Environmental Sustainability Strategies and Impacts:

A Case Study in Northport, Klang, Malaysia

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Abstract— **Given the relevance of environmental sustainability, the aim of the present paper is twofold: first, to investigate the impact of strategies implemented by Northport, Klang in order to be environmentally sustainable, and, second, to ascertain the priorities of these strategies. Using qualitative research design, data was collected through semi-structured interview with the officers in charge of environment at the Northport, Klang, Malaysia. Findings indicate that strategies implemented by the port have been successful in reducing emission and improve air quality, a big step to being environmentally sustainable. Several criteria were used to prioritize the strategies, chief among them are implementation cost and time, maintenance cost and reduction of carbon emission.**

Keywords- Environmental Sustainability; Air pollution; Port; Northport, Klang; Sustainable Supply Chain Management

I. INTRODUCTION

Over the past decade environmental issues have begun to dominate the agenda of many organizations. With the decline of overall global environmental quality, a proactive approach to environmental and resource issues to halt this decline is needed in order to help safeguard the environment in the future as embodied in the concept of "sustainable development" promoted by Dr Gro Harlem Brundtland in the United Nations' Report, Our Common Future, issued in 1987(Whitehead, 2000) .

Economic development, existing practices and environmental quality are very closely linked within the activities of ports and their related industries in respect to a wide range of operations, associated functions and natural habitats. Ports act as interface for related industries, however, their combined activities have the potential for considerable impact on the environment (Whitehead, 2000). To companies facing environmental problems, the costs can be devastating as it can ruin a firm's public image and costs million of dollars (Hunt and Auster, 1990). Port activities have the potential to cause deterioration of air and marine water quality in the surrounding areas due to multifarious activities. Hence, for the determination of levels of pollution, identification of pollution sources, control and disposal of waste from various point and non-point sources and for prediction of pollution levels for future, regular monitoring and assessment are required during the entire construction and operation phase of a major port (Gupta, Gupta and Patil, 2005; Whitehead, 2000; Hunt and Auster, 1990).

Northport, where the present study is based on, is situated at Port Klang Malaysia is owned by Northport (Malaysia) Bhd, handles wide range of activities such as loading and unloading, storage, warehousing and cargo containers cargo services and these activities require the use of heavy duty equipments that are associated with high smoke emissions that contributes to air pollution. From the environmental assessment and data collected in 2013, Northport, Klang was found to be emitting huge amount of carbon emissions to a staggering total of 40,723,931 or 40.72 million kg CO_2 per year thus contributing to air pollution from its business activities (Northport, 2013). Based on this environmental assessment, the port have started to develop environmental strategies to reduce carbon emissions in its vicinity.

However, little research has been done specifically to identify the impacts of the initiatives taken by ports in reducing its pollution problem and the effectiveness of the initiatives. Initial investigation indicates that in order to arrest the problems of huge carbon emission, Northport, Klang has devised a Green Master plan with which was used as a guideline to implement their environmental sustainability initiatives. The question is, how effective are these strategies in achieving the environmentally sustainable objectives that the port is aiming for? Do the strategies or initiatives implemented by the port reduce the environmental problems faced by the port? What are the impacts of these strategies or initiatives on their environmental sustainability efforts? Therefore, the first objective of this study is to ascertain the

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impact of the strategies implemented by the Northport in their efforts to be environmentally sustainable.

Once the effectiveness of the strategies is ascertained, the next question would be which one of those strategies are most effective and which are least? All businesses including ports have limited amount of resources and they need to know which strategies are most effective so that they can concentrate more on these strategies and make the most out of their investment. So far, there have been little efforts in ranking or prioritising these strategies based on their efficiency in efforts to be environmentally sustainable. Therefore, the second objective of this study would be to determine the ranking of the strategies based on its impact on environmental sustainability.

The paper is organised as follows. An overview of environmental sustainability is provided. Next, the qualitative method used to gather the data for this research is discussed. Third, key findings and its related discussion are presented. Finally, research conclusions are summarised.

