**Application of Information System in Prevention of Maritime Pollution**

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**Abstract**

Maritime industry pollution is one of the significant issues that face the industry. Maritime pollution is mainly caused by pollutants such as plastic bottles and bio-pollution caused by old spills and the excretion of harmful bio substances into the marine environments.

This paper uses the available literature to understand the nature and impact of pollution on the maritime industry and the role that is played by maritime information systems in preventing the same. The paper identifies the architectural design of maritime information systems and how they collect, interpret and integrate the information they collect to safeguard marine environments. The research identifies the service, operation storage, knowledge discovery, and notification units, showing how each is used in identifying information related to maritime pollution.

It identifies the importance of maritime information systems in preventing marine pollution. How emerging and existing technologies play a role in identifying, monitoring, and controlling environmental pollution threats within maritime borders. The paper concludes with the recommendation for using a marine information system to identify pollution and develop the most appropriate strategies for dealing with pollution.

**Application of Information System in Prevention of Maritime Pollution**

**Background and problem statement**

Increasing levels of pollution in the maritime industry are a growing concern. It affects maritime life and activities, increasing maintenance costs within the industry. The growth of the global economy has led to the overcrowding of sea shipping routes. The above, coupled with the increasing demand for petroleum products, has increased oceanic pollution risks. Maritime pollution through oil spills and garbage disposed of in such environments impacts the maritime industry's general growth, development, and sustainability. Thus, it is necessary to have information systems capable of monitoring and detecting environmental pollution in the industry. The marine information systems act as tools that integrate monitoring and survey tools to identify levels of pollution and thus understand the best strategies to deal with the problem.

**Research Questions**

1. What is the current level of maritime pollution globally and in the United States?
2. How are marine information systems used to prevent pollution in the maritime industry?
3. Do maritime industry information systems create awareness of pollution's dangers?

**Thesis**

Employing Marine Information systems (MIS) to fight the increasing pollution in the maritime industry improves and safeguards the marine environment.

**Purpose**

The purpose of writing the paper is to understand better the role of information systems and technology in preventing pollution in the maritime industry. Over the years, there have been numerous headlines of pollution in the marine environment, from increased levels of plastic trash to oil spills. Such pollution affects marine life and is thus a hazard to the marine industry. Information systems and technology could thus help reduce pollution and safeguard the maritime industry from irreversible damage.

**Review of Related literature**

Various researchers have critically studied marine pollution, its major causes, and its impacts on the maritime industry. They have identified pollutants such as oil spills to be the most rampant pollutants in the marine environment. Most of the literature currently available is thus pegged to oil as the major pollutant in the industry, basing the preventive strategies and technologies on the same. Other pollutants common in the literature include plastics and bio-pollutants that end up in marine environments due to poor regulations.

Jepsen and De Bruyn (2019) identify the increasing levels of plastic pollution in the ocean environment that endanger marine life. The authors research databases that report such pollution over the last 40 years to identify main areas of focus and, thus, mitigation strategies. The research spots reporting bias and a lack of understanding of plastic pollution as a problem. They thus identify the marine life most endangered by plastic to identify the best mitigation strategies.

In another research, Martinelli and Moroni (2018) identify the importance of detecting and monitoring pollution in the maritime industry, especially due to the high demand for pollutants such as oil transported through the oceans. The authors identify the importance of remote sensing to provide accurate results in major pollution events. They propose a monitoring framework based on geographic information systems that help collect, disseminate and decipher data on such pollution. Such devices linked to geographic information systems are critical to stopping the growing ocean and coastal pollution rates. The article is useful to the current project because it provides examples of information systems and how they are used to detect and develop strategies to reduce pollution. Remote sensing is part of the information sensing critical to the maritime industry as it provides essential data for monitoring and identifying ocean pollution, especially those caused by oil spills.

Chen et al. (2019) discuss the status of oil spills as a pollutant and the role of future governance in managing the same. Oil pollution is a major cause of oceanic pollution and wrecks havoc, as witnessed in numerous cases globally. The authors identify the importance of oil in driving the world economy. However, uneven resource distribution leads to the need to trade in the commodity and its movement from one border to the other through maritime transportation. Lack of safe transportation leads to oil spill pollution. The authors review the history of the oil trade and its transportation through oceans. They identify information related to oil spills and accidents and the strategies the maritime industry could use to prevent them.

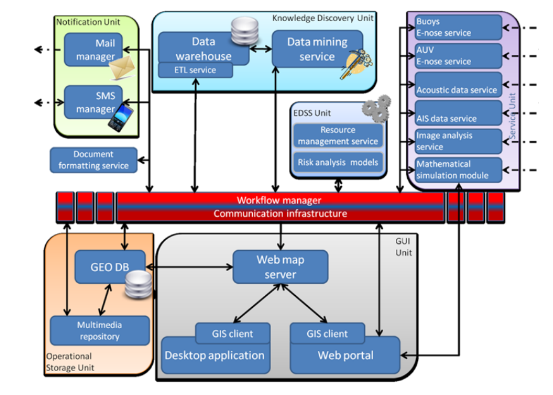
Moroni et al. (2015) also focus on oil spills as the number one pollutant in the marine industry. The authors identify the issue as a result of the rise in the demand for the use and sale of oil products globally, most of which are transported by sea. Safety in maritime industry transportation is critical to eliminate instances of pollution, and in case of such tragedies, there is a need to identify, monitor, and deal with the pollution. Maritime industry technologies for identifying and monitoring pollution are in demand as the world struggles with the fight against climate change and protecting life from the threat of pollution. Information systems and technologies in the maritime industry thus help monitor maritime traffic through sensing technologies. The marine information system creates interoperable and integrated systems that can monitor pollution through electronic sources. Information based on the communication infrastructure becomes useful in determining the best strategies to deal with pollution in the maritime industry.

