Doctoral Dissertation

The Development of Indicators for Sustainable Port Management and Applicable Lessons for Sub-Saharan African Ports

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ABBREVIATIONS

ACTA: Acta Corridor Transportation Authority

AIS: Automatic Identification System

AMP: Alternative Maritime Power

AQMP: Air Quality Management Plan

BMP: Best Management Practices

CCS: Carbon Capturing and Storing

CEAA: Canadian Environmental Assessment Act

CFC: Chlorofluorocarbons

CO_2: Carbon Dioxide

CPA: Canadian Port Authority

CWA: Clean Water Act

DPM: Diesel Particulate Matter

ECA: Emission Control Area

EEDI: Energy Efficient Design Index

EEZ Exclusive Economic Zone

EIS: Environmental Impact Statement

EPA: US Environmental Protection Agency

ESPO: European Sea Ports Organization

FOE: Friends of the Earth

GDP: Gross Domestic Products

GHG: Green House Gases

GRT: Gross Registered Tonnage

IAPH: International Association of Ports and Harbors

IMO: International Maritime Organization

ISM: International Maritime Code

ISPS: International Ship and Port Facility Security

LED: Light Emitting Diode

MARPOL: International Convention for the Prevention of Pollution from Ships

METS: Maritime Emissions Trading Scheme

MOU: Memorandum of Understanding

NDZ: Non Discharge Zone

NEPA: National Environmental Policy Act

NO_X: Nitrogen Oxides

PSC: Port States Control

PAD: Port of Douala

POA: Port of Antwerp

POR: Port of Rotterdam

POV: Port of Vancouver

POY: Port of Yokohama

RMP: Risk Management Plan

RTG: Rubber-Tired Gantry Crane

RTP: Regional Transportation Plans

TEU: Twenty-Foot Equivalent

UNCLOS: United Nations Convention on the Law of the Sea

WPCI: World Port Climate Initiative

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ABSTRACT

Sustainability practices in port operations are key issues in achieving port sustainability within port organizations across the world. The concept of port sustainability is quite recent, and it is defined by the American Association of Port Authorities (AAPA,2007) as a set of strategies and activities that meet current and future needs of port stakeholders while protecting and sustaining human and natural resources. The overall goal of this dissertation was to assist ports to successfully implant sustainability practices durably into their operations.

Today many ports around the world are embracing sustainability for various reasons. Some of these include the genuine efforts of ports authorities to take leadership initiatives to mitigate the environmental and social impacts emanating from the developments and operations of their ports, but other reasons could include pressure from civil societies and international organizations to address issues related to port emissions and climate change.

Many ports have now adopted sustainability as a key element of their management process and development strategy. However, if it is true that the port industry agrees on taking giant steps to embrace sustainability issues emanating from their industry, among scholars, there seems to have many schools of taught on the concepts, evaluation techniques and objectives of Port sustainability. This is widely due to the variety of ports, their nature, size, financial might and innovative capacity.

Additionally, the literature review reveals the extent to which ports from developing and developed countries address sustainability differs greatly. More so, empirical research on the evaluation techniques of sustainability issues at ports as well their implementation withinport organizations is still very limited in developing countries in general and sub-Saharan countries in particular.

For this dissertation, 2 research objectives were targeted: The first objective was to conceptualize the structure of sustainability practices in international port operations, by clustering the relevant issues within the field. In so doing, a detailed analysis of the theoretical issues related to port sustainability in general was done with the finality of determining an efficient sustainability framework for measuring sustainability performance within port organization; the second objective consisted in using the developed framework to test for its efficiency via the evaluation of the sustainability performance within 4 sampled ports. The framework was then used as benchmark for a fair evaluation of the sustainability initiatives within the Port of Douala. It is hoped that this framework can be standardized and serve as benchmark for a fair evaluation of the sustainability initiatives within seaport organizations in general and those from Sub-Saharan African Ports in Particular

The definition of sustainability in this context, was based onthe TBL-Triple bottom Line approach of sustainability, developed by John Elkington in 1994and served as a framework tool for sustainability evaluation. The TBL is a framework constituted of three parts, the social, environmental and financial branches. According to (Slaper et al 2011), many organizations have adopted the TBL framework to evaluate their performance in a broader perspective to create greater business value.

In this research, the methodology used in the selection of the 25 Sustainability Indicators Framework was a combination of a top-down indicators selection approach coupled with the implementation of a scoring method based on the 16 criteria indicator model developed by Peris Mora et al, 2005. The indicators obtained from the secondary source from the study were 207 initially, and after organizing them under their sub-categories in conformity with the three pillars of the TBL methodology, and implementing the aforementioned selection technic, a set of 25 Sustainability Indicators Framework were selected.

The 25 Sustainability Indicators generated were constituted by 6 Economic, 13

Environmental Indicators and 6 Social Indicators. An evaluation and a comparative study based on data gathered from all the ports involved in the study enabled a fair appraisal of the sustainability initiatives across sampled Ports. The data then gathered were presented and analyzed with the aid of statistical packages for social science (SPSS) version 22.

The summary of results in general indicate that Global ports have adopted various approaches in handling sustainability issues within their organizations. Also, European ports (The Port of Rotterdam and Antwerp) have made significant progress in adopting sustainability initiatives as compared to the other ports involved in the study. However, the Port of Metro Vancouver (North America) and that of Yokohama (Asia-Pacific ports) have also implemented over the years, very sounds sustainability policies within their respective organizations. The Douala Port (Africa) was the least proactive in integrating sustainability initiatives within its operations.

Results also showed that 4 out of the 5 ports have taken very strong policy initiative by integrating sustainability as part of their management strategy and this can be shown by policy statement right from their website but also, they were able to achieve 18 and above on the total overall indicators list.80% of Ports also had a certification, the Port of Rotterdam was PERS certified, and the Vancouver and Antwerp Ports had their ISO 14001 Certification.All the Ports had had strong collaborations as regular members to International Seaport organizations such as the International Association of Ports and Harbors (IAPH), the World Port Sustainability Initiative (WPSI) or the European Sea Port Organization (ESPO). These organization often designed policy programs and propose it to their member ports in order to mitigate their environmental and social impacts. Also, 80% of the ports had an environmental, management Assessment. Cold ironing is also implemented in 3 ports within our sample. Those are very heavy and costly investment to make but contribute a great deal in curbing port emissions. Also, 80% of Ports officered green incentives policies such as the ESI (The Environmental Ship Index), which is a policy developed and Proposed to Port authorities by

the IAPH and consists in reducing port charges for vessels calling at a port provided such vessels can prove they are taking mitigating measures to obtain a lower air emission. Furthermore, 3 of the ports have developed a greenhouse gas emission inventory system, consisting of laying down a system that enabled the development of a technics to evaluate the energy consumption by different machinery and fuel used that eventually produce greenhouse gas within the port premises.

This research also discussed the key and strategic support that Ports organizations specifically those from Europe receive from an Organization like ESPO in enhancing sustainability practices within their member ports through an internationally approved certification process, constant training, and joined projects developed between European ports, sponsored by the European Union.

Finally, as earlier mentioned, Sub-Saharan ports such as the port of +Douala are just starting to tilt towards embedding sustainability practices within their organization. The implementation of sustainability policies is still at an embryonic stage, the port of Douala laid more emphasis on complying with environmental national provision as well as those from international maritime organizations they are party to. Some of which include the Marpol 73/78, which deals with waste reduction and sustainable management of oil residues from vessels. Due to limited financial abilities, green infrastructure aimed, and climate change mitigation infrastructure were just barely developed as compared to other ports in the study.

CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE STUDY

1.0 Introduction

The main transport mode for global trade is ocean shipping. Today, around 90% of traded goods are carried over the waves (Shipping fact, 2021). As such, shipping is the main transport arteries for global trade. As demand for global freight grows, it is anticipated that maritime trade volumes triple come 2050. This new development comes with opportunities but also with challenges specifically for ports.

Ports are very important development infrastructure for countries and do have a real impact on their economic transformation. the recent growth in world seaborne trade had transformed ports, by expanding their sizes, might and reception capacities with more quays built and new handling facilities. (Alderton, 2005).

Also, this rapid growth has raised growing concern about threats to global environmental quality and increasing pressures on world resources. In that vein, port operations specifically and related activities may have adverse consequences on the environment (Gupta et al., 2005; Dinwoodie et al., 2012), impacting on air (e.g., Bailey and Solomon, 2004; Cooper, 2003), water (e.g., Grifoll et al., 2011; Kröger et al., 2006), and soil and sediments (Edoho 2008; Ray, 2008), affecting both the terrestrial and marine Corresponding environment.

The International Maritime Organization (IMO[1]) 0has since the 1970s developed and adopted seven international conventions for the prevention and protection of marine environment from pollution. Most of these conventions primarily deal with shipping related environmental impacts, as they were largely conceived and designed to regulate shipping activity (Nuke, 1992). Overtime, however, it has been realized that ports and port areas are the only place to effectively regulate shipping related environmental impacts. Attention is therefore on ports to implement these conventions effectively in addition to national and local environmental regulations. It is even more important for ports s to address this issue as they became a vital function in the global economy as earlier discussed.

According to (Puig et al 2014), Port authorities are now expected to address the advert effect the environmental and social impacts that emanates from their development and operations, by adopting a sustainable management approach to their organization. Figure 1.1 gives an idea of the new trend ports are taking in order to remain performant but as well to address the environmental and social challenges that come with them.

[1] The International Maritime Organization (IMO[1]) as the specialized United Nations agency responsible for maritime safety and pollution prevention from ships

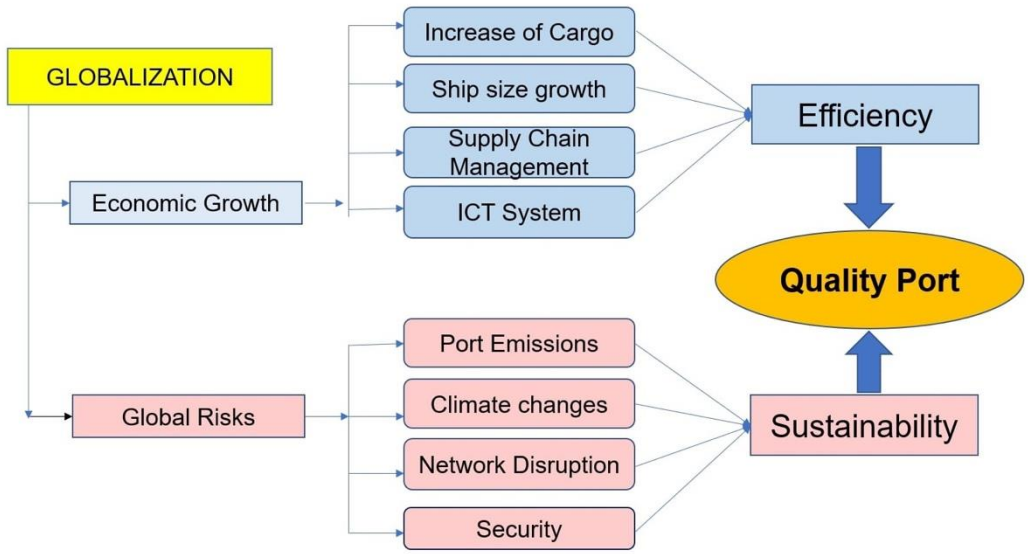

Figure 1.1 Globalization and the Need for the Development of Quality Ports

Port sustainable management is viewed as an important concept to operate in port operation and revolve around the three main pillars of sustainable development, namely, environmental (to reduce the impact on the environment), social (community management), and economic (to help the organization benefit and enhance its economic performance).

As environmental awareness is increasing throughout society, effective environmental management is essential if stakeholders are to continue their support for port operations and development. In order to deliver compliance, environmental protection and sustainable development, effective port environmental management needs to take into account the potential impacts on the environment, mitigating options, methods of prediction, information on environmental indicators and legislation (PPRISM, 2012). Ports are complex

organizations from many points of view: economically, socially, culturally and administratively because of the range of interests and responsibilities of the parties involved. These factors in conjunction with the local geography and hydrography mean that each port is unique (Bishop and Gray, 2005). In order to evaluate environmental performance of port authorities and to track progress towards continuous improvement, relevant Environmental Performance Indicators (EPIs) may be utilized (Donnelly et al., 2007). In this way, port authorities can demonstrate compliance and continuous improvement through scientific evidence and quantifiable measures.

The review of literature has demonstrated the use of environmental indicators within ports through various studies. The ESPO (European Seaport Organization, /Eco port in 2009, launched a study called PPRISM and funded by the European Union. During the study, 122 ports from 20 European Maritime States participated in the survey. This review revealed that 60% of the respondent ports have identified environmental indicators to monitor trends in environmental performance (ESPO, 2010). Nevertheless, when they were asked to name the environmental indicators used, the responses provided more than 100 different indicators. Also, (Mangan, 2019), conducted a study on sustainability Indicators across ports in Thailand and identified a set of 91 indicators 4 Grouped into 4 categories briefly organized as environmental aspect 22Indicatorss, social aspect Indicators, economic aspect 27 Indicators and port organizational management

aspect 14 Indicators. Many more of such studies do exist for modern ports mostly across European, American and Asian ports.

This means that although ports are becoming increasingly aware of the benefits of using environmental indicators, there is not a common approach as to which indicators to adopt. Therefore, there is still need for research in this field` There is, however, a clear difference between views expressed in the existing literature and the findings of this review. Taking a geographical perspective, Davarzani et al. (2016) show that many studies of green ports and maritime logistics have come from researchers in western Europe and the United States, while research into east Asian ports has been less common. African Ports involved in such research are quasi inexistant so far.

However, Africa did not stay aloof from this global growth trending in the shipping industry. Although very few research on port sustainability involving African ports could be found, it is worth nothing that some of the most important global sea lanes pass through the continent of Africa. Major routes navigate the Cape of Good Hope between the Atlantic and Indian Oceans, through the Red Sea and east-west through the Mediterranean Sea.

Although Africa's own maritime transport sector remains relatively underdeveloped, more than 90 percent of all imports and exports in Africa are facilitated by sea through ports along the coast. These will equally have similar social and environmental consequences on the African port sector. Port

authorities in Africa should then take responsibility in applying and committing themselves to taking policy initiatives with innovations necessary to meet sustainable development goals. African ports share common environmental and sustainability challenges, as other ports across the world. It is in that perspective that this study seeks to investigate the way port appraise sustainability around the world and draw from it, beneficial lessons for Sub-Saharan African ports. In that perspective, this study seeks to derive a set of sustainable indicators that can be efficiently used to appraise the level of sustainability of port across the world. In order to test the validity and efficiency of such system of indicators, this framework of indicators will be used for such evaluation within 4 ports carefully selected for this study on specific criteria detailed further in chapter 4. In that same vein, and after ensuring the framework of indicators is functional and meet the needs of the researcher in efficiently evaluating sustainability within Port organizations, it will finally be used for the careful evaluation of the sustainability level within the Douala Port in Cameroon. In so doing areas of strengths and weaknesses of the port will henceforth be determined on a comparative basis and adequate policies solutions will be proposed to foster sustainability practices within the Port of Douala in particular and that of Sub-Saharan African countries in general.

1.1 Research Problem

The recent growth in global trade over the years have had a tremendous impact and major transformation within the shipping business in general and on ports in particular. These resulted in port authorities around the world, to adopt various policy initiatives leading to the sustainable Management of their port organization.

However, due to the vast number of sustainable indicators, the complexity of the port organization where such indicators are expected to be implemented and the few available academic study on port sustainability appraisal within the port industry in general, but with African ports in particular, this research seeks to develop a framework of indicators that will be viable and efficient in evaluating sustainability initiatives within ports.

In the second stage of the study, the newly developed framework will be tested for his validity and efficiency by exploring the sustainability initiatives within 4 Ports selected across the world. The aim is to have a global overview of sustainability initiatives across ports around the world in order to determine which ports are proactively integrating sustainability into their operations and how they do that. Once the framework is tested and its efficiency validated, it will be used to determine the sustainability efforts within the Douala Port.

Based on a comparative and realistic analysis of the different initiatives across all the 5 ports involved in the study, one of the research goals of this

research will be to formulate realistic initiatives to foster sustainability practices within African ports.

1.2 Research Objectives

From the above discussion, the goal of this research is obtaining a framework of indicators that will enable ports to evaluate and incorporate sustainability within their organizations and to systematize their practice. Different countries and their ports have different approaches and methodologies in defining criteria and tools in determining sustainability and evaluating their performances. As of now, there is no consensus among scholars on a clear-cut method in evaluating sustainability within port organizations. The most effective indicators to be used in such evaluation, as well as their numbers for optimum appraisal is still to be agreed upon. With the above theoretical debates, the first research objective of my topic will be revolving around the following concern;

1) To determine an efficient sustainability framework for measuring sustainability performance within Por organizations

   In so doing we will focus on the following:

   - Defining port sustainability
   - Determining the purpose and objectives of port sustainability?
   - Determining the criteria and tools used in evaluating port sustainability?

The second research objective of this dissertation will be as follow;

2) To use the developed framework in order to evaluate the sustainability performance of sample ports selected for the study and determine reasonable strategies and policy initiatives that can help improve the sustainability performance of sub-Saharan African ports.

In so doing we will focus on the following

- What is the gap in sustainability performance evaluation among selected ports from the research?
- Despite the numerous differences between the different ports evaluated, what efficient and reasonable policies initiatives can be recommended to Sub-Saharan African ports in general in enhancing their sustainability practices and performance?

1.3 Research Questions

With the above research objectives, my research will revolve around answering the following four research questions:

1) How are ports authorities addressing sustainability issues within their organizations?

2) How are sustainability measured within Ports organizations and what tools

are used in that perspective?

3) What is the Gap in sustainability policy implementation between modern ports and Sub Saharan African ports?
4) What challenges need to be overcome by Sub-Saharan African ports to bridge the aforementioned gap?

1.4 Research Methodology

The methodology used for this research will consist of the review of the literature and case studies analysis. Data in this study were collected through two means. First there was site visit, interviews and observation to a number of ports within the sampled ports involved in this study. Secondly, corporate communications and internet research also gave the researcher secondary data through reports, brochures. Websites and internet research.

Ports in this study were selected to be regionally representative of different geographical areas across the world. This enabled the research to have a broad view on different cultural approach to sustainability. Ports asserting to make efforts in the field of sustainability within their organization were chosen in priority. Also, the opportunity to research via pre-established contacts and site visit in some cases by the researcher were equally considered in choosing sampled ports for this study.

The African port considered for this study is the Douala Port in Cameroon. Also, 2 ports in Europe, The Rotterdam and Antwerp Ports were as well chosen. In North America, the Vancouver Port was chosen for this study as well as the Yokohama Port, in Asia.

Lessons were drawn from the practice of their sustainability implementation.

The aim in sampling these ports was two folds, first, we wanted to get a good and general background of the environmental situation of these ports, and secondly to explore possible avenues for cooperation in order to boost their environmental performance. In achieving that, the legal compliance and environmental management practices were reviewed. Also, the environmental regulations were studied, and practices regarding the identified environmental challenges were accessed.

Finally, an efficient sustainability framework for measuring performance and truly systematizing this practice within the organization was determined.

Figure 1.2 below summarizes the above discussed research questions, objectives and methodology to be used throughout this study and illustrates the guiding framework for this study.

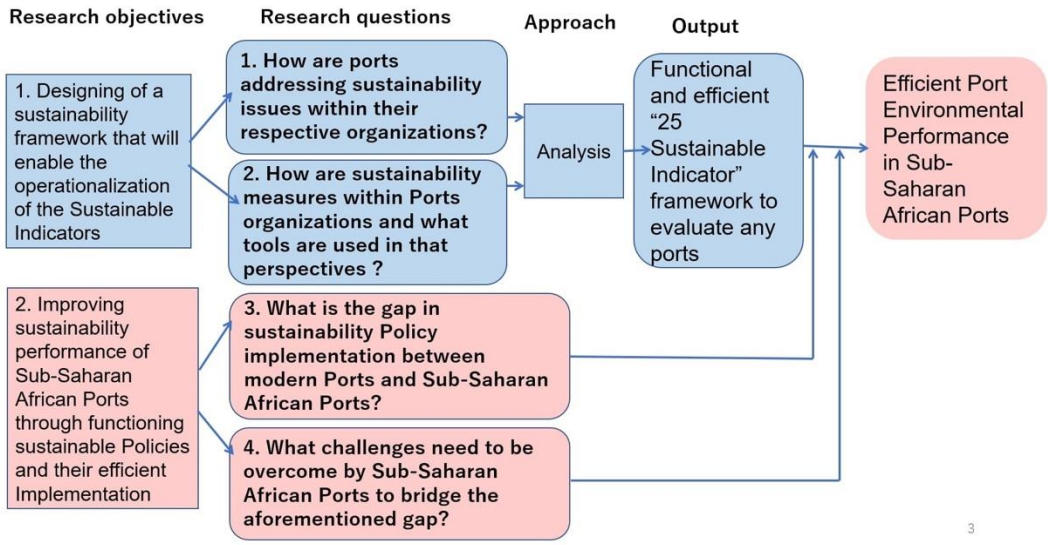

Figure 1.2 Guiding Framework of the Study

1.5 Structure of the Dissertation

This dissertation will be structured around the following chapters:

Chapter 1 of this dissertation reviewed summarily the background of this study, such as discussion on port sustainability, the theoretical framework and a brief skeleton on how this research was conducted. Research questions, objective, Methodology and the limitations of the study were equally discussed at this stage of the dissertation.

In Chapter 2, I critically review the literature on sustainability within organization in general and specifically the concept of sustainable ports and how it evolved the different steps and processes of making a port sustainable was as well discussed based on the current literature. Among other things concepts of corporate

sustainability, and the different approaches emanated from the sustainability sciences.

I further discussed the Triple Bottom Line approach to sustainability its various applicability. I also laid emphasis on some of the concerns from the TBL methodology. I further proceeded by discussing the concept of sustainability in corporate organizations in general.

The next step consisted in discussing the various means through which sustainability is measured and more specifically with the use of indicators. The characteristics as well as the number of such indicators for optimum evaluation of port sustainability within port organizations was as well discussed.

Finally, I discussed the concept of sustainability as it is applied in the port industry. Similarly, port sustainability indicators and their evaluation technic were as well discussed at the end of this chapter.

In Chapter 3, Based on the empirical available literature reviewed in chapter 2, in addition to a carefully chosen methodology consisting on a top-down approach coupled with a scoring method applied against a 16 criteria from a preset list of Indicators 'characteristics by Peris Mora et al, 2005, a framework made of a set of 25 sustainability indicators will be selected across the 3 sub-groups of the TBL approach to sustainability**.**

The predetermined sustainability framework was later used to evaluate the sustainability performance of carefully selected modern sampled ports

involved in our study based on their excellence and notoriety in sustainability practices. These results are further discussed in the next chapter.

In Chapter 4, I made use of the 25 sustainability indicators framework earlier selected from chapter 3 to test for its validity and efficiency by implementing it in the 4 ports chosen for this study. These four ports are the Port of Rotterdam, the Port of Antwerp, the Port of Metro Vancouver and the Port of Yokohama. The sustainability evaluation process consisted in evaluating sustainability policies against each of the 25 indicators as implemented within the 4 ports afore mentioned. Based on each criterion analyzed and data generated. The data derived in the at this stage will be presented and analyzed in detail. Through this mean, I was able to understand the sustainability culture and practices implemented in each port and therefore I could make a fair analysis of the different approach and draw lessons from it, which will later serve as reference basis for recommendation to other ports.

The information therefore obtained was used to validate how efficient the proposed framework was in successfully appraising sustainability policies and efforts within port organizations. In the second hand, the 25 Sustainability Indicators framework which was validated as an efficient tool for sustainability appraisal was used to evaluate the sustainability performance against the same criteria within the Port of Douala in the next chapter. Based on all the

information gathered thus far, elements of answers to the first two research questions 1 and 2 that guided this study will be discussed at this stage.

In Chapter 5, once the 25 sustainability indicators framework has been validated since proven efficient, the 25 sustainability framework is used to evaluate the sustainability performance of within the Port of Douala. The data derived at this stage were also presented and findings analyzed and discussed in detail. At this stage, and comparatively to the analysis made from the previous four ports, the gap between the Douala Port and the previous ones were discussed and, which answers the research question 3 of this study. The last research question will as well be discussed which related to the challenges to be bridged between the first 4 modern ports and the Douala Port.

In Chapter 6, I will give some recommendations for the improvements of port sustainability for the sub-Saharan Ports in the future. I will discuss the process and areas where improvements are needed.

I will also summarize the salient points of this research and give a general conclusion. I will as well discuss some of the limitations that ensued throughout this research exercise, and we will conclude by making some recommendations for future research in this field.

CHAPTER 2: LITTERATURE REVIEW

2.0 Introduction

This chapter will delve deeply with the study of the concept of sustainability primarily. In so doing, we will review the available literature revolving around this topic. We will mainly discuss about what sustainability is for organizations. Then we will look at the different empirical concepts and the evolvement of sustainability over the years. Further, we will as well discuss of the Framework of sustainability and the different sustainability existing approaches. I will conclude this part by specifically focusing of the TBL (Triple bottom Approach) approach to sustainability which will be the pillars guiding the development of this research.

I will equally focus on the sustainability concept as applied in the port industry and based on the TBL methodological approach. Within this framework, I will discuss about what sustainable ports are, their purpose and evolvement over the recent decades. I will then delve on the method of sustainability evaluation through sustainable indicators, and I will see how indicators are used in Policy decision making.

2.1 Theoretical Background

Many publications and scholarly work have discussed sustainability and its various approaches, evaluation and implementation within different industries.

Therefore, and in-line with the research goals, this part will provide a review of sustainability literature and perspective

2.1.1 Understanding Sustainability

The World Commission on Environment and Development (WCED), in the late 80s defined Sustainability as the science that focuses on meeting the needs of the current generation without compromising the ability of future generations to fulfill their needs. Sustainability however has many approaches and conceptions but the most famous concept of sustainability is composed of three pillars which are : economic, environmental, and social—also known informally as profits, planet, and people.

This concept is popularly known as the TBL approach to sustainability. Sustainability came to the public debate as a result of pressure from civil societies, NGOs and Transnational organizations that call governments around the word to cater for the Environmental and social impact of economic growth from human made actions. In short, it was requested for a more responsible or better still sustainable form of development. The concept of sustainable development equally Came to the public discourse.

The concept of sustainable development was theorized by many scholars. According to (Li et al, 2018) believes This form of development is the key to ensuring that the control of risks and pollution from traditional activities within

various organizations or industries. Therefore, it is agreed that sustainable development can be effectively appraised through the measurement of the level of sustainability within a given organization. (Field et al, 2017) argues that Sustainability, in turn, "... expresses concern about the quality of a system that relates to inseparable integration (environmental and human), and evaluates its properties and characteristics, encompassing environmental, social, and economic aspects". This concept expresses and draws a relationship about the three pillars of the TBL as earlier mentioned.

In that same vain, (Bartelmus, 2010) believes sustainability has several perspectives. Among which we can list its role in covering environmental protection and the economic services. Also, economic, financial and social issues can be listed among its prerogatives. Büyüközkan and Karabulut, 2019 on their own part describe sustainability as a process that extend towards a holistic, integrated and methodological understanding. Further and adding to the discussion, (Lobo et al, 2014) believe that decision makers are becoming more aware about adapting to sustainability in the evaluation of complex systems in replacing linear solutions (Wu, Zhang & Yang, 2020) believes sustainability is a new phenomenon recently used in times but will be adopted by more companies. Increasingly, more and more companies are taking the commitments to embark in sustainability as a strategic management tool. This is done through actions like

waste reduction technics, various investment in renewable energy, and through various other means.

Sustainability appraisal or evaluation has equally been a topic of concern. Many theories and research have been discussed over the years. However, sustainability indicators have been the most consensual and widely approach used by many scholars from the field for sustainability evaluation. (Feil, et al, 2019) argues that sustainability assessment "Is operationalized through indicators or indexes, and results in quantitative information, enabling the establishment of objectives or goals to be achieved through long-term strategies …" which therefore are implemented by a sustainable development.

2.1.2 Discussion on the TBL Approach to Sustainability

The core of sustainability concept rest on the Triple Bottom Line concept as earlier briefly discussed. Sustainability focuses on understanding and measuring the economic, environmental, and social value that corporations add or destroy (Elkington, 2018). The TBL looks at the result of the activities of an organization, voluntary or governed by law, which demonstrate the ability of the organization to maintain viable business operations while not negatively impacting social or ecological systems (Smith and Sharicz, 2011). The Smith and Sharicz study begin to assess to what extent organizations have begun to shift practices toward TBL sustainability. Milne (2005) strongly protest that despite the

association of TBL with sustainability, “It simply is not” and does not go far enough to support the underlying premise of sustainability that the equilibrium of natural ecosystems must be preserved and protected.

Chouinard et al (2011) argue in the Harvard Business Review that “no one denies the need for sustainable business practices, even those that only care about the bottom line recognize the viability of business depends on healthy ecosystems and the stability of just societies”. The authors posit further that the following trends are converging to result in a catalyst for sustainable business:

1) true cost accounting – the cost of resources previously treated as free, such as the pollination services of honeybees, are being monetized and accounted for;

2) companies that manage these costs efficiently are rewarded with capital, and

3) value chain indices are being created within industry sectors to allow true comparisons of products by examining the impacts accrued throughout their life cycle (Chouinard et al, 2011).

2.1.3. Concerns from the TBL Methodology

According to Wang et al (2015), there are various key themes that sustainable development addresses, amongst which we can list the following concerns;

- Concerns that the earth resources are limited and that there is a need for better resource efficiency. Rapid growth in population has put a great

amount of stress on earth's resources. These resources are limited in number so these resources will have to be utilized in an efficient manner so that we don't harm the capacity of future generation to meet their need.

- Concerns that developments may reduce the biodiversity and upset the ecology on which all life depends. Development at any scale should take into consideration the ecological factors and shouldn't disturb the earth's natural cycles, otherwise lives of all the species will be at a great risk.
- Concerns for future generation. As discussed before, sustainable development is primarily focused on safeguarding the needs of generations to come.
- The need to improve quality of life for all. Sustainable development also emphasizes on better living conditions for all the people living on earth.
- The need for equity between different groups of people on earth. With the development of the world, various groups in society should have equal rights, justice and there's no partiality amongst different groups.
- The need to balance between competing goals (economic, environmental, social). Sustainable development shouldn't be only looking at environmental sustainability, that only a part of SD; for long lasting sustainability, economic and social factors should also be taken in account. There should be parity amongst the three factors while moving forward.

- The realization of the interdependency within and between all communities on earth. No community or group can thrive in isolation, especially in the era of globalization. Everybody will have to realize that interdependencies will have to be created and respect in order to attain efficient and sustainable development.
- Intergenerational equity on the aspect of natural capital that has to be shared equally between now and future. It means that the future generation would have the same amount of natural resources available to them as the current generations have.
- The humility principle: it recognizes the limitation of human knowledge and puts burden of proof on those taking the action.
- The precautionary principle: it advocates caution when in doubt.
- The reversibility principle: it requires not to make any irreversible change.

