

# Advanced Navigation System (ANS) in the Mediterranean Sea “Regional Project for Management Control System”

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**Abstract-** Mediterranean Sea is a major oil and gas transportation route accommodating a large number of ships crossing the sea annually; it is an area in which the oil and gas industry is highly active with several important producers located in the region. Despite increased environmental awareness and international conventions on pollution, marine pollution continues to be an environmental issue; the oil well explosion was a tragic accident that preventable with different systems and procedures in place. Going forward, the safety of workers and the environment must be of paramount importance, and a guiding principal for all in the regulation, exploration, and production of oil and gas. New systems and procedures must now be described, implemented and regulated, however, in a way that is reliable and transparent. This will allow the nation's offshore oil and natural gas industry to return to work in a way that will preserve thousands of critical jobs, in a region just beginning to recover from unprecedented hardship.

Advancements in information technology have significant impacts on the shipping industry. Many of the modern navigational technologies and data are amenable to computerization. A key hydrographic survey within the Traffic Separation Scheme (TSS) of the Straits of Malacca and Singapore, as part of the Marine Electronic Highway (MEH) Demonstration Project, a regional project of the Global Environment Facility (GEF)/World Bank, which International Maritime Organization (IMO) is executing. The demonstration project aims to link shore-based marine information and communication infrastructure with the corresponding navigational and communication facilities aboard transiting ships, while being also capable of incorporating marine environmental management systems. The deployment of information systems in more mature applications such as in a Marine Electronic Highway could lead to the integration of maritime safety technologies with marine environment management and protection systems resulting in improved performance, new capabilities and innovative applications. MEH provides a host of potential opportunities and benefits not only for the shipping industry, but also to a variety of users. Its application may be extended to environmental management programs, search-and-rescue operations, anti-piracy program, environmental impact assessment, and fisheries/aquaculture management, among others. The use of such experience to execute a similar project as Malacca Strait MEH in the Mediterranean Sea can be considered an important need for such strategic place.

**Key words:** Marine Electronic Highway -The Traffic Separation Scheme – The oil industry – The Geographic Information System – The Space borne Synthetic Aperture Radar.

## 1. Introduction

The Mediterranean region has so far been a relatively small producer of offshore oil and gas as compared to the world production. In 2011, total offshore oil and gas production in the Mediterranean region was estimated at 87 million toe (Tone of Oil Equivalent) with 19 million toe crude oil, 68 million toe natural gas. However, Mediterranean oil reserves represent 9,400 million toe, equivalent to 4.6% of world oil reserves. Offshore structures and waste streams can affect marine species and the entire food web through intrusive noise and the possible introduction of non-indigenous species. Explosions and drilling can also cause seafloor and geological disturbances. This impact increases as

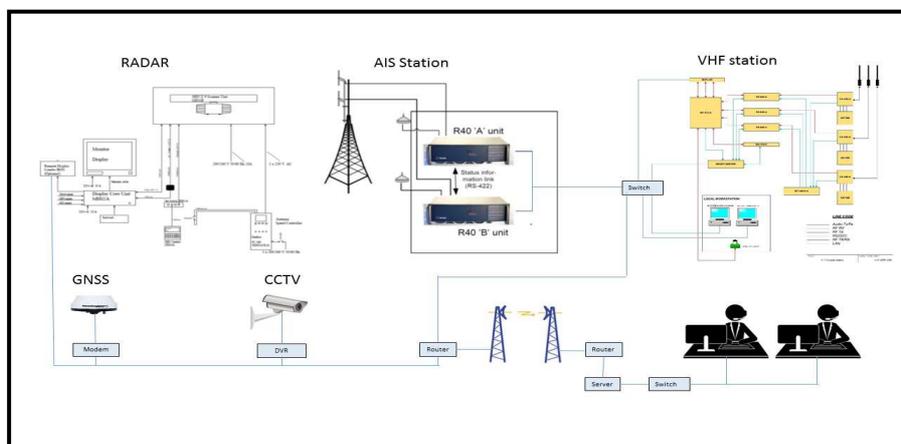
offshore exploration activities go deeper, a trend that is observed worldwide and in the Mediterranean Sea. (WWF, 2015) Overall vessel activity within the Mediterranean has been rising steadily over the past 10 years and is projected to increase by a further 18 per cent over the next 10 years. Transits through the Mediterranean are expected to rise by 23 per cent. Increases in vessel activity will be coupled with the deployment of ever larger vessels. The development of new pipelines by passing the Bosphorus and the expansion of current pipeline capacity is likely to result in a significant increase in the density of tanker deployment in the eastern Mediterranean. The Mediterranean is both a major load and discharge centre for crude oil. Approximately 18 per cent of global seaborne crude oil shipments take place within or through the Mediterranean. North African ports in Libya, Algeria, Tunisia and Persian Gulf oil shipped via Egypt account for over 90 per cent of all crude oil loaded in the Mediterranean. Italy accounts for nearly half of all crude oil discharged in the Mediterranean. Exports of crude oil from Black Sea ports averaging at over 100 million tons a year are expected to continue to rise, resulting in continued seaborne transits via the Bosphorus and increased use of eastern Mediterranean ports linked to new pipelines intended to bypass the Bosphorus. (SAFEMED, 2008)