Rezki et al. (2018) focus on pollution in the maritime industry by oil spills. They identify the role of information systems in determining the magnitude of such pollution and strategies to minimize the environmental impact. The authors identify the importance of integrating the Geographic Information System (GIS) to identify the impacts of such pollution. They advocate for using software to get the current data on pollution and its impacts on the maritime industry. The research is important to the current study as it shows information systems' impacts when dealing with issues in the maritime industry, such as pollution.

**Marine information systems and their uses**

The MIS is considered a flexible and modular system where the modification of a single module does not affect the global functioning of the MIS. The figure below shows the several units in marine information systems and the communication paths necessary for the MIS to operate:

Fig 1. The MIS architecture and its units



**Service unit**

The Service Unit is made up of several interfaces for gathering and integrating the collected data as well as for gaining access to external data sources. According to the interoperability and portability ethos that underpins the MIS design, the Service Unit is introduced to decouple the heterogeneity of the information examined within the MIS by offering a set of modular and highly specialized services (Pieri et al., 2019). In fact, each service's responsibility is to manage the specificity of the addressed data type and communication standard and turn the incoming data into an interoperable format for the MIS.

**Operational storage unit**

The goal of the operational storage unit is to manage user and administrative data while keeping and giving all the data required by the MIS to locate and identify an oil leak. It is made up of a multimedia repository and a GIS-based database. The unit uses a scheduled mechanism that examines the stored data and deletes the least recent entries to swiftly satisfy MIS demands. This allows the unit to keep the information current for a short period of time.

**Knowledge discovery unit**

The unit is committed to overseeing the processes involved in analyzing all the data generated and gathered by the platform to acquire more insight into the processes being watched.

**Notification unit**

The unit is used to dispatch information to the relevant personnel, such as the oil spill authorities. It allows the use of different notification methods, such as texts and emails, to disseminate data and thus create awareness of possible pollution in maritime environments.

**Technologies**

**Spaceborne SAR imaging and analysis**

Synthetic Aperture Radar (SAR) systems detect pollution in the seas and oceans through the use of short gravity capillary waves. The technology displays a darker color when oil spills on the water, contrasting the clearer colors of the surrounding environment. SAR also has the capabilities of tracking ship movements and linking spillages to ships in real-time, making it possible to identify ships responsible for spills. That allows abrupt inspection of such ships to ensure they meet global shipping and environmental standards. The tool does not have distance limitations from the shore (Pieri et al., 2018).

**Ground-based monitoring technologies**

Ground-based monitoring technologies (GBMT) mostly detect oil spills and other forms of pollution in marine environments. They detect spills and continue monitoring the process of clean-up. The tools use microwave radar and X-band radar to monitor pollution. They are installed in clean-up vessels and along coastal area platforms (Pieri et al., 2018). The footprint of the radars is a circle with a radius of 3.5km. Pollution on the ocean is identified through the reduced wave signals that wind generates on the water's surface.

**Hyperspectral imaging and analysis**

Hyperspectral imaging tools are developed to deal with the shortcomings of multispectral imaging. For instance, they can take data in irregularly spaced spectral bands between 100 and 200nm in width. Based on the spectral signatures of oil on water, the tool can detect oil spills in the marine environment.

**Electronic noses for hydrocarbons and oil spill detection**

The models were first demonstrated in the 1980s at the University of Warwick in the United Kingdom (Pieri et al., 2018). The tool is based on chemical sensors that help detect pollution on ocean surfaces. It detects the change in the compound structure of matter. For instance, it detects the volatile organic compounds (VOCs) associated with marine fuel and oil spills.

**Importance of information systems in preventing maritime pollution**

Maritime information systems are essential in managing and identifying pollution in the maritime industry. For instance, they enable the collection and analysis of data about the maritime environment. The data is used to detect whether there are pollutants within the environment and the type of pollutants if any. For instance, geo-imaging technologies share real-time data, such as pictures that show whether an area has an oil spill and the extent to which the oil spill has spread. The information provided includes the coordinates to precisely identify the affected area and the [possible causes of the pollution. With such information, marine scientists can act rapidly to avoid the adverse effects of pollution in the marine environment (Moroni et al., 2018). Quick reaction reduces the maintenance and rehabilitation costs associated with pollution.

The maritime information systems determine the pollution elimination strategies best fit for any situation. One of the major issues in the industry is the decision-making on accurate strategies to manage pollution issues. Managers find it difficult to identify appropriate techniques and strategies to manage certain pollution, such as oil spills. However, the use of information systems in the industry allows the sharing of data and thoughts based on what are collected, thus coming up with informed strategies to manage any damage within the industry.

**Conclusion and recommendations**

Much of the research identified shows the importance of information systems in dealing with pollution-related issues in the maritime industry. For instance, marine information systems are used to collect and analyze data related to pollution. Oil spills and mass plastic pollution are identified through such technologies that gather data on the spread of the pollutants and the likely impact they have on the industry as a whole. For instance, detecting oil spills and their impact on marine life and the environment helps create the appropriate strategies to deal with the pollutant. Information systems thus act as more than an eye in pollution prevention efforts. They act as a guide toward eliminating the issue.

Despite the conclusion identified in the research, more studies on the technologies available to collect maritime industry pollution information need to be studied. The studies are likely to provide greater gaps related to maritime industry pollution and the role of MIS in dealing with such issues.

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