2.2. Corporate Social Responsibility

Corporate Social Responsibility popularly known as CSR refers to the inclusion of environmental considerations whenever making business decisions. This comes as the result of the growing pressures on organizations from shareholders and other stakeholders to increase their focus on sustainability and environmental preservation.

(Krajnc et al, 2003) argues that most industrial practices are not sustainable due to the excessive consumption needs of nonrenewable natural

resources. Therefore, this also entails that companies should commit to more equity, and the acknowledge that embracing development goes beyond just economic growth (Dobers and Springett 2010). In the same vein, Dobers and Springett (2010) also lay emphasis on CSR as a means to prioritize a better public relations campaign. Similarly, (Azapagic et al, 2003) considers corporate sustainability as a very valuable tool in the analysis aimed at cost reduction, risk management, and the development of new products and the promotion of internal, cultural and structural changes.

Also, business leaders will have a level of commitment to change their operations beyond the status quo by the moment they have implemented more easy cost-saving and efficiency measures.

Babiak and Trendafilova (2009) also argue that while CSR practices have become increasingly popular, there is barely a discussion in the academic literature regarding the different motives driving these changes in practice. Vidaver-Cohen and Simcic Bronn (2008) argue that "the parameters of legitimacy for many businesses have changed in the new millennium, and that there may be both moral and strategic imperatives for corporate efforts to strengthen the communities in which they operate" (Babiak and Trendafilova 2009). Following the same line of argument, Campbell (2007) and Babiak and Trendafilova (2010) also discussed the institutional conditions which determine the different factors that could affect CSR behavior' occurrence and suggest that if "well organized

and effective industrial self-regulations". Other Institutions such as Lowell Center stated that industrial sustainability should be represented by the manufacture of products as well as systems desiring to use clean technologies in their processes.

Adding to this argument, other authors such as (Veleva and Ellenbecker, 2001) on their own part, gave suggestions of several conditions to be met by an organization in operating sustainably. This includes among other things i) the reduction of materials used and the energy involved in the process, ii) the promotion of conservation and limitation of waste to its barest minimum, iii) the prevention of waste generation and the promotion of reuse and recycling, iv) the promotion of the safe disposal of non-recyclable materials in a safe way, v) the promotion of the usage of clean Technologies in the production process, vi) the reduction of transport requirements, and finally vii) more support to social issues, among other things to do.

2.3 Measurement of Sustainability with Indicators

In evaluating sustainability within organizations, sustainability indicator are common tools used in that perspective. Sustainability indicator is a measure or set of measures that provide information on pre-defined variables (Joung et al, 2012) . In this sense, these indicators aim to quantify, analyze, and communicate complex information in a simple way (Singh et al, 2012). through systematic,

precise, consistent, and transparent measures of the Triple Bottom Line aspects (Linke et al, 2013).

The simplification of complex processes, regardless of the number of indicators used, implies the reduced capacity of translation of all the information collected in the field, generating, consequently, a variable margin of loss of the quality of the information about the phenomenon investigated (Lodhia, S, 2014).

The objectives of sustainability indicators include (a) increase awareness and sustainable understanding; (b) inform concise data on the current state and performance trends for decision making; (c) measure progress toward established goals; (d) promote organizational learning; (e) provide a tool to measure the organization's achievements against sustainability goals; and (f) provide a tool that encourages stakeholder involvement in decision making, among others. In this sense, the indicators should reflect the reality of the organization's business, values, and culture to be efficient and consistent (Keeble , 2003). Sustainability indicators should be identified and selected by observing the desirable qualities (Azapagic, 204) and the essential characteristics (Veleva, 2001) as presented in Table 2.1.

Table 2.1 Qualities and Characteristics of Sustainability Indicators.

Desired Qualities	Essential Characteristics
(a) based on reliable, valid, available, accurate, and accessible information	(a) the calculation and monitoring period
(b) technically measurable, reproducible, low cost, and easy to apply and evaluate	(b) the limit, i.e., the level of coverage
(c) elaborated, identified, and selected through an open process	(c) the unit of measurement
(d) simple and significant and an understandable set of indicators with a top down and bottom-up approach	(d)the type of measurement
(e) qualitative and quantitative metrics	(e) the unique alphanumeric identification of the indicator
(f) usable in time comparisons.	(f) its name, containing its distinctive designation
	(g) the definition of essential characteristics and their function
	(h) based and referenced on theoretical or pre-developed basis with technical and scientific adequacy

2.3.1 Number of Indicators to be Selected

Scholars have extensively debated over the number of indicators required in evaluating sustainability over the years. The number of indicators used should not be high, only sufficient to provide manageable analysis (Linke, 2013). Also, according to (Singh et al,2007) it is difficult to evaluate performance with a high

number of sustainability indicators. (Bui et al, 2017) on the other hand argued that the number of indicators selected depends on the specific interests and goals of organizations. In that same vein, (Nordheim et al,2007) suggested not more than 30 indicators in total considering the Triple Bottom Line aspects; but (Kinderyté, 2010) developed a set of 42 sustainability indicators to assess sustainability in companies. (Rahdari et al, 2015) emphasized that there is widespread confusion about the definition of sustainability indicators that reflect on the organizational performance and represent sustainability guidelines in terms of high available quantity. In this sense, it is noticed that there is no consensus on an ideal number of sustainability indicators, but these must meet the objectives they were created for.

2.4 Sustainability in the Port Industry

2.4.1 Definition of Sustainable Ports

According to the American Association of Port Authorities (AAPA), port sustainability is defined as strategies and activities that meet current and future needs of port stakeholders while protecting and sustaining human and natural resources (AAPA, 2007).

Similarly, green ports are defined as those engaged in the proactive development, execution, and monitoring practices targeted at reducing environmental effects beyond compliance (Acciaro, 2015). However, Lu et al. (2016) differentiated port sustainability and green ports.

Sustainability considers social, economic and environmental issues, whereas green is solely focused on environmental issues (Ashrafi et al., 2019, 2020). Lam and Van De Voorde (2012) proposed a combined framework that included stakeholder involvement, green market development, cost-effective environmental policy, and sustainable operations and development, as major elements of a sustainable port strategy.

The goals of each of the three pillars from a port perspective can be summarized as follows:

Environmental sustainability: minimizing the negative impacts engendered by a wide range of operational and shipping activities within the vicinity of ports (Narula, 2014, Shiau and Chuang, 2015).

Social sustainability: contributing to the enhancement of people's quality of life by supporting port activities to satisfy socio-economic priorities such as employment opportunities, education for employees and communities, and improving social stability of the area surrounding ports (Narula, 2014).

Economic sustainability: maximizing the economic performance resulting from implementing sustainable development initiatives, without adversely affecting social and environmental development (Cabezas-Basurko et al., 2008).

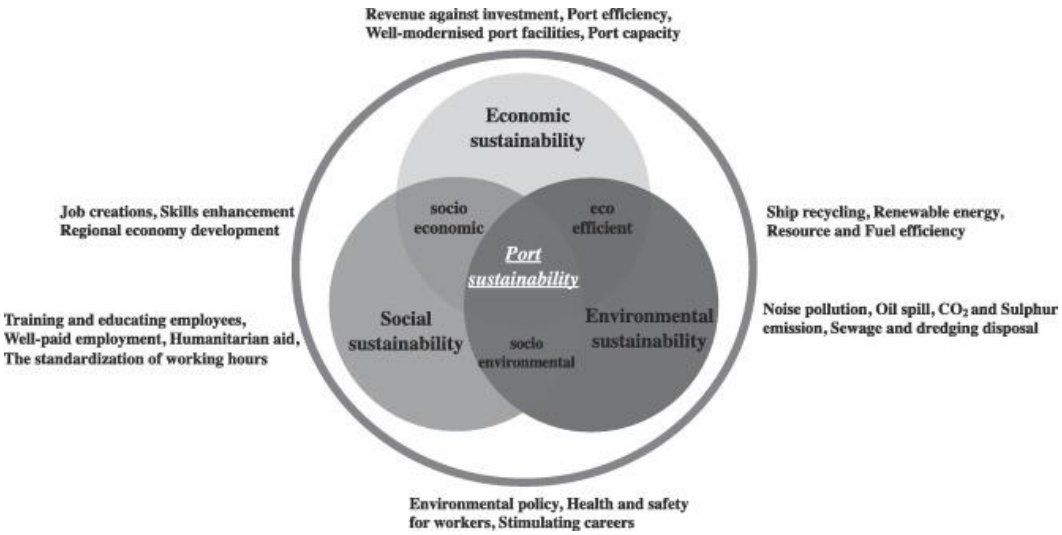

Figure 2.1 The 3 Pillars of Sustainability

Source: Adapted from (Sehwa lihm, 2019)

Triple Bottom Line recognizes the three aspects will have equal impacts in terms of allowing the generations to meet there need and protecting the needs of future generations. Hence, a conspicuous relationship between the two can be identified. According to Payne and Raiborn, 2001 without Sustainable Development "neither business nor the societies in which they exist will have a long-term future".

There have been various definitions of sustainable development proposed like those by Fergus and Rowney, 2005, MacDonald, 2005 and Baumgartner, 2004 etc, but none has gone outside the scope of Triple Bottom Line.

Some scholars argue that ports must be sensitive and careful about environmental protection and social progress in economic development. Also, Hiranandani (2014) argues that there are no doubts that ports need to be sustainable. While port operations have improved, in numerous ways, the life standards in most of the urban areas. Therefore, there are certain numbers of challenges that are faced by ports where they are situated. For instance, native air pollution from ports, ships or local transport, traffic and congestion, co-location of risky or contaminating industrial conveniences around ports have serious effect on the nature of seaports. Therefore, ports need to develop in sustainable ways. In 2006, the City of Rotterdam implemented an aim to lessen the city's greenhouse gas discharges by 50% by 2030 (Fenton, 2014)

Subsequently for ports, sustainability also suggests business systems and exercises that help the venture and its stakeholders, whilst securing human and characteristic assets. This means ports have to balance their roles as coastal stewards, facilitators of business and transportation and parts of their particular groups (Gouglielmos, 2000 & Hiranandani, 2014).

According to the recent research from Hiranandani (2014) the idea of sustainability is gaining mindfulness in the port business, obliging them to accomplish new ability and apply new practices. Some approaches and actions to guide ports towards lower emissions of greenhouse gases and air pollutants, and in general terms to be more sustainable port (Abood,2007). Whilst the

criticalness of different environmental and management aspects clearly relies on the features of each port, ports face a few regular environmental issues, for example

1. Energy conservation
2. Air quality
3. Water conservation
4. Indoor Environmental Quality
5 Materials & Resources conservation
6. Dredging and disposal of dredge materials
7. Storage, transport and management of hazardous substances
8. Ballast water control.
9. Dredging
10. Habitat restoration

These 10 specific port operational topics are discussed by many authors to reach a sustainability perspective in harbours. All of them resulting from lower energy , water utilization, wastewater and emanations creation, lower expenses and reserve funds from expanded gainfulness and wellbeing.

As earlier mentioned, the achievement of the development of sustainable ports earlier discussed in SSA is the target and before proceeding, it is important to discuss about most of the organizations that framed venues for regional and

international collaborations among ports with the overall aim to foster port sustainability practices. It is important to mention that all the ports used in our studies belong to one of these organization.

The author believes it is important for some light to be shed on these organizations, how they came about, their working mechanisms and how they enabled ports to tackle sustainability issues at regional and global levels. This will go a long way on enlightening our development during the presentation of results and the role these organizations play within the sampled ports.

2.4.2 Purpose of Sustainable Ports

The increasing attention to "sustainability" has resulted in steadily developing polices, regulation, and a guidance in order to promote sustainable development. In the shipping and port industry, sustainability practices have applied over a wide range of spatial and temporal scales (Cheon and Deakin, 2010; Seuring and Muller, 2008), including many types/routes for implementing practice such as resource, environmental, community and human resource management, continuous growth, and port operators and supply chain management (Sydney Ports Corporation, 2011). These wide-ranging implications obtained from sustainability principle, policy and strategies laid the foundations for developing port practices, activities and procedures.

On the other hand, numerous case studies have identified the benefits resulting from sustainability practices (e.g. Dinwoodie et al., 2012; Cheon and Deakin, 2010; Seuring and Muller, 2008; Francisco, 2007), including reductions in operating costs, production and process improvements, reduced liability and risk, enhanced brand image, increased employee morale, increased opportunity for revenue generation-new markets and price premiums, better supply chain management, and better relationship with customers. Leading ports such as the Rotterdam Port also aims to implant sustainability challenges into their practice and achieving benefits that generates long term value (Hossain ,Adams & Walker, 2019).

Particularly, literature maintained that sustainability strategy and practices can enhance the sustainability of competitive advantage (Rodriguez et al., 2009), simultaneously reducing the negative effects of their performance on the natural environment (Lun, 2011). Since the concept of sustainable ports has been briefly reviewed with its benefits, it is important to as well discussed of the indicators enabling their level of performance within the port industry.

2.5 Port Sustainability Indicators

2.5.1 Definition and Importance of Port Sustainability Indicators

Port Indicators are crucial instruments for understanding of, communicating on, and evaluating of environmental processes and policies (Rodrigo Gonzalez, 2020). They consist of data or parameters easy to understand, which are able to

represent a more complex reality. If available for different years, the data can be aggregated to time series, creating indicators able to show trends.

Indicators may consist either of single data which can be assumed to be a "key data", representing the state or a trend of environmental, economic or social conditions. Also, Indicators are considered of crucial importance for the measurement of sustainability in local contexts as well as for national and international policies, as they allow to communicate, discuss and take decisions on complex facts and trends, using relatively few data. Considerable work has been done for the development of sets of sustainability ports indicators by various scholars.

The sustainability of port regions is a problem that can be defined through a three-dimensional perspective (economic, environmental and social), the application of composite indicators for sustainability assessment enables better information and facilitates decision-making of all stakeholders. The next chapter will delve with the procedures applicable in the selection process of an efficient framework of sustainable indicators for an overall reliable and efficient appraisal of sustainability performance within port organizations.

CHAPTER3: DEVELOPMENT OF A 25 TBL INDICATORS FRAMEWORK FOR THE EVALUATION OF SUSTAINABILITY PERFORMANCE WITHIN SAMPLE PORTS

3.0 Introduction

This section will deal with the selection process of the 25 TBL Sustainability Indicators used in this research. In so doing a brief discussion will be made on the rationale for sustainability indicators. I will then proceed by reviewing qualitative and quantitative port Sustainability Indicators. Finally, the steps taken in selecting the final set of indicators in this study will be discussed in the second part of this Chapter.

3.1 Rationale for the Selection of Port Sustainability Indicators

Ports are complex organizations in several respects and mostly differ economically, socially, culturally and administratively. This is due to the range of interests and responsibilities of different parties involved. In order to evaluate port's sustainability performance, and track their progress towards continuous improvement, relevant sustainable indicators may be used (Donnelly et al., 2007).

In this way, port authorities can demonstrate compliance and continuous improvement through scientific evidence and quantifiable measures.

The review of the literature on this topic shows that several ports did use environmental indicators as a tool to evaluate the state of sustainability within

their organization. However, due to the vast number of available indicators, various ports might use completely different set of indicators for such evaluation. For instance, in 2009, "a study initiated by the ESPO involving 122 ports within 20 European countries, revealed that 60% of the respondents' ports have identified environmental indicators to monitor trends in environmental performance. Nevertheless, when they were asked to name the environmental indicators used, the responses provided more than 100 different indicators". (ESPO, 2010).

The above entails that although ports are becoming more aware of the benefits of using environmental indicators, it should be noted that no common approach to sustainability implementation is adopted and consensual, showing clearly that much research needed to be done in that perspective. This Chapter will therefore discuss on the steps taken in developing the set of 25 TBL Sustainability Indicators framework used throughout this research. This framework will be utilized in appraising sustainability initiatives within the 5 ports involved with this research.

3.2 Qualitative Review Analysis of Indicators

As discussed in Chapter 2, a Sustainability indicator is a measure or set of measures that provide information on pre-defined variables. However, in order to obtain qualitative and efficient data, such indicators must meet certain criteria.

Table 3.1 details the general characteristics a sustainable indicator needs to possess in order to have a quality evaluation of sustainability.

Table 3.1 General Characteristics of Port Sustainability Indicators

Characteristics	**Definitions**
Representativeness	The indicators should represent environmental behaviour as accurately as possible
Conciseness	The indicator should allow for the simplification of the number of variables, which characterizes a phenomenon of condensing the information with the least possible loss of information
Purpose	The indicator should allow an activity to be evaluated in such a way that goals are accomplished
Usefulness	The indicator should be a useful tool for the activity
Relevance	Within the environmental awareness framework
Adaptability	Being adapted or easily adapted to other indicators, models and prediction systems (EEA, OCDE, EC, etc.)
Comparability	Over time (the development of a phenomenon), and within regional, national and international frameworks
Sensitivity	The indicator should be sensitive to environmental changes with fast, adaptable and appropriate responses to them. Thus, they should have variable values according to the changes in the phenomenon
Clarity	The system should be coherent and focus on essential data. The indicators should be concise, accurate, simple and easy to interpret
Reliability and objectivity	In obtaining and developing the data
Easy to obtain	From the phenomenon being evaluated
Continuity	The collecting data criteria should be constant over time in order to compare results

Regularity	The indicators should be determined at appropriately short intervals for the purpose of having the opportunity to actively pursue and influence the desired data
Scientific verification	The indicator should be preferably quantitative. If this were not possible, it should be hierarchically categorized
Well-defined limits	The indicator should provide information about its own limitations
Cost-effectiveness	The indicator should be administratively efficient in terms of the costs involved in obtaining the data and use of the information

Source: Peris Mora et al., 2005: 1653.

3.3 Quantitative Review Analysis of Indicators

The table 3.2 below describes illustratively, one of the many sources used by the researcher to appraise quantitatively indicators from empirical sources. The main concern was the general organization of these indicators across the main pillars of sustainability and their characteristics fitting those discussed in table 3.2. In total 207 indicators were recapitulated across various primary sources.

The table 3.2 Port Sustainability Indicators

Ports Sustainability Indicators	
Environmental Indicators	Emissions of GHGs Emissions of air pollutants Noise Renewable/alternative energy usage Recycling of ships Recycling of hazardous wastes Recycling of equipment Emissions of GHGs/area of warehouse Emissions of GHGs/average service time for ships Emissions of GHGs/number of import and export containers Emissions of GHGs/annual revenues Fuel consumption

	Electric consumption Water consumption Air quality Atmospheric contaminant emissions: CO, NOx, SOx, PM10 particles Greenhouse effect (Carbon footprint): CO2, CH4, N2O Water quality Waste creation Waste disposal Eco-efficiency Wasted resources Material recycling Noise pollution Inner port water quality High risk areas for soil pollution Creation of sludge from dredging Efficient electric energy consumption
Financial Indicators	Annual capital investments Floor space of passenger service areas Annual ship visits Annual revenues Annual passenger visits Annual revenues/capacity of annual container throughput Annual revenues/area of container yard Annual revenues/handling efficiency of gantry cranes Annual passenger visits/annual capital investments Capacity of annual bulk and general cargo throughput/annual capital investments Capacity of annual container throughput/annual capital investments Dwell time Rate of return on turnover Cargo handling revenue per ton of cargo Capital equipment expenditure per ton of cargo Labor expenditure
Social Indicators	Annual accident rate in port area Annual fatalities in port area Annual number of injured in port area Employee training Social impacts of operations Stakeholder engagements Human rights Workplace conditions Security

Source: (Ozipa, 2018)

3.4 Methodology for the Selection of the Port Sustainability Indicators

The development and selection of environmental indicators is a relatively complex process because of their multifunctional nature (Kurtz et al., 2001). For instance, they are expected to reflect a wide range of environmental issues, show trends over time, predict changes, and influence management decisions (Donnelly et al., 2007). As a consequence, the selection of environmental indicators should be accompanied by a rigorous validation process.

Although several methods for the selection of indicators have been suggested (e.g. Hammond et al., 1995, OECD, 2001), there are two main approaches to select indicators: the top-down and the bottom-up. The top-down approach is based on identifying indicators from literature review (e.g., publications, reports, and standards) and narrowing down to a final set of agreed indicators. The bottom-up approach consists of compiling the final set of indicators from the proposals of sector stakeholders based on their perceptions of issues and significance (Chamaret et al., 2007). The methodology followed in this research is that of the top-down approach.

Initially, a wide-ranging list of EPIs currently in use was compiled. In order to provide an exhaustive database of possibilities, this collection was based on an extensive literature review and the identification of current industrial and sector best practices. The indicators were analyzed individually and filtered against specified criteria.

Environmental reports and reviews from the sampled port authorities in this study were used in that perspective. Usually, when Port Authorities make efforts towards the environment, they are keen to show these efforts by publishing these performances for their stakeholders. Most of the port authorities that publish an Environmental Report make it publicly available in their website. This was a key source for data gathering during this research.

3.4.1 Indicators Assessment

All the identified indicators (207) were evaluated, screened and filtered following the 'theoretical' assessment, in which indicators were evaluated following the set of specified criteria discussed in table 3.1 above. These reviews aimed to obtain a final set of effective environmental indicators that comply with the selection criteria.

Effective indicators should comply with the following set of criteria: They should be policy relevant, informative, measurable, representative and practicable to monitor to briefly summarize. A scoring method was developed in order to rank potential indicators based on this set of criteria. Each indicator was assessed by questions discussed and related to these criteria (See table 3.1) so that a positive answer ('yes') denoted compliance with the specific criterion. Indicators that obtained the highest positive answers were regarded as being of high significance and recommended for acceptance. The higher the positive

answers obtained, the higher the possibility of being considered for the final selection within the set of indicators for the study.

Also, in that same vein, the lower the positive answers, the higher the possibility to be considered for rejection.

The final set of indicators selected for this research were obtained following a balanced of a number of factors including the following;

- Indicators that scored the highest on the scale above discussed against the criteria listed in Table 3.1
- At the same time, a deliberate choice was made during the selection process based on the three pillars of sustainability. Therefore, it was ensured that indicators were grouped into the 3 sub-categories following the TBL sustainability approach (Economics, Environment and Social). From that perspective, the indicators considered were those that scored the highest in their respective sub-categories.
- Finally, we kept the number below 30 indicators for optimum efficiency as suggested by (Nordheim et al,2007)

Based on the above selection criteria, From the preliminary list of 207 potential indicators 25 final sustainability indicators were selected following the TBL approach to sustainability. Figure 3.1 gives a brief summary of all the steps described in the selection process of indicators for this study.

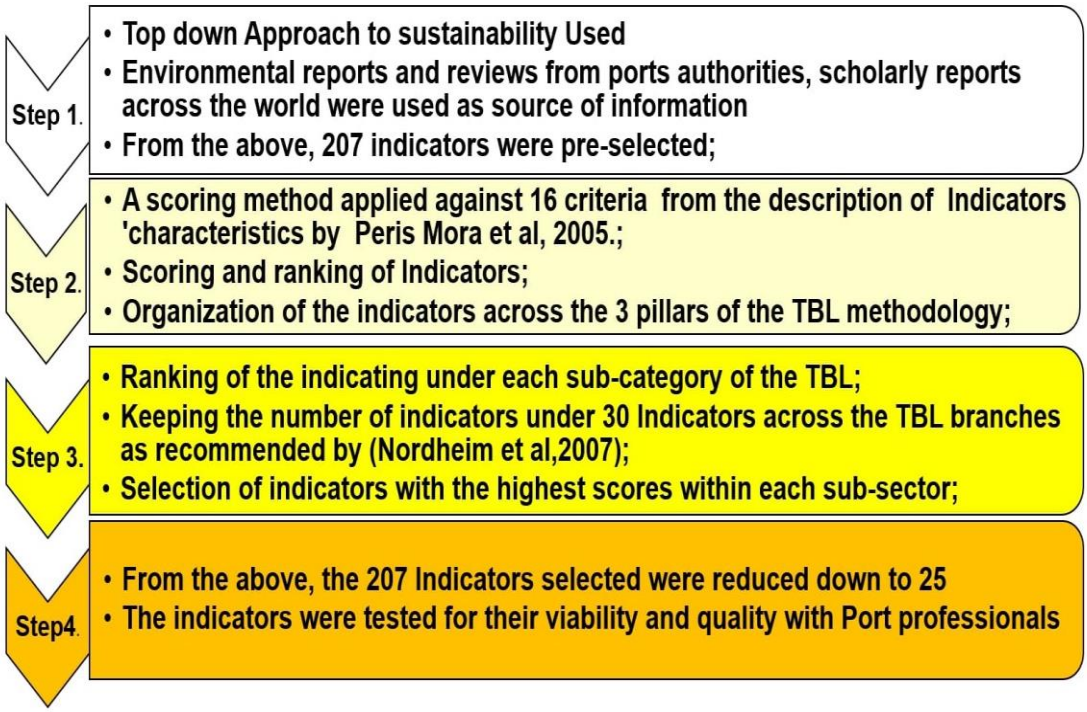

Figure 3.1 Selection Process of the 25 Sustainability Indicators

Following the selection process of the indicators as discussed, a set of 25 sustainability indicators were derived and used for the study as they can be seen listed in table 3.3.

Table 3.3 List of the 25 Indicators Selected for the Study

25 Sustainability Indicators		
6 Economic Indicators	**6 Social Indicators**	**13 Environmental Indicators**
Indicators for each sub-section		
Financial Strength	Ethical Behavior	Environmental Policy
Innovation and Technology	Stakeholder Engagement	Environmental Management System
Knowledge Management	Training and Development	Environmental Certifications
Processes	Corporate Governance	Air Quality
		Water Quality
Port Collaboration	Motivation and Incentives	Energy Efficiency and Conservation
Sustainability Reporting	Port Security	Waste Management
		Biodiversity Management
		Green Infrastructures
		Green Incentives
		Climate Change Adaptation Policies
		Sustainability Website
		R§ D Unit

Source: Author

3.5 Discussion on the 25 TBL Sustainability Indicators

Based on the Table 3.2 above, a brief discussion of each indicator is discussed below.

3.5.1 Economic aspects of the 25 TBL sustainability Indicators

This aspect will focus on the economic indicators that can give a clear appraisal of the economic strength and aspect of sustainability within port organizations sampled. Emphasis will be led on the financial strength of the Ports, Innovative Technologies implemented, the way sustainability knowledge is managed as well as the processes in considering sustainability in business decision.

3.5.1.1 Financial strength of Ports

This indicator will be akin to the total cargo tonnage of the port. It is the most fundamental measure of port and terminal throughput. Cargo tonnage includes the volume of dry bulk and liquid bulk cargo, break-bulk cargo, roll-on/roll-off (Ro/Ro) vehicles and industrial equipment, and the container cargo volumes measured in twenty-foot equivalent units (TEU[2]s).

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[2] TEU ratio is calculated by simply dividing the length in feet of the container by Twenty. For example, a (20ft x 8ft x 8ft) container will be 1 TEU. A (40ft x 8ft x 8ft) container will be 2 TEU (48ft x 8ft x 8ft) the container will be 2.4 TEU. TEUs are the standard unit of measuring the carrier capacity.

The ranking and market Share of these ports will as well be indicated, and their perspective outlined.

3.5.1.2 Innovation and Technology

This refers to the innovative research implemented within ports to create new technologies, reduce environmental impacts, improve business operations; Use of best available control technologies (BACTs[3]), focus on cleaner production and zero emissions. Other aspect of this section includes Investments on customers to reduce impacts of operations. Innovative policy structures and approaches.

3.5.1.3 Knowledge Management

This refers to the summation of actions and approaches to obtain, share and retain sustainability-related knowledge in the organization. Use of systemic approaches, organizational learning; Methods to plan, develop, organize, apply, and measure specific knowledge and to improve the organizational knowledge base. Database systems.

[3] (BACT) is one of the pollution control methods covered by the U.S. Clean Air Act. Title 1 of the Act promotes air quality, protects the ozone and places limitations on emissions.

3.5.1.4 Processes

This concern the sum of sustainability issues considered in business processes; Clear processes and roles are defined so that business activities are efficiently conducted, and every employee understands what is expected of him or her; Implementation of sustainability systematically throughout the business units and operations. Integration of sustainability into daily business life.

3.5.1.5 Collaboration

Cooperation and collaboration in this context refer to the working relationship ports do have with private organizations, sisters' ports as well as with regional and international port organization different ports can be member to.

Port Collaboration with Regional Organizations

Port collaborates on the field of sustainability with various regional and international organizations . For this study, and considering the ports involved, The European and African Regional Port Organizations will be briefly discussed as well as their contribution in fostering sustainability.

Case of Europe (Eco-port)

EcoPorts is a leading environmental initiative directly associated with the port sector in Europe. It was set by a number of proactive ports in 1997 and since 2011 it has been incorporated into the European Sea Ports Organization (ESPO), the representative body of the port authorities, port associations and port administrations of the seaports (member states) of the EU and Norway (ESPO, 2018).

The EcoPorts network [4] provides its members with two tools: Self-Diagnosis Method (SDM[5]) and Port Environmental Review System (PERS[6]). These tools are voluntary and are used by member ports in the EcoPorts network, sharing knowledge and experience with each other. This way, EcoPorts can efficiently communicate the concerns and priorities of European ports to the authorities and public. Table 3.4 below briefly discusses the role and importance of these tools.

[4] The Eco-Port's network is the organizational driving force that improves and protects the environment through cooperation and knowledge sharing between the ports. -

[5] To join the network, port has to get registered on the EcoPorts website and complete an SDM Checklist of 206 questions. SDM Checklist is an environmental checklist that allows the port authority to identify the main environmental challenges and risks in port. Once the questionnaire is completed, the member port gets an access to the SDM Comparison, SDM Review and Port Environmental Review System (PERS). SDM Comparison is an option to apply for a comparison of the port's SDM score with the sector's benchmark of performance, which is based on aggregate average data provided by EcoPorts members. SDM Review allows port to apply for an expert's advice and customized recommendations on how to improve port's environmental performance.

[6] The Port Environmental Review System (PERS) is the only available port sector specific environmental management standard (EcoPorts, 2018). EcoPorts claims PERS to incorporate the main requirements of recognized environmental management standards and also take into account specificities of the ports

European Directives Affecting Port Sustainability

Ports in Europe operate based on Directives[7] passed by the European parliament and enforced

The combination of these directives set targets for ports operating within the EU to substantially reduce their emissions and operate at very high environmental standards with an overall positive outcome from the total emissions from the EU. For instance, by 2017, the EU had reduced its emissions by almost 22% compared to 1990, reaching its 2020 emission reduction target three years ahead of schedule (EC, 2021) . Table 3.4 below, for an illustration purpose, sets a number of such directives by describing the purpose such directives are intended to play in enhancing sustainability practices within European Ports.

[7] The Directives are legislative act that sets out a goal that all EU ports must achieve in the field of port sustainability. EU countries are expected to meet the goals of such directives and later translate them into their national legislation within a defined time frame.