II. LITERATURE

A. Sustainability and Sustainable Supply Chain Management

The Brundtland Commission's (1987) definition: "development that meets the needs of the present without compromising the ability of future generations to meet their need" is perhaps the most adopted definition of sustainability (Carter and Rogers, 2008) and includes issues such as environmental impact (Erlich and Erlich, 1991), food security (Lal et al, 2002), meeting basic human needs (Savitz and Weber, 2006) and conservation of non-renewable resources (Whiteman and Cooper, 2000). Within the field of supply chain management, although there exists a divergence of definitions of sustainability, most definitions incorporate a consideration of environmental and economic concerns (Carter and Rogers, 2008) and Elkington (1998, 2004) developed the concept of the triple bottom line (TBL) which suggests that at the intersection of social, environmental and economic performance (the three dimensions of sustainable development), there are activities that firms can engage in which there will be positive effect on the natural environment, society as well as long-term economic benefits and competitive advantage for the firm.

The introduction of sustainability in supply chain management produces the concept of sustainable supply chain management (SSCM). SSCM can be defined as "the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development" (Seuring and Miller, 2008). Academically, SSCM is increasingly important as reflected by the geometric growth of related scientific publications during the past two decades (Brandenburg, Govindan, Sarkis and Seuring, 2014; Min and Kim, 2012; Seuring and Muller, 2008).

Brandenburg et al., (2014) conducted a content analysis of 134 papers in the area of SSCM and categorized the literature reviews into reviews published prior to 2008 and recent reviews published within the last five years. Accordingly, they found out that literature reviews prior to 2008 incorporated green product and process development, green operations management, remanufacturing and close loop supply chain management (Gungor and Gupta, 1999; Kleindorfer et al., 2005), environmental management (Daniel, Diakoulaki and Pappis, 1997) on water resources, solid waste and air quality (RaVelle, 2000) and combinatorial optimization problems in green logistics (Sbihi and Eglese, 2007). Literature reviews after 2008 focused on drivers to the adoption of SSCM (Gold, Seuring and Beske, 2010), the requirement of vertical coordination and supply chain-wide implementation (Carter and Rogers, 2008) with focus on single firms (Carter and Easton, 2011).

However, SSCM implications vary depending on the structure of the specific supply chain that they belong to (a steel supply chain could be different than children's toys supply chain) and therefore a sectorial snapshot is required for further applications in leading supply chains (Turker and Altuntas, 2014). Majority of extant literature on SSCM focused on manufacturing firms (Turker and Altuntas, 2014; Hsu, Tan, zailani and Jayaraman, 2013; Zailani, Eltayeb, Hsu and Tan, 2012; ElTayeb, Zailani and Jayaraman, 2010). Research is lagging on other players in the supply chain, especially ports. Our work begins to bridge this gap in efforts to provide a better understanding on non-OEM's (original equipment manufacturer) environmental sustainability impacts on SSCM.

III. METHODOLOGY

The research is based on qualitative methods and was initiated through semi-structured interviews with officers in charge of environment area in Northport, Klang, Malaysia. We used the constant comparative technique of grounded theory to analyze the extensive interview transcript, organize the results into emergent themes, and identify the major findings (Charmaz, 2006; Glaser and Strauss, 1967). We have also utilized the qualitative process framework (qualitative process Steps 1 to 6) used by Randall et al., (2011).

A. Qualitative process

We began the qualitative process by developing questions for the semi-structured interview (Step 1). At Step 2, interviews were conducted with officers from Northport's Health, Safety and Environment (HSE) and Marine Services department involving the environment executive and the marine superintendent. During Steps 3 and 4, the researcher reviewed 25 percent of the initial interviews for themes and relationships. Multiple meetings were held to cross-validate findings and gain consensus on our initial insights. We continue to code in order to develop and refine higher order categories in Step 5. As questions arose (Step 6), we reviewed previous transcripts for clarification. If required, we conducted additional interviews to resolve questions and complete our understanding of the emerging categories. During this step, we came together again to harmonize our findings.