The Mediterranean Sea is a high risk of marine pollution, and came up with possible ways of which the marine pollution can be prevented with measures in place to check and minimize the occurrence of the spill in this special area. The most important challenge of IMO nowadays is to develop a framework which accommodates and builds on existing systems already furthering the concept of Navigation system by integration and display of maritime information onboard and ashore by electronic means to enhance berth-to-berth navigation and related services, safety and security at sea and protection of the marine environment. The most important projects in focused and related with the Navigation system are World Bank-funded Marine Electronic Highway (MEH) project in the Malacca Straits. During the last years the possibilities and value of satellite based detection of oil spills could be impressively demonstrated, as well as in operational near real time processing and transmission of the satellite based results to the users on board vessels. (Bak, 2013) Pollution can be caused by a collision or by accidental or deliberate dumping. Pollution from vessels is often not discovered until it is found on the coastline many hours after the vessel has departed the area. This provides a problem for Law Enforcement and so it is clear that if pollution incidents are to be handled effectively the important criteria are early detection and the ability to contain the pollutant before it spreads uncontrollably. In addition, if early detection can be implemented then it may be possible to identify and arrest the polluter before he leaves the area. Safety of Navigation and efficiency of Vessel traffic services (VTS) are essential to minimize the risk of collisions that could pollute the marine environment. (VTMIS, 2016)

## **2. The development of Vessel Traffic Services**

Traditionally, the master of a ship has been responsible for a ship's course and speed, assisted by a pilot where necessary. Ships approaching a port would announce their arrival using flag signals. With the development of radio in the late 19th century, radio contact became more important. But the development of radar during World War Two made it possible to accurately monitor and track shipping traffic. The world's first harbor surveillance radar was inaugurated in Liverpool, England, in July 1948 and in March 1950; a radar surveillance system was established at Long Beach, California - the first such system in the United States. The ability of the coastal authority to keep track of shipping traffic by radar, combined with the facility to transmit messages concerning navigation to those ships by radio, therefore constituted the first formal VTS systems. The value of VTS in navigation safety was first recognized by IMO in resolution A.158 (ES.IV) Recommendation on Port Advisory Systems adopted in 1968, but as technology advanced and the equipment to track and monitor shipping traffic became more sophisticated, it was clear guidelines were needed on standardizing procedures in setting up VTS. In particular, it became apparent that there was a need to clarify when a VTS might be established and to allay fears in some quarters that a VTS might impinge on the ship's master's responsibility for navigating the vessel. As a result, in 1985, IMO adopted resolution A.578 (14) Guidelines for Vessel Traffic Services, which said that VTS was particularly appropriate in the approaches and access channels of a port and in areas having high traffic density, movements of noxious or dangerous cargoes, navigational difficulties, narrow channels, or environmental sensitivity.

The Guidelines also made clear that decisions concerning effective navigation and maneuvering of the vessel remained with the ship's master. The Guidelines also highlighted the importance of pilotage in a VTS and reporting procedures for ships passing through an area where a VTS operates. (IMO, 2016a) Vessels Traffic Management Systems (VTMS) are making valuable contribution to safer navigation, more efficient traffic flow, and protection of the environment. Incidents and emergency situations can be dealt with quickly. The VTMS traffic image is compiled and collected by means of advanced sensors such as radar, Direction Finding (DF), Closed-Circuit Television (CCTV), Automatic Identification System (AIS) and Very High Frequency radio (VHF) or other co-operative systems and services. A modern VTMS integrates all of the information into a single operator working environment for ease of use and in order to allow for effective traffic organization and communication. The Mini-VTS-Systems as shown in figure 1 or complex VTMS with several radars, integration with VHF, AIS, GNSS, CCTV, DF, Operator Positions, and Power Supplies etc. For the smaller harbors the Mini-VTS should be more than sufficient, with options for add-ons if any rise in demand occurs. For large ports covering larger areas with several operators and integration with other ports or Authorities, a more complex system is recommended. The VTS also has many impacts especially in the Mediterranean Sea due to many challenges in this area. (ARLO, 2016)