Table 3.4 List of Directives Applicable to EU ports

Legislations/ Conventions	Purpose
Directives 2018/410/EU	Directive on emission reduction and Low Carbon Investments
Directive 2016/802/EC	New Sulphur Directive. It limits the Sulphur content of marine fuels to 0.1 % in SECA regions
Directives 2015/575/EC	Mandatory Monitoring, accounting and reporting of C02 emissions from marine activities
Directives 2014/94/EC	A framework for deploying alternative fuel infrastructure in the Union to minimize dependance on heavy oils
Directive 2012/33/EU	Directive requiring ships to use marine fuels with a maximum sulphur content of 1.5% within EU ports
Directives 2012/27/EU	Directive to harmonize administrative and reporting formalities for ships calling at EU ports
Directive 2004/35/EC	New Air Quality Standards for Europe
Directive 2002/49/EC	Directive on Environmental liability to prevent environmental damage on polluter pays principle
Directive 2000/60/EC	Directive on noise pollution to curb the negative of noise at EU ports on human health
Directive 2000/59/EU	Requires all EU ports to have in Place port reception facilities for receiving ship waste

https://www.consilium.europa.eu/en/policies/climate-change/

Case of Africa (African Port Management Association)

In Africa, the ports are organized under three big regional blocks of Port Association which are namely the North African Port Management Association (NAPMA), for mostly North African member ports, The Port Management Association of Eastern & Southern Africa (PMAESA), for mostly East and Southern African member ports, and finally the Port Management Association of West and Central Africa (PMAWCA) for mostly Central and West African member ports.

PMAWCA is the sub-region of concern for me in this research since the Port of Douala involved in this study is a member port of PMAWCA. This organization was established in October 1972 under the auspices of the Economic Commission for Africa (UNECA), and it covers the seaports located along the West Coast of Africa including Mauritania and Angola.

3.5.1.6 Sustainability Reporting

The practice of sustainability reporting, beyond mere environmental reporting, started in the late 1990s. More recently, the port industry is adopting this reporting to conceptualize sustainability and as an essential basis for the license to operate. Mainly larger port authorities have started producing sustainability reports or integrated reporting on a voluntary basis in the past decade (e.g., Antwerp, Rotterdam). In contrast, others have been obliged to adopt

the practice due to enforced legislation by governments when it comes to example-setting by state-owned enterprises (e.g., Swedish ports).

Ports increasingly follow global guidelines and standards for sustainability reporting (such as the Global Reporting Initiative – GRI). Such report is set up along six dimensions (Market Trends and Structure indicators – Socio-Economic indicators – Environmental and Occupational Health, Safety and Security indicators – Logistics Chain and Operational Performance indicators – Governance indicators – User Perceptions on Port Quality indicators).

3.5.2 Environmental Aspects of the 25 TBL Sustainability Indicators

The following will discuss the environmental aspects to be considered within Ports Organizations related to sustainability with a focus on policies implemented to either mitigate or annihilates all forms of emissions into the Port Environment. Emphasis will as well be laid on certifications and environmental management Programs, Green Infrastructures/ policies implemented within each of the Port organization with the 13 indicators used in this section.

3.5.2.1 Environmental Policy

The Environmental Policy could be considered as the Organization's commitment to reduce its impact on the environment and provides a framework for setting objectives and targets to improve the Port environmental performance.

In general, the EP is a statement by the organization of its intentions and principles in relation to its overall environmental performance, which provides a framework for action and for setting its environmental objectives and targets (ISO, 2015). Existence of an Environmental Policy established within an organization demonstrates that the environmental values are considered in organizational decision making. Unfortunately, this is not always the case due to the several reasons. First, environmental effects are economic externalities and polluters do not bear the consequences of their actions as the adverse effects occur globally or/and in the future. Second, natural resources are common goods that are easily accessible and, therefore, underpriced.

3.5.2.2 Environmental Management System

The Environmental Management System can be considered as Set of processes and practices that enable the organization to reduce its environmental mpacts and increase its operating efficiency.

Although implementing and certifying EMS is voluntary, ports that choose to do so, get an opportunity to demonstrate a proactive commitment to managing their environmental impacts and working towards continual environmental improvement (Waste & Resources Action Programme, 2015).

The key benefit of having EMS onboard is an improved environmental performance because of a robust system of environmental performance indicators,

allowing the port to consistently quantify, monitor and control its impacts. Additionally, EMS boosts sustainability initiatives, such as waste recycling or reduction of noise from port activities. Additionally, it provides a structured management of environmental risks, ensuring safer operations and working conditions for port employees (Waste & Resources Action Programme, 2015).

3.5.2.3 Environmental Certification

The Environmental Certification refers to a form of environmental regulation and development where the Port can voluntarily choose to comply with predefined processes or objectives set forth by the certification service. For this study most prominent ones include The ISO 14001, The EMAS with worldwide reach and the PERS, the SDM above discussed and tools of Eco-portall briefly described below:

The ISO 14000 is a family of standards related to environmental management that exists to help organizations minimize how their operations negatively affect the environment; comply with applicable laws, regulations, and other environmentally oriented requirements.

The EU Eco-Management and Audit Scheme (EMAS) is a premium management instrument developed by the European Commission for companies and other organizations to evaluate, report, and improve their environmental performance. EMAS is open to every type of organization eager to improve its

environmental performance. It spans all economic and service sectors and is applicable worldwide.

Table 3.5 Eco-port Tools Used Within European Ports

Initiatives	**Aim**	**Implementation**
SDM (Self-Diagnosis Method)	Identify Environmental risks and Establish Priorities for action and compliance	Port Managers complete a checklist . Ecoports guidance on Benchmarking performance, Analysis of strengths, weaknesses, opportunities and threat (SWOT Analysis)
PERS (Port Environmental Review System)	Assist Port in Implementing Environmental Management System (EMS), through developing components within it to raise its effectiveness	Eco ports offers an independent review consisting of guidelines and policy documents
ISO 14001	Promote continued improvements by encouraging Ports to adopt and implement EMS. Also assist systematic development of a formalized management Process and evaluate effectiveness of activities, operations, products and services	Continuous monitoring. Improves understanding and assist risk management, supported by appropriate data collection techniques and record keeping.
EMAS (Eco-Management Scheme)	Identify Environmental issues and associated risks . In order to achieve scale economies	Preparation of an environmental review and standards . Setting of a multi-site application of standardize procedures

3.5.2.4 Air Quality

This refers to a set of tools used to gather monitoring data and information on air, and on which decisions can be made. Air emission can emanate from either ship calling at different ports or from cargo-handling machinery, trucks, trains, etc that are used to move goods or containers across the ports.

To regulate emissions, emanating from ships, The Marpol[8] convention in its Annex VI addresses that concern as discussed below.

With respect to legislation addressing emission from cargo-handling equipment or vehicles, usually, local legislation from these respective countries is used to regulate such emission.

[8] MARPOL, the International Convention for the Prevention of Pollution from Ships, is concerned with preventing marine pollution from ships. Specifically, Annex VI of MARPOL addresses air pollution from ocean-going ships. The international air pollution requirements of Annex VI establish limits on nitrogen oxides (NO_x) emissions and require the use of fuel with lower sulfur content, protecting people's health and the environment by reducing ozone-producing pollution, which can cause smog and aggravate asthma.

3.5.2.5 Water Quality

This indicator will address the data and information on water quality and their safe disposal generated within ports. Used water can emanate from either ship calling at different ports and in the form of sewage from ships, from Ballast water or as well from oily residues that could come from Oil tankers calling at port.

To regulate these used waters emanating from ships, The Marpol convention in its Annex II[9] and IV[10] address used water at ports.

Finally, this part will be concerned with the management of [11]Ballast water within Port as well.

The Management of Ballast Water at port is codified by the Ballast Water Management Convention or BWM Convention (International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004) which is a treaty adopted by the International Maritime Organization (IMO). The purpose of the Ballast water+ convention is to prevent the introduction of alien or new species in the aquatic environment. These species are being carried on board of sea-going vessels in the ballast water and may be harmful to the aquatic environment. Ships

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[9] Annex II the other hand consists of a set of regulations regarding the discharge of sewage into the sea from ships, including regulations regarding the ships' equipment and systems for the control of sewage discharge, the provision of port reception facilities for sewage, and requirements for survey and certification

[10] VI establishes conditions for the prevention of Oil spillage from ships and to keep the sea and Port water safe from Oil Pollution

[11] Ballast water is fresh, or saltwater held in the ballast tanks and cargo holds of ships. It is used to provide stability and maneuverability during a voyage when ships are not carrying cargo, not carrying heavy enough cargo, or when more stability is required due to rough seas.

will have to treat their ballast water or will have to prevent in another way the transport of species.

This Convention entered into force by September 8th and is applicable to all ships carrying Ballast water. These ships need to have a certificate, an approved management plan and a ballast water record book on board.

3.5.5.6 Energy Efficiency and Conservation

This refers to the set of rules and policies put in place by port organizations to eliminate energy waste.

Simply put, energy efficiency means using less energy to get the same job done – and in the process, cutting energy consumption and reducing pollution.

3.5.2.7 Waste Management

Unsafe management and disposal of ship wastes can readily lead to adverse health consequences. Humans can become exposed directly, both on ship and at port, as a result of contact with waste that is not being managed in a safe manner. Exposure can also occur via the environmental transfer of disease-causing organisms or harmful substances due to unsafe disposal. However, waste can be managed and disposed of in ways that prevent harm from occurring. Waste can contain hazardous microbial, chemical or physical agents.

Risks of harm arising as a result of improperly managed ship waste are increasing with the greater number of ships in service and the increase in habitation in port areas. Waste streams on ships include sewage, greywater and garbage, as well as effluent from oil/water separators, cooling water, boiler and steam generator blow-down, medical wastes (e.g. health-care wastes, laboratory wastes and veterinary-care wastes), industrial wastewater (e.g. from photo processing) and hazardous waste (radioactive, chemical and biological wastes and unwanted pharmaceuticals).

Restrictions on depositing hazardous wastes into water bodies mean that ships need to capture and retain those wastes on board for periods of time. The process of packaging and storing hazardous wastes is in itself hazardous to the crew, and the storage of hazardous wastes leads to the risk of harm arising should spills or leaks occur. Waste needs to be appropriately disposed of in accordance with the rules and regulations applicable at the point of disposal.

Local regulations from countries often regulate the management of waste within port organization. However, Annex V of Marpol also addresses the management of garbage from ships at port.

3.5.2.8 Biodiversity Management

Biodiversity is a term used to describe the enormous variety of life on Earth. Biodiversity refers to every living thing, including plants, bacteria,

animals, and humans. Scientists have estimated that there are around 8.7 million species of plants and animals in existence. In this context, Biodiversity management at port will consist of the Identification, analysis and evaluation of best practices and outstanding actions taken by ports in addressing biodiversity in their vicinity .

3.5.2.9 Green Infrastructure

This indicator refers to a set of infrastructures developed by port with the overall aim of helping port in their quest for sustainable operations within their port organizations. These main components of this indicator include the different superstructure and infrastructure leading to the reduction leading to the reduction of heat stress, increasing biodiversity, better air quality, sustainable energy production, clean water and healthy soil. Green infrastructure also serves to provide an ecological framework for social, economic, and environmental health of the surroundings.

3.5.3.2.10 Green Incentives

Set of guidelines and policies put in place by port organizations to reward Port customers who are taking sustainable initiatives at their end that definitely have positive impact on port operations.

3.5.2.11 Climate Change Adaptation Policies

This indicator refers to changes in processes, practices, and structures within ports to moderate potential damages or to benefit from opportunities associated with climate change. It should be mentioned that in various countries and cities around the world, ports have in recent years introduced their own incentive programs to encourage ships calling at their ports to use cleaner marine fuels or in other ways reduce air emissions while in the port area. With the introduction of and gradual tightening of emission limits for so-called Emission Control Areas (ECA), which regulate sulfur oxide (SOx) and/or nitrogen oxide (NOx).

Through the International Association of Ports and Harbors (IAPH)[12] World Port Climate Initiative (WPCI), the world's key ports have committed themselves to reduce greenhouse gas emissions while continuing their role as transportation and economic centres. As part of the effort to reduce greenhouse gas and air pollutants emissions in port areas, ports seek the cooperation of visiting vessels in order to address their exhaust emissions. In order to target that part, WPCI initiated in 2010 the Environmental Ship Index (ESI) project. ESI identifies seagoing ships that perform better in reducing air emissions than required by the current emission standards of the International Maritime

[12] The International Association of Ports and Harbors is the global trade association for seaports worldwide. It is headquartered in Tokyo, Japan. Formed in 1955, it is now recognised as the NGO representing ports worldwide.

Organization. Other notable programs that can be considered as green initiatives include the Clean Ship Index, the Cold Ironing mechanism and many more. This does not include individual initiatives that some ports have taken to achieve the same goals by sometimes making some schemes available to entrepreneurs to implement innovative projects with the aim of cutting down emissions at ports.

The Environmental Ship Index (ESI)

Working Mechanism of the Environmental Shipping Index (ESI)

The ESI formula evaluates the amount of nitrogen oxide (NOx) and sulphur oxide (SOx) that is emitted by a ship, while incorporating a reporting scheme on the greenhouse gas emissions of the ship and additionally rewarding ships that can use Onshore Power Supply while at berth. ESI scores range from 0 that indicates ship's legal compliance with to 100 that indicates close to zero exhaust emissions. As such, the ESI score is a perfect indicator of the exhaust emissions' performance of ocean-going vessels and assists in identifying cleaner ships that proactively go beyond legal compliance.

ESI is completely voluntary and [13]WPCI hopes that the global port and maritime community will assume its role in improving the maritime and port

[13] The World Ports Climate Initiative (WPCI) is a global programme to provide ports worldwide with a framework to mitigate their impact on climate change. The WPCI was launched in 2008 by the International Association of Ports and Harbours (IAPH) and regional Port Organizations.

environment. On a voluntary basis, ship owners register their vessels in the ESI database and their ESI score is calculated. The index is then used by ports and other incentive providers to reward cleaner vessels (e.g., by offering discounts on their port dues on the basis of ESI scores) but can also be used by shippers and ship owners as their own promotional instrument.

Benefits of Participating in The Scheme

Ports participating in the ESI scheme send a signal to ship operators that they value lower emissions. Because of the monetary reward, ships who regularly call at participating ports are more likely to use cleaner fuel or to retrofit their vessels in order to reduce emissions as the extra costs of doing so can be partially or fully paid back for by the reduction in port dues. Participation has seen a considerable increase in eligible ship calls at port over the course of the past few years, showing a clear interest from ship operators. The increase is potentially driven by peer pressure and/or increasing requirements for lower emissions on the side of shippers commissioning loads. In the past 2 years, the scheme has also seen more than a fourfold increase in the number of ESI registered ships that have an ESI score of 50 or higher.

ESI Figures

Currently, more than 7000 ships globally are registered in the ESI database and there are more than 50 organizations (the majority of which ports) that actively provide incentives to cleaner vessels on the basis of ESI. The ESI scores of the participating vessels and the types of incentives that are provided by each incentive provider are publicly available on the ESI website. Figure 3.2 below gives a good illustration of the ESI Process.

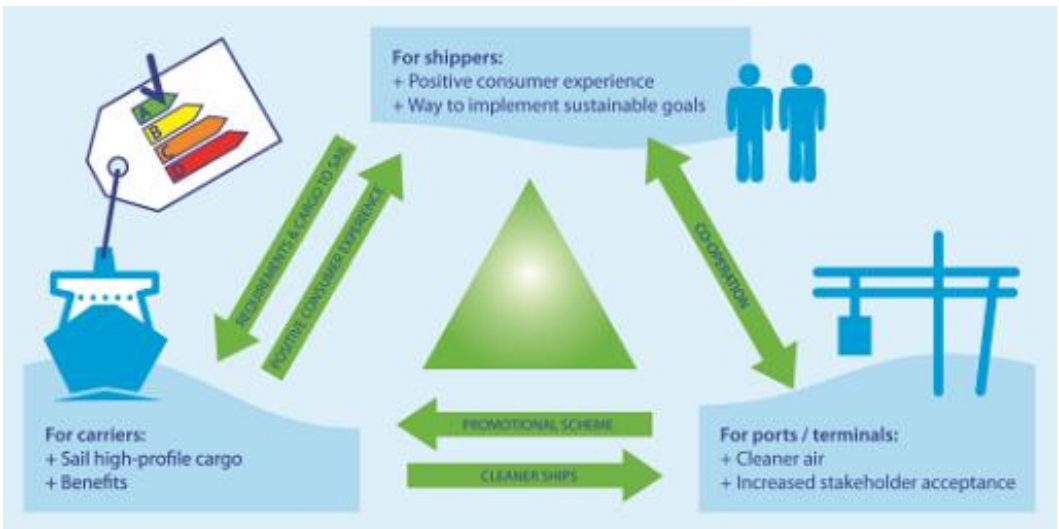


Figure 3.2 ESI Process (Source: https://www.iaphworldports.org/)

Cold Ironing

Cold ironing, or shore connection, shore-to-ship power (SSP)or alternative maritime power (AMP), is the process of providing shoreside electrical power to a ship at berth while its main and auxiliary engines are turned off. Cold ironing permits emergency equipment, refrigeration, cooling, heating, lighting and other

equipment to receive continuous electrical power while the ship loads or unloads its cargo. Shore power is a general term to describe supply of electric power to ships, small craft, aircraft and road vehicles while stationary.

The source for land-based power may be grid power from an electric utility company, but also possibly an external remote generator. These generators may be powered by diesel or renewable energy sources such as wind, water or solar. Shore power saves consumption of fuel that would otherwise be used to power vessels while in port and eliminates the air pollution associated with consumption of that fuel. Use of shore power facilitates maintenance of the ship's engines and generators and reduces noise. Figure 3.3 below gives an illustration of the Cold Ironing process.

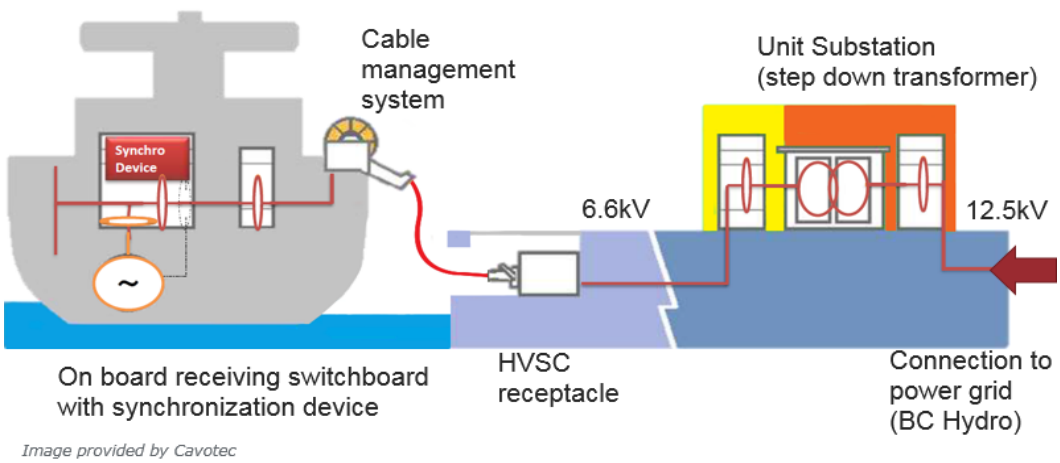


Figure 3.3 Cold Ironing Process

3.5.2.12 Sustainability Website

Availability of a Port Environmental Site where the Port communicate on the activities and policies implemented to foster sustainability practices within the Port .

3.5.2.13 R and D unit

This refers to the role assigned to the Research Department with the aim helping the Port maintain its performance and competitiveness in the field of sustainability. This is done by keeping an eye on developing trends within the industry. Personnel in this department performs research and development duties for their ports. They use research theories, principles and models to perform a variety of experiments, activities and projects with the private or public sectors that will be aimed at keeping to the industry's standards in the field of sustainability.

3.5.3 Social Aspects of the 25 TBL Sustainability Indicators

The following discusses the social aspects of port organizational sustainability, applied both external to the organization, with a focus on stakeholders and the surrounding community, and internally, with a focus on employees and performance management. The table below summarizes the social

Indicators of sustainability within port organizations, with the 6 criteria chosen in this aspect.

3.5.3.1 Ethical Behavior

This refers to the set rules to follow by the port organization in Conducting business fairly and without manipulation of Business practices. Behavior such as corruption to gain competitive advantages are as well to be avoided. Finally, conducting business in a way that respect human right and human values without endangering public health and their safety is as well very important.

3.5.3.2 Stakeholder Engagement

Stakeholder Engagement is the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people It is a powerful vehicle for bringing about environmental and behavioral changes.

Stakeholder engagement is important and can lead to improved outcomes for communities when government organizations and public decision-making entities seek out the aspirations, concerns and values of communities, who, in turn, share their aspirations, concerns and values with port authorities.

Incorporated into decision-making processes, public decision makers are better informed and better able to meet community needs.

Establishing long standing, effective partnerships between government organizations and communities, too, results in a greater sense of community ownership and an improved uptake of services as they are tailored to the unique aspirations of the community.

In this study, emphasis will be laid on the role stakeholders play in participating in port planning processes and various other projects initiated by the Ports organizations. Their role in decision-making processes will as well be addressed under this indicator.

3.5.3.3 Training and Development

Workforce development is considered an interconnected set of solutions to meet employment needs. Workforce development can include changes to culture, changes to attitudes, and changes to people's potential that help to positively influence a business' future success. Workforce development is also sometimes referred to as employee development and is considered an important aspect of business success.

For the sake of this study, this indicator will address the job created within the ports and available for the surrounding communities , direct and indirect jobs, the continued professional development of the workforce within port

organizations through seminars or upgrading courses, educational training and partnership with training Institutes.

3.5.3.4 Corporate Governance

Corporate governance is the system by which companies are directed and controlled. Boards of directors are responsible for the governance of their companies. The shareholders' role in governance is to appoint the directors and the auditors and to satisfy themselves that an appropriate governance structure is in place. Corporate governance is therefore about what the board of a company does and how it sets the values of the company, and it is to be distinguished from the day-to-day operational management of the company by full-time executive.

Focus on this study will be more laid on transparency and giving insight to all relevant data that guides decision-making; Develop initiatives ahead of regulations to manage risks appropriately; Extent of performance management; Existence of performance measurement.

3.5.3.5 Motivation and Incentives

The incentive theory of motivation is a behavioral theory that suggests people are motivated by a drive for incentives and reinforcement. The incentive theory also proposes that people behave in a way they believe will result in a reward and avoid actions that may entail punishment.

Employees might behave differently in similar situations depending on the incentives available. For example, an employee might work harder on a project to earn a good review at all. Their motivation is their desire to receive a reward or avoid punishment via a performance review at the end of the project the incentive theory of motivation is behavioral theory that suggests people are motivated by a drive for incentives and reinforcement. The incentive theory also proposes that people behave in a way they believe will result in a reward and avoid actions that may entail punishment.

Under this indicator, I will look at available programs to help employees to prevent risks, and policies that enable employees to remain healthy, Productive and motivated whilst working at the Ports.

3.5.3.6 Port Security

This indicator seeks to address the set of activities, law, treaty enforcement and counterterrorism activities that fall within the port and maritime domain. This indicator will as well be looking for identifying the protective measures of port employees, the seaport, and the protection of the cargo moving through the ports. I will also seek to investigate if the port concerned with my study are compliant with the ISPS (International Ship and Port Facility Security Code) norms.

Internationally, port security is governed by rules issued by the International Maritime Organization and its 2002 International Ship and Port Facility Security Code (ISPS Code).

The ISPS Code is an amendment to the Safety of Life at Sea (SOLAS) Convention (1974/1988) on Maritime security including minimum security arrangements for ships, ports and government agencies. Having come into force in 2004, it prescribes responsibilities to governments, shipping companies, shipboard personnel, and port/facility personnel to "detect security threats and take preventive measures against security incidents affecting ships or port facilities used in international trade.

At the level of the individual port party to this Code, The ISPS Code specifies that the Port Facility Security Officer (PFSO) is responsible for the development, implementation, revision, and maintenance of the Port Facility Security Plan (PFSP) to keep the port safe and secure.

Couple to the ISPS Code, many Ports do take further initiatives and policies that contribute to the reinforcement of their port facilities. Such measures will be investigated under this indicator as well.

CHAPTER 4: CASE STUDY OF SAMPLED PORTS

4.0 Introduction

This chapter focuses on the implementation of the 25 TBL sustainability indicators developed in the previous chapter. In this chapter, those indicators will be used in the evaluation of sustainability initiatives within four ports across the world carefully selected for the purpose of this study. These port organizations sampled for this study are namely the ports of: Rotterdam, Antwerp, Vancouver and Yokohama.

The goal here is to make an in-depth analysis of the different sustainability strategies and level of maturity within each Port organization in order to understand the context and the policy choices and strategies each port has made in addressing sustainability issues within their organizations. This initiative will surely enable the researcher to test for the validity of this framework of indicators and ensure of its efficiency in analyzing the various sustainability policies implemented in each port organization. In so doing, the local context for each port is then presented, with some challenges and advanced practices highlighted.

The final section of this chapter summarizes the major findings and provides a comparison of the sustainability strategies and tools used within various ports.

The second goal at this stage will consist in using the same framework of indicators to assess the level of sustainability practice within the Port of Douala, in Cameroon as well. Then based on a SWOT analysis, we will obtain a fair understanding of efforts made by the port authority in Douala in fostering sustainability practices.

4.1 Methodology

The following case studies are based on information collected through site visits, interviews, corporate communications, and internet research. A set of semi-structure interview questions were provided to participants in Douala Port (Cameroon), Antwerp Port (Belgium), Rotterdam Port (Netherlands) in Europe whereas site visits and face to face interviews were organized in the Metro Vancouver Port (Canada) and the Yokohama Port (Japan) where the researcher was opportune to travel to gather the needed information.

In total, 80 respondents were involved with the study from various levels of the managerial stratum. An explicit discussion of their qualification and level of responsibility as well as open ended questions on the importance of sustainability practices within their port organizations is discusses and the results annexed to this dissertation as appendix 2.

The choice of semi-structured questionnaire was used for this study, As discussed by (Kumar et al, 2019), The choice of semi-structure questionnaire is

designed to give more flexibility during questioning. It is then expected from respondents to expand on questions as much as they would want to base on a preset interviewer guide which could enable a follow up of questions and address several other issues revolving around the main topic of concern.

Through this method, the researcher could have a broad understanding of how the different port authorities involved in the study address the problematic of port sustainability within their organization.

The majority of information therefore gathered were provided by port officials who kindly filled information requested from the questionnaire for some and took part to the interviews for others. Also, secondary sources of information were used to source for complementary needed information for the thesis.

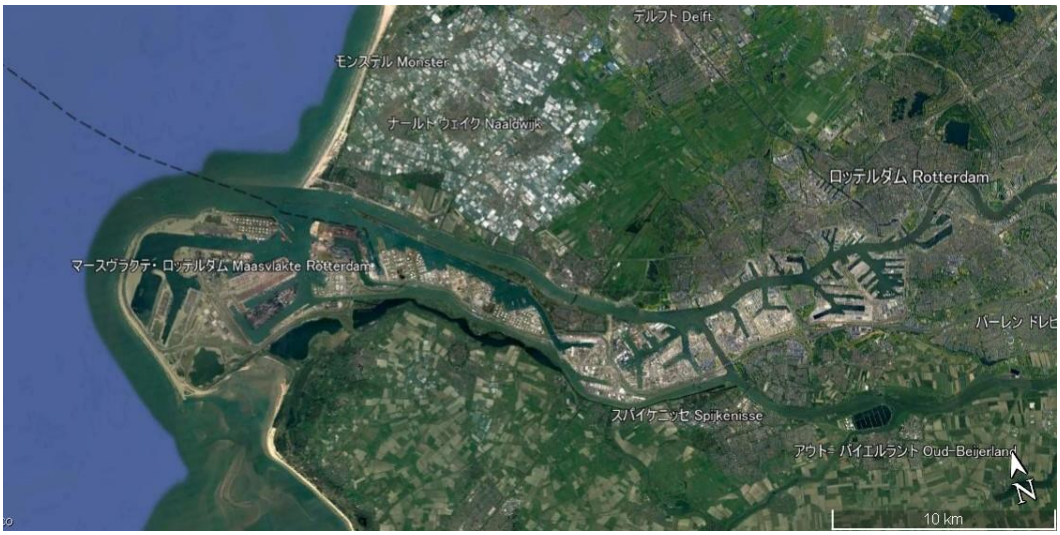
Specifically, I was granted access to the database of the International Association of Port and Harbors (IAPH), where magazine, sustainability reports, corporate reports, press release, news and industry journal articles and websites from hundreds of ports across the world were accessible.

4.2 European Ports

The following 2 case studies focus on 2 European container ports in Netherlands (Rotterdam Port) and Belgium (Antwerp port).

4.2.1The Port of Rotterdam (POR)

Figure 4.1: The Rotterdam Port



Source: Source: https://www.google.com/maps/

4.2.1.1 Background Information and Country Description

Located in the Netherlands between the North Sea and the City of Rotterdam, the Port of Rotterdam (POR) stretches over twenty-five miles inland and is the largest port in Europe, both in containers and by total cargo volumes. The PoR started 800 years ago as a small fishing town, and over the years it grew to the largest port in the world. However, it lost this position in 2004 to Shanghai, and then Ningbo and other Asian ports over time . (ICCT, 2014)

In 2016, 11.1 million TEUS moved through the port, with total cargo volumes reaching 435 million metric tons (POR 2011). Liquid bulk (oil and

chemical products) and dry bulk (coal, ore, scrap, and minerals) make up the major portions of the cargo mix, along with containers.

Each year, over 35,000 oceangoing vessels and 135,000 inland vessels visit the port area (POR,2020),

The POR Authority was originally a municipal department until 2004. Now it is an unlisted public company, with approximately seventy percent of ownership controlled by the City of Rotterdam and approximately thirty percent shared with the Dutch State (POR Authority 2011, 79). The POR Authority is managed daily by an Executive Board and an independent Supervisory Board, which oversees the activities of the Executive Board. There is also a General Meeting of Shareholders, which is authorized to appoint and retire members of the Executive Board .

4.2.1.2 25 TBL Sustainability Indicators Data from the POR

A. Economic Aspect of Sustainability

A.1 Financial Strength

The Port of Rotterdam is the largest seaport in Europe, and the world's largest seaport outside of East Asia,

In 2020, Rotterdam was the **world's tenth-largest** container port in terms of twenty-foot equivalent units (TEU) handled. In 2017, Rotterdam was also the world's tenth-largest port in terms of annual cargo tonnage. Annual container

volume: 14,512,661 TEU, Annual cargo tonnage: 469.0 million tonnes, Annual revenue: € 707.2 million (2018), Vessel arrivals: 29,476 sea ships (POR, 2020)

A.2 Innovation and Technology

The Port of Rotterdam exhibit innovation and technology through several modern projects. For instance, in 2021 the POR started making use of the blockchain Technology and autonomous shipping's application for its users. (POR, 202)

The Port of Rotterdam Authority's also embarked on a digitization program. The aim of this program is to better control port the Port 'infrastructure. The initiative in this project revolves around improved insight into or efficiency of logistics process.