IV. FINDINGS AND DISCUSSION

The research results provide an exploratory overview of environmental sustainability strategies and impacts for

Northport Klang Malaysia. Two primary questions are addressed in this section:

RQ1. Do the strategies or initiatives implemented by the port reduce their environmental problems and if they do, what are the impacts of these strategies or initiatives on their environmental sustainability efforts?

RQ2. Which one of those strategies is most effective and which is least?

A. Strategies implemented and its impact

In general, Northport, Klang believes that the environment is the essential part in their business operations and continuous strategies, initiatives and awareness programs were conducted to ensure that the port not only gain economic sustainability but also conserve the flora and fauna. This is partly evidenced by a statement by a representative at the HSE department:

"We (Northport, Klang) have implemented initiatives in being environmental sustainable not only in the environmental issues of air pollution at the port but also in the other concerning issues of water, noise, and other pollutions". (Environmental Executive Northport, 2014).

With focus on achieving better port performance, enhanced employee relations, building stronger relationships with communities, promoting favourable reputation and branding, improving risk management and also relations with the investment community, the port have taken initiatives in the environmental aspects based on the Northport Green Master plan involving long term strategies to reduce overall pollution at the port. Based on Table I, the strategies and initiatives that have been implemented by Northport were:

TABLE I. NORTHPORT, KLANG ENVIRONMENTAL EMISSION REDUCTION STRATEGIES

Strategies	Specifics
Infrastructure and Equipment strategy	1. Emission control technology 2. Equipment and engine replacement
Operational strategy	Vessel speed reduction
Image improvement	Green building

a. Sources: Environment Executive, Northport (2014)

1) First Category: Infrastructure and equipment strategy

In this first category, two initiatives were implemented: equipment and engine replacement of their "Terberg" Terminal Tractor fleet and the emission control technology of micro clean filter installation in their rubber tyre gantry (RTG) hydraulic system.

The port have successfully implemented and incorporated the Euro 4 emission standards requirements for their new 92 units "Terberg" Terminal Tractors Fleet with the objective of improving air quality at the port. "Terberg" Terminal tractor is used to handle container cargo in and around the port playing a major role in moving the containers from one container terminals to another in the container yards. With the implementation of the emission standards, the tractors now emit exhaust emission which is parallel to the European standard where emissions are reduced and the reduction is better if compared to average Malaysian emission standard This implementation was successfully completed in January 2011 which resulted in savings of fuel consumption rate of 43, 617 liters in comparison between 2011 against 2008. In 2012, further savings of 214,044 liters were recorded (compared to 2008 figures). With this initiative, Northport, Klang was able to reduce a total of 1,443,023 kg of CO_2 per year compared to the emission level of the previous year.

Another initiative under the first category (Infrastructure and Equipment strategy) is the installation of micro clean filter for rubber tire gantry (RTG) hydraulic system (which also doubles as one of the initiative in improving the waste management system), resulting in the improvement of air quality. Micro clean filter is a product that effectively minimizes the waste oil disposal up to 90% from the standard practice of waste oil disposal in the market. This micro clean filter also gives the port the benefit of reducing downtime losses through lesser and effective repair and maintenance resulting in the cost reduction of maintenance and repair. With the implementation of micro clean filter to their 22 RTG, a sum of RM150,800.00 worth in cost reductions for the past three years was achieved. There was also reduction of emission from the RTGs of approximately 21,669.83 kg of CO_2 per year. Not only that, the cost related to changing the hydraulic oil was reduced to RM24,780.00 in 2012 compared to RM41,592.50 in 2011. This reduction of cost (approximately 59.6% of the hydraulic systems maintenance costs) shows some evidence that the initiative that the port made was effective and efficient not only in reducing air pollution but also in reducing cost of operations.