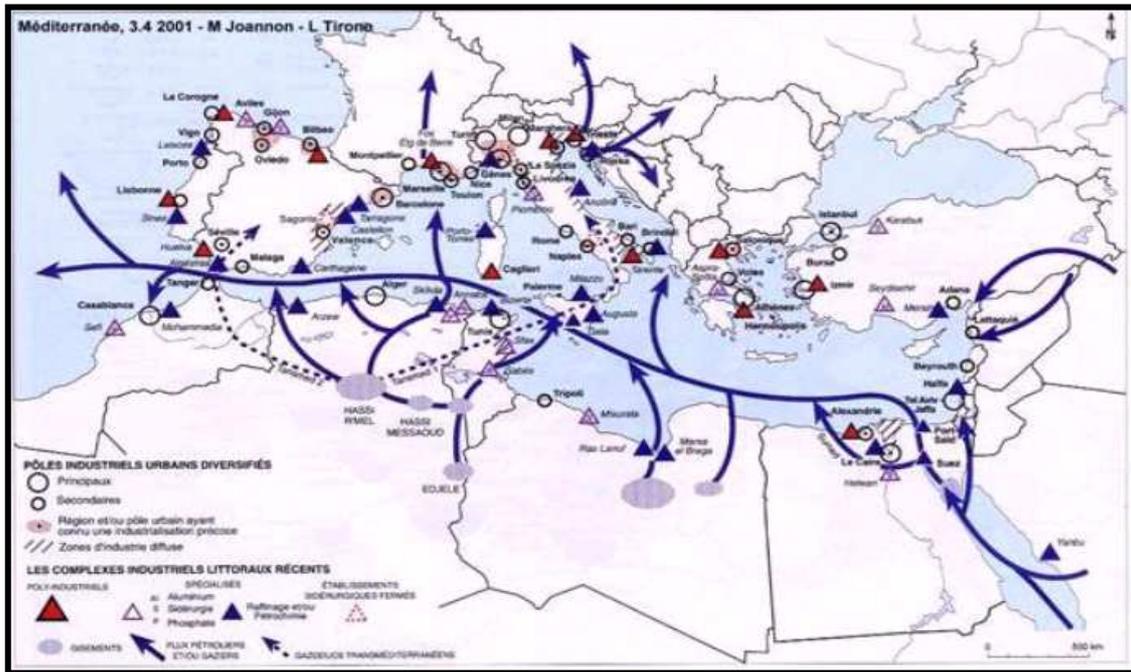
**Figure 1: The Mini-VTS-Systems**  
Source: (ARLO, 2016)

### 3. Environmental Challenges in the Mediterranean Sea

The Mediterranean Sea is one of the most important areas in the world in terms of maritime transport; it is the world's largest inland sea covering an area of 2,499,350 sq km. The Mediterranean Sea also is a body of water that is almost completely surrounded by land. It lies between three continents: Europe to the north, Asia to the east and Africa to the south. It stretches over 2,500 miles (4000 km) from Gibraltar to Israel. It is connected to the Atlantic through a 14 km wide strait, where Europe and Africa meet. The Suez Canal links it to the Red Sea and the Bosphorus to the Black Sea. The environmental challenges in this area depend on the shipping and trades there. (Worldatlas, 2016)

#### 3.1 Shipping in Mediterranean Sea

The Mediterranean Sea is one of the crowded area in terms of shipping activities as shows in figure 2, with about 30% of international marine trade taking place among the ports of Mediterranean and nearby seas. Every year nearly 20.000 tons of petroleum leaks to Mediterranean from the surrounded 60 oil refining plants as a result of consciously or unconsciously accidents.