The POR has a well-defined sustainability framework based on the Triple Bottom Line that guides investments and incentive structures and is integrated into its strategic plan, Port Vision 2030, which was created based on a SWOT analysis, forecasting, trends analysis, and back casting. AMP for new terminals at MV2, inland shipping, and ferry service Building with Nature Approach: The Sand Motor Peninsula Pilot Project – Scientists are studying a new way of coastal reinforcement by creating a sand peninsula to protect the new coast at Maasvlakte 2. Wind, waves, and sea currents spread the sand slowly along the coast. The added sand that is moved naturally acts as buffer and creates a dynamic nature

and recreation area. The sand motor consists of 21.5 million cubic meters of sand from the ocean floor, in the shape of a hook. Over time, it will slowly be incorporated into new dunes and a wider beach (POR, 2020).

Dedicated electric rail line for freight up to as far as possible. Policy Incentives/Innovations – Front-Runners Policy POR offers financial incentives and penalties to inland barge operators based on air emissions (POR, 19). POR participates in the Environmental Ship Index (ESI) incentives program at the request of their customers. Maasvlakte 1 is home to ECT Delta, the world's first automated container terminal, which was built in 1996. Maasvlakte 2, under construction, will have three automated electric container terminals (POR, 2019).

A.3 Knowledge Management

IT database and GIS systems are used to track environmental and land use data. Databases are also used for project control systems to manage costs and schedules. Lessons learned developing the Maasvlakte 2 port expansion project were applied to the Port Compass 2030 strategic planning process to guide sustainable development port-wide and build on the community dialogue. Rotterdam intends to become a "Knowledge Port." Rotterdam University has established a new campus for research, design, and manufacturing (RDM) in a section of the old port area.

The RDM Innovation Dock, managed by the Technical University of Delft is part of the campus, and acts an incubator for practical research and entrepreneurship, connecting universities, business services, and industry. Major research and development themes include water management, climate change technologies, floating communities, and sustainable mobility.

A.4 Processes

A substantial portion of the Port's Key Performance Indicators, which are used to measure organizational performance, focus on sustainability.
In 2010, the POR published a Business Plan for 2011 – 2016 with the following objectives regarding their carbon footprint: 10% reduction of CO2 emissions with the 2015 – 2018 business plan period; operational activities are to be CO2-neutral as of 2011 – other objectives include: sustainable use of space; sustainable transport and sustainable organization/sustainable operations.

These objectives have Key Performance Indicators and progress is measured quarterly; There is also a yearly strategy audit for reevaluating or introducing new metrics.

The Port Identifies CSR as the key for a successful future and an essential part of business processes and corporate culture (POR 2011).

A.5 Collaboration

Nineteen City councils and 3 regional planning platforms are involved in port issues; There is consistent communication with stakeholders (POR, 2017). Future Land visitor center highlights port operations and the construction of M2. The Port Vision 2030 strategic planning process included a dialogue among the following stakeholders: customers, port service providers, community residents, municipalities, employees, non-profit organizations, and others (POR, 2017).

In 2012, the port conducted its first stakeholder involvement survey, where stakeholders rated port performance a 7.6 on a scale of 1-10. The port was acknowledged as a reliable venture partner, but area of improvement includes supply chain efficiency and accessibility and continuing to make the port a more attractive place to learn, work, and live (POR, 2017).

The POR is active in the International Association of Ports and Harbors (IAPH) World Ports Climate Initiative, which shares best practices with other ports to address climate change and air quality impacts. The PoR is also a contributing member to PIANC, which is currently preparing a Green Ports Guide.

Dialogue and collaboration are also conducted with local and regional ports within the European Sea Ports Organization (ESPO).

A.6 Sustainability Reporting

The port has since 2011 an integrated annual report; GRI compliant A+. The port equally Publishes a yearly footprint report regarding CO2 emissions from its own operational activities (25 vessels, 170 leased cars, 50 operational vehicles).

B. Environmental Aspects of Sustainability

B.1 Environmental Policy

Sustainability is the balance between the TBL; Sustainability priorities are: optimum use of space; accessibility; air quality and climate (POR, 2017). Sustainability provides the POR a future license to operate.

Investments in sustainability are necessary for consensus and growth (POR, 2017). The POR subscribes to a mutual gains approach to sustainability and has an official CSR statement on its website.

The POR's concept of the TBL is PPP – People in and outside the company; Planet – the environmental consequences; Profit and Prosperity– production and economic impacts of goods and services; social benefits in addition to economic gains (POR, 2017).

The authority at the POR has the ambition to develop the port of Rotterdam into the most sustainable port in the world.

The guiding Vision make mention of the committed to the continued development of port/industrial complex so as to become the most efficient, safe, and sustainable in the world."

B.2 Environmental Management System

The Environmental management system at the port is translated into an ambitious sustainability program (Programma Duurzaam), that is set up every 3 to 4 years in close cooperation with public and private stakeholders, including the municipality of Rotterdam, DCMR (regional environmental protection agency) and Datalinks (industry association of companies in the port).

As part of the program, the port develops and adopts environmental innovations and policies. Example include using differentiated port tariffs for ships based on their environmental performance to motivate shipping companies to reduce their polluting emissions. The port also incorporated requirements for the modal split of the hinterland transport from a new port area (Maasvlakte 2) to reduce the carbon footprint of the hinterland transport and to keep the congestion to a minimum.

B.3 Environmental Certification

The Port of Rotterdam is PERS Certified which requires amongst others that the port increases transparency by making its environmental report publicly

available. It also implies that the port is effectively monitoring environmental challenges and is actively improving its environmental management.

B.4 Air Quality

Clean air: High levels of particulate matter (PM), NO_X, SO_X and other harmful exhaust gas emissions in the port can be barriers to growth of the port. Reduction of GHG emissions as part of their contribution to climate protection:

Also, there is a focus on reduction of CO2 footprint – goal is 2% reduction a year; in 2017it saw a 6% reduction; Compensate for CO2 emissions by purchasing offsets – Gold Standard Emissions rights. In 2017 POR was CO2 neutral company (for own operations – building emissions, 14 inspection boats, fleet cars and trucks) Clean Air Action Program for port fleet started in 2006; Using ULSD and have done engine retrofits; includes use of biofuel (veggie oil) in patrol vessel.

Front Runners Policy addresses emissions reductions from tenants (the policy has criteria for modal splits, NOx and PM emissions, CO2 capture and storage, application of biomass, and application of vapor recovery units).

The operation 2050 emission free is actually ongoing at the Port of Rotterdam. The port of Rotterdam will still be an epicenter of activity and employment. However, this will be created by virtually emission-free industry and shipping.

B.5 Water Quality

The Ballast Water Convention is enforced at the POR since 2017, date of its entry into force and its provisions are enforced by Port State Control inspections from POR staffs. All ships having Ballast Water tanks have to exchange their ballast water during their voyage at POR. The exchange has to be performed according to the regulations of the convention. For ships calling from the North Sea, a special area is designated. Ship do not have to deviate of their course or have undue delay. This must be demonstrable and duly noted in the ballastwater record book.

With regards to the management of sewage at the Rotterdam Port, ships may discharge treated sewage in Dutch Ports from galleys, messrooms, laundries, pantries (gray water) and sewage (black water) since July 1, 2020 under certain conditions. The Convention on the collection, deposit and reception of waste generated during navigation on the Rhine and other inland waterways (CDNI) includes a ban on the discharge of greywater and black water for ships with more than 50 persons on board. The CDNI stipulates that this prohibition does not apply to sea-going ships in seaports, which must comply with the provisions of MARPOL. MARPOL Annex IV (sewage) applies to sea-going vessels as soon as the ship is leaving the port. Up to 3 miles from the coast, only treated black water may be discharged.

B.6 Energy Efficiency and Conservation

Renewable/Alternative Energy - The POR has invested in an LNG bunkering fuel station that will became operational in 2014 to prepare for LNG fueled ocean-going vessels.

Also, 330MW of wind power came under construction and went online in 2013. Moreover, two hydrogen power plants were built in 2011 at the port. A gasification cluster was also built in 2015. (POR, 2017).

The port has also created infrastructure for *cold ironing* (using shoreside electrical power). By 2022, only LED lights will be burning in the port. LED lighting is more economical and safer.

B.7 Waste Management

In 2012, the port was given the authority by the Dutch Ministry of Infrastructure and the Environment to conduct waste inspections on board ocean-going vessels. An enforcement plan has recently been drafted for this purpose (POR, 2017).

With 79,000 movements of ocean-going vessels a year, and a multiple of that for inland shipping, the port has set a threshold of 250 spills/instances of water pollution that result annually from bunkering (ship fueling). In 2012, there were 192 spills. The port provided a clean-up service 24-hour a day to address the spills immediately and then bill the responsible party (POR, 2017).

B.8 Biodiversity Management

Building with Nature approach used to create MV2 (description under Innovation/Technology).

For MV2 – provided compensation for impacted habitat areas (EU Habitat directive); replaced Dune's habitat and marine habitat area with an area ten times as large as the impacted area provides intertidal habitat for birds and fish and a dedicated nesting area.

POR is also working with WWF on a project for the southern delta.

B.9 Green Infrastructure

There are On-shore power supply available at all public docks for inland vessels.

By 2030, the two authorities want a significant share of sea-going vessels to 'plug in' once they have moored along one of the port's quays. This will allow them to power down their diesel generators while berthed.

Over the next five years, the partners will be initiating a series of projects that are intended to accelerate and scale up the adoption of shore-based power. Depending on the experiences gained in these projects, the municipality and the port authority may adapt their targets in this area in 2025.

Two traffic noise barriers have been constructed; recreation areas have been expanded; Five of eleven planned neighborhood parks have been created;

Bicycle routes have been improved and expanded. Traffic congestion remains a major issue. The construction of a new tunnel and some bridges are under construction to address that need.

The port also stimulates the use of LNG as a marine fuel and rewards ships with low emissions by reducing their port fees. This is done for oceangoing ships with a good ESI (Environmental Ship Index) score and for inland ships that meet the CCNR2 emission requirements.

There is also a cold ironing infrastructure available which allows ships to switch off their engines and to use electricity from the shore so while ships are moored, they can switch off their diesel generators and use this shore power, eliminating local exhaust gas emissions in the port.

B.10 Green Incentives

Implementation of ESI at the Port

In the port of Rotterdam, sustainable seagoing vessels are rewarded. Vessels that score high on the Environmental Ship Index (ESI) receive a discount on seaport dues under the following conditions.

- The discount applies to all ships that have an ESI score of 31 or higher on the moment of arrival (ATA) in Rotterdam.
- The discount doubles if the ship also has an individual ESI-NOx score of

31 or higher.

- The discount applies to each call in a quarter, with a maximum of 20 calls per ship per quarter.
- If the ESI score is adjusted by the International Association of Ports and Harbors (IAPH) to below 31 points, the discount paid must be repaid within four weeks. This also applies if the ship is given the 'inactive' status.
- Ask for the discount when declaring the seaport dues. The discount is calculated automatically.

B.11 Climate Change Adaptation Policies

As part of the Port Climate adaptation program, The Port has the ambitions to reduce the exhaust of CO_2 by 50% by 2025 compared to 1990. With its partners of the sustainability program, the ports aim to increase energy efficiency, stimulate the use of renewable energy and prevent CO_2 from going into the atmosphere. Carbon capture and storage (CCS) and carbon capture usage (CCU) is being examined together with authorities and private partners. It is expected that this will contribute about 60 to 70% of the port's CO_2 reduction goal. The figure shows how the port plans to reduce its CO2 emissions so drastically.

The port also Focuses on cleaning supply chain through cleaner modes of transport (fuels and engines) and improving accessibility, reducing congestion.

- **Incentive Scheme for Climate-Friendly Shipping**

The Port of Rotterdam Authority is using the scheme to support innovative projects involving alternative fuels in sea-going shipping. The ultimate goal: a considerable reduction in CO_2 emissions. The aim of the incentive scheme is to give a boost to projects that are perhaps difficult to get off the ground without financial support. The scheme started on 21 January 2019 and will continue to 31 December 2022. A total of EUR 5 million is available. The incentive contribution amounts to a maximum of 40% of the project costs.

B.12 Sustainability website

The Port of Rotterdam has a website dedicated to its sustainability practices.

B.13 R and D Unit

In 2015, The Maritime and Port authority of Singapore (MPA) and the Port of Rotterdam signed a Memorandum of Understanding (MOU) to exchange information on marine services and to jointly collaborate on research and development (R&D) in the areas of efficiencies and optimization, and new developments in the maritime and port sectors, such as LNG bunkering, green shipping and port optimization (POR, 2020).

C. Social Aspects of Sustainability

C.1 Ethical Behavior

In 2012, the port signed the UN Global Compact Letter of Commitment, subscribing to the ten UN Global compact business principles related to human rights, labor conditions, environment, and anti-corruption (POR, 2017).

C.2 Stakeholder Engagement

The port regularly schedules Resident Evenings" so they can talk with residents about port development projects and related environmental impacts. Since opening in 2009, the Future land visitor center at Maasvlakte 2 has received 445,000 visitors. The port uses the center to convey information and past, current, and future port development plans and ongoing events in the port recreation areas (POR, 2017).

Annual consultations, called "The Sustainable Dialogues" are held with municipalities in the port region to discuss development project, plans, and impacts and work through stakeholder agreements.

A quarterly port newspaper is distributed to 500,000 residents in the port region (POR, 2017).

C.3 Training and Development

Total direct and indirect employment attributed to the port is 350,000 people, of these 140,000 are in the region. The port conducts an annual labor market survey. To address the expected labor shortage in coming years, the port has invested in the Port Rangers, a teaching program focused on the port and nature for primary education levels.

C.4 Corporate Governance

The port has identified stakeholders in annual reports. The POR has also conducted a stakeholder involvement survey in 2016 for feedback on performance. The Port is transparent in reporting (2020 report) regarding risks, challenges, and dilemmas (development of coal fired power stations, speed limitations, construction of shore-based power for inland shipping). External auditing for reporting).

Although not legally required because the port is not a publicly listed company, the port has chosen to implement provisions of the Corporate Governance Code wherever possible and relevant related to transparency and management accountability. The port also has a very well developed and defined "strategic risk management" process that is updated yearly. Principles and project controls from the process are applied to the Port Vision 2030 framework and five-year business plans, which are discussed in the Port's annual reports.

C.5 Motivation and Incentives

In 2011 the port launched the Sustainable Employment Initiative to motivate employees to work in a productive and healthy manner through mobility and timetabling for flexible scheduling.

There are yearly performance reviews; career development is based on PRINCE2 project management 890 In 2011 the port launched the Sustainable Employment Initiative to motivate employees to work in a productive and healthy manner through mobility and timetabling for flexible scheduling.

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All employees are accountable and responsible for meeting the objectives in the 2011-2015 Business Plan, which is framed by sustainability principles (POR, 2017).

C.6 Port Security

The POR is ISPS compliant and is placed under the authority of the Harbor Master, here assuming the duties of the PFSO. He is in charge of the entire security of the Port on behalf of the Mayor of Rotterdam. To keep the risk of security incidents to a minimum, security rules from the ISPS Code, applied in the port of Rotterdam.

In compliance with the ISPS Code, the government must prepare a risk assessment for terminals where sea-going vessels are handled, and the administrators of these terminals are required to prepare a security plan. The ISPS evaluation team (police, customs and the Port Authority) evaluates whether the risk assessment and the security plan comply with the requirements. The team advises the PSO on approval of the documents. A risk assessment and a security plan must also be prepared for sea-going vessels. They are evaluated by the flag state of the vessel or by a registered security organization on behalf of the flag state. (POR, 2020)

Since 2019, MOBI , which is a Dutch nation-wide online application, has been used by the POR, enables the PFSO, the ISPS Assessment Team and the ISPS supervisors to share information with each other in order to secure the port in compliance with the ISPS Code. Users can log on to the application.

4.2.1.3 Sustainability Analysis of the Port the POR

The PoR has a sophisticated understanding of the concept of sustainability, as described above. Not only do they understand and accept the economic, social, and environmental dimensions of sustainability, but they use it to measure their organizational performance and guide their strategic planning, both in the short term, with their five-year Business Plan (2015 – 2020) , and into the future, with Port Vision 2030.

The POR has a high level of maturity across most economic and environmental aspects, with all social aspects meeting or exceeding the industry standard.

4.2.1.4 Salient Points and main Sustainability Strategy of POR

The primary sustainability strategy exhibited by the POR is Conventional Visionary, which embraces a holistic approach. The POR demonstrates this focus by working to stimulate companies in the port area to work in a more sustainable manner, facilitate cleaner transport in and around the port, and by aiming to become a more sustainable port organization (POR, 2017). The port has a highly developed commitment to become a market leader in sustainability issues, as exhibited by their goal to develop into the most sustainable port in the world by 2020. They have recently created a Sustainable Development Department that

focuses on refining organizational processes to promote and further integrate sustainability within the organization.

The POR believes it is necessary to invest and excel in sustainability to retain support for port activities and grow operations. Their future growth plans are ambitious. In 2016, they handled 13.1 million TEUS. After the opening of M2 in 2014, they progress to the handling capacity of 17 million TEUS. Upon full build out of M2 in 2033, which will host three new electric automated container terminals, they will be able to handle an additional 17 million TEUS. The POR's cargo forecast for 2035 is 38 million TEUs.

Because Rotterdam is home to a large energy industry cluster and is a port industry leader in reducing carbon emissions, the Conservative Strategy that focuses on efficiency could also be applicable in that the port has well defined processes and investments in appropriate technologies with generally sophisticated approaches to environmental management.

The Transformative Extroverted strategy, which focuses on positively influencing the basic conditions of corporate sustainability and legitimizing the industry sector as a whole, could also be included in the POIR's hybrid strategy approach.

4.2.2 The Port of Antwerp (POA)

4.2.2.1: Background Information and Country Description

The Port of Antwerp, located in Belgium, is an inland seaport approximately sixty-two miles upstream the river Scheldt. In 2016, the Port processed 9.8 million TEUs and 189 million metric tons of cargo. The cargo mix is roughly half liquid bulk/dry bulk and half containers While a river port, the Port is capable of serving cargo container vessels as large as 15 thousand TEUs during tidal windows. The Port of Antwerp is the second largest rail port in Europe and also Europe's largest petrochemical industrial cluster.

Figure 4.2 the Antwerp Port

Source: https://www.google.com/maps/

Until almost 15 years ago, the Port of Antwerp was part of a city department. It is now managed by a municipal group with a governing board of eighteen people consisting of representatives from elected officials (fourteen), and the rest from industry, non-governmental organizations, and independent citizens.

4.2.2 25 TBL Sustainability Indicators Data from the POA

A. Economic Aspects of Sustainability

A.1 Financial Strength

The total throughput of Port of Antwerp in 2020 amounted to 231 million metric tons of cargo, a fall of 3.1% compared with the previous year. At the same time, The Port of Antwerp has Recorded a total throughput Container volume of 9,664,243 TEUs the same year.

There are 16, 240 Vessels calls in 2020 with TEU Market share (2016) ranked 2nd in Europe with 25% of the container market share.

The port was Ranked 14 th in the world in TEUs (2016)

The Port of Antwerp has the particularity of being considered as the largest petrochemical industrial cluster in Europe (Port of Antwerp 2017).

A.2 Innovation and Technology

Approved 2011 – 2025 Investment Plan (1.6B Euros) for port expansion, infrastructure and to improve competitiveness; IT systems to improve transparency, community, productivity.

In2011 signed letter of intent to invest/construct biomass power station in the port area (CO2 neutral combustion, could allow for reduction in GHG of 20% by 2020); Focused on carbon capture, utilization, and storage initiatives; working with universities and Flemish government (Port of Antwerp 2017).

To strengthen links between the port and the hinterlands, the port has established several collaborative agreements and has acquired a 20% ownership share in the inland Beverdonk Container Terminal in Gobbendonk.

The terminal acts as a transfer point to consolidate containers from truck to barge for trips in and out of the port area. The port also created a rail freight connection to Chongquing, an inland port logistics center in China (Port of Antwerp 2012, 30).

The Port is conducting LNG feasibility study (as a ship fuel) and catered to LNG ships by 2015; Collaborating with regional ports – reduces NOx and Sox up to 90%, along with CO2 (Port of Antwerp 2017).

The Port of Antwerp is providing 400K Euros to retrofit cargo handling equipment. Operations in new port headquarters will be paperless, more transparent

The port is focused on developing a knowledge center that gathers relevant information to implement a coordinated environmental and nature policy for the port area (Port of Antwerp 2011). They are benchmarking port performance against international and European environmental targets.
digital management diaries, hot-desking for collaborative work, more efficient use of digital file management (Port of Antwerp 2017).

A.3 Knowledge Management

IT, GIS, and database systems are used to manage data, track efficiency, and assist with port planning processes. In May 2011 the Antwerp Port Community System (APCS) was launched, which efficiently conveys goods. The Antwerp Port Information and Control System (APICS) was also updated in 2011, which assists the port in monitoring shipping traffic, including tug activities, conduct lock planning, berth management and port dues collection, and registration of dangerous goods. An additional update was done in 2012, which allowed for further optimization in port planning processes (Port of Antwerp 2017).

Port expertise is also housed and packaged in APEC. In 2011, a collaboration agreement was signed with the Antwerp Management School to augment port management approaches and measure performance (Port of Antwerp 2017).

A.4 Processes

Master Plans created for rail, barge, and road to improve efficiency and consolidate freight, reduce emissions, creating mobility Impact Assessment for the community when planning future projects.

The port has an environment policy and an environmental charter (Port of Antwerp 2017)

A.5 Collaboration

The Port of Antwerp created the world's first port community sustainability report and collaborated with industry to produce it for the port area. The Port has focused on collaborative agreements with the private sector to improve intermodal connections – rail and barge transport options. There is also a new rail link to China.

The Port is collaborating with Alfa Port (private companies) on consultation processes for trade facilitation and with Customs for border control and extending work hours for customs services/container clearance notices. They are also working to Collaborative agreement with nature association to create a network of ecological infrastructure within the port area – network of core areas and corridors for flora and fauna (Port of Antwerp 2017).

For 30 years, the Port has been affiliated with APEC, the Antwerp/Flanders Port Training Center, which offers short, practical interactive

training seminars to share the Port's expertise with foreign ports. Over 9,000 people from 140 countries have attended (Port of Antwerp 2017).

A.6 Sustainability Reporting

The reporting style at the port is in conformity with the GRI norms and standards which follows an Integrated approach for TBL GRI guidelines. The port has been GRI Certified since 2011.

B- Environmental Aspect of sustainability

B.1 Environmental policy

Attention is paid to TBL is of fundamental importance for future growth (Port of Antwerp 2017); TBL one of core values.

The primacy of the economy is no longer absolute. It is now generally accepted that the economy, social support, and ecology are in balanced relationship or not. (Port of Antwerp 2017).

Mission: to position Antwerp as the sustainability leader in the Hamburg/Le Havre range (Northwestern Europe) (Port of Antwerp 2017)

The Port notes that environmental costs and benefits must be in reasonable proportion to one another, and that "any environmental efforts that go beyond what is legally required must not distort competition, either between companies or with respect to neighboring ports." (Port of Antwerp 2017)

Regarding carbon capture and storage, the Port's main task is to "safeguard access to CO2 storage locations and prevent this leading to distortion of competition between ports" (Port of Antwerp 2017).

B.2 Environmental Management System

The Port of Antwerp strive to be among the most sustainable Ports in Europe. Sustainability and the SDGs of the United Nations development goals are the touchstone for everything done at the port. Sustainability Policy and Business plans are built around the five cores SDGs: health and welfare, work and economic growth, innovation, sustainable cities and communities and climate action. They form the guidelines for further development of the port.

B.3 Environmental Certification

The Port of Antwerp is ISO140001 Certified

The Port of Antwerp was the first ever company of its kind to **obtain ISO 50001** certification, in 2015. Now for the three-year cycle from 2015 to 2017 inclusive the Port Authority has once more obtained an ISO 50001 certificate,

B.4 Air Quality

The port Tracks CO2 Equivalents (GHGs) – direct and indirect emissions of its own operations and entire port area; Looking at Carbon offsets where reductions aren't possible (Port of Antwerp 2017).

The port also has a dynamic traffic management system with signage to reduce traffic congestion and emissions.

Regarding air quality, there are eight monitoring stations in the port. The Port of Antwerp experienced a slight increase in emissions in 2015. Overall, they have seen a deep reduction in sulfur dioxide over the past 20 years. Many port vessels have been retrofitted to reduce NOx. The port vehicle fleet has been replaced with more environmentally friendly vehicles and /+bicycles are available to staff for short journeys (Port of Antwerp 2017).

Regarding water quality, the Port of Antwerp has a monitoring program and they also look at sediments. They support integrated water management in collaboration with the University of Antwerp.

B.5 Water Quality

The Flemish Government decided to build a mechanical, silt dewatering plant in the port area as a long-term, sustainable and innovative solution for the treatment and storage of dredged spoil but of used water too. This ambitious project is known as AMORAS, which stands for 'Antwerp's Mechanische

Ontwatering, Recyclage en Applicatie van Slib' (Antwerp Mechanical Dewatering, Recycling and Application of Sludge). The purpose of this big infrastructure is to manage safely the vast amount of dredged spoil emanating from the constant dredging needed by the POA.

This infrastructure is also used as a filtration process for used water and other effluent and is subsequently pumped to a water purification plant. There the particles in suspension are removed through a physico-chemical process. In a second step the organic material and nitrogen is removed by means of biological cleaning. The POA also possess a reception facility plant for the treatment of sewage and bilge collected from visiting vessels.

B.6 Energy efficiency and Conservation

In 2011 the Port Authority carried out an energy audit of approximately 20% of its own 140 or so buildings. Measures such as turning down unnecessary heating, making modifications to the outer skin of the buildings and getting people to change their behavior yielded savings of 1,540,000 kWh in 2011. The audits will be continued in 2012.

The Port Authority has now drawn up an energy policy statement for the next three-year period (2018 - 2020). The ambition is to further improve the energy efficiency of the authority's own buildings and installations so as to reduce the in-house CO2 emissions by 10% (compared with the 2016 level). In addition,

the CO2 emissions of the authority's own fleet of boats will be reduced by around 5% per tugging operation between now and the end of 2020. Within the Port Authority an energy team has been set up to be responsible for implementing the energy management

Finally, the port is investing in a large-scale wind farm (55 turbines to deliver power to 100,000 households) and has transferred the electricity distribution network to an inter-municipal company IVEG, which has allowed for the creation of sufficient transmission capacity for more solar units. Permitting authority has been relaxed for units up to 5MW per site (Port of Antwerp 2017).

B.7 Waste Management

In Oct 2011, the Port of Antwerp began to operate the Amaras project, which allows for dewatering, recycling, and application of dredge spoils within the port (allows for controlled and efficient processing of dredge material into filter cake, which is stored onsite. They are looking at ways to recycle it into bricks, concrete, and building materials (Port of Antwerp 2017).

The port maintains centralized waste data base to track reduction goals and costs. Last year they created two barge waste collection centers (Port of Antwerp 2017). Regarding ship waste, incentivizes ships to use port collection services; uses data management system to monitor ship waste (oil, garbage, chemicals) collection volumes and dates – then efficiently facilitates inspection

services; 50K tons of oil and hazardous waste was collected in 2015 at the Port of Antwerp.

Reports 70-110 oil spills (registered incident of oil on surface water) a year within the port.

B.8 Biodiversity Management

The POA has committed to reserving 5% of port area (600 hectares) as suitable habitat for specific species and protect/manage habitat. The goal is to comply with EU Bird and Habitat Directives but provide flexibility within port area – conserve species across the port area as opposed to numbers at a particular site; An additional 1400 hectares within and around the port have already been created as “ecological infrastructure” to protect several bird species (Port of Antwerp 2017).

B.9 Green Infrastructure

Hydro tug: the first hydrogen-powered tug in the world

The Port of Antwerp also does manage a fleet of 32 vessels, consisting of tugs, dredgers and support vessels. This fleet is responsible for almost 85% of the Port Authority's total CO2 emissions. In order to limit that impact, a multi-year project to modernize, green and optimize the fleet was set in motion.

For example, 3 new energy-efficient RSD tugs were commissioned in April 2021. (POA, 2021)

In addition, a tug powered by hydrogen is under construction. This '**Hydrotug**' is one of a kind, powered by combustion engines running on hydrogen in combination with diesel. The construction is the result of a collaboration with Compagnie Maritime Belge (CMB), a pioneer in the use of hydrogen in shipping. Here, Port of Antwerp has taken an important step in the transition towards a sustainable and CO2-neutral port.

- **Shore power for better air quality**

Port of Antwerp already offers barges shore power and will also roll this out for seagoing vessels. In time, this will mean that all ships at the port will use electricity from the quay and switch off their engines when moored. This is good for air quality and for the ship's engines. In addition, ships that emit less are given a discount. Port of Antwerp is setting a good example by allowing its own fleet to use this shore power system.

- **Nul-O-Plastic**

Plastics have a place at the port, but that place is not in the Scheldt or in nature. Port of Antwerp is taking various initiatives to prevent pollution and protect nature by cleaning up plastic waste.

At the Doel Dock, 'Patje Plastic' is fishing out floating waste and plastics (using passive energy) so that they do not spread further along the waterways

The port was trying to increase barge transport to relieve traffic congestion and has created master plans for barge, rail, and road. Antwerp is the second-largest rail port in Europe; it is continuing to build new infrastructure to provide sufficient capacity; also trying to improve internal freight transport within the port.

B.10 Green Incentives

- **Particulates Action Plan**

Antwerp Port Authority seeks to attract ships that make use of innovative, sustainable technology, encouraging them to come to Antwerp as the city and its port both suffer from high concentrations of air pollution such as particulates. The Particulates and NO2 Action Plan for the Port and City of Antwerp brings together the various measures that can be taken to reduce emissions of these polluting substances.

The new discount system is one of the measures for tackling the environmental impact which ships have on the air quality in Antwerp.

Ships started claiming the discount as of 1 June 2016, based on their ability to demonstrate that they either could make effective use of scrubbers (in closed

mode) or were powered by LNG for a period of at least 24 hours before they call at the port of Antwerp. Ships powered by LNG can receive a discount of 20%, while those that make use of closed scrubbers can get a discount of 15%.

- **ESI discount**

In addition to the particulates discount, more environment-friendly ships in the port of Antwerp have benefited from the ESI discount for some time now. The ESI (Environmental Ship Index) is based on a system of credits ranging from 0 to 100 that ships can earn for having environmental performance better than required by the regulations for NOx, SOx and CO2. Ships that obtain 31 or more credits can have their bill for port dues reduced by 10%.

B.11 Climate Change Adaptation Policies

To become climate neutral by 2050, Port of Antwerp is pushing back the boundaries with innovations that will make the port greener. For example, Port of Antwerp has introduced sustainably produced methanol and hydrogen as alternative fuels for its own fleet. Along with other companies, The Port of Antwerp is taking measures to reduce pollution in the air, water and soil. The port is also looking for solutions to contribute to the energy transition.

B.12 Sustainability Website

The Port of Antwerp has a web page with regular information updated about the port sustainability practices.

