THE IMPACT AND CONTROL STRATEGIES TOWARDS MARINE POLLUTION: A CASE STUDY AT A PORT

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ABSTRACT

To serve guard maritime safety and the safety of the marine environment is generally served by a port state control (PSC) inspection. There are varieties control strategies played by the port. This paper focuses on the control strategies and the impact of marine pollution played by one port located south of peninsular Malaysia. The objective of this research is to analyze the types of port activities that could cause marine pollution, evaluate the environmental impact, and determine how the control strategy is applied by the port in minimizing marine pollution. The questionnaire survey is applied in this research which consists of several sections. Section A covers the demographic profile of the respondents, Section B covers the type of port activities that contribute to marine pollution. Meanwhile, Section C covers the evaluation of the control strategy, and Section C covers the environmental impact of marine pollution. The pilot test was carried by distributing the questionnaires to check the reliability and validity of the questionnaire. The data were analyzed by using the Statistical Package for Social Science (SPSS) that indicates Cronbach's Alpha 0.820. There were 68 respondents have participated in the questionnaire survey. The mean result shows that the port activity for the oil leakage from ships causes marine pollution at 4.20. Meanwhile, the marine pollution gives impact to the marine life at 4.71 and, the port continuously develops the efficiency of the control strategy at 4.59 to prevent the marine pollution. As for the conclusion, an effective control strategy is crucial to be developed and should be implemented in each marine activities especially in the port area. Thus, the ocean will be saved from any unwanted environmental harm.

Keywords: *Marine Pollution, Port Activities, Control Strategies*

INTRODUCTION

The port activities can also cause some serious marine pollution. The marine pollution could either come from ships or ferries, but also the seaport activities (Nitonye & Uyi, 2018). The marine pollution at the port can generate harmful influences equally on the natural ecosystem and the city residents. The urban population involves people who live near the port area who may get affected as well from the marine pollution once it has occurred. The port authorities must be aware to continue the port operation with proper precaution in marine pollution. Once, the port authority ignores effective precaution could lead to marine pollution and may affect the seawater. The selected location is near the Pulai River, close to the Strait of Malacca and the Strait of Johor. Thus, a proper and efficient control strategies approach in marine pollution must have been adhered to. The suggestion is also covered to move away from the port from the near water sources which seem unlikely to happen (Jeevan et al, 2015).

Since our country, Malaysia is located among the east and west and is known as the boundary to the world maritime trade. The port has played a crucial role in the shifting container business in south-eastern parts of Asia (Jeevan et al, 2015). The leading container terminals in Malaysia such as Port Klang and Port of Tanjung Pelepas are placed amongst the top twenty ports in terms of volume conducted because of their strategic locations to the other Asian countries, India and China (Jeevan et al, 2015). The control

strategy involves effective actions that need to be taken. When the port activities have out of control, it is the responsibility of the management to find the cause of the out of control. The control strategy involves action plans in bringing the process or activities back to control. The concept of the analytical control strategy carries the set of controls planned, derives from the considerate of the necessities for appropriateness determination of the reportable value, an understanding of the analytical procedure as a process, and the administration of hazard to confirm the presentation of the process and the excellence of the reportable value (Kovacs et al, 2016).

RESEARCH OBJECTIVES

The objective of this research is to adhere to

i) To analyze the types of port activities that could cause marine pollution.
ii) To evaluate the environmental impact of marine pollution resulting from port activities.
iii) To determine how the control strategy is applied by the port in minimizing marine pollution.

SIGNIFICANCE OF RESEARCH

As we are aware, the port authorities must play an important role to ensure their control strategies are effective against reducing marine pollution. Thus, the port activities should be fully operated by the port authorities in controlling their rules and regulation to minimize the damage to the environment around the port (Senarak, 2016). By practicing this, may enhance, and improve the port's environmental performance to reduce the marine pollution resulting from their port activities.