Subsequent to the implementation of the micro clean filter for RTG hydraulic system, the port have further installed power converter at the RTGs and this results in fuel consumption reduction by ten percent. This installation was made on all their 22 RTG units after a trial run (in 2011) at one of their RTG unit for five months. The result of the trial run was fuel saving of 9.36% equivalent to 20,592 liters per month. Based on the trial run of this initiative, the port believes that it can achieve cost reductions of RM520,800.00 per month plus reduction of 4,160kg of CO_2 emission per year.

2) Second Category: Operational Strategy

Under the operational strategy, the port has implemented vessel speed reduction initiative for any calling vessels entering the port. This initiative aims to reduce emission from ships that are coming or going out of the port by reducing the speed of the vessels.

Northport can be approached via the southern or northern entrances. Vessels approaching from the north can use the Northern Pulau Angsa Approach which lies between the mainland in the east and vast area of mudflats and sandbanks known as Angsa Bank. The approaches are marked by two major lighthouses, Kuala Selangor and Pulau Angsa with

additional numbers of beacons and buoy to help vessels navigate through the approach. An alternative approach is by using the Southern Pintu Gedung approach which lies off the adjacent North Bound Lane of Malacca Straits Traffic Separation Scheme. This approach is marked by Bukit Jugra Lighthouse, Tanjung Rhu light beacon and South Fairway Buoy. Vessels are prohibited to navigate by themselves into the port. In the North Channel, the vessel are recommended to anchor while waiting for the harbor pilot at 0.5 nautical miles east of the pilot boarding ground where depth of between 15 meter – 22 meter are available. If coming from the south (the Southern Channel), vessels that are waiting for the berthing instruction can anchor at the South Fairway Buoy.

Safe speed shall be observed throughout the passage plan where speed limits will be consistent with safe navigation with regards to harbor regulations, prevailing circumstances and conditions including the capabilities and limitations of the piloted vessel. Thus, all vessels need to be navigated at a safe speed not exceeding 12 knots. Furthermore, vessels navigating within 300 meters of the wharves or other mooring structure shall not exceed speed limit of 8 knots. With the implementation of vessel speed reduction initiative, Northport, Klang have succeeded in reducing approximately 55% of the amount of CO_2 emissions (coming from the vessels) and improve the air quality at the port.

3) Third Category: Image improvement strategy

In the image improvement strategy, the port has taken the initiative to establish a green building. An example of a green building initiative is the installation of inverted air conditioning in operator's cabin resulting in low consumption of energy, is environmentally friendly and safer to human health. This initiative was completed in August 2001 where 10 units of inverted air conditioning technology using cleaner refrigerated gas was installed at Northport, Klang in 10 units of its quay cranes. The saving that Northport achieved was a total cost reduction of RM87,463.00 for six months after using the inverted technology.

Besides the installation of inverted air conditioning technology, the port has also installed LED street light fitting. With this initiative, the port was able to achieve 70% energy efficiency. Northport, Klang was also able to reduce 250 kg of CO_2 emissions per month. Other than that, the port has also replaced 40 air conditioning units using green gas. This implementation was completed in 2011 and enabled the port to achieve 29% of energy efficiency and reducing approximately 24,178.56 kg of CO_2 emission per year.

Besides implementing strategies and initiatives in and around the port as discussed earlier, Northport, Klang has further conducted their own ambient air pollution study. The study was made at main critical operation areas in the port with the objective of improving air quality. This measure was taken as compliance to the Environmental Quality Regulation (Clean Air) 1978, EQA 1974, Usechh regulation 2000 and OSHA 1994. The sample taken was analyzed in a certified laboratory and the result was compared to Recommended Malaysian Air Quality Guidelines (RMAQG) by Department of Environment (DOE). From the assessment, the result showed that all pollutants levels are not at dangerous levels and passed the minimum requirement of DOE. This indicates that the ambient air quality in Northport's vicinity is good. It also indicates that the environmental sustainability strategies that the port has implemented were successful. However, even though the level of air quality at the port is good, the port through either its port operation or shipping activities, can still contribute to the huge amount of emission throughout the year. The initiatives need to be continuously implemented to ensure that the environmental sustainability can be maintained.

