maritime Administrations of the EU, and make provision for further research in this same line to further enhance safety of navigation. The conclusion tries to provide a possible answer to the research question, "What do Maritime Administrations of the European Union (EU) think of the AIS as a possible practical tool to serve in meeting the short comings of previous aids to navigation" such as the RADAR, ARPA, and ECDIS?

6.2 Summary of Findings

Literally speaking, the IMO to meet her slogan of "Safe, Secure and Efficient Shipping on Clean Oceans" has adopted the two approaches discussed earlier in Chapter three. These two approaches have been guided through conventions and the putting in place of all safety measures such as aids to navigation. Safety of navigation can be said to be more than just through increasing aids to navigation and conventions, but on the total commitment of all stakeholders concerned.

Here is a summary of the findings simply put in two paragraphs:
Firstly, the AIS is considered to possess greater advantages as an aid to navigation over the others that existed before, considering the easy identification of ships without having to call on the VHF, if updated with the LRIT, then the shortcomings of the present status of the AIS will be upgraded using the long range communication. Through the LRIT, ships will be identified even before they enter the coastal waters;

accidents like the mysterious sinking of the British bulk carrier, Derbyshire that sank off the coast of Okinawa on September 10, 1980 would have at least not gone unnoticed had it been in an era of AIS and LRIT installed on board.

Secondly, the AIS has a greater impact on collision avoidance especially as previous aids to navigation such as ARPA, and RADAR data had their shortcomings that will be better corrected with the coming into force by AIS use. These shortcomings include the following:

ARPA information:
- There is usually delay in all ARPA data, which makes manoeuvring poor
- In cases where ARPA data is received, for the data to make sense as to be used for communication, such data must be smooth.
- It is easy to loss tracked targets using the ARPA especially in clutter, manoeuvring, and target swaps.
- It was difficult to identify other targets on ARPA

RADAR information:
- The range of coverage was highly limited in areas of poor metrological conditions such as in snow, or rain.
- Targets that are close to each other were not easily separated by use of the RADAR, since RADAR depended mostly on reflection of the targets on the screen
- In areas such as bends, bridges, or major obstacles, the targeting of objects was said to be masked and made RADAR impossible to detect the targets.

With these shortcomings, collision avoidance with ARPA and RADAR was hard. But all these shortcomings will be corrected with the use of AIS especially as it possesses the following tracking potentials over the previous two:

- Vessel identification be it from long range or short range, through ships voluntarily sending out such information to other ships and coastal authorities.
- Real time target data such as speed over ground, draught of ship, navigational status, heading, and rate of turn is easily made available to oncoming ships, making talking on VHF reduced.
- Manoeuvring detection is easy and immediate
- Increased coverage during navigation is easy. The mariner is able to look behind the masked targets.
- Increased detection in conditions of sea clutter; no ghost targets; targets are not lost thereby making decisions unambiguous.

6.3 Conclusion

Safety of navigation can be said to be far from increasing the bridge equipment. But this all depends on how well the bridge equipment is properly used. Increasing bridge equipment leaves the officer on watch with much to do in order to take a final decision when faced with any situation. Therefore delays may be very dangerous and may also lead to unnecessary accidents.

In most cases, ships are just fitted with the simple AIS especially as the data received by the mariner still cannot make sense to many of them. This therefore means, just as some flag states simply ratify international instruments for ratification sake, without the necessary man power to enforce them, ship owners may turn to installation of more bridge equipment for the sake of their ships not being detained by Port State Control Officers when they call at ports. The use of AIS cannot be under estimated, but what comes out from such use and the way the international community reacts to the use of it, may be the area of concern.

It can be realised that using the AIS, security concerns may even increase in the days ahead as pirates may easily target their ships on the high seas, since one can easily identify the ship, and in situations where the mariner erroneously provides the information of the type of cargo the ship is carrying, that may make things worse. Tracking of the vessel may even be made worse in cases where the mariner switches off the AIS in piracy prone areas. This means loss of contact with may be the shore authorities, thereby leaving the mariner at the mercy of the sea and pirates.

The AIS should not be considered as an end to navigational problems especially as it man made and operated by man. There may be some serious problems with targets not being displayed on the screen of the mariner, because may be target is not fitted with the AIS, or in cases where the AIS has been switched off. In situations where the GPS position is wrong, there will be problems with the AIS network, therefore resulting in wrong information about ghost targets, and ghost manoeuvring. Imagine the impact of such information being transmitted to other ships and the recipient ship uses such information to navigate. This implies serious accidents. Even though the AIS has made it easy to identify the targets, there is a tendency that these targets at times are over crowded and overflow. In congested waters, this will create problems as mariners are faced with certain targets being static (non moving ships).