LITERATURE REVIEW IMPACT OF MARINE POLLUTION

Marine pollution can be defined in different aspects. According to Vikas & Dwarakish (2015), the word pollution comes from the verb pollute, which means to make impure. It is referring to any type of pollution that happened across the globe. Generally, pollution is anything that can make the elements such as water, air, and land turn to pollute. It is an introduction of chemical and dump that mostly comes from the land area and is carried away by water runaway into the ocean. According to the World Health Organization (WHO), the term of coastal pollution is the introduction by humans, directly or indirectly, of any type of material, chemical, dangerous liquid into the marine environment. This type of element is dangerous as it will damage the sea environment. It is also known as human activities whether on land or sea which contributes to the environmental damage of the world marine biological life (Vikas & Dwarakish, 2015).

IMPACT ON MARINE ANIMALS

Marine pollution is slowly harming the condition of the planet earth. There is a lot of marine life living in the ocean and needs to be protected at all costs to avoid extinction (Nitonye & Uyi, 2018). The level of oxygen in the contaminated seawater will decrease and produce dangerous around and will endanger the life of marine animals and human life. When the contaminated area has been polluted and causes a low level of oxygen which will affect hypoxia with an inadequate supply of oxygen and create dead zones. For example, marine life such as fish, marine mammals like dolphins, and whales will have compilation living in the dead zone (Nitonye & Uyi, 2018). The contamination element is one of the major issues in the marine ecosystem due to their different sources and creates harmful effects on marine life such as

shellfish (Jahan & Strezov, 2019). Besides that, the plastic waste from the port and ships also causes marine pollution. The marine animal will consume this plastic debris as they are thought of as algae or small fish. In addition, when we eat contaminated marine fish, we will also face health problems (Pash et al, 2017).

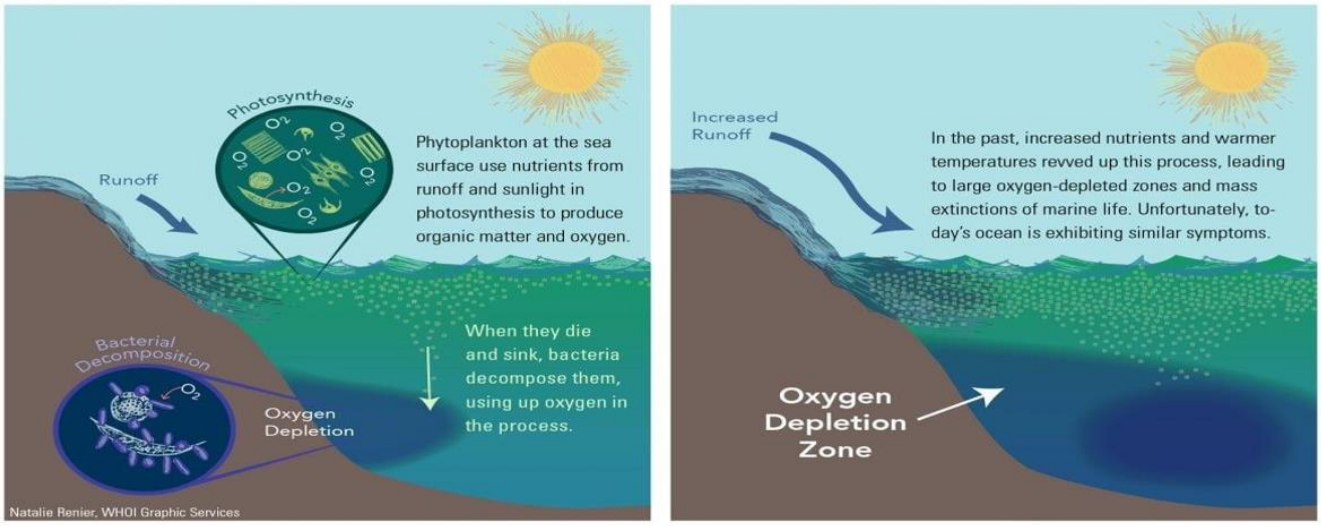

Figure 1. The Depleted Oxygen process (Griffin & Druffel, 1985)

CAUSES OF MARINE POLLUTION

The marine pollution causes may form from the pollution occurrence. It may come from the ships that move between the areas to the water pollution and caused the oil leakage (Zafirakou et al., 2018). The other possible sources may also come from the chemical leakage from painting activity for the ships and the discharge of ballast tank which could affect the marine organism in the marine water. The other sources of marine pollution areas are mentioned in Table 1.