B.13 R & D Unit

In June 2021, Global Innovation platform, Plug and play, together with the Port of Antwerp decided to launch a joint program with the purpose of connecting international startups with the founding partners to pilot their technologies and drive the future of maritime of maritime shipping as world-class leaders of R& D and innovation.

C Social Aspects to Sustainability

C.1 Ethical Behavior

In 2010 established corporate values: reliability, respect, innovation, customer orientation, and collaboration; In 2011 these values were anchored in behavior agreements with employees; New code of conduct was established (Port of Antwerp 2017).

C.2 Stakeholder Engagement

Has identified stakeholders in port planning processes; went through extensive consultation process to create 2010 port community sustainability report.

The port engages in dialogue with stakeholders through media, events, and MAS Port Pavilion, which welcomed 80,000 visitors its first year. The Pavilion serves as a meeting place for the port community and features a 360-degree screen that allows the viewer to experience the sights and sounds of the working port.

Interactive educational exhibits focused on the port are also included. The Pavilion is also the starting point for four bicycle routes throughout the port. More than 30,000 maps of the bike routes have been distributed (Port of Antwerp).

C.3 Training and Development

The port provides direct and indirect employment for 150,000 people. In 2011, they were recognized as Top Employer in Belgium. They were also voted port of the Year by the International Seafarers.

The results of a 2011 port industry workforce survey revealed that there are over 4,000 vacancies for the port cluster to fill over the next few years, and they are facing labor market shortages (1 in 4 jobs can't be filled). Most of the jobs are for technicians – process operators, pipefitters, maintenance mechanics, and welders. There is also a high demand for industrial and civil engineers (977 engineers over the next three years) (Port of Antwerp 2017). To address these issues, as part of the port's Total Plan (the Port's strategic port development plan), a Talent Workgroup has been formed with the City of Antwerp, Chamber.

Workforce development efforts also include partnership efforts with ACTA, a training center for the process industry and chemical sector that focuses on electrical, measurement and control technology, industrial automation, and safety and transport systems. Many of the attendees are from the port area.

The port has also partnered with ANTTEC, a technology center for the metals sector in Antwerp, the Pipe Tech Academy, which trains pipefitters for the building and installation of pipelines and SIRA which targets young people between the ages of 18-26 for careers in the chemical sector (Port of Antwerp 2017).

C.4 Corporate Governance

The port is transparent in its annual reporting, identifying risks, challenges, and liabilities. For example, to comply with new sustainable funding of pension legislation, the port set aside 299M Euros in 2011; This resulted in a 170M Euro loss for 2011, as disclosed in the 2011 annual report.

Annual reports are audited by two sets of auditors and reviewed for appropriate disclosures of financial risk and to ensure regulatory compliance.

C.5 Motivation and Incentives

In 2011 job and behavior agreements with all port employees require a commitment to collaboration and innovation, which support the focus on sustainability.

C.6 Port Security

The port of Antwerp has for many years put considerable efforts into meeting international standards and continues to ensure close compliance. The POA is ISPS compliant and has a Port Facility Security Plan (PFSP) being implemented to ensure its safeguard. This PFSP is developed to ensure the application of measures designed to protect the port facility and ships, persons, cargo, cargo transport units and ship's stores within the port facility from the risks of a security incident.

The POA also seeks to play a coordinating role in matters of port security by participating in several other projects. Some of those include the use of drones in the surveillance of the port's vicinities. Also, the port authority also started using an AEOS access control system since 2005. The AEOS system is a powerful and user-friendly web-based security management system, based on intelligent network technology. Currently at POA, this system protects most of the authority's buildings, including data centers, technical buildings, lock complexes and drawbridges.

4.2.2.3 Sustainability Analysis of the POA

While the Port of Antwerp has the highest level of maturity among economic and some environmental aspects, virtually all of the aspects are integrated at or above the industry average. For internal motivations and incentives, there are some measures in place, but diffusion throughout the organization has not yet occurred. This is also true for some organizational processes related to environmental management, which is usually a port organization's foot in the door to addressing or confronting its approach to sustainability.

In reaction to a European Union court action regarding their environmental impact assessment process, unhappy NGOs, and the recognition that it would be beneficial to do better planning, a Board Committee was formed in 2007 to consider environmental policy issues for the port as a whole.

Over the past five years, the port's environmental department has struggled with integrating environmental standards into Port policies and practices, but this realization among employees and management is slowing evolving. The creation of the port community sustainability report and supporting stakeholder consultation and workshop process was the first time everyone in the port community came together as a team and the experience has served as a catalyst for a more integrated approach. The outcome of the two-year process was the identification and agreement to track and report on forty sustainability

indicators every two years, consistent with Global Reporting Initiative (GRI) guidelines.

The Port of Antwerp has a satisfying or standard understanding of the concept of sustainability, realizing the need to consider and address environmental and social impacts of business operations while still maintaining profitability. They recognize that "attention paid to TBL is of fundamental importance for future growth" and provides them with a social license to operate now and in the future. While the port's mission is to be the regional market leader in sustainability, they don't want environmental efforts to distort competition between ports.

4.2.2.4 Salient Points and main Sustainability Strategy of the Port of Antwerp

Since the Port of Antwerp hosts the largest petrochemical industrial cluster in the European Union and one of their main sustainability-related goals is to achieve energy efficiency, the Conservative (Efficiency) strategy seems to apply. However, based on the general trend of the sustainability aspect maturity rankings, the Transformative Extroverted Strategy that is focused on legitimization and maintaining a social license to grow, could also characterize part of the Port of Antwerp's sustainability strategy. The port's initiative and approach to creating the first port community wide sustainability report has also

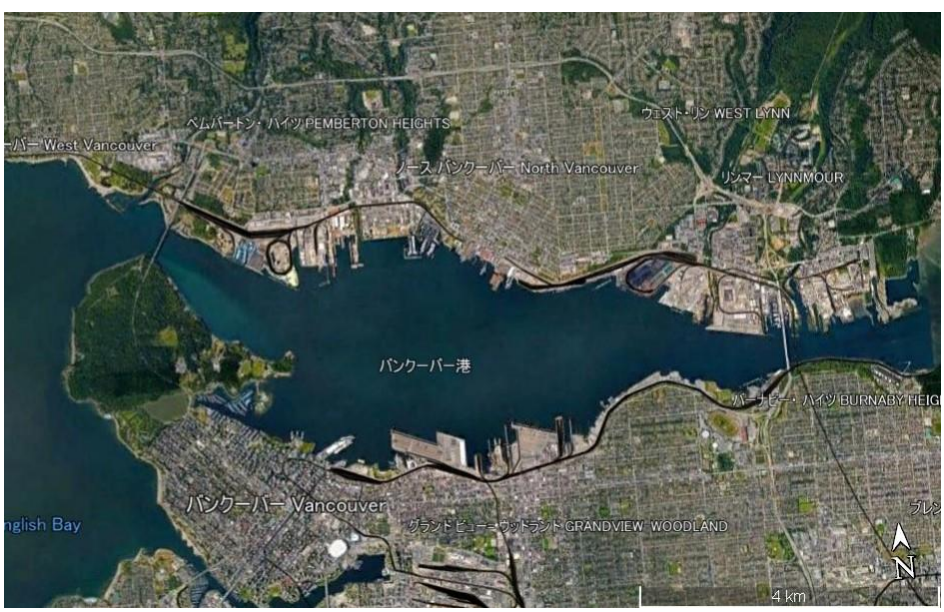
contributed to advancing the practice of sustainability reporting within the port industry.

4.3 North American Port (Canada)

4.3.1 The Vancouver Port (POV)

Vancouver is a coastal seaport city in Canada, located in the Lower Mainland region of British Columbia. As the most populous city in the province, the 2016 census recorded 631,486 people in the city, up from 603,502 in 2011. The Greater Vancouver area had a population of 2,463,431 in 2016, making it the third-largest metropolitan area in Canada.

Figure 4.3 The Port of Vancouver



Source: https://www.google.com/maps

4.3.1.1 Background information and Country description

Located in a naturally beautiful setting on Canada's West Coast, the Port of Vancouver is Canada's largest port. The Port of Vancouver extends from Roberts Bank and the Fraser River up to and including Burrard Inlet. The Port is Canada's largest, supporting trade with more than 170 economies around the world.

With the most diversified range of cargo of any port in North America, the port operates across five business sectors: automobiles, breakbulk, bulk, container and cruise. In 2017, 142 million tons of cargo moved through the port, valued at $200 billion. Almost 95% of the Port's total volume serves Canadian import and export markets shares.

Many different enterprises operate in the port including cargo and cruise terminals, industries requiring tidewater access, shipyards, tugboats, railways, industries requiring tidewater access, shipyards, tugboats, railways, trucks, shipping agents, freight forwarders, suppliers, builders, and administrative agencies.

The port is home to 27 major marine cargo terminals, three class 1 railroads, and a full range of facilities and services to the international shipping community. Deep-sea terminals provide Super Post-Panamax capacity and extensive on-dock rail facilities with virtually no draft restrictions. Freshwater facilities offer integrated services for the automobile and coastal forest industries,

and for short-sea shipping. The Canada Place cruise terminal at the Port of Vancouver serves as homeport for the Vancouver-Alaska cruise industry.

4.3.1.2 25 TBL Sustainability Indicators Data from the POV

The following summarizes the sustainability aspects of the Port of Vancouver organization and ranks the maturity level of each aspect, along with the Port's overall concept of sustainability.

A. Economic Aspects of Sustainability

A.1 Financial Strength

POV is ranked as the number 1 port in the Canada supporting trade with more than 170 economies around the world the most diversified range of cargo of any port in North America. The port operates across five business sectors: Automobiles, breakbulk, bulk, container and cruise. In 2017, 142 million tons of cargo moved through the port Valued at $200 billion. Almost 95% of Port's total volume serves Canadian import and export markets.

The port enables the trade of approximately $200 billion in goods, the POV is an important facilitator of economic development in Canada. Port activities annually sustain:

- $24.2 billion in economic output
- $11.9 billion in gross domestic product (GDP)

- $ 7 billion in wages
- 115,300 jobs in Canada
- 96,200 jobs in British Columbia
- $67,900 average wage for direct jobs
- $ 44,000 average wage in Canada
- $1.4 billion per year in tax revenues

Many different enterprises operate in the port including cargo and cruise terminals, industries requiring tidewater access, shipyards, tugboats, railways, trucks, shipping agents, freight forwarders, suppliers, builders and administrative agencies.

The port is home to 27 major marine cargo terminals, three class 1 railroads and a full range of facilities and services to the international shipping community. Deep sea terminals provide Super Post-Panamax capacity and extensive on-dock rail Innovation, Technology, and Investment.

Incentive's facilities offer integrated services for the automobile and coastal forest industries, and for short-sea shipping. The Canada place cruise terminal at the Port of Vancouver serves as homeport for the Vancouver-Alaska cruise industry.

A.2 Innovation and Technology

The Port of Vancouver has made numerous investments in port-related green technologies to reduce environmental impacts. They installed shore side power facilities at two of its container terminals, a move which reduced greenhouse gas emissions by 75 tons per connection. The facilities were installed by BC Hydro, Global Container Terminals-Operators of Delta port terminals-and DP Word Vancouver, Operators of Vancouver's Center.

The Port of Metro Vancouver was the first port in Canada to implement shore power for cruise ships, and since 2009, over 11,000 tons of greenhouse gas emissions have been avoided.

The use of shore power at Port Metro Vancouver container terminals contributes to Canada's emission reduction targets and assists the port in reaching targets under the Northwest Ports Clean Air Strategy, a collaboration it has in place with the American ports of Tacoma and Seattle.

Other examples include the electric drayage trucks, hybrid tugboats, hybrid and electric cargo handling equipment, Alternative Maritime Power (AMP), which provides shore-side power to ocean-going vessels, a seawater scrubber system to filter contaminants from vessel engines, and others.

These technologies are supported through POV's technology advancement program, which provides grant money and pilot-testing assistance, and Port Tech,

a public/private non-profit technology commercialization center and incubator that helps bring technologies through the testing phases and to the marketplace.

POV has also created innovative policy structures and approaches to reduce emissions from port-related mobile sources that are beyond their direct control.

Financial incentives offered to customers to reduce impacts from the operations include participation in the Environmental Ship Index (ESI) program. Past programs included the Vessel Speed Reduction Incentive Program and the Low Sulfur Fuel Incentive Program**.**

A.3 Knowledge Management

For large capital projects, there is an opportunity to systematize sustainable design approaches and apply mitigation measures to reduce environmental impacts through a standardized environmental review process. POV also has policies regarding green buildings, sustainable design guidelines, and sustainable construction guidelines. However, the guidelines are not consistently used on all projects and there is not consistent training of staff throughout the relevant divisions about using them as a resource.

POV is exploring further integration of their GIS system and environmental data. Database systems are used to document compliance with

various air quality, water quality, and environmental mitigation monitoring programs.

A.4 Processes

For large capital development projects requiring new leases, environmental and social criteria are considered in leasing policies and environmental permitting processes. It is not clear that sustainability criteria are applied to decision-making processes throughout all divisions

A.5 Collaboration

POV have partners with the ports of Seattle and Tacoma, along with government such as Environment Canada and Metro Vancouver since 2007, to develop and implement a strategy called the Northwest Ports Clean Air strategy called the Northwest Ports Clean Air Strategy. The program reduces port-related air emission in the Puget Sound Georgia Basin air shed. POV published the first progress report on the 2013 Northwest Ports Clean Air strategy objectives in 2014. The strategy was established in 2007 with the ports of Tacoma and Seattle in partnership with a host of Government stakeholders, including Environment Canada and Metro Vancouver.

POV is active in port industry stakeholder organizations, such as the IAPH and AAPA, and a founding member of the World Ports Climate

Initiative (WPCI) and Pacific Ports Clean Air Collaborative (PPCAC). They have had joint board meetings with the adjacent port – Port of Los Angeles, and partnered together on environmental initiatives and planning, such as the Clean Air Action Plan, Clean Truck Program, Technology Advancement Program, and Water Resources Action Plan.

For a new energy efficiency management initiative in June 2015, the port is Partnering with terminal operators and port customers for data collection and participation, and a local university.

Also, POV Collaborates with government and industry on the development of goals and objectives, performance monitoring, and progress reporting

A.6 Sustainability Reporting

At POV, a Sustainability Assessment and Plan Formulation is issued yearly. Also, a sustainability report is released and is available on the POV' website. This sustainability report discusses a commitment to do annual reporting. POV releases annual corporate reports that discuss some environmental information, and there is a discussion of sustainability-related topics on POV's website.

B. Environmental Aspects of Sustainability

B.1 Environmental Policy

While the POV subscribes to the Triple Bottom Line concept of sustainability (environmental, social, and economic), as reported in its 2011 Sustainability Report and in various staff and management presentations, in POV's Strategic Plan Vision, social responsibility is listed separately from sustainability, which creates some confusion regarding how holistically or integrated the port views the concept.

Common policy statement on port press releases – "The Port of Vancouver has a strong commitment to developing innovative strategic and sustainable operations that benefit the economy as well as the quality of life for the region and the nation it serves."

Goals

Regarding broad sustainability policy goals, there are a few points of reference. The Port of Vancouver strategic Motto is to enable Canada's trade objectives, ensuring safety, environmental protection and consideration for local communities.

The Port's Motto is to become the world's most sustainable port. POV define a sustainable port as a port that delivers economic prosperity through trade, maintains a healthy environment, and enables thriving communities through communities' accountability, meaningful dialogue and shared aspirations. "Advancing Technology and Sustainability" is also a Strategic Objective in POV's 2050 Strategic plans.

B.2 Environmental Management System

The port s Protection Area EMS is designed to address water quality, water supply, pollution prevention and system integrity to ensure the water system is continually improving. By bringing together a cross-departmental EMS team, who not only evaluates the goals, but puts them into action, the port is able to identify opportunities to help further ensure that potential risks to the Port are prevented and properly managed.

B.3 Environmental Certifications

- **ISO 140001 Certified**
- **Green Marine certified**

  The green Marine Certification is an Environmental Certification for the North American Marine Industry. It is a voluntary, transparent and inclusive initiative that addresses key environmental issues through its 11 performances indicators.

B.4 Air Quality

Every five years, the port conduct a port-wide emissions inventory to estimate air emissions from marine, rail, on-road and off-road equipment, and administrative activities associated with the Port of Vancouver.

The inventory includes data on port-related air pollutants, greenhouse gas emissions and energy usage. It complements regional and national emissions inventories that capture other sources, such as commuter vehicles, buildings and commercial activity, to provide a complete picture of emissions in the Lower Mainland. The inventory takes into account the unique conditions in each transportation and cargo sector at the Port of Vancouver and helps track and report the port's progress.

The inventory and other measurements help identify trends that inform policies and programs to reduce the emissions that contribute to climate change.

The POV leads a suite of initiatives that reduce air emissions associated with key port activities: Ships, trucks, cargo-handling equipment and terminal activities. POV's approach is to collaboratively work with industry and stakeholders in each sector to develop programs that respond to their unique operating context and meet industry leading environmental objectives. The approach to reducing emissions in each activity sector is guided by the following goals:

- Protect air quality through the reduction of criteria air contaminants such as Sulphur oxide, nitrous oxides, and particulate matter emissions;
- Reduce port contributions to climate change through reduction in greenhouse gases, and develop coordinated climate change adaptation

pans for infrastructure and ecosystems;

- Promote culture of continuous improvement and energy conservation throughout the port, with a focus on transitioning industry toward renewable energy and clean technologies;

Initiatives that support the above objective include increasing the number of zero emission trucks in the port drayage fleet by 2020, partnering with educational institutions to create workforce development programs that support a transition to automated terminal technology, and exploring less expensive but as effective alternatives to Alternative Maritime Power (shore-side power) for vessels (POV 2017).

B.5 Water Quality

The POV is party to the Ballast Water Management Convention. Also, since the new regulation of April 2004, there is an obligation on vessels calling at the Port of Metro Vancouver to comply with the following:

- Vessels must have on board a ballast water management plan;
- Vessels intending to discharge ballast water within port limits must carry out mid-Ocean ballast exchange.

The mid-ocean exchange requirement can be waived by the harbor master where safety considerations make it impracticable and also when the vessel has an approved ballast water treatment method.

B.6 Energy Efficiency and conservation

The port has partnered with BC Hydro to create an Energy Action initiative, which connects port tenants and terminal operators with an energy management specialist to help reduce energy consumption and make the switch from diesel or gasoline to electrical energy sources.

Switching to electricity allows tenants and terminal operators to earn BC Hydro financial incentives, as well as save energy through energy-efficient equipment, buildings, and operational practices that reduce costs. They may also be eligible for recognition through the port annual Blue Circle Awards.

B.7 Waste Management

POV has recently inventoried and prioritized contaminated port-owned properties and is the process of remediating the largest contaminated site in the port area. POV is strategically using contaminated sediments within Confined Disposal Facilities (CDFs) to create new land for port development.

B.8 Biodiversity Management

Biological impacts are considered during project planning, construction, and operations, and appropriate mitigation measures are applied.
POV manages a 15-acre nesting site for the endangered Least Tern on Terminal Island, adjacent to active container cargo operations.

The POV is also engaged in several habitat restoration projects to mitigate for open water that was displaced by port development.
Within the port area, POV actively manages the Saltwater Marsh, which it plans to enhance and enlarge the mudflat habitat within it in the future to mitigate for construction impacts from its port redevelopment project.

B.9 Green Infrastructure

Shore power is a technology that enables ships to shut down their diesel-powered auxiliary engines and plug into land-based electrical power. At the Port of Vancouver, where electricity primarily comes from low-emission hydroelectricity, this significantly reduces emissions of air pollutants and greenhouse gas emissions while also reducing engine noise.

Shore power is not a one-size-fits-all system. There are a number of conditions that affect whether a ship can plug in, including availability of terminal facilities, configuration of a terminal's shore power equipment, the location and limitations of the ship's shore power equipment, and the availability of power from BC Hydro.

B.10 Green Incentives

- **Port of Vancouver's financial incentives for clean ships**

Since 2007, Vancouver Fraser Port Authority's Eco Action Program has offered the opportunity for vessels to receive a discount of up to 47% off their harbor dues per call for meeting voluntary best practices that reduce emissions and other environmental impacts. Examples include obtaining acceptable third-party environmental ratings or designations for cleaner, more efficient and quiet ships, or using alternative fuels and technologies

B.11 Climate Change adaption Policies

Climate smart program

Since 2015, the port authority has partnered with Vancouver-based social enterprise Climate Smart to help Port of Vancouver tenants conserve energy and reduce greenhouse gas emissions.

Through the Climate Smart program, businesses measure their total emissions by conducting a greenhouse gas inventory, and then identify ways to reduce those emissions by creating a tailored reduction plan.

To date, 24 unique tenants have gone through the training and certification program, and 18 businesses have achieved Climate Smart certification, an annual process requiring businesses to submit an approved emissions reduction plan. In

total, the Climate Action initiative has resulted in cumulative greenhouse gas emission reductions of 6,087 tons.

Eco-action

Also, The POV promotes and recognizes cleaner ships in its harbor through the Eco-action program for ships. Ships obtain up to 47% off harbor dues for implementing emissions reductions measures and other environmental practices. In 2009, The Canada place cruise ship terminal became the first in Canada and third in the word to offer shore power for cruise ships, allowing ships to turn off their engines while in port.

- **Natural Gaz Program**

The port recognizes there is growing interest in the use of liquefied natural gas (LNG) because it can reduce air pollutants and greenhouse gas emissions that contribute to climate change and affect air quality.

To support the transition to LNG as a marine fuel, the port is planning to provide LNG bunkering services at the Port of Vancouver as early as 2024.

B.12 Sustainability Website

The Port of Vancouver do have a functioning website with constantly updated information about the different policies carried out at ports within their organization.

B.13 R and D Unit

There is a well establish and functioning Research and Development department within the Port with active collaboration with the private sector and other entities.

C. Social Aspects of Sustainability

C.1 Ethical Behavior

There is a code of ethics governing the behavior of port employees, management, and Board members. Board meetings are open to the public, televised on a local channel. Board decision-making documents are available on POV's website or available through public requests for information.

To protect public safety, POV has adopted a public health risk threshold for incremental residential health risk - No project will be approved by the Board of Harbor Commissioners unless the public health risk to residents posed by toxic air emissions from proposed project is less than 10 in a million.

C.2 Stakeholder Engagement

Stakeholders are given opportunities to participate in port planning processes through port master planning workshops and project environmental review processes. Port representatives also attend monthly neighborhood council meetings to provide updates on port topics and answer questions from the community.

Public comments are taken at Board of Harbor Commissioner Meetings regarding pending items, as well as items not on the agenda.

POV maintains a website, community newsletter, and occasionally releases Informational videos. Other initiatives include the Transporter, a mobile interactive educational exhibit about POV that visits schools and community events, and POV's affiliation with POV High School, a maritime focused magnet school.

C.3 Training and Development

In 2015, The Maritime and Port authority of Singapore (MPA) and the Port of Rotterdam signed a Memorandum of Understanding (MOU) to exchange information on marine services and to jointly collaborate on research and Development (R&D) in the areas of efficiency and optimization, and new developments in the maritime and port sectors, such as LNG bunkering, green shipping and port optimization (POR, 2020)The POV generates more than 96,200 jobs in British Columbia regional jobs and 115,000 jobs across Canada with $7 billion in annual wages and tax revenues of $ 1.4 billion yearly. (POV 2018).

Workforce development efforts include POV's sponsorship of the International Trade Education Program, which is designed to introduce local high school students to careers in international trade. Approximately 200 students participated in 2012.

In 2011, POV negotiated a 5-year labor agreement with local building and trade unions. The targets unemployment and underemployment in concentrated poverty neighborhoods, particularly in communities near the port area, which advances skills of the local labor pool. The agreement requires that local residents perform at least 30% of total work hours and disadvantaged workers perform at least 10% of total work hours on upcoming projects. Additionally, apprentices shall perform at least 20% of the total work hours, and local residents in specific low-socioeconomic area zip codes shall be given the opportunity to perform 50% of these apprenticeship hours (POV 2017).

In 2007, POV initiated the Trade Connect Program, a trade development program for small to medium businesses. The Program provides educational workshops to assist the businesses to expand their operations to export internationally. Offered in partnership with government agencies and local officials, the workshops connect businesses with resources, expert advice, and services.

POV also has a student internship program, hosting interns year-round on a part-time basis. A summer internship program sponsors interns from local schools and from schools across Canada. (POV 2017).

C.4 Corporate Governance

Strong transparency has been inserted into the environmental review process for large capital development projects. Technical studies, findings of environmental impacts, mitigation measures, public comments, and port responses and rationale for policy decisions are all posted on POV's website. The Port has also been very aggressive about developing pilot incentive programs to reduce air emissions; Many of these programs have become the basis for current state regulations.

There is room for improvement regarding overall performance measurement of the organization. Projects are generally evaluated by schedule delivery dates and budget. Performance metrics are included in the strategic plan, but it is debatable about their helpfulness in measuring effectiveness of the organization.

C.5 Motivation and Incentives

There is no general sustainability training for employees; A recent employee newsletter discussed the topic of sustainability and the port's perspective (Triple Bottom Line approach). Employees may be familiar with certain port

initiatives that are particular to their daily work (Engineers are aware of Green Building Policy) and most port employees are aware of the Clean Air Action Plan and its relationship to demonstrating responsible future growth at the Port, but it is doubtful that most employees have a holistic sense of Port sustainability issues and how their role in the organization is connected to this.

C.6 Port Security

The Port of Metro Vancouver security is catered for by a number of partners. The POV is fully ISPS compliant. The ISPS provisions are implemented within the POV by Transport Canada, which is the federal institution in charge of implementing transportation policies within Canada.

Transport Canada is also in charge of the following activities :

- The compliance of the ISPS Code in Canada,
- The monitoring of vessels entering Canadian waters,
- The consulting and approval of Port facilities Assessments,
- To ensure terminals and the port authority comply with the national Marine. Transportation Security Act and related regulations.

4.3.1.3 Sustainability Analysis of the POV

The Port of Vancouver POV has a satisfying or standard concept of sustainability. The organization understands the need to address the

environmental and social impacts of port operations while maintaining business profitability, as this procures its social license to operate and grow.

Similar to the Ports of Rotterdam and Antwerp, POV came to embrace more sustainable environmental and social practices by addressing challenges to its environmental management approaches, public health impacts created from its tenants' operations, and efforts to build support with local communities around implementing an ambitious capital development program. While POV has developed many approaches and tools to advance sustainability locally and throughout the port and goods movement industry, it hasn't started using it as a framework to consistently measure its own organizational performance and is still struggling to integrate it into organizational processes, governance processes, and culture.

POV exhibits a sophisticated maturity regarding many economic sustainability aspects (Financial Strength; Innovation, Technology, Investment & Incentives; and Collaboration) and environmental ones (Emissions, Waste, Biodiversity, and Environmental Issues related to the goods movement chain, such as public health impacts). For the social aspects, the maturity level is transitioning from satisfying to sophisticated or has achieved a sophisticated level, such as Community Engagement and Corporate Citizenship. There is room for improvement related to POV's Processes, Sustainability Reporting, and the

Motivation and Incentives that are given to employees to advance sustainability throughout the organization.

4.3.1.4 Salient Points and Main Sustainability Strategy of the POV

What is most striking about POV s sustainability strategy is the lack of integration of its innovative sustainable practices and the most recently adopted strategic plan and land use plan.

The POV has designed some very successful sustainability-related programs and has achieved more results in the near-term over the other ports examined in the study (for example the port wide diesel emissions reductions through the CAAP and related reductions in public health risks). However, while the Port of Vancouver makes sustainability an explicit, broadly integrated part of their future business and spatial plans, POV has yet to do so.

4.4 Asian Port

4.4.1The Yokohama Port (POY)

4.4.1.1 Background Information and Country Description

Japanese society had been one of the most isolated in the world until a United States Navy commodore named Matthew C. Perry sailed his fleet into Tokyo Bay in 1853 opening up the country to the West. From the mid-19th century on, Japan embraced a policy of rapid industrialization and aggressive economic growth.

Today, Japan is home to the world's third largest economy, despite a series of economic setbacks in the 1990s. The Japanese economy is powered by the production of motor vehicles, electronics, industrial tools, steel and other metals. The country also has a modest agricultural sector, growing mostly rice, and sugar beets, along with some fruits and vegetables. Japan is also known for its fishing and beef industries.

- **Environmental protection policy in Japan**

During the 20 years after the establishment of the Environment Agency in 1971, the environmental situation at the national and global levels has undergone substantial changes. At the national level, notable achievements have been made in combating severe pollution during the period of high economic growth. However, air pollution by nitrogen oxides in major urban areas and water pollution caused by household effluent and waste disposal have continued to pose great problems. Furthermore, various development projects, such as resorts, have created more threat to the natural environment.

On the other hand, concerns over global environmental issues, such as global warming, depletion of the ozone layer, deforestation, loss of biodiversity, transboundary movement of acid rain, and hazardous waste, etc., are mounting worldwide. In the years after the Earth Summit, many countries are being urged

to implement concrete actions and measures to realize sustainable development, which was agreed on at the Earth Summit.

In Japan, the Basic Environment Law, which set out basic principles and directions for formulating environmental policies, was enacted in November 1993. In December of the same year, the "National Action Plan for Agenda 21" was submitted to the United Nations. In December 1994, an action plan called "the Basic Environment Plan" is adopted. It was the most important measure introduced under the Basic Environment Law. The plan systematically clarifies the measures to be taken by the national and local governments, as well as actions to be carried out by citizens, businesses and private organizations by the beginning of the 21st century. It also defines the roles of parties involved and the ways and means for effectively pursuing environmental policies.

Moreover, the Environment Agency is proactively implementing supportive measures, including one measure to support the UNEP International Environment Technology Center as a core organization for appropriately transferring technology to enrich and reinforce the ODA system to realize sustainable development in developing countries.

- **Yokohama City**

Yokohama is the second largest city in Japan by population, after Tokyo, and the most populous municipality of Japan. It is the capital city of Kanagawa

Prefecture. It lies on Tokyo Bay, south of Tokyo, in the Kantō region of the main island of Honshu. It is a major commercial hub of the Greater Tokyo Area.

Yokohama's population of 3.7 million makes it Japan's largest city after the special wards of Tokyo. Yokohama developed rapidly as Japan's prominent port city following the end of Japan's relative isolation in the mid-19th century and is today one of its major ports with Kobe, Osaka, Nagoya, Hakata, Tokyo, and Chiba.

Figure 4.4 The Port of Yokohama

Source: https://www.google.com/maps

The **Port of Yokohama** is operated by the Port and Harbor Bureau of the City of Yokohama in Japan. It opens onto Tokyo Bay. The port is located at a latitude of 35.27–00°N and a longitude of 139.38–46°E. To the south lies the Port of Yokosuka, to the north, the ports of Kawasaki and Tokyo.

Yokohama Port has ten major piers. Honmoku Pier is the port's core facility with 24 berths including 14 container berths. Osanbashi Pier handles passenger traffic including cruises, and has customs, immigration and quarantine facilities for international travel.