**Figure 2: Shipping Routes in the Mediterranean Sea**  
**Source: (IRIT, 2005)**

In the last few years there has been growing acknowledgement that the seas which surround Europe offer significant opportunities for - and potential risks to - territorial development. The sea provides resources on and in its waters and on and under the sea bed that can be harnessed as the basis for territorial development; it enables the flow of goods, services and people, connecting different parts of Europe to each other and the wider global community; and it provides an important environmental asset that needs careful management not least because the health of the sea is critical to efforts to combat climate change. However, different stakeholders have different priorities in terms of what uses and priorities should be privileged in different parts of the maritime environment and few have an overview of the range of issues that require consideration in making such judgments in an informed way. (Sciencedirect, 2016)

### 3.2 Crude Oil and Gas Trades within the Mediterranean

Crude oil and Liquefied Natural Gas (LNG) trades are concentrated around a relatively small population of load and discharge ports and routes in the western and central of Mediterranean Sea. Crude oil shipment from Novorossiysk (Russia) to the Mediterranean destination and from Sidikerir to both Mediterranean destination and ports west of Gibraltar as well as exports from the Persian Gulf through the Mediterranean via Suez dominated the major traffic lanes. (Unepmap, 2008) The largest vessels observed operating in the Mediterranean are crude oil tankers. Crude oil tankers calling at Mediterranean ports average 125,000 DWT - an increase in size of 26 per cent over the past 10 years. During the same period the number of crude oil tanker port calls within the Mediterranean has increased by 41 per cent. Conversely, average crude oil tanker sizes for vessels transiting the Mediterranean have fallen by 31% to 160,000 DWT whilst the level of transit activity has risen significantly by 147%. The Mediterranean is both a major load and discharge center for crude oil. Approximately 18% of global seaborne crude oil shipments take place within or through the Mediterranean. North Africa port in Libya, Algeria, Tunisia, and Persian Gulf oil shipped via Egypt account for over 90% of all crude oil loaded in the Mediterranean. Italy accounts for nearly half of all crude oil discharged in the Mediterranean. Exports of crude oil from black sea ports averaging at over 100 million tons a year are expected to continue to rise, resulting in continuous seaborne transits via the Bosphorus and increased use of eastern Mediterranean ports linked to new pipeline intended to bypass the Bosphorus. The resumption of Iraq; crude supplies via Ceyhan in turkey and via Pipeline

development will increase oil exports from eastern Mediterranean sea load terminals, but if black sea exports continues to increase, this may not result in a significant fall in oil exported through the Bosphorus. (Statoil, 2013) Around 80 per cent of Mediterranean ports are located in the west and central Mediterranean region. The majority of Crude Oil consumed by Mediterranean countries transported by pipeline. Spain is currently an exception in transporting a large portion of its Crude Oil supplies by ship to its six terminals (3 of which are in the Mediterranean). Several Mediterranean countries have plans underway to develop Crude Oil terminals in order to lessen dependence on a small set of supplier countries. (Ports, 2014) Due to all this information should establish a demonstration project same the MEH system in the Straits of Malacca and Singapore.