Table 1. The Sources of the Marine Pollution

Authors	Sources
Nitonye & Uyi, 2018	In ports, jetties, and harbors, cargo management operations could trigger accidental leaks. The sources of environmental pollution from ports can be from ships that carry oil such as tankers, causing an accident.
Magris et al., 2019	Mining also affects river systems with contaminated water from waste products from mining such as mud and chemical material spillages such as oil resulting from dam construction and failures.
Pash et al., 2017	The type of port's operation activity has risen such devastations. The major causes of contaminations are frequently air, noise, water, soil, and debris.
Jahan & Strezov, 2019	Trace element pollution because of various sources from the port and dangerous impact on bio-organism in marine life.
Onwuegbuchunam et al., 2017	Sources that involve human intervention. Pollution from oil or toxic from incidental and illegal discharge.
Senarak, 2016	The port's activities produce many kinds of pollutants which cause multiple problems such as natural degradation and death of aquatic creatures.

PORT ACTIVITIES

The seaport contains different types of marine operations which are depending on what types of services they have provided to the ships who sail to the related port. Seaport activity is very important in maintaining economic sustainability (Pash et al., 2017). The port is known as the main center of economic activities for the country. The immediate development of sea haulage has left substantial influences on the expansion and growth of the global business by almost 90% of the global market is handled through ocean transportations. The trading world is managed by the cargo for the raw material shipments such as sand, iron ore, and cement. These raw materials are much easier to carry by the cargo ship because it carries in a large quantity. The trading activity needs the seaport for the completion of the need for ships to berth and unload the cargo. Thus, port activity plays a crucial role in the global economy (Pash et al., 2017). The port activities are categorized by numerous complicated ventures as contrasted to the other logistic node (Nitonye & Uyi, 2018).

Figure 2. Example of dry bulk carrier

CONTROL STRATEGY

The effective control strategy at port requires proper management administration. When the action is out of control, it is the responsibility of the management to find the cause of the out of control and eliminate the cause. The control strategy is the action plan for bringing the process or activities back to the original control. But trying to maintain the seaport activities and getting the regular basis activities is not as easy as it looks as it required full observation on the control strategy that needs to be developed. Another concept of the logical control strategy is a deliberate set of controls, derivative from a considerate of the necessities for appropriateness for determination of the reportable value, and considerate of the logical process as a procedure, and the administration of danger, all of which confirm the presentation of the process and the excellence of the reportable value (Kovacs et al, 2016).

The control strategy is very much crucial as the seaport needs to their handling activities. The level of management involves a variety of regulations and controls to inspire law and prosecution by flag states, coastal states, and port state control. For an instant, a proper management plan is required to efficiently utilize the control strategy requirement at the port such as to have a proper port waste management planning (Onwuegbuchunam et al, 2017). The control strategy is coined as a term applying the strategy such as organizing a management plan for controlling negative elements which could impact the port

performance efficiently. The other management plan at the port includes how to manage the discharging of the oil from the port's storage. Thus, the oil spill control strategy preparedness unit is to get prepared in facing the actual accomplishment by describing the space of the strategy, the topographical attention, the supposed hazards, the danger valuation, the roles and accountabilities of the person in control of the implementation of the control strategy plan, the availability of the required equipment and the selection of the best option to counter the issue in the oil spill problems (Zafirakou et al, 2018) and (Pratistha, 2016).