Detamachi, the "banana pier," is outfitted for receiving fresh fruits and vegetables. Daikoku Pier, on an artificial island measuring 321 hectares, is equipped with container logistics facilities including seven container berths and houses a million square meters of warehouse space at the Yokohama Port Cargo Center.

At Minami Honmoku, the newest facility to be developed, there are four 350-meter operational berths with a depth of 18 meters capable of handling larger post Panamax container ships with 6 mega container cranes for 22 lines of containers. Additional berths are under construction for larger ships in dimensions equal to or exceeding the size of a Mærsk E-class container ship.

Seven berths of Mizuho Pier are used by the United States Forces Japan. Additional piers handle timber and serve other functions.

4.4.1.2 25 TBL Sustainability Indicator Data from the POY

A. Economic Aspects of Sustainability

A.1 Financial strength

Yokohama Port is Japan third busiest port after Tokyo and Kobe Ports. In 2015, the Port of Yokohama served 37,706 ships. It handled 271,276,977 tons of cargo and 2,888,220 TEU containers. The total value of the cargo was 10,921,656 million yen.

APM Terminals Yokohama facility at Minami Honmoku was recognized in 2013 as the most productive container terminal in the world averaging 163 crane moves per hour, per ship between the vessel's arrival and departure at the berth (Yokohama Port has ten major piers. Honmoku Pier is the port's core facility with 24 berths including 14 container berths. Osanbashi Pier handles passenger traffic including cruises, and has customs, immigration and quarantine facilities for international travel.

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Yokohama Port started the incentive for the ship in consideration for environment in April 2017. Entrance fee 15% of certification ships of two incentive systems. (Environmental Ship Index and Green Award) reduce taxes. As for joining both systems, Yokohama Port is the first in Japan.

A.2 Innovation and Technology

There are many existing LNG bases located next to the port. (i) The operation of an LNG-fueled tugboat “Sakigake” started in 2015, so know-how of LNG bunkering is accumulated.

The City of Yokohama is also on the verge of building LNG bunkering hub in the Port of Yokohama in cooperating with the national government and private sectors.

The port works on the promotion of hydrogen energy utilization and application enlightenment to a citizen by displaying in-vehicle model H2One by an event.

In January 2018, the port introduced Toyota Motor Corporation "MIRAI" one as a public car of Port Authority. Fuel Cell Vehicle (FCV) of Yokohama city It is the tenth unit for the FCV introduction results.

The transfer cranes found at the Port are equipped with a diesel engine and an electric storage device. The principle is to accumulate electricity and later roll it up and sometimes use the energy to wind it up, and to occur at the time of a fall of the container.

The port is also focusing on investment in LNG for fueling vessels and providing necessary infrastructure.

The have implemented an electronic container tracking system for more efficient operations, along with a pilot integrated air quality, water quality, and noise monitoring system (real-time) at a few select terminals

Incentives: The port plans to administer an energy savings and emissions reductions incentive program. They are in the process of making a booklet that explains potential energy consumption reduction opportunities and technologies. They will give this to the terminals to help them understand their options for reductions. They will also identify standards and select five role models, who will receive incentives (subsidies from the central government) .

The POY has also created innovative policy structures and approaches to reduce emissions from port-related mobile sources that are beyond their direct control.

Financial incentives are also offered to customers to reduce impacts from the operations include participation in the Environmental Ship Index (ESI) program.

A.3 Knowledge management

Yokohama Port is currently developing and planning an organizational knowledge base related to energy efficiency approaches throughout marine operations and equipment. They are currently using database systems to increase operational efficiencies and for environmental monitoring. For integrated terminal environmental monitoring, they are using a GIS system for data collection and to display and analyze information.

The system serves as an early warning system and allows them to analyze emissions data at several terminals, currently in the pilot testing phase.

A.4 Processes

Very clear energy efficiency – energy consumption reduction targets; A holistic approach to environmental and social issues has been taken throughout the organization.

A.5 Collaboration

Economic strategic planning – has partnerships with Port of Oakland, Port of Vancouver in North America and the Port of Dalian and Port of Shanghai in Asia, Port of Hamburg in Europe and the Port of Melbourne in Australia.

Through engagement and collaboration, the POY agreed to do air emissions inventory and share results of port mobile sources. Staff exchange program also is done with the listed ports above and others to learn best practices and share technologies. Communicates with environmental staff and suppliers of port enterprises regarding improvements needed in environmental management, shares.

The POY is active in port industry stakeholder organizations, such as the IAPH and a founding member of the World Ports Climate Initiative (WPCI).

A6. Sustainability Reporting

Yokohama Port does issue a sustainability report, an environmental report, and an integrated annual report. The City of Yokohama has also recently created an annual reporting brochure on environmental information that contains rich and diversified port-related information.

B Environmental Aspects of Sustainability

B.1 Environmental Policy

The Yokohama Port committed to becoming a “resource conservation and environmentally-friendly port”. The Port of Yokohama has been actively tackling environmental and safety issues for years. The port of Yokohama has participated in research on implementation of facilities for LNG-fueled vessels together with

MLIT (the Japanese ministry). Port takes pro-active approach to safety and environment and recognizes its role in regional economy and community. (POY,2018)

Further promotion of environmental safety and Corporate Social Responsibility principles by the port becomes more efficient. In order to emphasize more on-air quality measures and emissions reduction, the Port of Yokohama is also partnering in the ESI (Environmental Ship Index) program.

There are defined targets for reductions in energy consumption, CO2 emissions, the reduction of dust and particles from bulk cargo, and collection targets of bilge water and wastewater. Only for terminal side (buildings, cargo handling equipment).

B.2 Environmental Management System

Attention is paid to TBL and is of fundamental importance for future growth of the Yokohama Port.; TBL one of core values.

“The primacy of the economy is no longer absolute. It is now generally accepted that the economy, social support, and ecology are in a balanced “

On 30 th March 2017, A Green Award Certificate, which is an international ship certification and incentive scheme, recognized world-wide, was handed to the Mayor of Yokohama Mrs. Fumiko Hayashi.

This certificate reward an excellent performance, outstanding quality and safety record and high environmental standards operated at port level.
Ports and companies in over 20 countries support this initiative and reward ships meeting top notch standards. The scheme helps to reduce risks of incidents and accidents and to promote quality shipping as well.

B.3 Environmental Certification

The Port of Yokohama is ISO 14001 Certified, and this Certification is constantly renewed.

B.4 Air Quality

Air emissions from new large capital projects (during construction and operations) are estimated, avoided, and mitigated where feasible through the use of clean construction equipment and newer engines in mobile sources or mitigation technologies. Port policy and public health risk reduction goals emphasize cleaner production and a pathway to a zero emissions port. The POY became efficiency by introducing low carbon use strategy at the port and harbor.

The plan was revised in December 2014, and the Smart ports system based on the security of business continuity at the time of disaster was equally implemented. Also, in order to wrestle by making proof introduction of

independence type, hydrogen fuel battery system to Yokohama Port distribution center was also experimented.

Profit of hydrogen energy as part of an approach based on inflecting today as the Port introduced fuel cell-powered car (FCV: Fuel Cell Vehicle) as a means of emissions reduction at Port.

B.5 Water Quality

The Port of Yokohama has sewage disposal station in port area. Therefore, sewage water transfer from station to ship is able to use a pipeline to the treatment plant. Ships are only allowed to discharge sewage in ports if they use an IMO-approved sewage treatment plant. Comminuted and disinfected sewage using an approved system must be discharged at a distance of more than 3nm from the nearest land.

With regards to Ballast management, this water is pumped in to maintain safe operating conditions throughout a voyage. This practice reduces stress on the hull, provides transverse stability, improves propulsion and maneuverability, and compensates for weight changes in various cargo load levels due to fuel and water consumption.

B.6 Energy efficiency and Conservation

The POY became efficiency by introducing low carbon use strategy at the port and harbor. The plan was revised in December 2014, and the Smart ports system based on the security of business continuity at the time of disaster was equally implemented. Also, in order to wrestle by making proof introduction of independence type, hydrogen fuel battery system to Yokohama Port distribution center was also experimented.

Profit of hydrogen energy as part of an approach based on inflecting today as the Port introduced fuel cell-powered car (FCV: Fuel Cell Vehicle) as a means of emissions reduction at Port.

B.7 Waste Management

Reduction goals are in place regarding collection of bilge water from ships. Over the past years, Yokohama Port has worked with the City of Yokohama Municipality to perform more than 50 environmental site assessments, human health impact assessments, and soil remediation projects on port and city properties.

B.8 Biodiversity Management

The Port of Yokohama works on upbringing of the eelgrass to improve the biotope of the creature of the waterside. The port makes the shade by eelgrass,

and oxygen is supplied, and an effect such as a fry and spats gathering is expected by photosynthesis.

The City and Port of Yokohama started “Yokohama Blue Carbon Project” in 2014, which was an original carbon offset program utilizing marine resources in Yokohama. the Yokohama Blue Carbon Project and makes carbon credits. The credits offset CO2 emissions from sports events and another activity in Yokohama.

B.9 Green Infrastructures

Yokohama Port develops as an international port on behalf of Japan. The Port works on reduction of the greenhouse gas in Yokohama Port or maintenance activity of the water environment in cooperation with a private company or a citizen's group.

H2One

“Hydrogen-based Autonomous Energy Supply System” (H2One) has been set in Yokohama Port Cargo Center for a demonstration experiment in an energy management and usage energy in case of disaster

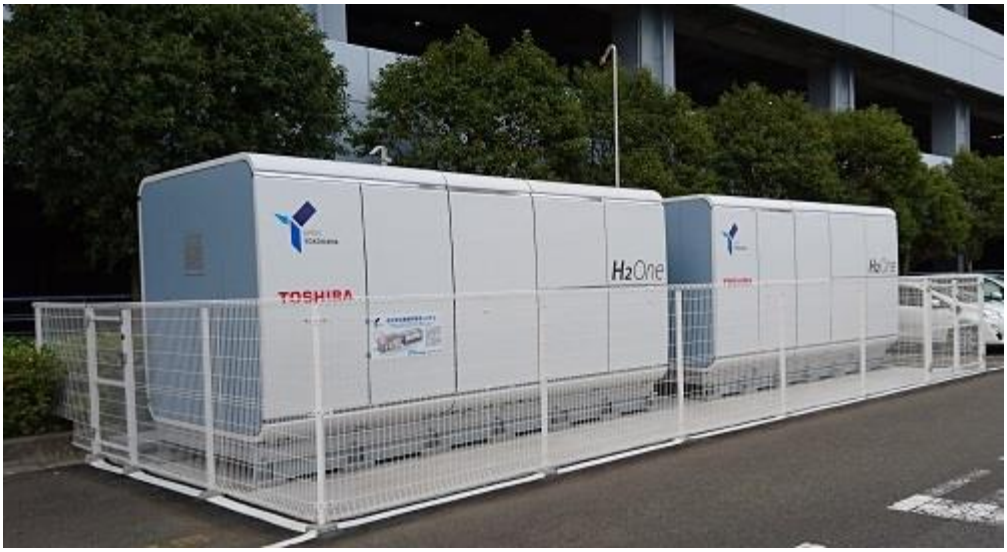

Figure 4.5 H2 One at Yokohama Port

Source:https://www.city.yokohama.lg.jp/lang/overseas/port/kankyo/20180227153007.html

In-vehicle model H2One

The port works on the promotion of hydrogen energy utilization and application enlightenment to a citizen by displaying in-vehicle model H2One by an event.

Figure 4.6 H2One Vehicle at Yokohama Port

Source:https://www.city.yokohama.lg.jp/lang/overseas/port/kankyo/20180227153007.html

FCV

In January 2018, the port introduced Toyota Motor Corporation "MIRAI" one as a public car of Port Authority. Fuel Cell Vehicle (FCV) of Yokohama city It is the tenth unit for the FCV introduction results.

Source:https://www.city.yokohama.lg.jp/lang/overseas/port/kankyo/20180227153007.html

Figure 4.7 Fuel Cell Vehicle

It is equipped with a diesel engine and an electric storage device. The principle is to accumulate electricity and later roll it up and sometimes use the energy to wind it up, and to occur at the time of a fall of the container.

Figure 4.8 Hybrid Transfer Crane

Source:https://www.city.yokohama.lg.jp/lang/overseas/port/kankyo/20180227153007.html

LED lighting

The LED of the streetlight in illumination and the wharf in the yard.

Figure 4.9 LED lighting at Yokohama Port

Source:https://www.city.yokohama.lg.jp/lang/overseas/port/kankyo/20180227153007.html

PV system

Setting of the PV system to sheds.

Figure 4.10 Picture of PV system at Yokohama Port

Source:https://www.city.yokohama.lg.jp/lang/overseas/port/kankyo/20180227153007.html

Eelgrass

The port works on upbringing of the eelgrass to improve the biotope of the creature of the waterside. In this process, shades are made by eelgrass, and oxygen is supplied, and an effect such as a fry and spats gathering is expected by photosynthesis.

Figure 4.11 Image of Eelgrass at Yokohama Port

Blue carbon

City of Yokohama started "Yokohama Blue Carbon Project" in 2014, which was an original carbon offset program utilizing marine resources in Yokohama. the Yokohama Blue Carbon Project and makes carbon credits. The credits offset CO2 emissions from sports events and other activities in Yokohama.

carbon offset program

- reduction of food mileage by local marine food

- introduction of thermal energy by seawater heat pump

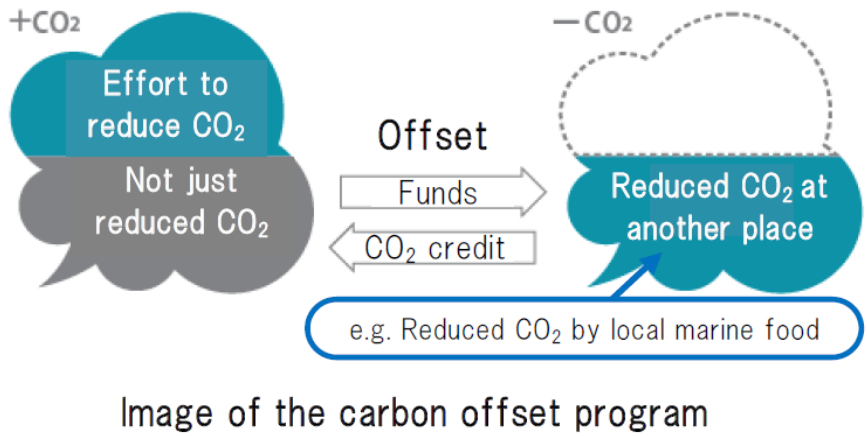

Image of the carbon offset program

Source:https://www.city.yokohama.lg.jp/lang/overseas/port/kankyo/20180227153007.html

Figure 4.12 Carbon Offset Program

Eco-friendly Terminal

There was a move made to push forward recycling such as processing asphalt gallaya konkuritogara which occurred in recycling facilities for outbreak restraint of waste occurring by maintenance repair construction of Container Terminal to push forward the making of eco-friendly port.

Figure 4.13 Eco-friendly terminal at Yokohama Port

Source:https://www.city.yokohama.lg.jp/lang/overseas/port/kankyo/20180227153007.html

B.10 Green Incentives

The Port of Yokohama is an incentive provider for environmentally friendly ships. Since 1 April 2017, all types of ESI over 30 points or Green Award certified ships are entitled to a 15% discount on the port dues. To apply this environmentally friendly incentive, ships are required to submit an application and certificate of ESI or Green Award in advance of arrival to the port.

B.11 Climate adaptation Change policies

Drive Slow Campaign

As one of the measures against global warming, "Drive slow" campaign has been promoted in cooperation with port entities since 2010, aiming at the decrease of CO2, accident and cost. YPC encourages port customers to consider global warming, not merely participating in this campaign.

B.12 Sustainability Website

The Yokohama Port has a port dedicated to vulgarizing sustainability issues.

B.13 R and D Unit

There is a unit dedicated to the research where all the above innovation were addressed.

C. Social Aspects of Sustainability

C.1 Ethical behavior

To protect public safety, The POY has adopted a public health risk threshold for incremental residential health risk - No project will be approved by the Board of Harbor Commissioners unless the public health risk to residents
posed by toxic air emissions from proposed project is less than 10 in a million.

Yokohama pursues a variety of policies in the health, welfare, and medical care fields to enable all residents of whatever age to enjoy secure lives, and it is moving forward with barrier-free development of the city center to ensure access for all.

C.2 Stakeholder Engagement

For public outreach, Yokohama Port posts public notices on a website. They currently visit nearby communities and conduct public surveys; reports from these surveys are made public. They also hold stakeholder meetings for proposed projects and have created a hotline to receive public complaints. Noise complaints are common, so there is a process set up to do investigations to resolve the complaint.

The POY also maintains a website, community newsletter, and occasionally releases informational videos. They have released a children's book, a book on port history to commemorate the POY's anniversary.

C.3 Training and Development

Total full-time employment numbers and hiring policies are unknown.

C.4 Corporate Governance

There are performance measures for safety, efficiency, and environmental protection. Strong transparency has been inserted into the environmental review process for large capital development projects. Technical studies, findings of environmental impacts, mitigation measures, public comments, and port responses and rationale for policy decisions are all posted on POY's website. The port has also been very aggressive about developing pilot incentive programs to reduce air emissions.

There is room for improvement regarding overall performance measurement of the organization. Projects are generally evaluated by schedule delivery dates and budget.

C.5 Motivation and Incentives

Employees are aware of the need to achieve energy efficiency and emissions reductions targets.

C.6 Port Security

Japan being a country always subjected to nature forces, it is very important to protect Yokohama Port from disaster such as a big earthquake and since the port supports civic life. The followings are therefore steps taken by the POY to ensure its safety and protection against disaster:

- The POY is ISPS Compliant,
- The POY provides information such as measurement data of (the atmosphere, seawater) such as radiation doses to have all of domestic and foreign shippers, shipping companies use Port of Yokohama safely,
- Quay reinforcement against earthquake:

  When the disaster including earthquake occurring below the Tokyo metropolitan area happens and a hindrance to land transportation occurs because of the collapse of the building, it is necessary to have an earthquake resistance quay so that relief supplies or restoration material are delivered from the seaside.
- Container crane with seismic isolation system:

  Container cranes are designed with seismic isolation with the goal of minimizing damage in the case they could be subjected to large-scale earthquake disaster. These isolations prevent the structure from shaking and being dismantle by containing the seismic energy away.

4.4.1.3 Sustainability Analysis of the POY

The following Table summarizes the sustainability aspects of the Yokohama Port.

and ranks the maturity level of each aspect, along with the port's overall concept of sustainability. summarizes the sustainability maturity of the Port of Yokohama across the 25 aspects.

The port has a high level of maturity across most economic and environmental aspects, with all social aspects meeting or exceeding the industry standard. The port also has a good networking capacity within the country and with other sister ports around the world with good exchange of information and best practices.

The Port of Yokohama has a sophisticated understanding of the concept of sustainability, as described in. Above not only do they understand and accept the economic, social, and environmental dimensions of sustainability, but they use it to guide their strategic planning, both in the short term but with their long-term plan as well.

4.4.1.4 Salient Points and Main Sustainability Strategy of the POY

The primary sustainability strategy exhibited by the Port of Yokohama is Conventional Visionary, which embraces a holistic approach. The port is indeed laying emphasis on energy efficiency and reducing environmental load at the

same time through the various program currently being implemented such as the PV,ED, FCV and H2O One . These programs are highly innovative and requested heavy investment. The port also has a coherent and harmonized development pan with the city. The local communities are equally highly involved in decision making policies at the port.

The Port of Yokohama also demonstrates his focus to thrive in sustainability practices by working to stimulate companies in the port area to work in a more sustainable manner, facilitate cleaner transport in and around the port, and by aiming to become a more sustainable port organization
The port has a highly developed commitment to become a market leader in sustainability issues, as exhibited by their goal to develop into the most sustainable port in the country and among the best in the world in future.

Having used the TBL framework in evaluating sustainability initiatives policy programs within ports organizations, it is interesting to notice that the framework enabled us to appraise a very detailed analysis of the different policies used in various ports to ascertain their involvement in implementing green policies within their organization. This information is accurate, updated, quantifiable and can be used in a comparative approach with other ports. The 25 sustainability indicators will therefore be used to also evaluate the state of sustainability practices within the Douala Port as below discussed.

4.5 Discussion on Research Question 1

This research sought to address specific research questions revolving around the different strategies and initiatives taken by sampled ports in addressing sustainability evaluation and performance. At this stage and based on the information gathered thus far from the four western ports, I will address the first 2 research questions as below discussed on the key issues of concerned when evaluating sustainability within port organizations as well as the tools used in efficiently evaluating port sustainability performance.

Question 1: What are the existing trends in port sustainability performance and assessment research?

Port sustainability is a recent trending issue in the field of Port management as discussed in chapter 2 and has gained momentum within the ports in the European, Asian and North American regions for close to two decades now. Also, within these port organizations themselves, and judging from the available literature on the topic, there are ranges of means and approaches used among various ports organizations to evaluate port sustainability. The most pertinent one is the use of sustainable indicators for and optimum and efficient evaluation of sustainability. This is highly significant,

since it contains the priorities of the port, highlighting issues and demonstrating port environmental commitment at port level.

Many ports around the world and regional port organization such as the European Seaport organization evaluate on a yearly basis the top sustainability issues within their ports organizations which has been monitored since 1996. The ranking of sustainability concerns is crucial to the port sector and to other relevant stakeholders, since it shows what ports prioritize when it comes to environmental issues. It also informs the political and policy priorities of ESPO and provides context to European policymakers working with ports. Figure 4.15 below gives an illustration of such ranking of sustainability trending issues within European ports.

	1996	2004	2009	2013	2016	2017
1	Port Development (water)	Garbage / Port waste	Noise	Air quality	Air quality	Air Quality
2	Water quality	Dredging: operations	Air quality	Garbage/ Port waste	Energy Consumption	Energy Consumption
3	Dredging disposal	Dredging disposal	Garbage / Port waste	Energy Consumption	Noise	Noise
4	Dredging: operations	Dust	Dredging: operations	Noise	Relationship with local community	Water quality
5	Dust	Noise	Dredging: disposal	Ship waste	Garbage/ Port waste	Dredging: operations
6	Port Development (land)	Air quality	Relationship with local community	Relationship with local community	Ship waste	Garbage/ Port waste
7	Contaminated land	Hazardous cargo	Energy consumption	Dredging: operations	Port development (land related)	Port development (land related)
8	Habitat loss / degradation	Bunkering	Dust	Dust	Water quality	Relationship with local community
9	Traffic volume	Port Development (land)	Port Development (water)	Port development (land)	Dust	Ship waste
10	Industrial effluent	Ship discharge (bilge)	Port Development (land)	Water quality	Dredging: operations	Climate change

[18]

Figure 4.14 Top Environmental priorities of the Port sector in Europe

In 2021 the result of this study shows that no new issues have entered the top 10 has shown above since 2017. The issues that appear consistently over time are shown with the same colour in the table to make it easier to identify trends over time. Table 4.15 shows that the top 3 priorities of ports remain the same compared to last few years. On the other hand, the last five priorities have seen some changes in their internal ranking.

Air quality is undoubtedly the top environmental concern of the sector, having been the first environmental priority for ports since 2013. Air pollution in port areas can come from vessels navigating in the port or at berth, port operations, and related land traffic within the port area. Furthermore, ports are often sites of industrial activities and clusters, which also contribute to air quality concerns. Since the majority of ports are located in or near urban areas, air quality is not only an environmental concern, but also important to safeguard the health of the port workers and the citizens around the port. This makes good air quality fundamental to a port's license to operate in urban areas. The importance of air quality to ports is shown both by its status as top priority, but also through ports taking action to monitor and improve air quality in ports.

Climate Change remains another top priority of the sector and it has grown in importance since in line with the growing focus on climate change in

political and social arenas. As ports increasingly face operational challenges as a result of climate change, addressing this issue is an imperative for ports, placing reductions of carbon emissions and climate-proofing port infrastructure front and centre. Increasingly, collaborative efforts are being undertaken as ports work with industrial and community stakeholders to develop a low-carbon economy and to become carbon-neutral.

Energy efficiency is also considered today among the very top sustainability priority, which is critical for ports and terminals seeking to reduce energy consumption and consequently their emissions. Improved energy efficiency is therefore a means to both reduce operational costs and contribute to greening efforts. Accordingly, a large number of ports and terminals are working to improve their energy efficiency.

Water quality is also a top priority in port sustainability. Ports are intrinsically linked and dependent on water, making water management and water quality fundamental to their operations, environmental responsibility, and license to operate. This is reflected in the fact that water quality has continued to rise in the ranking of top priorities for ports over the years

Waste management within port is as well considered as an issue of key concern. There are two main sources of waste in Europe's ports: the waste generated by port based activities, and the waste delivered by ships calling at the port. Preventing waste from being created, and avoiding it spreading, are key to

addressing waste from port-based activities. The more waste that can be reused and recycled, the better. Therefore, waste management is a key component of the positive contribution of ports to climate and environmental management. As a result of its importance, port waste has continuously been among the most monitored indicator within ports.

Most of these trending issues in the field of Port sustainability above discussed can be classified under environmental indicators as discussed in this study under the sub-sector of environmental indicators.

Relationship with the local community is also of great importance as a port sustainability priority. The vast majority of ports are located in, or very close to, an urban area, where ports tend to be perceived as representatives of the larger maritime sector by the local population. This means that ports need to address the general concerns of citizens and ensure that the port is viewed as a positive force in the local community. To achieve this, ports strive to increase transparency as demonstrated by their continued communication efforts, especially in reaching out and involving the local community in their initiatives. The social indicators chosen for this study mostly cater for this issue.

Having discussed the main trending issues in the field of sustainability, the next goal of this research was to evaluate the adequate tools in the evaluation of the sustainability performance within port organizations. For purpose of this

study, I selected 25 sustainability indicators across the three pillars of the TBL sustainability methodology. This will be further detailed in the next research question.

4.6 Discussion on Research Question 2

Question 2: How are sustainability measured within Ports organization and what tools are used in that perspective?

Empirical data from the review of literature on port sustainability topics and also from primary data emanated from this research, reveal that indicators are established and widely accepted for the assessment of port sustainability. This enabled an easy understanding and monitoring of port sustainability performance from each indicator in order to have a good grasp of strategies and policies to be adopted to foster sustainability practices within port organizations. However, it was also noticed a wide variety of indicators was used across board and for different purposes based on each port's needs. However, consistently these indicators often abide by the TBL mythological approach to sustainability concepts which are revolving around Economics, Environmental and Social aspects of Port practices and operations of port organizations. However, and consistently, specific indicators from each of these pillars are always featured across most ports.

Tools used in measuring sustainability at Port

In order to evaluate Port sustainability within port organizations, I developed a 25 TBL sustainability framework Indicator aimed at generating specific data and identifying policies designed by each port addressing the issues sought from each of those indicators. The framework was organized around 3 sub-groups of indicators which are Economics, Environmental and Social indicators. Each of these sub-groups are below discussed.

To evaluate the Economic aspects of sustainability, ports rely on quantitative data such as the gross domestic products, since ports are taken in this context as private enterprises. Of course, the institutional positions of port vary from countries to countries including that of the ports involved in this study. Even though this wasn't the focus of the study, it will be fair to argue that most if not all the ports involved in the study had a real level of autonomy in their operation and policy decision making.

The economic performance in this area measured through quantitative data from the number of container throughput annually (TEUs), mostly for container ports, the Market share of the port in a given area and the total Cargo volume for multi-purpose ports. Also, investment made in promoting research and innovation and adapting to new available technology to foster sustainability practices. Also, the collaboration with other institutes or private sectors as well as other ports and international organizations to enhance the port' sustainability standards of operations are also often considered at this stage.

On the evaluation of environmental performance, emphasis is often laid on the evaluation and monitoring of greenhouse gas emissions, water management technics, air pollution management, energy efficiency and conservation, the availability of an Environmental policy at the port and an Environmental Management Plan. I was also keen in investigating if the port had an Environmental Certification. I checked if there were policies addressing Climate change concerns. The building of green infrastructure was also considered important. Also, whether or not there were incentive policies rewarding vessels going green prior and when calling at the port was investigated. The availability of waste management policies and infrastructure was also looked upon. Finally, I inquired about the availability of a research and Development unit as well as that of a website dedicated for sustainability issues. To implement these environmental goals, most ports rely on the local, regional and environmental available legislation to that effect, just as discussed in chapter 3.

In measuring social aspects emanating from port operations, ports tend to focus on issues that could impact health and safety and security of workers or the neighboring community leaving in the vicinity of the port. Issues related to ethics at work, security of the port and employees, training and developments well as incentive policies for personnel, corporate governance issues and the involvement of local communities in partaking in sustainable decision making were also of great importance at this stage.

The sum of data gathered from these 25 TBL indicators after their implementation within the sampled western ports, as earlier discussed in this chapter, enabled the identification of clear and specific policies that enabled a good understanding and evaluation of the sustainability performance of these port in this study which validated this tool. The next stage consists in using it to evaluate the port sustainability performance within the Douala Port.

CHAPTER FIVE
APPLICATION OF THE 25 SUSTAINABILITY INDICATORS WITHIN THE SUB-SUHARAN AFRICAN PORT

5.0 Introduction

The main purpose of this chapter is to analyze, interpret and present the data that was obtained after the implementation of the 25 TBL framework within the Port of Douala as previously done with the previous other four ports sampled for this research. This process will enable a clear understanding of the sustainability level of performance within The Port of Douala. In so doing, I will be able to assess the strength and weaknesses of policies implemented in that regards.

Secondly, I will proceed by making a comparative analysis of sustainability policies within all the 5 ports organizations revolving around the main 25 TBL selected sustainability indicators. The data generated will be discussed in an attempt to answering the main research questions three and four that guided this study. This will enable me to ascertain the response organization in their quest to make their ports more sustainable.

Finally, and based on the comparative study made above, a policy proposal plan to foster sustainability practices at the Douala Port will be made.

5.1 Implementation of the 25 Sustainability Framework within Sub-Saharan African (SSA) Ports

5.1.1 The Case of the Douala Port (PAD)

5.1.1.1 Background Information and Country Description

Cameroon is a sub-Saharan African country, located at the Gulf of Guinea between latitude 2° and 13° N and longitude 8° and 16° E. It has a surface area of 475,440 km^2, with a 420 km South-West maritime border along the Atlantic Ocean. Cameroon has a population of 25,739,218 inhabitants (2015) (urban 54.4% and 45.6% rural) and is the most populated country in Central Africa.

An estimate in 2000 shows that 48% of the population live below the poverty line and in 2015, USAID reports that about 40% of Cameroonians live below the poverty line of $2/day. The population growth rate and economic (GDP) growth rate are 2.59% (2015) and 5.9% (2015), respectively. Over 60% of Cameroon's active population is employed in agriculture, representing 42% of GDP while mining and industry accounts for 22%.

Cameroon is endowed with significant natural resources: oil and gas, high timber species, minerals (uranium, tin, platinum, limestone, iron), hydropower etc. and agricultural products (coffee, cotton, cocoa, maize, cassava, banana and oil palm) and serves as a transportation hub for good moving into the Central African Republic and Chad. However, the industries heavily depend on hydro

energy of about 90%. The Carbon dioxide emissions from the consumption of fossil energy in 2012 stood at 6.224 million metric tons.