#### **4. Marine Electronic Highway (MEH) Demonstration Project**

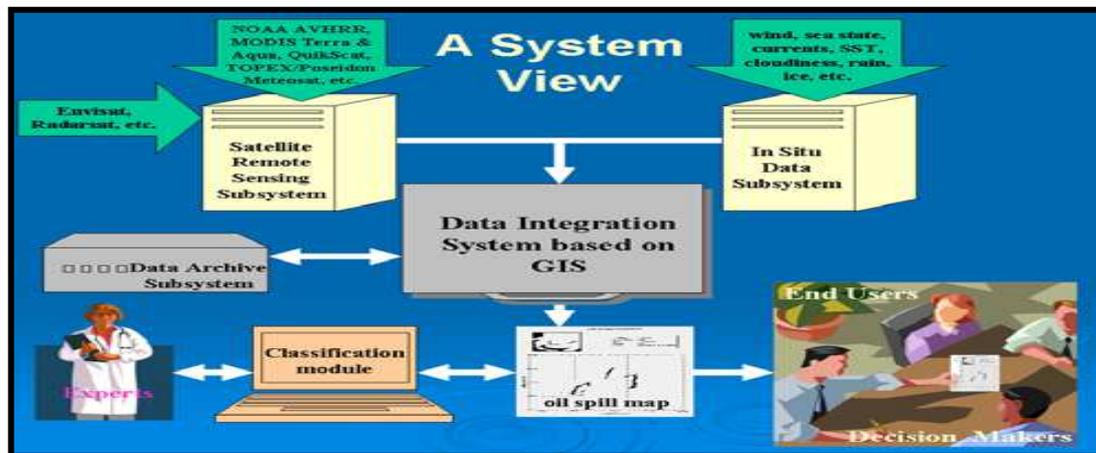
The International Maritime Organization (IMO) implemented the Marine Electronic Highway (MEH) Demonstration Project in the Straits of Malacca and Singapore (SOMS) following the signing, on 19<sup>th</sup> of June 2005, agreement between the Global Environment Facility (GEF)/World Bank and IMO. This project was developed by a separate grant from GEF/World Bank to IMO with the participation of the three littoral States and shipping associations. The MEH Demonstration Project was a collaborative agreement between IMO and the littoral States of Indonesia, Malaysia and Singapore and in partnership with the Republic of Korea, International Hydrographic Commission, the International Chamber of Shipping and the International Association of Independent Tanker Owners. The regional demonstration project aimed to link shore-based marine information and communication infrastructure with the corresponding navigational and communication facilities aboard transiting ships, while being also capable of incorporating marine environmental management systems. The overall objectives were to enhance maritime services, improve navigational safety and security and promote marine environment protection and the sustainable development and use of the coastal and marine resources of the Straits' littoral States, Indonesia, Malaysia and Singapore (Sekimizu, 2006).

The MEH system with its environmental modules can be used in marine pollution response and control such as to predict the direction and speed of oil spill and aid in response and clean-up. It is also possible to use it to identify and track ships that illegally discharge their bilges or dump other oily wastes. The Marine Electronic Highway (MEH) is envisioned to be a regional network of marine information technologies linked through the ENC-ECDIS. The availability of differential global positioning system (DGPS) with accuracy of 1 to 5 meters enhances the navigational accuracy of ENC-ECDIS especially in congested and confined waters. Recent enhancements in maritime safety infrastructure and regulatory mechanisms have improved navigational safety and traffic flow. Singapore has an efficient radar-based ship position monitoring system covering the Singapore Strait. In 1998, the three littoral states of Republic of Indonesia, Malaysia, and Republic of Singapore jointly commissioned a mandatory ship reporting system (STRAITREP) for the most congested 300 kilometer section of the Straits from One Fathom Bank to the Singapore Strait, which combines radar and automatic ship identification and tracking. However, the threat of collisions and groundings and of consequent environmental damage is still significant and, with rapid traffic growth, is increasing. (IMO, 2016b)

#### **5. Development of technologies to detect oil spill**

In dealing with oil spill, a number of technologies have been developed to detect and deal with oil spill. Some of the technologies developed include; Geographic Information System (GIS), Satellite-Mounted Synthetic-Aperture Radar (SAR), Ground Penetrating Radar (GPR) and Remote Sensing Technology (RST). The Geographic Information System (GIS) is proven to be an excellent management tool for resource assessment, oil spill response, and planning damage assessment. GIS approach to a problem of oil spill mapping includes integration of the geographical, remote sensing, oil & gas production/infrastructure data and slick signatures, detected by SAR, in GIS as shows in figure 3. Compiled from data of several sources including nautical maps, geo-databases, ground truth and remote sensing data, GIS allows retrieval of key information, i.e. predict spill locations, reveal

offshore/onshore sources, and estimate intensity of oil pollution. SAR and GIS technologies can significantly improve identification or even classification of oil spills allowing making the final product - oil spill distribution maps.



**Figure 3: A view of oil spill monitoring system based on GIS**

**Source: (Scanex, 2009)**

GIS became widely used for spill planning and response because they support integration and preparation of geospatial information on the location, nature and sensitivities of different resources with rapid access. Developments in geospatial and remote sensing technologies have also assisted improvements in GIS systems for oil spill management. Recent examples include the use of real-time multisensory satellite information, development of internet-based GIS systems, which better support sharing of GIS information among users and the public, and oil spill drift models. GIS is especially useful in oil spill sensitivity mapping, planning and response because these systems allow the integration of information from many different sources and allow the displaying this information. (Scanex, 2009) The Space borne Synthetic Aperture Radar (SAR) is the primary method for oil-spill detection involves satellite-mounted synthetic-aperture radar. This technology, which can see through clouds and in the dark, involves bouncing radio waves from orbiting satellites off the surface of the sea. (Businessinsider, 2012)