In conclusion, it will be wrong for mariners to totally rely on the use of the AIS for navigation. AIS can be said to be a means to an end and not an end in itself. In other words, for there to be safety of navigation, the mariner should try as much as possible to base his decisions on two or more sources, comparing the results of two navigational aids.

6.4 Recommendations

In every society, they are rules and norms that must be followed. The same too is the maritime industry that has its rules in the form of conventions that have to be followed. But the problem comes in at the level of how the reality is perceived. This reality is governed by different cultures and many people turn to look at things from a different perspective, thereby making implementation of these conventions not uniform and so doing compromising safety of navigation.

It is therefore to the advantage of the international community to look at the pros and cons of all aids to navigation and recommend what they think best rather than leaving the market to be forced by technology. This should be done taking into consideration what is wanted to be achieved. In other words, if comparing the advantages derived from the combination of AIS/ECDIS as opposed to AIS/RADAR, and AIS/ARPA. Care should be taken as how there could be a possible back up system and voyage recording during any voyages as it is in the aviation industry where there is a voice recorder (black box), as to permit accident investigations should there be any. But from all indications, the best recommended combination that the international community should be based on should be ECDIS/AIS since ECDIS in itself integrates GPS information with other sailing sensors such as the RADAR, AIS, the fathometer and at same time gives sailing directions (through the route planning and route monitoring functions) that helps in avoiding grounding. Not only this, ECDIS is equipped with a voyage recording system. Therefore, the best combination with AIS for mariners for safety of navigation should be the AIS/ECDIS.

Due to the huge amount of data from AIS, most often the mariner has so much to do and may be confused with what to do with such data. Therefore, it would be better for the international community to encourage AIS data to be presented in a simplified manner such as graphically, which will be easy to interpret by mariners. AIS

information for now is considered to be complex any software to analyse such information is still in-existent. Therefore, the best manner of presenting such information is graphically.

Another area of concern is the Collision Regulation (COLREG) that should be amended since it was adopted in the years when there were still slow moving ships. But the industry today is made of fast ships of more than 40 knots. This will make provisions for compatibility with new technology the industry is using today.

Further research should be encouraged in the area of safety of navigation especially using the safety culture of various flag states. This is because the conventions and technology are there, but there is still no safety in navigation. Is it a matter of new conventions needed or what is the problem that the industry is still not safe? A critical look should be taken into how the flag states uniformly implement the existing conventions and what is needed for them to do so.

Appendix

Questionnaire Administered to Maritime Administrations

General Information

1. Name of respondent:
2. Organisation/Maritime Administration (MA):
3. Position held:

Use of AIS

4. i) Is your MA using AIS as a VTS service? a) Yes b) No

   ii) If No, do you consider the use not important? a) Yes b) No c) other reason
5. How long has your administration adopted the use of AIS?
6. How effective has your MA compliance with ships on the issue of AIS?

   i)   a) very effective b) effective c) not effective d) neutral

   ii)   If your answer to i) above is c or d, what should be the problem then? a) difficult to implement b) concept not well understood c)other reason
7. i) Compared with other navigation aids such as GMDSS, do you think the AIS is more   preferred? a) Yes b)No

   ii) If your answer is NO, briefly, what is your opinion to the use of AIS?
8. Do you think AIS can effectively replace the other navigational aids to fight against crime? (tick where appropriate)

   i)   Piracy

   ii)   Deviations

   iii)   Environmental damage

   iv)   Other known crimes (list)

9. Is there a system of feedback within your administration whereby, shipping companies give their ideas from the use of AIS?

Use of data collected

10. i) Is there any central agency charged with collecting AIS data? a) Yes b) No

   ii) If Yes, is the agency part of your administration or an independent body?

   iii) How many employees are they in the department charged with collecting such data?

11. What exactly does this information/data serve your administration?

12. Do you think AIS data really give the desired results as to serve for ship security during navigation? How do you analyse the data collected to be able to come out with the results needed?

13. Briefly, in your opinion, do you think AIS data gives more advantages than what was gotten before from other navigational aids?

Benefits from use of AIS

14. How beneficial has AIS come to ease your task of surveillance?

15. If beneficial, can you list some areas that your administration has benefited most from the use of AIS?

16. If your answer to question 8 above was Yes, list, what benefits do shipping companies and seafarers say they derive from the use of AIS?

Problems from use of AIS

17. i) Was it easy making shipping companies install AIS on board their ships?
    a. Yes b) No
    ii) If No, what types of problems did they pose

18. Briefly, what type of problems do you encounter generally with the use of AIS data?

19. If your answer to question 8 above was No, list, what were the problems posed by these shipping companies/seafarers?

20. Say five years from today, how do you foresee the future of AIS as a means to fighting the problems you mentioned in question 7 above?

21. In your opinion, what other weaknesses have your administration realised from the use of AIS (list)?

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