Cameroon is generally referred to as “African in miniature” as it represents all the major climatic, geographical and vegetation characteristics typical of the African continents (deserts, coastal, mountains, rainforest and savannah regions) , as well as it great cultural and ethnic diversities. The climate varies within the terrain from tropical along the coast to semi-arid and hot in the North. The environmental issues prevalent in Cameroon are water borne diseases, deforestation, overgrazing, overfishing, desertification and poaching.

Environmental Policy Structure and Process

Existing environmental policy regulations in Cameroon are surprisingly extensive. Regulations exist for protection of marine resources, air quality, water quality, soil, noise, etc., preparation of an environmental impact assessment before project construction, and public involvement in the environmental review process.

Regulations are promulgated from central government in Yaoundé by the Ministry of Environmental Protection. Implementation of central government initiatives are carried out by local governments. Implementation and enforcement at local level that is consistent with the central government’s intent has been a challenge. As a result, there is a renewed focus on enforcement

- **Cameroonian Ports: Background and Sustainability Analysis**

This study focuses on Cameroon's top container port Located in Douala. It is hoped that information generated will be of great use to the newly built port in Kribi.

The following case study will provide background information, highlight challenges and practices, and present an analysis with the use of the adapted framework of the sustainability maturity and strategy of the port organizations.

Figure 5.1 The Port of Douala

Source: https://www.google.com/maps

The Port of Douala is the Cameroon's major seaport. Located on the shores of the Wouri River estuary some 24 kilometers upstream and about 210

kilometers west of Yaoundé, the city has road, rail, and air connections to all of the country's major cities. This deep-water port is home to most of the country's international trade, and it has facilities dedicated to cargoes that include timber, gasoline, bauxite, and bananas. It has served a busy fishing industry.

The Port of Douala is among central Africa's most important industrial centers. It is home to breweries, food-processing plants, and factories that produce palm-oil, soap, building materials, plastics, soaps, glass, bicycles, and paper goods. The port includes a ship repairing facility.

The Port of Douala contains eleven cargo berths. Nine berths are dedicated to the movement of general cargo and offer 58 thousand square meters of warehouse space.

The port also contains about 380 thousand square meters of open storage and eight thousand square meters of storage space for chilled and refrigerated cargoes. The Port of Douala's timber-handling facilities include 200 thousand square meters of stacking yards.

The Port of Douala contains 2300 meters of quay, with two container berths of 500 meters. Alongside depth at berths is 8.5 meters. The Container Terminal has three berths and has capacity for five thousand full TEUs in its stacking area. The terminal also allocates space for roll-on/roll-off cargo.

Challenges & Advanced Practices

This section highlights just a few of the key challenges and advanced practices demonstrated by the Port of Douala.

Douala's port's institutional framework for environmental management follows a hierarchical politico-administrative arrangement with multiple and overlapping state institutions.

Although the Douala Port authority has awareness of its environmental risks, it seems inert toward them. Policies to address environmental risks are routed through the NPA (National Port Authority) to the Ministry of Transport which then takes it up with MinENP (Ministry of Environment) and other appropriate institutions.

After becoming landlord in 2006 however, the port authority has established an environment committee and initiated an adhoc environmental role for itself. The Port authority, though not having the mandate, used the environmental committee as a mechanism alongside existing state procedures to get port actors to comply with the national Environmental regulations and other International Convention Cameroon is party to.

5.1.1.2 25 TBL Sustainable Indicators Data from the Port of Douala

The following summarizes the sustainability maturity of the Douala Port across the 25 aspects.

A. Economic Aspects of Sustainability

A.1 Financial Strength

Ranked 1st nationally as well as regionally (CEMAC) this is as well the biggest container port in the Central African sub-region.

The port infrastructure consists of a wharf of 60 meters dock-shopping seven private wharves, shops connected by a path of 60 meters. Bonaberi at this time, will be served by a dock-shopping 100 meters long. Well-equipped workshops and dock footing 900 tons complete. Annual traffic capacity is evacuated at 100 000 tons of cargoes. (PAD, 2018)

A.2 Innovation and Technology

There is no structures or infrastructural innovating investment.

A.3 Knowledge Management

The stated values of the Port are security, environmental friendliness, and financial strength. However, economic development appears to be the primary factor in their decision making.

Port officials could not highlight or share any environmental or social metrics or goals in general for the port. “Environmental friendliness” is often mentioned as an achievable goal for the Port when it comes to environmental regulation.

A.4 Processes

No significant data were found for this indicator at the PAD.

A.5 Collaboration

The Ports of Douala often strategically plan for port Infrastructure development in the region and better compete against neighboring ports such as Abidjan Port in Cote d Ivoire1, Lagos Port in Nigeria and Tema Port in Ghana as the main competitors.

The capital and management resources of the Port are now available to further develop Bonaberie Industrial zone, allowing it to focus on expansion of future bulk commodities**.** Transportation and storage among multiple terminals.

There is collaboration with the City of Douala regarding land use and master planning and with DIT (Douala International Terminal) ,they have joint annual meetings and have jointly invested in terminals development within the port. There is no evident stakeholder collaboration with community residents or NGOs.

A.6 Sustainability Reporting

The Ports of Douala does not publish sustainability information on its website neither do they have a magazine where sustainability issues can be published.

B. Environmental Aspects of Sustainability

B.1 Environmental Policy

The stated values of the port are security, environmental friendliness, and financial strength. However, economic development appears to be the primary factor in their decision making.

Port officials had some understanding of the sustainable development concept as balancing economic benefits with reducing environmental impacts.

There is an expressed desire to be "environmentally-friendly" but there is not a sign of systemic integrated thinking about the relationship between development decisions and environmental and social impacts. There is a lack of understanding of ecosystem health and biological impacts of port operations.

- Goals

The Port of Douala's goal is to become the Pole of reference at the hearth of the Gulf of Guinea.

The port also has some metrics related to energy consumption. However, no specific numbered goals were identified

B.2 Environmental Management System

A Vision guiding the Environmental Management system at the Port could not be clearly identified.

B.3 Environmental Certification

The Port of Douala is on the Verge of becoming an ISO 14001 Certified port.

B.4 Air Quality

The following priorities were identified as environmental hazard often monitored at the Port:

-dust from cargo operations (mostly from iron ore and clinker,

-leaks from crude oil operations, as the largest oil terminal;

-The Port does have a Security and Environmental Protection Department to enforce local environmental protection laws within the port area.

The teams intervening at the port for monitoring and control is made of experts from the ministry of environment (MINEP), the Ministry of Transport (MINT), Customs Department and Port officials.

The Port of Douala has funded its own wastewater processing factories, and they have special facilities to collect spilled oil.

There is no air emissions inventory; Emissions from construction activities do not seem to be considered. Mitigation strategies are applied to some air emissions from operations.

Emissions from some cargo handling equipment (RTGs) are mitigated by the conversion to Electric RTGs, which also saves on fuel costs. While there does not seem to be any specific air emissions reduction targets or goals, a number of priority projects for implementation in 2012 were identified (some previously

mentioned), including the installation of dust screens and sprinkler systems at several bulk terminals to address fugitive dust emissions (PAD 2019).

B.5 Water Quality

The Port of Douala is a party to the Ballast Water Management Convention and organizes inspection on a weekly basic to ensure of its effective implementation.

B.6 Energy Efficiency and Conservation

No specific program was identified

B.7 Waste Management

Pollution prevention assessments are conducted before purchasing new facilities (PAD 2017). The port also provides services to support the disposal of ship garbage. A company named Hysacam is responsible for the Garbage management system at the port since 2003. Also, a different company called BOCAM is giving the contract for the management of oil generated at the port

B.8 Biodiversity Management

The Port of Douala is the largest port in the country and an estuary port; it needs to be maintained and dredged annually to ensure the channel's navigable depth.

In 2016, the China Harbor Engineering Corporation (CHEC) won the bid for the channel dredging project of port of Douala in Cameroon, with a contract value of some 28 million euros and a construction period of 24 months.

There does not seem to be a general awareness of biological impacts of port operations.

B.9 Green Infrastructure

There is a basic code of conduct for staff posted on the port website that highlights the need for "Well-disciplined conduct, safe and efficient operation, high quality services, pragmatic and innovative attitude.

The Port has the ability to create Special Economic Zones(SEZs), which attract foreign investment by creating a preferential investing environment. Examples include tax reductions for new plants and foreign exchange settlement. The Bonaberi Free Trade Zone, located adjacent to the port area, has successfully attracted numerous import and export processing and manufacturing facilities

Unless they create policies to address these issues, these problems will continue and stay concentrated in the coastal region (PAD 2017).

B.10 Green Incentives

No clear Policies identified

B.11 Climate change adaptation policies

No specific policies addressing climate change was identifies here.

B.12 Sustainability website

Although the port has a website, it does not address sustainability issues on it.

B.13. R &D Unit

For now, there is no Research and development Unit at the PAD yet.

C. Social Aspects of Sustainability

C.1 Ethical Behavior

There is a code of ethics governing the behavior of port employees, management, and Board members.

C.2 Stakeholder Engagement

Generally, appears to be low; There is little to nonpublic engagement; port planning occurs at the central government level and also privately by National Port Authority at Yaoundé , The state-owned parastatal in charge of port planning and development across the country nationally.

The local environmental protection bureau official seemed to be uninformed, not motivated, and not engaged in port environmental issues.
The perception depicted is that the Douala Port management board are more concerned with focusing on profits than environmental pollution" (Abena, 2017)

C.3 Training and Development

There are 2,000 employees at the Port, 600 of which a redirect hires with labor contracts (Abena 2017).

The port expresses a desire to be people oriented, with a scientific outlook of development. Statement on website:

"The core value of Douala Port is to care for employees, protect employees and value their enthusiasm, initiative and creativity as the foundation and source for enterprise development. People orientated principle and scientific outlook of comprehensive, harmonious and sustained development are the value premises for the survival and development of the port and are the soul for the enterprise culture of Douala Port.

C.4 Corporate Governance

There is a basic code of conduct for staff posted on the port website that highlights the need for "Well-disciplined conduct, safe and efficient operation, high quality services, pragmatic and innovative attitude" (PAD, 2017).

C.5 Motivation and Incentives-

Management engagement with employees on topics related to sustainability seems to be low.

C.6 Port Security

The PAD is ISPS compliant, and its implementation placed under the authority of the Port Captain.

5.1.1.3 Sustainability Analysis of the Douala Port

The Port of Douala has an elementary understanding of sustainability, viewing it with a focus only on environmental protection. The Port of Douala is mostly in transition from beginning to elementary regarding its maturity level for the majority of sustainability aspects. It has an elementary level of maturity related to Financial Strength and the poorest performance related to Sustainability Reporting, Biodiversity and Habitat.

Management, Community Engagement, and motivating employees to focus on sustainability. It should be noted that the port reports a high rate of use of AMP shore-power technology (1500vessel calls) to mitigate vessel emissions. While the motivation is most likely to reduce fuel costs (and not environmental protection), this is a higher rate of use than what is reported by many ports who have installed AMP at their facilities.

5.1.1.4 Salient Points and Main Sustainability Strategy of Douala Port

The Port of Douala exhibits a hybrid sustainability strategy that combines a focus on risk mitigation and basic compliance with rules and guidelines

(Introverted Strategy) and legitimization (Conventional Extroverted Strategy) to potential investors of DIT Island and the central government of Cameroon.

5.2 Port Sustainability Performance : a Comparison between POR, POA, POV, POY and PAD

This section aims to find the similarities and differences of the sustainability policies initiatives in each individual port by laying more emphasis on their strength and weaknesses and by putting contrasting them with those as implemented within the PAD for better understanding of their level of performance.

Summary of discussions on the main sustainability initiatives from the Douala Port

The stated values of the PAD are security, environmental awareness, also financial strength. However, economic development seems to be the primary factor driving decision making at the PAD.

Port officials had a good understanding of the sustainable development concept seen as balancing economic benefits but also reducing environmental impacts.

The officials have also acknowledged their growing interest for port sustainability as a trending movement within the industry and discussed the prospects of PAD joining in the movement despite all the challenges faced so far.

It is worth mentioning that the port does not have a green port policy, neither does it implement a specific Environmental Management system guide. There is no official communication or policy statement from the port's website communicating about sustainability efforts done by port.

Nonetheless, environmental activities at the Port are managed by a service placed under the authority of the port' Captain. This service, in charge of the environment preservation and fight against pollution as it is originally labelled in French "(Service de Protection de l Environment et lute contre la Pollution)" at PAD, was created in 2001.

The mission of this service mainly consists in fighting pollution and managing port' waste, based on the Marpol 73./78 provisions . (Ref to Annex 1 for the Decree creating the Service of Environmental Protection and fight against Pollution). The Government of Cameroon as a member of the IMO, has ratified most environmentally related conventions and enforced their provisions within the country' local legislation.

Members of the environmental service at the PAD, and despite the little means placed at their disposal, develop yearly environmental goals and management procedures. (PAD 2018)

Table 5.1 gives a snapshot of the conventions applicable to Cameroon followed by their brief description.

Table 5.1 International Legislation on Port Environment Applicable in Cameroon

Conventions/Legislations	Purpose
Maprpol 73/78	This convention is mainly focused on the prevention of pollution from ships. It was first introduced in 73and later modified and amended in 78. It entered into force in 1983. The Convention contains 6 annexes as follow: i) Oil and Oily water; ii) Noxious liquid susbstances carried by ships; iii) harmful susbtances carried by ships in packaged forms; iv) sewage from ships; v) garbage from ships; vi) Air Pollution from ships
Basel Convention 1992	This Convention deals with the Transboundary movement and disposal oh harzadous waste
UNTACD 1993	Need for Sustainable Development for Ports
BWM (Ballast Water Management) Convention 2004	Convention for the control and Management of ship Ballast Water sediments (Ref to Annex 2 for forms used by PAD in sustainably managing Ballast water at Port)

Source: from the author

This service, in charged on environmental protection mainly carries activities revolving around meeting the provisions of the above legislation in order

not only to be compliant with International and national norms, but also reduce the environmental impacts that emerge from the port operations.

The port also provides services to support the disposal of ship garbage. in that perspective, reception facilities were built to collect Sewage, sludge Oil and waste from ships calling at Douala Port. These wastes are later recycled by licensed private companies such as BOCAM, ECOMARINE, GEOMARINE, EQUI-Environmental, OK Clean and VALTEC. These companies are traditional partners to the PAD and were licensed by the Ministry of Environment (MINEP) to specifically execute this task at the PAD.

These companies are specialized in waste recycling and assist the port in that perspective. The building of these facilities has enabled the PAD to manage waste efficiently and in compliance with the provisions of Marpol. This service from PAD comes at a fee which has generated over the years, a good revenue for the PAD (PAD 2020)

Also, it is worth mentioning that the PAD does make use of electrified rubber-tired gantry cranes during their operations. This equipment aims at reducing emission from port operations. (PAD 2020).

Also, authorities from PAD, levy a charge to shipping compagnies calling at the port based on the polluter pays principle for marine oil spills and other forms of pollution in the port area. This measure serves as a punitive policy to discourage pollution of any kind by shipping companies operating in the port

area. Supplementary fees have also been placed to prevent vessels from dumping their waste at sea or within the country s territorial waters.

Regarding Environmental Certification, The PAD is ISO140001 Certified. This certification is an acknowledgement of the efforts been deployed by the PAD in following a set of environmental guidelines in addressing environmental issues within the port. The Certificate was obtained by the Certification Bodies (CABs) after a thorough audit of the port on its management of water pollution, garbage, oil spills, effluent discharges and all other forms of waste from the port and the city and preventing such waste generation.

It is harder for ports to have a good mitigation policy towards air emission due to the lack of measuring and monitoring equipment for such emissions. Concerning Climate change Policies, there is no specific targeted policies geared towards that goal noticed at the PAD.

On sustainability reporting aspects, it should be mentioned that the PAD does not issue a sustainability report, or a sustainability magazine, an environmental report, or an integrated annual report. The website of the PAD does not also make mention of activities on sustainability issues.

When it comes to energy efficiencies, there was no specific energy conservation or resource reuse policies observed at the port. There is no environmental metric to that effect.

The Port of Douala is also an estuary port; also, often need to be maintained and dredged annually to ensure the channel's navigable depth. During such operations, port officials do not seem to be aware of the biological impacts of such port operations to the environment and neighboring communities.

Very little is done on social issues within PAD. Local communities do not seem to be involved in decision making regarding environmental projects developed in their vicinity. There was not much information as well on ethical behavior within the PAD. However, the PAD ensures its senior staffs are constantly enjoying Continued Professional Development training on different environmental management related issues. The PAD been member of many organizations such IAPH, PMAWCA, IMO, many such training are often offered by these organizations for staffs of their member ports.

Overall, we can fairly argue that Port officials from the service managing environmental issues are motivated but lack adequate training and means to excel at their work. Also, the general belief here is that the Douala Port Management board are more concerned on profit making than environmental pollution.
Based on the above listed and discussed weaknesses emanating from the key 25 TBL sustainability indicators, it will be fair enough to ascertain that The Port of Douala has a lower implementation of sustainability policies, viewing it with a focus of mainly preserving the environment.

5.3 Discussion on Research Question 3

This part will discuss briefly about issues relating to the gap in sustainability performance between modern Ports in this study and the Port of Douala. That analysis is done as discussed below:

Research Question 3: What is the Gap in sustainability policy implementation between modern Ports and Sub Saharan African Ports?

The methodology used in addressing this research question will consist in making a comparative analysis of the salient and strong points emanating from the data gathered from the 4 ports involved in the study based on the 25 TBL indicators developed. This will be in contrast with the ones developed above from the Douala port. On that premise, the contrast will enable to have a fair idea of the gap that currently exists between more mature sustainable ports and that of Douala. The next research question will deal will potential policy proposal to address some of the challenges needed to bridge that gap.

5.3.1 Summary of discussions on the main sustainability initiatives from the Port of Rotterdam (POR)

In order to implement a sustainable management in the POR, the Authorities have provided several sustainable policies and measures and have adopted environmental goals including the followings;

Concerning the development of the Green Infrastructure, we may specify that the POR, has developed a waste reception facilities infrastructure to receive and sustainably discard various waste from ships and vessels that call at PoR. The collectors take the deposited waste by truck or barge to authorized waste processing companies. The Port Waste Handling Plan contains more information about depositing waste. A list of port reception facilities in the seaports of Dordrecht, Maassluis, Moerdijk, Rotterdam, Schiedam and Vlaardingen are also available. (POR)

The fees for the disposal of waste can be obtained from the designated collectors. The amount of the contributions and rights of disposal for all seagoing vessels are given in the Port Waste Handling Plan and the port Tariffs brochure. Some waste flows are subject to indirect funding: vessels pay a contribution and are reimbursed (part of) the costs of disposal. The Port Waste Handling Plan 2015 contains extensive information. (POR, 2020)

The port embarked in 2006 on a program called a Clean Air Action Program for port fleet was started in 2006 with a clear goal of cutting down greenhouse gas emissions. This program is developed across a combination of actions, policies and development of green infrastructure.

The port has also been implementing the ESI to conforming vessels to provide clean OGVs. Vessels that perform better than the legal norm will be

rewarded a 10% discount on the gross tonnage part of the port dues. Since 01-01-2015, the discount is doubled when vessels also have low NOx emissions. Low NOx emissions are achieved by using LNG as fuel or large catalysts. The discount for clean vessels is in line with the policy of the Port of Rotterdam Authority on sustainable port development.

The following conditions must be met by vessels to benefit from the ESI policy:

- The discount applies to all ships that have an ESI score of 31 or higher on the moment of arrival (ATA) in Rotterdam.
- The discount doubles if the ship also has an individual ESI-NOx score of 31 or higher.
- The discount applies to each call in a quarter, with a maximum of 20 calls per ship per quarter.
- If the ESI score is adjusted by the International Association of Ports and Harbors (IAPH) to below 31 points, the discount paid must be repaid within four weeks. This also applies if the ship is given the 'inactive' status.
- Ask for the discount when declaring the seaport dues. The discount is calculated automatically.

The port also developed an LNG gate terminal which is a joint venture of Gasunie and Vopak. The terminal is Located on the Maasvlakte near the port entrance, the LNG terminal is easily accessible to LNG tankers. Three storage

tanks, each with a storage capacity of 180,000 m3, make it possible to unload large amounts of LNG at once.

The liquefied natural gas is either regasified at Gate to be transported through an underground pipeline to the European gas distribution network, or it is loaded into vessels or trucks.

Aside from the ESI and LNG, the POR, based on the EU directive on Sulphur content has also started using a low-Sulphur bunker oil VLSFO (Very Low Sulphur Fuel Oil with a maximum 0.5% Sulphur). This measure has become very popular in Rotterdam, Europe's largest bunker port. This became apparent from the bunkering notifications via the Port of Rotterdam Authority's time to Bunker Application.

As of 1 January 2020, sea-going vessels on the world's oceans started using fuel with a Sulphur content of no more than 0.5%. The current maximum is 3.5%. High-Sulphur fuel will only be permitted on vessels that have scrubbers - an installed filtration system - on board.

Although even stricter Sulphur regulations apply to shipping on the North Sea and bunker oil may only contain 0.1% Sulphur, many shipping companies in Rotterdam are ordering VLSFO, because they also sail intercontinentally and not just across the North Sea.

Regarding certifications, it should be pointed that the Port of Rotterdam has also been certified to the European Sea Ports Organization's Eco-Port's Ports Environmental Review System (PERS). This result is an acknowledgement of the port s efforts to implement a combination of tools and measures to green its operations. Being PERS certified requires amongst others that the port increases transparency by making its environmental report publicly available. It also implies that the port is effectively monitoring environmental challenges and is actively improving its environmental management. The certificate has a validity of two years, after which it is revised. This ensures that the port continues to meet the requirements.

The bundle of measures the port has adopted recently can be linked to new and very tight legislation by the European Union especially the comprehensive Directive 2008/50/EC. This Directive is linked to ambient air quality and cleaner air for Europe. Many Member States so far have already either been brought to the European Court of Justice or have been convicted for violating air quality levels actually legally accepted.

5.3.2 Summary of discussions on the main sustainability initiatives from the of Antwerp Port (POA)

The Port Authority works on the basis of its own policy vision. This has been defined as “preserving and promoting the development potential of the port as an economic gateway for Flanders, as part of a sustainable environment policy, in a critical, proactive and responsible way.”

One basic criterion is of course that all legal obligations must be met. Further, the environmental costs and benefits must be in reasonable proportion to one another. In the meantime, the Port Authority goes for “quick wins,” with priority being given to initiatives that cost less and yield greater environmental benefits. Finally, any environmental efforts that go beyond what is legally required must not distort competition, either between companies or with respect to neighboring.

The port is financially fit ranking in terms of cargo throughput as the second busiest port in Europe behind Rotterdam.

The port equally initiated several projects aimed at addressing sustainability concerns. Some of those include the biomass power station in the port area (this project consists in a CO2 neutral combustion, which will allow for the reduction in GHG of 20% by 2020).

Other projects at the port, in collaboration with universities or private partners equally are operational which focuses on carbon capture, utilization, and storage initiatives.

The Port also conducted an LNG feasibility study (as a ship fuel) and catered to LNG ships from 2015; Collaborating with regional ports – reduces NOx and Sox up to 90%, along with CO2

The port keeps an updated annual reporting to the World's First Port Community Sustainability Report (2010) – GRI Certified C 2011 Integrated Annual Report – followed an integrated

Approach for TBL; GRI guidelines.

Environmentally wise, the port Measures environmental performance; has an environmental policy; tracks environmental expenditures; Has an energy and climate policy.

The Port of Antwerp has created an emissions inventory of SO2, NOX, PM10, CO2 and COE of port users/by source/industry.

Tracks CO2 Equivalents (GHGs) – direct and indirect emissions of its own operations and entire port area; Looking at Carbon offsets where reductions aren't possible (Port of Antwerp 2017).

The Port also has a dynamic traffic management system with signage to reduce traffic congestion and emissions.

The Port is investing in a large-scale wind farm (55 turbines to deliver power to 100,000 households) and has transferred the electricity distribution network to an inter-municipal company IVEG which has allowed for the creation of sufficient transmission capacity for more solar units.

Many port vessels have been retrofitted to reduce NOx. The port vehicle fleet has been replaced with more environmentally friendly vehicles and bicycles are available to staff for short journeys

The port vehicle fleet has been replaced with more environmentally friendly vehicles and bicycles are available to staff for short journeys

The Port of Antwerp introduced the Environmental Ship Index program in 2011. They offer a 10% discount on port dues with a score of 31 or higher (ships must reduce SO, NO, and CO2).

The Port of Antwerp provides onshore power to barges and container vessels (which reduces NOx and noise).

Regarding water quality, the Port of Antwerp has a monitoring program and they also look at sediments. They support integrated water management in collaboration with the University of Antwerp.

Based on the above-mentioned key indicators, we could grasp the approach and philosophy of the sustainability approach of the Port of Antwerp**.** While the Port of Antwerp has the highest sophistication among economic and some environmental, virtually all of the aspects are integrated at or above the industry average .

For internal motivations and incentives, there are some measures in place, but diffusion throughout the organization has not yet occurred. This is also true for some organizational processes related to environmental management, which is

usually a port organization's foot in the door to addressing or confronting its approach sustainability.

5.3.3 Summary of discussions on the main sustainability initiatives from the Port of Metro Vancouver (POV)

The Port of Vancouver has a strong commitment to developing innovative strategic and sustainable operations that benefit the economy as well as the quality of life for the region and the nation it serves." The POV also subscribes to the view sustainability through its through pillars which are the TBL concept of sustainability (environmental, social, and economic)

The Port of Vancouver strategic Motto is to enable Canada's trade objectives, ensuring safety, environmental protection and consideration for local communities.

The Port's Motto is to become the world's most sustainable port.

POV define a sustainable port as a port that delivers economic prosperity through trade, maintains a healthy environment, and enables thriving communities through communities' accountability, meaningful dialogue and shared aspirations.

"Advancing Technology and Sustainability" is also a Strategic Objective in POV's 2050 Strategic plans.

POV is ranked as the number 1 port in the Canada supporting trade with more than 170 economies around the world the most diversified range of cargo of any port in North America**.** Many different enterprises operate in the port including

cargo and cruise terminals, industries requiring tidewater access, shipyards, tugboats, railways, trucks, shipping agents, freight forwarders, suppliers, builders and administrative agencies.

- **Green Infrastructure**

The POV has several green infrastructure and projects that contribute to cutting down GHGs emissions. Some of such projects include the following;

Shore Power and Hybrid Equipment

Port Metro Vancouver was the first port in Canada to implement shore power for cruise ships, and since 2009, over 11,000 tons of greenhouse gas emissions have been avoided. At the Port of Vancouver, where electricity primarily comes from low-emission hydroelectricity, this significantly reduces emissions of air pollutants and greenhouse gas emissions while also reducing engine noise.

Shore power is available to container ships at Center container terminal and at Delta port, Canada's largest container terminal. The port authority installed shore power with support from Transport Canada and BC Hydro, and in collaboration with the respective container terminal operators Global Container Terminals and DP World Vancouver. Shore power facilities at Center berth five have been operational since May 2018, and the container shore power system

there is the first in Canada adhering to current international standards for container ships. Shore power at the third berth at Delta port has been operational since November 2019. The port authority has been considering the expansion of shore power facilities to additional berths, depending on the uptake by shipping lines, feasibility studies to confirm infrastructure conditions and electrical availability, and funding.

Since 2009, shore power installations at the Port of Vancouver cruise ship terminal and container terminals have eliminated 691 tons of air pollutants and 25,495 tons of greenhouse gas.

(1) Trucking system

Port policy and public health risk reduction goals emphasize cleaner production and a pathway to a zero emissions port. Traffic management and efforts to reduce congestion and truck idling are also implemented. Discharges into the water and soil are prohibited, and best management practices are followed to avoid releases during construction or in-water work. Water quality throughout the port area and San Pedro Bay is managed through control measures contained in POV's Water Resources Action Plan

(2) Cargo Handing smart system

In 2015, the Port of Vancouver was the first port in Canada to have fees implemented reducing emissions of diesel equipment used in terminal operations. Oder diesel engines without modern emissions controls produce fine particulate

matter emissions that are harmful to human health. The non-road diesel emissions program includes a fee applied to the operation of older, dirty equipment as well as mandatory idle reduction policies, opacity restrictions, equipment labeling, reporting and auditing.

(3) Terminal system

The Port of Vancouver was the first Port in Canada to partner with an electrical utility to pace a focus on energy conservation at Port terminals. In partnership with BC Hydro, this energy Action Initiatives is helping Port tenants pan for the future by advancing efficient, reliable, competitive and clean energy systems.

POV Energy Action Initiative helps tenants on port and identify and implement opportunities to reduce energy costs, access financial incentives and support increased operational productivity.

When it comes to reporting, At POV, a Sustainability Assessment and Plan Formulation is regularly issued yearly. Also, a sustainability report is released regularly and is available on the POV' website.

From the environmental side, there are air quality, water quality, and waste and hazardous waste management and monitoring systems in place which are been taken cared off through several sponsored projects.

POV also tracks recycling for several materials and maintains a credible carbon emissions inventory. A new energy management plan for POV introduced in June 2013 highlighted more its focus on energy efficiency at the POV.

In terms of curbing air emissions, Initiatives that support the POV's objectives include increasing the number of zero emission trucks in the Port drayage fleet by 2020, partnering with educational institutions to create workforce development programs that support a transition to automated terminal technology, and exploring less expensive but as effective alternatives to Alternative Maritime Power (shore-side power) for vessels (POV 2017).

POV also has the following specific air emissions reductions targets in the Clean Air Action Plan (CAAP)

Biological impacts are considered during project planning, construction, and operations, and appropriate mitigation measures are applied.

Also, it common that Stakeholders are given opportunities at POV to participate in port planning processes through port master planning workshops and project environmental review processes. Port representatives also attend monthly neighborhood council meetings to provide updates on port topics and answer questions from the community.

Strong transparency has been inserted into the environmental review

process for large capital development projects. Technical studies, findings of environmental impacts, mitigation measures, public comments, and port responses and rationale for policy decisions are all posted on POV's website.

As an analysis and based on the few indicators discussed above, it is obvious that POV exhibits a sophisticated maturity regarding many economic sustainability aspects (Financial Strength; Innovation, Technology, Investment & Incentives; and Collaboration) and environmental ones (Emissions, Waste, Biodiversity, and Environmental Issues related to the goods movement chain, such as public health impacts). For the social aspects, the maturity level is transitioning from satisfying to sophisticated or has achieved a sophisticated level, such as Community Engagement and Corporate Citizenship.

There is room for improvement related to POV's Processes, Sustainability Reporting, and the Motivation and Incentives that are given to employees to advance sustainability throughout the organization.