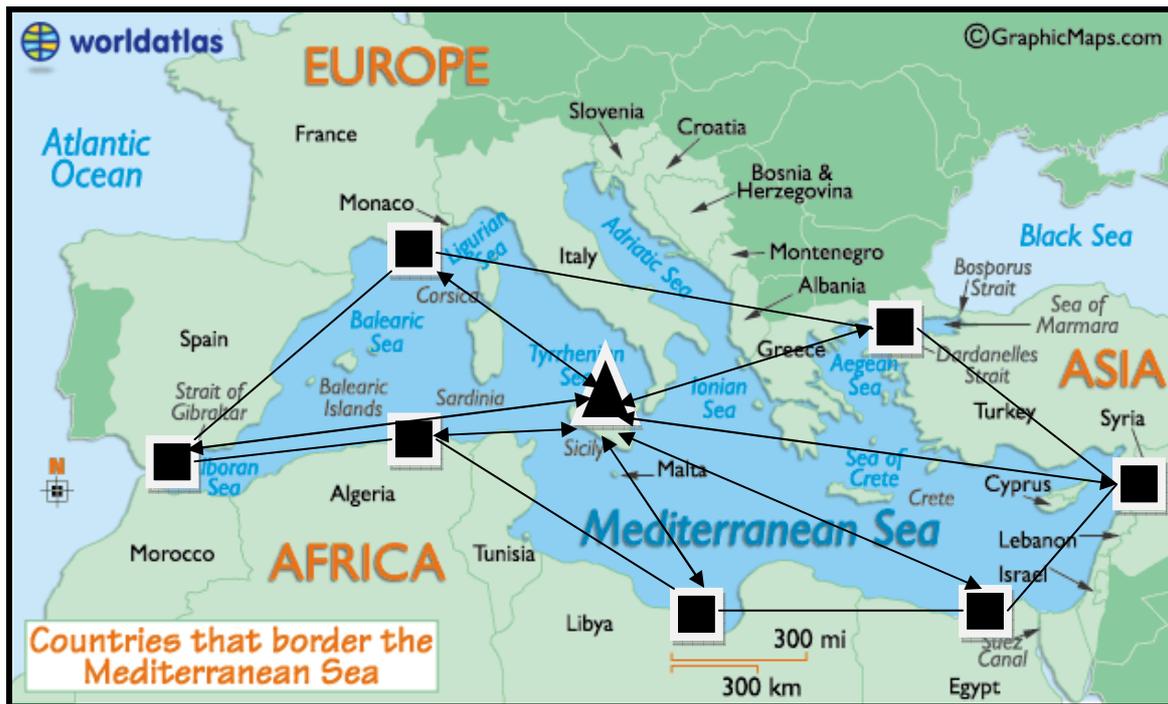
This component provides for the production of the navigational information on which the MEH system will be based. The activities comprise: first the navigational and hydrographical activities Install and operate tidal and current equipment on the Republic of Indonesia's coast of the Strait of Malacca, including provision of relevant maritime navigational facilities, second the hydrographic survey which carry out of multi-beam hydrographic survey within the Traffic Separation Scheme of the strait Malacca and Singapore, third the Electronic Navigation Charts (ENC) which Production of high resolution ENC for the Project Area, including provision of ENC software licenses to the Republic of Indonesia and Malaysia, fourth and finally the information exchange system which establishment of a MEH information exchange system, including data servers, data exchange protocols and training of staff in data exchange, which part of the MEH Data Centers. (MEH, 2005)

## **6. Proposed (ANS) project for the Mediterranean Sea**

The Mediterranean Sea plays a historical role in the maritime trade; it continue to be a vital area for international shipping today and considered to be world's sensitive shipping lanes, primarily due to its proximity to the oil and gas field in the area. Most of the ships that use the Mediterranean Sea for transportation purposes are large tankers, whose travels often conclude in Asia, Africa or Europe.