B. Prioritizing the strategies

In prioritizing the strategies, based on the interview conducted, the port uses several criteria: a) implementation cost of the strategy, b) the maintenance cost, c) the time needed for the strategy implementation, d) technical feasibility of the strategy and e) the reduction of emissions from the strategy.

1) First Rank: Operational Strategy

The operational strategy in terms of vessel speed reduction initiative was selected as the first priority because of very low implementation cost needed for this initiative. Besides that, very low maintenance cost is required as the port need only to monitor the speed of the vessels coming and going out of the port. Very short implementation time and technical feasibility were needed as this initiative will be monitored by the harbor pilot that will come to the vessel upon arrival. The impact of this initiative in reducing the amount of pollution is at the medium level because vessels continuously emits CO_2 and thefore contributes to air pollutions and further depend on the cooperation between the port and the vessel owner.

2) Second Rank: Infrastructure and equipment strategy

The infrastructure and equipment strategy with equipment and engine replacement was selected as the second priority. New and modern equipment and engine help significantly in reducing emission problems. The implementation cost of this strategy is at the medium level. However, the maintenance cost of is high as the machine and equipment requires proper maintenance to operate especially in the long term.

It is the same for emission control technology where this strategy require medium level of implementation cost, and short implementation time because the emission control technology such as the installation of micro clean filter and power converter that the Northport have implemented at their equipment will be ready to be used after the installation. However, the maintenance cost is high as it requires the port to maintain the technologies installed in all the equipments at the port. The On the other hand, this implementation results in high reduction of emission because it directly solves one of the main contributors of emissions at the port which is the exhaust emissions to the air by the equipment and the machine. This strategy requires medium implementation time, but, the technical costs in implementing this initiative is high as it requires training and practices especially with new

equipment and modern technologies. The reduction of pollution and emission are medium as it only reflects the amount of the reduction of the emission from the machine or equipment that was replaced with new equipment or engine.

3) Third Rank: Image improvement strategy

The image improvement strategy with the implementation of green building is selected as the third priority. This practice requires high cost because of the need to have high levels of technology (one that induces zero pollution and does not only focus on air pollution). Even though the port have benefited in terms of lowering the energy used, good water disposal management, lower operation and maintenance cost, this strategy needs a long time to implement to make it truly successful. At the moment, the port could only implement inverted air conditioning and LED lights installation in its streets.

V. CONCLUSION

In its efforts to be environmentally sustainable, Northport has implemented several initiatives in three areas: infrastructure and equipment, operations and corporate image incorporated in their Green Master Plan (GMP). Findings of this study indicate success as evidenced by reduction of emissions, energy and costs.

With regards to prioritizing the strategies implemented towards environmental sustainability, this study has found that the port has used several criteria such as implementation cost, maintenance cost, technical feasibility and reduction of emissions. In the order of priorities from first to last, the priorities of the strategies are: operational strategy in terms of vessel speed reduction initiative, followed by infrastructure and equipment strategy with equipment and engine replacement and emission control technology and lastly, image improvement strategy with the initiative of the implementation of green building.

The main limitation of this study is the number of company (port) interviewed to get data. This effectively limits the generalizability of the findings. However, an in-depth interview does provide a certain element of richness in data that a large scale survey could provide. Environmental sustainability in Malaysia is still a new field of study and one of the best ways to investigate a new phenomenon is by conducting in-depth case study, with which this study has strived to do. For future research directions, the next research should consider more than one port in Malaysia in order to see the pattern and impact that other port have implemented to be environmentally sustainable. Future research could also look into alternative strategies that port can implement and how these strategies impact not only the environmental sustainability performance but also the performance of the port socially and economically, thereby completing the three pillars of sustainability (TBL) proposed by Elkington (1994) and later further developed by Carter and Rogers (2008).

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