5.3.4 Summary of discussions on the strong sustainability initiatives from the Yokohama Port (POY)

Yokohama Port is Japan third busiest port. The POY started an incentive for the ship in consideration for environment in April 2017 which is yielding appreciating results. The Port also has many existing LNG recognizes its role in regional economy and community. (POY,2018)

Further promotion of environmental safety and Corporate Social Responsibility principles by the port becomes more efficient. In order to emphasize more on air quality measures and emissions reduction, the Port of Yokohama is also partnering in the ESI (Environmental Ship Index) program. At the POY, there are defined set targets for the reduction of energy consumption and CO2 emissions.

The Port works on the promotion of hydrogen energy utilization and application enlightenment to a citizen by displaying in-vehicle model H2One by an event. The transfer cranes found at the Port are equipped with a diesel engine and an electric storage device. The principle is to accumulate electricity and later roll it up and sometimes use the energy to wind it up, and to occur at the time of a fall of the container.

The POY has also created innovative policy structures and approaches to reduce emissions from port-related mobile sources that are beyond their direct control. Financial incentives are also offered to customers to reduce impacts from the operations include participation in the Environmental Ship Index (ESI) program

Also, at the Port there is a very clear energy efficiency – energy consumption reduction targets; A holistic approach to environmental and social issues has been taken throughout the organization.

Also, it is fair to mention that the POY also focuses on clean ocean, transportation efficiency air quality, water quality, gathering data on soil contamination, and some biological baseline information.

The Port works on promoting hydrogen energy utilization and application enlightenment to a citizen by displaying in-vehicle model H2One by an event.

On the biodiversity side, The Port of Yokohama works on upbringing of the eelgrass to improve the biotope of the creature of the waterside. The port makes the shade by eelgrass, and oxygen is supplied, and an effect such as a fry and spats gathering is expected by photosynthesis.

In all, we can ascertain that the POY has a good level of understanding and implementation of the concept of sustainability. This concept at the POY clearly integrates the `economic and environmental aspects, with all social aspects meeting or exceeding the industry standard. The port also has a good networking capacity within the country and with other sister ports around the world with good exchange of information and best practices.

5.4 Discussion of Research Question 4

Research Question 4: What challenges need to be overcome by SSA Ports to bridge the gap in improving their Sustainability Policies

From the data gathered throughout this research, it is clear that the PAD to some degree has taken steps within their organization towards enhancing sustainability culture within their organization. Efforts have been made by

opening a service in charge of managing environmental pollution and catering for port generated waste.

However, the service seems too small, ill equipped and with little financial resources to embrace the environmental and social challenges the port will be confronted to in the near future.

Also, some substantial investment has been made by acquiring reception facilities to collect various waste from visiting vessels. However, other ports featuring in this study have started investing in alternative power source from renewable energy

Provide vessel from clean sources for a fee which on the long run could prove to be economically beneficial. Also, the PAD did not exhibit specific innovative projects or investment in technology innovation or research and development. Most at times the PAD simply on the ISO certification as a gratifying reward proving the port's commitment to sustainability issues. It will be judicious for the PAD to invest more in small solution and in collaboration with local innovative enterprise or research institute to implement lees capital intensive project that could foster sustainability and cut down emission. Areas of collaboration could involve studies to decongest the Douala Port which has been a lingering issue for years faced by PAD. Solutions could pass through making procedure paperless and more online, fixing policies on trucks, their age and the fuel used when circulating at ports. Finally, this could as well mean developing an

innovative efficient and multi-modal transportation system that will decongest the port and therefore cut down PAD emissions. A mix of such solution were developed in many of the port featured in this study.

The PAD does not also report on sustainability. There is no magazine, corporate documentation or webpage from the PAD website, which gives details on efforts carried by the port to make its operations more sustainable. Here again, much more could be accomplish provided efforts are effectively done by PAD on the field. The port has a monthly magazine already and a webpage. There is no doubt that the lack of communication on those is directly related to the lack of content to report about.

Also, all ports involved in this study except for Douala Port have implement the ESI index pricing policy to attract more vessels in their vicinity as well as cutting down emissions. Similar initiative we believe could be easily implemented at PAD provided there is a strong drive for that from the Management board. The technology involved is simple and less capital incentive. However, this will go along with a strong commitment to educate shippers to get accustom with the new trend.

On the energy efficiency front, the European ports, The Vancouver Port and Japanese Port excelled by building several infrastructures such as shore power, cold ironing, LED lighting, LNG infrastructure etc to maximize on the energy usage at their various port organization. In so doing many alternatives

were given to vessels calling at those ports to switch their plug into the port provided energy rather than using their auxiliary engines. It is obvious that big project on carbon foot reduction, Cold ironing, developing alternative source of energy generation, and much more are far beyond the reach of a small port like PAD. However, efforts could be made on areas above listed.

Also, among the port organizations studied, it was obvious that most ports viewed the concept of sustainability as a balance between environmental and economic concerns . All the ports except the Douala Port had established Environmental Plans and had a clear vision towards achieving sustainability with clear cut goals in the short, medium and long term, everything being guided by a Vision.

Most ports except PAD, had genuine policies and activities set to monitor air and water and ground emissions with emissions percentages annually reported in corporate sustainability reports of their organizations. Those ports conduct annual emissions inventory to determine the source, composition, and level of air pollutants, to track air quality improvement initiatives and GHG emission reductions, and health risks to stakeholders and port users. Because of the initial high investment required to implement these measures, it will be wise for PAD to at least keep these actions as a long-term project on their agenda.

Concerning Biodiversity management, Most Ports but PAD also laid down policies to protect marine species and protect their natural habitat

specifically by abiding to conventions measures from the IMO and conducive policies. PAD despite being a river port, and constantly having to dredge their approach channel, has done little to lay down protective policies on biodiversity management.

Various port emissions strategies and policy initiatives were adopted by most port to address Climate change. It should be emphasized that the two European ports had clear ambitions with respect to this goal with set target and a timeline to achieve them. This vision was usually backed by massive investment in specific programs conducted at their ports. The PAD can as well consider this objective as a long-term project on their agenda.

Learning from the experience of European ports, through the ESPO, it will be interesting for Sub-Saharan ports, especially those from the PMAWCA Sub-region, to develop a strong port regional organization with some of the following mission.

- That PMAWCA should provide a set of legislation on issues pertaining to port sustainability and ensure their harmonization within the member ports
- The organization should also set environmental goals to be met by member ports and it ensure the attainment of such goals through monitoring and control;

- Experts should be sent to member ports for regular trainings on issues of concerns through seminars and conferences;
- Regional projects should be funded in order to foster the collaboration among ports on environmental issues but also to facilitate the collaboration among ports organizations;
- Member ports should build port Infrastructure, even if they can build different infrastructure to diversify their services and avoid unnecessary competition;
- Member ports should be encouraged to join the ECO-Port Certification Network for a first time and set their own certification system in the long run.

5.5 Interim Conclusion

In summary, we can discuss that the PAD strategy on sustainability mainly revolves around adopting measures that are aimed mainly towards sustainable waste management, oily sludge, oil spills and ballast water management. It is also evident that port authorities so far have adopted different combinations of measures at different time periods based on available means and their environmental priorities. The PAD is expected to gradually embrace new policies and investment in the near future to remain competitive but also sustainable which will undoubtedly increase its attractivity. A strong collaboration with

regional port organization like PWAMCA but also international Port organizations such as the IAPH will be beneficial in fostering sustainability within PAD.

Figure 5.2 Gives a summary of the sustainability outcome of the different ports. As can be seen from the table 5.1, the Port of Rotterdam, with regards to all the initiatives adopted to foster sustainability practices within their organization is considered the most sustainable. The Ports of Antwerp, Vancouver and Yokohama are equally having a relatively good level of sustainability policies going om within their ports. The Port of Douala in the other hand is the least sustainable port as can be seen from the table, 10 sustainability indicators could not fetch any data from the Port of Douala. The port needs to undergo series of reforms in that perspective.

Port	Views of Sustainability	Sustainable Indicators Observation
Rotterdam	***Sophisticated***	All indicators data Available implemented trough various policies initiatives
Antwerp	Very Satisfying	All Indiocators data available but withnot as diversified program as in the PoR
Vancouver	Very Satisfying	All Indiocators data available but withnot as diversified program as in the PoR
Yokohama	Very Satisfying	All Indiocators data available but withnot as diversified program as in the PoR
Douala	Elementary Understanding Level	**Lacking Sustainable Indicators:** Innovation and Technology, Sustainability Reporting, Environmental Management System, Energy Efficiency and Conservation, Biodiversity Management , Green Incentives , Climate change adaptation policies, Sustainability Website, R &D Unit , Environmental Certification

Figure 5.2 Summary of the sustainability outcome of the different port

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

Following the growing and certain interest within the shipping industry of port sustainability, this research mainly assessed the current sustainability initiatives taken by 5 ports selected for the study. The ports chosen for the study were sparsely represented around different geographical areas. These were namely The Port of Rotterdam, the Port of Antwerp, the Port of Metro Vancouver, the Port of Yokohama, the Port of Douala.

The sustainability assessment was made based on a 25 TBL sustainability indicators derived by the researcher. The TBL indicators mainly investigated the main strategies and practices used by the different ports in addressing sustainability issues within their organization. Factors influencing the implementation of such strategies was as well discussed. Some of the key indicators investigated included the Innovation and technology , reporting, collaboration, workforce development, motivation and incentives, the availability of Environmental or ISO Certifications and Port Environmental Review System (PERS), the implementation of an Environmental Management System, the monitoring of air, water and ground emissions, the management of hazardous waste efforts deployed in energy efficiency and conservation, the implementation

of Climate change mitigation policies, the development of green infrastructure, and much more.

6.1 Research Findings

Port sustainability emerged in the recent scholastic debate when it became obvious that port operations do play a significant role in contributing to significant number of emissions which could have advert environmental and social effects on their surroundings. However, ports are different in size, capacity, financial might and adapted to each country's working culture.

The results of the research show that most ports have adopted different strategies and practices to address sustainability even though at varying degrees. The most sustainable ports were the Rotterdam and Antwerp Ports based on the number of implemented activities covering the quasi totality of all indicators involved in the study. Those ports were taking active initiatives and implementing various programs to mitigate their social and environmental impact. In so doing, they place sustainability practices as a core element of their management strategy, which is mainly based on a TBL approach.

It should be noted that the above-mentioned ports have permanent offices with the dedicated to addressing environmental and social impact emanating from port operations. These offices are all made of specialized personnel with a good understanding of port operations and practices and with the requisite knowledge

to mitigate port environmental practices. They seat on the board of directors and their opinion is key and embedded in the general management strategy of the port.

It is also worth noting that most policies adopted in these two European ports were often as part of an individual initiatives from the port authorities themselves but sometimes also as a result of regional initiatives directed by the ESPO through its specialized branch the Eco-ports with the main purpose of organizing port at the regional level to address questions of sustainability. Some of the tools used for that are a system of certification such as the PERS and SDM and other tools such as the ISO certification that these two ports had and constantly update.

Also, the challenges arising from port emissions are well aware and taken care of by well trained personnel and following predetermined set standards. Also, 80% of port have a GRI compliant reporting system with a website where they communicate on efforts to tackle sustainability challenges. Most ports also do Publish a yearly footprint report about their CO2 emissions. Furthermore, most ports have some sort of Environmental Certifications such as PERS and ISO 14001 and also do implement an Environmental Management System.

Substantial investment was made by most ports in acquiring green infrastructure such as onshore power supply devices or LNG infrastructures. Additional appealing policies or incentives such as the Environmental Ship Index,

corporate citizenship was made available to 2 ports. However, the research also showed that while sustainability is regarded as very important for port managers, it is not fully embedded into the management process and considered during key decision making process, like the case with Rotterdam, Antwerp and Metro Vancouver, It is not the case with other ports in the study.

The study also laid emphasis on the challenges and difficulties of ports across in efficiently adopting and implementing successful sustainability policies. The study also exhibited a set of strategies that influence factors in ports to adopt sustainability practices in future.

Another key point to mention is the exiting collaboration between ports and between ports and international and regional port organizations.
A strong dynamic was observed among European ports and their regional organization, ESPO which represents the interest of port authorities from European ports. Eco ports, the main environmental initiative of ESPO, has raised awareness since 2011 on environmental protection through cooperation and sharing of knowledge between European ports and has therefore helped in improving environmental management within European ports organizations. Among the different regional organization discussed, Eco port was the most structured and committed organization in raising environmental standards within port organizations of its geographical area.

Finally, there are a number of factors which were highlighted as impediments in implementing sustainability initiatives within ports. A few that could be mentioned here include the lack of financial resources to invest in green infrastructure at ports, the lack of trained personnel to design, operate and monitor sustainability policies at ports. Sometimes too customers do not always find interest in subscribing to sustainability initiatives which are often slightly costly as a result of the investment made by ports to install the required infrastructure.

6.2. Limitations of Research

Just as it is the case for many research, this one is not without limitations encountered. One of the limitations of the study was the small number of ports involved in the study specially the only one port from Sub-Sahara Africa.
Some limitations that can quickly be mentioned as follow;

- The first limitation was the lack of financial resources that did not allowed the researcher to do site visit to gather primary data for all the Ports. In such instance, like in the case of Douala Port, the researcher relied mainly on research assistants to provide him with the sought data and information gathered via the submitted semi-structure questionnaires. In the case of Rotterdam and Antwerp Port, the researcher mainly relied on secondary data from corporate organizations website, open-source data like the one

from the IAPH and related articles. It was obviously a challenge comparing sustainability culture and attitude from different countries with different working cultures, and between different port organizations. It was obviously a tremendous task which required a lot of flexibility in making policy decision.

Finally, recommendations were made for future research areas in this topic and conclusions were finally made

6.3. Recommendations for Future Research

Based on the thesis findings, the researcher experience and the of the review of literature, the following recommendations could be made for future research topics in this field:

- More studies should be done on the field of port sustainability specifically with African ports to have different experience and available empirical data. Such studies with bigger sample size of ports involved will provide a more generalized set of data and further informed the literature in this field specifically for African ports. Similar comparison could as well be done with other ports from not only African port but as well with other developed countries to have as many diversified information.

- Also, it could be interesting to investigate means by which ports could improve upon their sustainability performance by focusing on development of a relationship between ports organizations and the private sector/ research Institutes and specialized stakeholders as a key and strategic partnership
- Also, the empirical research regarding the objectives and goals of this research should be developed in order to test for its validity, which can be later used in other developing countries' port.
- More future studies could focus on the implementation of sustainability by developing an original approach going from a regional perspective looking at the very limited number of resources most ports from Africa often do have. It will be interesting to see how ports from the same geographical atmosphere could come together and combine their resources to tackle sustainability issues. Especially when it comes to building green infrastructure, some ports from the same region may decide to focus on different green infrastructure which will eventually give assess to all available green infrastructure to vessels heading to a specific sub-region. This will still make those Ports attractive and eventually at a lower cost from individual ports.

6.4 Conclusions

This dissertation sought to address four research questions and fulfill two research objectives as aforementioned in chapter 1. The theory review of port sustainability and the means for its evaluation has shown how varied and complex it could be with different models, strategies and approaches and factors influencing its implementation. Till date, scholars still argue about what forms of approach and sustainability evaluation should be ideal for specific organizations, especially those like the ports.

However, from different standpoints and various approaches, each researcher gives informed opinions in favor of his viewpoint regarding the above issues discussed during the course of this thesis.

The findings from the field through the semi-structure interviews revealed that the culture of Sustainability within Port organizations is a long process, capital intensive but most especially requires a lot commitment from management of such organization not only to initiate them, but also to ensure they are sustained in times for overall benefits.

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Appendix1:

Questionnaire:

Port Authority and Terminal Operator questions and interview By FOKOUA TEWA ERIC

FOKOUA TEWA ERIC YOKOHAMA National University Port Authority sustainability s questionnaire. Port Sustainability Case study-

Port of …….

Part 1: Demographic information

1. Gender: Male ( ) Female ( )
2. Types of Port: () Container port () Multi-purpose port
3. Position: () Top manager () Middle manager () Operation manager () Administrator
4. Responsibility () port management () Sustainable development () Others
5. Education: ( ) B.sc ( ) M.sc/MBA ( ) PhD ( ) Others

Part 2- Approach to Sustainability

6. Do you make use of Indicators to evaluate sustainability Performance within your Port?
7. If yes, how did you choose the indicators used to measures environmental, social and Economic performances within your organization?
8. In total how many indicators did you chose and what method did you use in selecting the indicators used within the Port Organization?

9. Who is in charge of meeting the sustainability target set by the Port and who do they report to? what level are they at in the organization?

10. What issues are important to Port Organization? Economic prosperity, community involvement, air quality, water quality, soil quality, effects on marine life, historic resources, others? Clearance delays ( ) Captivity issues ( ) Increased freight rate ( ) Inappropriate international mandate ( ).

11. What do you consider to be the major challenges related to environmental and social impacts resulting from Port Operations?
12. How do you balance achieving growth in Port operations with managing environmental and social impacts? Think about breakwaters ( ) Reduce current ( ) Quay lying ( ) Knowing the Direction ( )

13. How do you define Sustainability? Does it apply to environmental, economic, and social impacts? Or just environmental? Do you consider yourself a sustainable port?

    Yes ( ) No ( ) Not sure ( ) Undecided ( )

14. What environmental and social impacts result from your Port operations?

water quality ( ) Health of marine life ( ) degradation of habitat ( )
Harm invasive species ( )

15. What motivates your organization in addressing this issue? What are the drivers for your approach?

    Port cost ( ) Hinterland proximity ( ) Operational efficiency ( ) Port service quality ( )

16. How important is reducing environmental impacts relatives to other strategic priorities. How important is sustainability in your organization? How does it impact your decision-making Process?

Help reduce air ( ) Manage pollutants ( ) Decrease gas emissions ( ) Greenhouse control ( )

17. Please give examples of achievements, success stories, and best practices in sustainability at your port?

Facilitates smooth export ( ) Facilitate smooth imports ( ) Nerve of foreign trade ( ) Supply services (

18. Is your Port having any sustainability Certification? If so, which one do you often renew it ?

19.Have you documented any cost saving or avoided cost due to sustainability efforts like energy efficiency, water efficiency, recycling, waste reduction or cleaner fuel projects?

20. How do you share this information with environmental regulators? How do you share it with the public?

21. Is there a person in your organization that is responsible for managing , communicating and educating the employees about the environmental and social impacts from Port operations?

22.Have you created an annual sustainability report? Do you create environmental reports? How often do you report? Do you communicate on your website about the sustainability issues at Port?

23.What metrics do you use to measure success related to environmental performance and sustainability? Are they things that are important to your success that you do not have metrics for yet?

24. Regarding specific targets from the Ministry in charged, what is your progress related to: - Overall energy consumption of total cargo handling - Energy efficiency - Emission reduction technology - Overall particulate mitigation - Reducing pollutant discharges - Treating Port Wastewater –

25. How do you measure and address vessel's emissions? And do you have an incentive Policy like the Ship Index to promote sustainability at your Port?

26. How do you design transportation infrastructure to avoid environmental impact?

27. How do you manage hazardous Wastewater at Port?

28. Who participates in port planning decisions? what role do non-Government organizations play in your decision-making process related to environmental or social issues? Do you consult with them about how your policies may impact them?

29. Do you have a department for environmental management? Communications? Technology, and what are the responsibilities of each department?

30.What form of collaboration does your Port entertain with sister Ports and Regional Ports in addressing sustainability issues?

31. Do you share our approaches with other ports? Are the opportunities for other ports to share information and discuss common challenges? Do you participate and how? What is the motivation for your collaboration?

32. Do you pay attention to what other ports are doing related to environmental performance and sustainability? If so, please give examples.

33. What Policies has the Port implemented to address climate change issues? and what green Infrastructure has the Port acquired to mitigate emissions at Ports

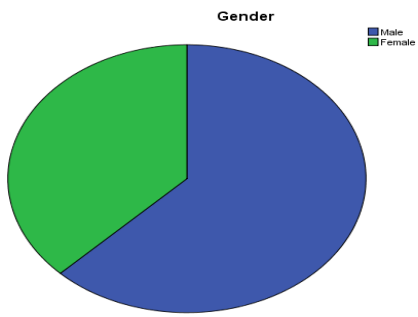
34. Does the Port implement a Port Environmental Review system?

35. Does the Port has a R^D Unit dedicated to Sustainability issues?

APPENDIX 2

Analysis of the demography of respondents

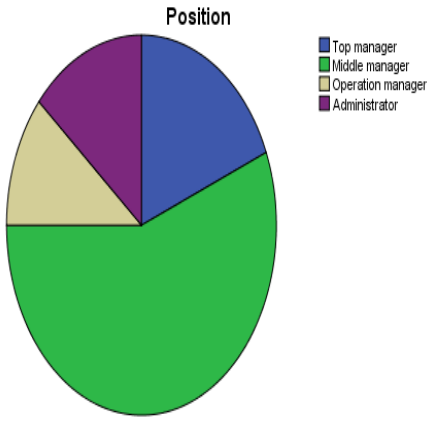
Fig.app.1 Gender of Respondents



Source: Field Survey, 2021.

The distribution of the respondents according to their gender is presented above. This result shows that 50 which represent 62.5% of the respondents are males while 30 which represent 37.5% are females. This implies that majority of the respondents were male who shared their views on the development and implementation of sustainability policies in their Port organizations.

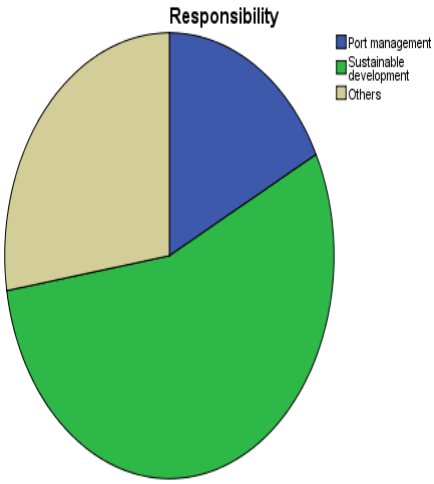
Fig.app.2 Position of Respondents



Source: Field Survey, 2021.

The distribution of the respondents according to their positions. This result shows that 15 which represent 18.8% of the respondents are top management, 45 which represent 56.3% of the respondents are middle management, 9 which represent 11.3% of the respondents are operation manager, while 11 which represent 13.8% are administrator. This implies that majority of the respondents are middle management personnel.

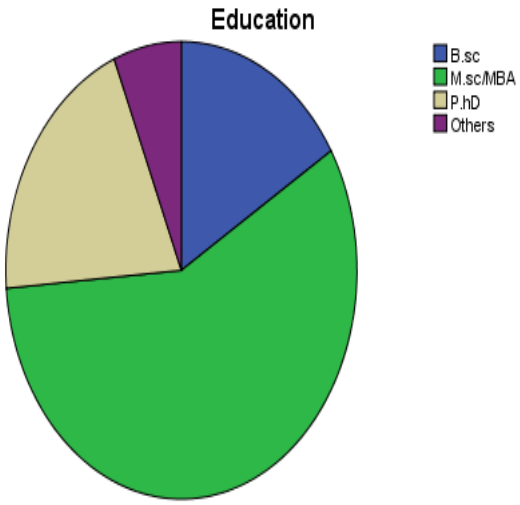
Fig.app.3 Responsibility of Respondents



Source: Field Survey, 2021.

The distribution of the respondents according to their responsibility. This result shows that 14 which represent 17.5% of the respondents are working as port managers, 44 which represent 55.0% of the respondents are sustainable development that is those in charge of designing and sustainability policies and Environmental Management plans to be implemented in the Port organization, , while 22 which represent 27.5% represent others and this involve operational field officers.

Fig.app.4 Education Level of Respondents



Source: Field Survey, 2021.

The distribution of the respondents according to their education. This result shows that 13 which represent 16.3% of the respondents are B.sc holders, 46 which represent 57.5% of the respondents are M.sc/MBA, 16 which represent 20.0% of the respondents are P.hD while 5 which represent 6.3% are others. This implies that majority of the respondents are holders of M.sc/MBA.

7.2. Analyses of main Research Variables across Ports

Tab.App.1 What issues are important to Port Organization?

		Frequency	Percent	Cumulative Percent
Valid	Clearance delays	43	53.8	53.8
	Captivity issues	22	27.5	81.3
	Increased freight rate	8	10.0	91.3
	Environmental and social impact emanating from Port development and operations	7	8.8	100.0
	Total	80	100.0	

Source: Field Survey, 2021.

Table 5.1: shows the distribution of the respondents according to their responses. The result shows that 43 which represent 53.8% of the respondents chose clearance delays, 22 which represent 27.5% of the respondents are captivity issues, 8 which represent 10.0% of the respondents are increased freight rate while 7 which represent 8.8% chose Environmental and social impact emanating from Port development and operations. This implies that majority of the respondents' beliefs that clearance delays are big issues to port organization. However, it is important to notice that most Port respondents now consider Environmental concerns among the top priorities issues to be address by Port Management.

Tab.App.2 What do you consider to be the major challenges related to environmental and social impacts resulting from Port Operations?

		Frequency	Percent	Cumulative Percent
Valid	Climate change at Port	45	56.3	56.3
	Carbon footprint	14	17.5	73.8
	Air emission	13	16.3	90.0
	Wastewater	8	10.0	100.0
	Total	80	100.0	

Source: Field Survey, 2021.

Table 5.2 shows the distribution of the respondents according to their responses. The result shows that 45 which represent 56.3% of the respondents chose climate change at Port, 14 which represent 17.5% of the respondents are Carbon footprint 13 which represent 16.3% of the respondents are Air emissions while 8 which represent 10.0% are more concern on Wastewater. This implies that majority of the respondents' say delay of imports/exports processes are the major challenges related to environmental and social impact of port organization.

Tab.App.3 How do you balance achieving growth in Port operations with managing environmental and social impacts.

		Frequency	Percent	Cumulative Percent
Valid	Strategic Policy Initiatives	13	16.3	16.3
	Involvement of all stakeholders and NGO	39	48.8	65.0
	Business decision and sustainability	13	16.3	81.3
	Communication and training	15	18.8	100.0
	Total	80	100.0	

Source: Field Survey, 2021.

Table 5.3 shows the distribution of the respondents according to their responses. The result shows that 13 which represent 16.3% of the respondents are Strategic Policy Initiatives, 39 which represent 48.8% of the respondents are Involvement of all stakeholders and NGO the 13 which represent 16.3% of the respondents are Business decision and sustainability while 15 which represent 18.8% chose knowing the direction. This implies that majority of the respondents' say that reduce current can aid the balance in achieving the growths of ports operations.

Tab. App.4 What environmental and social impacts result from your Port operations?

		Frequency	Percent	Cumulative Percent
Valid	Water quality	25	31.3	31.3
	Health of marine life	40	50.0	81.3
	degradation of habitat	9	11.3	92.5
	Harm invasive species	6	7.5	100.0
	Total	80	100.0	

Source: Field Survey, 2021.

Table 5.5 shows the distribution of the respondents according to their responses. The result shows that 25 which represent 31.3% of the respondents are water quality, 40 which represent 50.0% of the respondents are health of marine life, 9 which represent 11.3% of the respondents are degradation of habitat while 6 which represent 7.5% are harm invasive species. This implies that majority of the respondents' say that health of marine life has environmental and social impact on their port operations.

Tab. App. 5 What are you doing to address these issues?

		Frequency	Percent	Cumulative Percent
Valid	Efficient energy usage	8	10.0	10.0
	Install renewable alternative energy source	21	26.3	36.3
	Climate change mitigation policies	9	11.3	47.5
	Efficient goods Shipping	42	52.5	100.0
	Total	80	100.0	

Source: Field Survey, 2021.

Table 5.6 shows the distribution of the respondents according to their responses. The result shows that 8 which represent 10.0% of the respondents say efficient energy usage, 21 which represent 26.3% of the respondents are install renewable, 9 which represent 11.3% of the respondents are near source while 42 which represent 52.5% represent efficient goods shipping. This implies that majority of the respondents' say that efficient goods shipping can address the ports issues.

Tab. App. 6 What motivates your organization in addressing this issue?

		Frequency	Percent	Cumulative Percent
Valid	Port reputation and leadership on tackling environmental issues	10	12.5	12.5
	Improving social impacts	18	22.5	35.0
	Operational efficiency	48	60.0	95.0
	Port service quality	4	5.0	100.0
	Total	80	100.0	

Source: Field Survey, 2021.

Table 5.7 shows the distribution of the respondents according to their responses. The result shows that 10 which represent 12.5% of the respondents say port reputation and leadership, 18 which represent 22.5% of the respondents are on improving social impacts issues proximity, 48 which represent 60.0% of the respondents are operational efficiency while 4 which represent 5.0% represent port service quality. This implies that majority of the respondents' say that operational efficiency motivates their organization in addressing the issues.

Tab. App.7 How important is reducing environmental impacts relatives to other strategic priorities. How important is sustainability in your organization?

		Frequency	Percent	Cumulative Percent
Valid	Help reduce air	10	12.5	12.5
	Manage pollutants	11	13.8	26.3
	Decrease gas emissions	44	55.0	81.3
	Greenhouse control	15	18.8	100.0
	Total	80	100.0	

Source: Field Survey, 2021.

Table 5.8 shows the distribution of the respondents according to their responses. The result shows that 10 which represent 12.5% of the respondents say help reduce air, 11 which represent 13.8% of the respondents manage pollutants, 44 which represent 55.0% of the respondents are decrease gas emissions while 15 which represent 18.8% represent greenhouse control. This implies that majority of the respondents' say that sustainability is important in their organization.

Tab.App.8 Please give examples of achievements, success stories, and best practices in sustainability at your port?

		Frequency	Percent	Cumulative Percent
Valid	Involving local population in environmental decision-making process through the implementation of various projects	14	17.5	17.5
	Recycling used water and residual particles from vessels	20	25.0	42.5
	Sustainable management of waste at Ports	10	12.5	55.0
	Clean service supplied	36	45.0	100.0
	Total	80	100.0	

Source: Field Survey, 2021.

Table 5.9 shows the distribution of the respondents according to their responses. The result shows that 14 which represent 17.5% of the respondents say sustainability facilitate the involvement of local population into decision making process, 20 which represent 25.0% of the respondents say it facilitates smooth handling of oil residues, 10 which represent 12.5% of the respondents chose waste management at ports while 36 which represent 45.0% represent supply services. This implies that majority of the respondents' say that their supply services has improved as a result of sustainability in their organization.

Tab. App. 9 What do you feel are the main hurdles for developing environmental/sustainability initiatives and policies?

		Frequency	Percent	Cumulative Percent
Valid	Air pollution	13	16.3	16.3
	Water contamination	12	15.0	31.3
	Slow energy transition	45	56.3	87.5
	Insufficient share of energy	10	12.5	100.0
	Total	80	100.0	

Source: Field Survey, 2021.

Table 5.10 shows the distribution of the respondents according to their responses. The result shows that 13 which represent 16.3% of the respondents chose air pollution, 12 which represent 15.0% of the respondents say water contamination, 45 which represent 56.3% of the respondents chose slow energy transmission while 10 which represent 12.5% are insufficient share of energy.

This implies that majority of the respondents agree that slow energy transmission can serve as hurdles for developing environmental/sustainability initiatives and policies of the port operations.