RESEARCH METHODOLOGY RESEARCH QUESTIONNAIRE SURVEY

The closed-ended and the open-ended method have been applied in designing the questionnaire in this research. After completing the questionnaire design, the questionnaire was applied to be distributed in a pilot test to five samples for the reliability and the validity of the required questionnaire. The five pilot respondents were among the port controller, subject matter experts at the port, and academicians who have working experience at port previously. This research applied a questionnaire survey in collecting the data from the targeted population sample as their respondents. The data has been gathered and used for the analysis. The content of the questionnaire survey covers the following:

a) *Section A: Information regarding the respondent:*

This section consists of general information of workers who are known as the respondent for this research. It contains information for age, gender, race, education level, position at the port, and year of the working experiences.

b) *Section B: Type of port activities that cause marine pollution*

Marine pollution may cause by several sources and, one of the causes is due to port activities. This section requires data that leads to marine pollution such as the list of port activities available at the port.

c) *Section C: Environmental impact from port activities*

Uncontrollable port activities may lead to several bad impacts on the marine environment. This section highlights the respondents' opinions and experiences of the impact of the port activities on marine pollution.

d) *Section D: Evaluation of the port's control strategy*

In minimizing the impact of the marine pollution resulting from the port's activities, a control strategy must be measured and to evaluate its effectiveness.

POPULATION, SAMPLE, AND RESPONDENTS

The population is the subject that the research is interested to investigate (Sekaran & Bougie, 2003). The population involves the staff at the selected port. Meanwhile, the targeted population has been chosen randomly to participate in the questionnaire survey. The sample was taken from 20% of the total population at the selected port as smaller than the population identified (Sekaran & Bougie, 2019). The main reason why the sample was at 68 is due to the covid pandemic that has the restriction to meet the targeted population. The management has identified which staff to participate in the questionnaire survey. The respondents covered 100 % of the desired number of samples. These respondents make the data analysis more efficient and suitable for gathering information and data for this research due to the covid pandemic season now.

Table 2. Population, Sample, and Respondents

Company	Population	Sample	Respondents

One port	340	68	68
Total and percentage	340	20%	100%

RESULTS AND DISCUSSION

The data has been examined utilizing the Statistical Package for the Social Sciences (SSPS) edition 27. This software is commonly applied in social science studies to obtain data based on the desired research objective.

PILOT TEST ANALYSIS

The pilot test data has been applied for the reliability and validity of the questionnaire. The value of Cronbach's Alpha is determined to be accepted when the value is above 0.5. If the value is below 0.5, the questionnaire is suggested to be rejected. The key objective of the pilot study is to assess the viability of the recommended main research. Five respondents participated in the pilot test before the actual questionnaire survey must be distributed to the real targeted sample. This is to ensure that the future desired respondent will be able to understand the questionnaire and to answer it accordingly to the given research objectives. The Cronbach's Alpha value shows that the validity and reliability have reached at 0.892 value and are to be accepted.

Table 3. The Cronbach's Alpha Value

Reliability result	
No of items	Cronbach's Alpha
20	.892

DEMOGRAPHIC PROFILE

This section explains the background of 68 respondents who participated in this research. The descriptive statistics are applied to present the respondent's data on gender, age, education level, working experiences towards the marine pollution incidents. The respondent's background shows that 54 respondents are Male by 79.41%. This is because a male is dominant involves in the marine working environment. Most of the staffage is at 31-40 years old or by 32.35%. This staff is relevant and suitable to work in the marine industry as they have sufficient working experience after completing their studies. 48 respondents hold diploma studies or by 70.58% from various fields from the various educational institutions. Finally, 48 respondents or 70.59% have experience in the marine pollution field. These experiences enable them to perform better in the workplace.

DESCRIPTIVE ANALYSIS OF THE PORT ACTIVITIES

The descriptive analysis involves analysis on mean and standard deviation based on the desired research objectives. The interpretation of the mean score is based on the Moidunny (2009) as shown in Table 4.

Table 4. Mean Score Interpretation (Moidunny, 2009)

Mean Score	Interpretation
1.00-1.80	Very Low
1.81-2.60	Low
2.61-3.20	Medium
3.21-4.20	High
4.21-5.00	Very High

The result has shown that the mean range for the types of port activities that may lead to marine pollution is between 4.07 to 4.20 value as shown in Table 5.