The new system (ANS) based built upon a network of electronic navigational charts using electronic chart display and information systems (ECDIS) and environmental management tools as shows in figure 4, which use main station nearby Sicily island and another seven substations distributed upon some countries in the Mediterranean Sea by integrated system between all of them, all combining in

an integrated platform covering the region that allows the maximum of information to be made available both to ships and shipmasters as well as to shore-based users, such as vessel traffic services. The overall system –which would also include positioning systems, real-time navigational information like tidal and current data, as well as providing meteorological and oceanographic information –is designed to assist in the overall traffic management and provide the basis for sound marine environmental protection and management. Characteristics of marine traffic are becoming intense, with faster and bigger ships of all categories. The potential for accidents with dangerous cargos involving chemical or oil pollution has been stated and underlined many times during the past decades, so need to tract the movement of ship had become evident, especially in narrow and curved channels which are difficult to monitor and required much more complicated rules of procedures.



**Figure 4: Demonstration Project in the Mediterranean Sea**  
**Source: (Worldatlas, 2016)**

Improve the performance of maritime safety and maritime security and protection of the maritime environment in the region. The Proposed project for the Mediterranean Sea could be initiated and run through stages. **First stage** is to be developed for the purpose of gathering the data and information of current situation of the VTS system, Marine Communications, SAR system, Marine Pollution. **Second stage** is planning and organizing the project component and action plans for different aspects which may include baseline Survey, Ship Board Equipment and communications, Marine Environment Project, Emergency Response system and Management system. **Third stage** is to establish the information system includes Electronic Navigational Chart (ENC) for the Area, Tidal Equipment and Automatic Identification System (AIS) stations. **Fourth and last stage** is to carry out in addition a continuous monitoring and assessment of the technical functionalities. It provides a host of potential opportunities and benefits not only for the shipping industry, but also to a variety of users. Its application may be extended to environmental management programs, search-and-rescue operations, anti-piracy program, environmental impact assessment, and fisheries/aquaculture management, among others. The implementation of the Project and the lessons to be learned will thus be much anticipated.

## 7. Conclusion and recommendations

## 7.1 Conclusion

Amongst the numerous environmental concerns we are facing, the marine environment is one of the top priorities that must be addressed. The Mediterranean Sea is one of the most important and busiest seas in the world in terms of maritime transport, and shipping activities, with about 30% of international marine trade taking place among the ports of Mediterranean and nearby seas. The Mediterranean is both a major load and discharge center for crude oil. Approximately 18% of global seaborne crude oil shipments take place within or through the Mediterranean. There are more than 40 refineries with a combined capacity of around 458 million tons per annum. The largest exporters of oil are in Libya, Algeria, Egypt, and Syria, with major imports taking place into France, Italy, Spain and Turkey. Oil spills only make up about 12% of the oil that enters the ocean, but it is still the worst form of ocean pollution, with its effects being immediate, long-term and extremely damaging. The oil spreads rapidly, and forms a thin, film-like layer on the surface, as it cannot be dissolved. The oil slick suffocates fish, gets caught in marine birds' feathers, and blocks light. With a long-term outcome, oil spills can cause reproductive and growth problems in marine creatures.

Furthermore, the Mediterranean Sea is considered as an area with a high risk of accidental pollution due to the density of traffic, the large number of ports and the existence of a large number of scattered islands and other insular features situated at short distances from international shipping routes. The use of information systems in more mature and expansive applications such as in a marine electronic highway that integrates maritime safety technologies and environmental management systems will improve the performance, situational awareness and innovative applications to enhanced monitoring system. Offshore exploitation activities increase the risk and potential for a major oil spill incident. As such, it creates new demands and challenges to Mediterranean countries which must not be underestimated.

## 7.2 Recommendations

- 1) Initiate the application of a pilot project which integrates maritime safety technologies and environmental management systems to improve the performance, situational awareness and innovative applications to enhance monitoring systems in the Mediterranean Sea.
- 2) The potential efficiency of cooperative and joined ventures of oil response should be recognized, facilitated and any mutual support of regional agreement must be included in exercise programs to ensure their effective integration into response efforts.
- 3) The National Maritime Administrations, in the Mediterranean Sea Region after identify and establish personnel with high degree of preparedness and equipment to support oil spill contingency plans.
- 4) Familiarizing personnel with oil spill management and mitigation techniques.
- 5) Establish a link between all the ECDIS and the AIS systems on all the platforms operating in the Mediterranean Sea to share and exchange information (data) which will be helpful in the event of an oil spill.
- 6) Take full advantage of the Geographic Information System (GIS) and Satellite-Mounted Synthetic-Aperture Radar (SAR) for full coverage of the Mediterranean Sea, and the necessary information should be relayed to the platforms and ships operating within the Mediterranean Sea.

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