Table 5. The Mean and The Rank for The Port Activities

No.	Port activities lead to marine pollution	Mean	Rank	Interpretation
1	**The oil leakage from ships causes marine pollution**	**4.20**	**1**	***High (the highest mean)**
2	Improper waste management leads to marine pollution	4.14	4	High
3	Ship accident at port cause marine pollution	4.07	7	High
4	Rusty anchor dropped in the ocean pollutes the seawater	4.15	3	High
5	Construction of port development cause the marine pollution	4.17	2	High
6	Contamination made such as cement and construction material is harmful to marine life	4.13	5	High
7	Improper refueling ship activities at the port cause harmful and affect to ocean condition	4.11	6	High

It shows each of the items of the port activities that cause marine pollution are at high interpretation. Among the port activities that could lead to marine pollutions is oil leakage from a ship, improper waste management, ship accident at the port, rusty anchor dropped in the ocean, construction of port development, contamination made such as cement and construction material is harmful to marine life and improper refueling ship activities at the port cause harmful and affect to ocean condition and cause marine pollution. The mean analysis has shown that the average of the several port activities which could lead to marine pollution. It is obtained by taking the sum of a set of scores and dividing the total number of scores. Based on the sum scores, the extremely different outliers from the mean of the majority of scores for the group (Moidunny, 2009). From these port activities, the activity of oil leakage from ships contributes as the highest mean at 4.20 and ranked at the top lead to the marine pollution.

DESCRIPTIVE ANALYSIS FOR THE ENVIRONMENTAL IMPACT OF MARINE POLLUTION

The majority about 90% of the world's oil activities are conducted by the sea (Zhang, et al., 2015). Even though technological improvements significantly enhanced the security requirements, oil transportation remains to be an extremely hazardous activity (Onate, 2017). Oil spills from tankers represent about 13% of all oil pollution in oceans around the world (Board et al., 2003). Leakage from tankers is not only endangered the wellbeing and life of crew members but also signifies massive ecosystem damage and severe destruction of the natural environment and ecologies. (Galieriková, 2016). Once the oil is released to the sea, disperses and flows with the oceanic tides and wind speed, polluting coastlines and it also creates the serious destruction of the natural environment, particularly the coastline tourism areas with the serious influence on the sea ecosystems.

The mean range for the environmental impact of marine pollution by 4.43 to 4.71 as shown in Table 6. It shows several impacts of the marine pollution such as the effects on the river ecosystem, water source from the village, contaminated food sources such as fish, marine pollution effect on the marine life, contaminated land for crops, damage plant ecosystem such as mangrove, and affect the condition of the seawater resulting from ships burn fuel which causes marine pollution. From the results, it has been shown that all the impacts have been interpreted as high. The highest impact of marine pollution has significantly affected marine life as shown in Table 6 by 4.71.

Table 6. The Mean and The Rank for The Impact of Marine Pollution

No	Impacts of the marine pollution	Mean	Rank	Interpretation
1	The river ecosystem is affected by the water pollution	4.43	6	Very High
2	Water source from the village is affected by the water pollution	4.51	4	Very High
3	Food sources such as fish are to be contaminated	4.45	6	Very High
4	**Marine pollution gives an impact on the marine life**	**4.71**	**1**	***Very High (the highest mean)**
5	The land for crops is contaminated with the marine pollution	4.48	5	Very High
6	Plant ecosystem such as mangrove is damaged by the marine pollution	4.61	2	Very High
7	Condition of the seawater resulting from ships burn fuel cause marine pollution	4.54	3	Very High

DESCRIPTIVE ANALYSIS FOR THE EVALUATION OF THE CONTROL STRATEGY

Table 7 explains the mean range for the evaluation of the control strategy that may trigger marine pollution by 4.11 to 4.59. The evaluation of the control strategy covers several strategies such as the control strategy application to all types of pollution, annually updated control strategy by the port authority, employees always practice the control strategy for the reduction of the water pollution, the port always refers to the control strategy for any accident that contributes to marine pollution, the port continuously develops the efficiency of the control strategy, the regular control strategy practices and the standard of the control strategy applied at ports. The result has shown that the highest mean is the port continuously developing the efficiency of the control strategy by 4.59.

Table 7. The Mean and The Rank for The Control Strategy

No	Evaluation of the control strategy	Mean	Rank	Interpretation
1	The control strategy is applied to all types of pollution	4.35	3	Very High
2	The control strategy is updated by the port authority annually	4.20	5	High
3	Employees always practice the control strategy for the reduction of the water pollution	4.53	2	Very High
4	The port always refers to the control strategy for any accident that contributes to marine pollution	4.30	4	Very High
5	**The port continuously develops the efficiency of the control strategy**	**4.59**	**1**	***Very High (the highest mean)**
6	The regular control strategy practices lead to low marine pollution	4.18	6	High
7	The standard of the control strategy can be applied at ports	4.11	7	High

THE LIKERT SCALE OF THE AGREEABLENESS

Table 8. The Likert Scale of the Agreeableness

Strongly Disagree	Disagree	Moderate	Agree	Strongly Agree
1	2	3	4	5

Table 8 explains the five Likert scales of the agreeableness towards marine pollution which covers the strongly disagree, disagree, moderate, agree, and strongly agree respectively.

Table 9. The Likert Scale of The Agreeableness Frequency Towards the Marine Pollution

Descriptions	Likert scale	Frequency	Percentage
1. The port activities lead to the marine pollution	Strongly Disagree	0	0
	Disagree	0	0
	Moderate	0	0
	Agree	**40**	**58.82**
	Strongly Agree	28	41.20
2. The environmental impact of marine pollution resulting from port's activities	Strongly Disagree	0	0
	Disagree	0	0
	Moderate	0	0
	Agree	**50**	**73.53**
	Strongly Agree	18	26.47
3. The control strategy applied by the port in minimizing the marine pollution	Strongly Disagree	0	0
	Disagree	0	0
	Moderate	0	0
	Agree	**59**	**86.76**
	Strongly Agree	9	13.24

Table 9 shows the Likert scale of the agreeableness frequency towards marine pollution at the agreed frequencies for each research objective. For example, the port activities lead to marine pollution by 58.82%,

The environmental impact of marine pollution resulting from port's activities by 73.53%, and the control strategy applied by the port in minimizing the marine pollution by 86.76% respectively. Therefore, the control strategy at the port is crucial in helping the port to minimize or control marine pollution.

CONCLUSION AND RECOMMENDATION

CONCLUSION

Even though marine oil shipment creates huge economic advantages to many countries, on the other hand, it also creates enormous risks with negative influences on health, life, property, and the environment (Galieriková & Materna, 2020). In a nutshell, marine pollution is very dangerous to us as our planet earth is covered mostly by the ocean. As a human, we should always take care of the marine environment and ecosystem to be free from marine pollution (Galieriková & Sosedová, 2016). The port activities should monitor and control their port strategy to prevent our ocean from any damage. Human activities involve agriculture, manufacturing, fisheries, shipping, marine litter, and other unwanted activities to the marine pollution. There are three forms of marine pollution such as from the land, water, and air, and each of them is caused by human mistakes. For example, the oil spill from ships at the ocean has prevented the sunlight from reaching the marine lives and plants such as coral reefs under the seawater. Thus, it indirectly has affected the photosynthesis process Therefore, the efficient control strategy is very important to the port authority and the other industries. By analyzing the port activity, it helps the port to upgrade and develop better strategies to cure marine pollution. Even though it is not easy to prevent marine pollution from occurring, but at least we can assist to reduce and control our marine activities to ensure they are clean and safe for our next generations.

RECOMMENDATION

The recommendation from this research is for the port authority to create or develop a specific department to be in charge of handling the control strategy regarding safety and, also to counter any accident or action that may lead to marine pollution. In addition, the port authority may improve and implement related rules or regulations regarding the control strategy at a port to monitor their port activities from leads to marine pollution.

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