
# SYSTEM-BASED BARRIERS FOR SEAPORTS IN CONTRIBUTING TO SUSTAINABLE DEVELOPMENT GOALS



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| Journal: | *Maritime Business Review* |
| Manuscript ID | MABR-02-2021-0007.R5 |
| Manuscript Type: | Research Paper |
| Keywords: | Sustainable Development Goals, Port Sustainability, Change Management, Port Management, Principal Component Analysis, Barriers |
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# SYSTEM BASED BARRIERS FOR SEAPORTS IN CONTRIBUTING TO SUSTAINABLE DEVELOPMENT GOALS


## ABSTRACT

Purpose – The main purpose of this paper is to identify the reasons for the stagnant behaviour of seaports contributing towards SDGs.

Design/methodology/approach – Global seaport sustainability practices that correspond with SDGs were identified through an extensive literature review. Five (5) focus interviews were carried out with port managers in Sri Lanka to identify the existing knowledge about seaport sustainability, and the reasons for disparities between the global standards and country-level port sustainability practices. Data collected from a questionnaire survey of 55 seaport terminal managers in Sri Lanka were analysed using Exploratory Factor Analysis (EFA) and Thematic Analysis.

Findings – Deficient collaborative policies, structural and managerial constraints, market constraints, and the absence of a well-established SDG-driven global port framework were identified significant barriers for seaports to contribute towards SDGs.

Social Implications – Identifying barriers in implementing sustainable practices in ports helps the responsible authorities tackle them. Hence, seaports in return and the wider society benefit from the spill over effects of port operations aligning to SDGs.

Originality/value – This paper provides port organizations insights on the barriers needing to be addressed in their operational and management systems to best incorporate practices aligning to SDGs in seaports.


Keywords –Port Management, Sustainable Development Goals, System Based Barriers, Port Sustainability, Change Management, Principal Component Analysis

## 1. Introduction

The term 'sustainable development' was first mentioned in an international agenda, a report titled "Our Common Future" by the Brundtland Commission, the World Commission on Environment and Development, formally institutionalized as a sub-organization of the United Nations. It was described as 'meeting the needs of the present generations without compromising the future generation's ability to meet their needs' (United Nations, 1987). Subsequently, several efforts were put forward to establish sustainability measures in different economic layers, and one of the significant steps is Agenda 21 and Millennium Development Goals (MDGs). This aggregation of endeavours of different organizations and countries emerged as the latest 2030 agenda for sustainable development in 2015 (The United Nations, 2015). 17 Sustainable Development Goals and 169 targets were introduced in the agenda by providing a broad interpretation to the word "sustainability". The 17 goals are indivisible and encompassing three dimensions of sustainability - environmental, social, and economic sustainability. All UN member states (193 members) pledged on common agenda for sustainability (United Nations, 2015). Several international efforts were made towards SDGs in terms of capacity building, knowledge management, agency level coordination, stakeholder engagement, and active communication within the society (Fleming *et al.*, 2017). The recent Intergovernmental Panel on Climate Change (IPCC) embarked on achieving net zero economy by 2050 and urged governments to facilitate industries to implement decarbonization strategies. OECD (2021) highlighted the role of governments and industrial policies and business organizations in designing and implementing strategies contributing to the SDGs. Similarly, the UN specified finance, technology, capacity building, trade, policy coherence, partnerships, data monitoring and accountability as the key means of SDG implementation (Stafford-Smith *et al.*, 2017). In fact, there are existing efforts for each of implementing strategies such as developing inter-organizational networks, organizing trainings, exchanging personnel, and developing communication tools (Kravchenko, 2012; Langenus and Dooms, 2018).

Seaports are in the best position to take a lead in contributing towards SDGs due to their wider role in the society and the significant contribution to the national and world economy being a critical node in the global supply chain. Seaports begun to incorporate different sustainability practices into their operations due to increased compliance requirements for directives issued by regulatory authorities (Lozano *et al.*, 2020). Ports have incorporated certain sustainability initiatives with the motivation of positioning their image as a sustainable port in intense inter-port competition (Monte and Moreira Campos da Cunha Amarante, 2017).

Sustainability efforts such as cold ironing, green port development programs, vessel speed reduction programs, and smart port initiatives are several such efforts (Lu *et al.*, 2016a). Yet there are only a few numbers of selected seaports perceived them aligning to SDGs. There is extant research on port sustainability defining it with different connotations. Adams *et al.*, (2009) and Sislian *et al.* (2016) defined port sustainability by aligning it with the general triple bottom line concept of sustainability. Lu et al., (2016a) presented a sustainability assessment criterion along with a set of sub criteria aligning to triple bottom line concepts. A paradigm change of sustainability from the triple bottom line of environmental, social, and economical aspects to SDGs calls for action for seaports to incorporate SDGs into their operations at the policy level.

Contribution towards SDGs in any field is not an easy task due to the complexity and diversity of the global agenda (Gusmão Caiado *et al.*, 2018). Specifically, in the seaport sector, this effort becomes further tedious due to its compound structure which makes it hard to implement any new tools in ports (Poulsen *et al.*, 2018). The main objective of this paper is to identify significant barriers to seaports' contribution towards SDGs. Failure to align ports' operations with SDGs can impact the business and the reputation of the port. The increasing pressure from shipping lines as they build their public image as sustainable entities make port sustainability a mandatory requirement for port management to duly consider. Moreover, sustainability in a port can be used as an advantageous strategic tool to attract investors and trading partners. Thus, the objectives relating to sustainability also should be a priority among other management objectives such as cost and risk reduction (Oh *et al.*, 2018). Hence, exploring barriers to the implementation of operational practices contributing to SDGs in seaports is paramount as that is the only way to eliminate the barriers to encourage seaports to contribute to SDGs.

## 2. Literature Review

Sustainability has been scrutinized in the maritime industry by dividing it into three categories as shipping, maritime logistics, and ports (Shin *et al.*, 2018). In the shipping industry, the concept of green shipping is one of the emerging trends where the key focus is on ship emission. Shipping companies seek ways to minimize their fuel and operational cost, and thereby the external costs by optimizing their transport networks and shipping routes (Lun *et al.*, 2013). Similarly in the maritime logistics sector, implementing clean trucking programs in Long Beach and Los Angeles ports in the United States and establishing rail connections to transport containers at the port of Rotterdam demonstrate genuine efforts to create a sustainable modal

shift in the hinterland connections (Lam and Notteboom, 2014). The launching of the World Port Sustainability Program (WPSP) intended to enhance sustainable efforts of ports globally by demonstrating sustainability initiatives of leading seaports targeting the 2030 Agenda for Sustainable Development (The International Association of Ports and Harbours, 2018).

Environmental sustainability in a port is about providing necessary facilities to mitigate negative effects of port operations such as noise and air pollution from port operations, water pollution from shipping, and marine biological environment damage due to dredging (Adams *et al.*, 2009). Port environmental indicators commonly include in areas such as ballast water discharge, sediment quality, water purification, dredging, energy consumption, erosion, emission of greenhouse gases, biodiversity loss, and habitat destruction. Further, key environmental indicators as waste, water consumption, noise, air quality, carbon footprint, and marine ecosystems are also important (Schipper *et al.*, 2017). Green ports are also in the spotlight of attention in research at present specifically concerning the environmental sustainability of ports. According to Zis (2019), a port that has taken a substantial amount of effort to reduce negative environmental externalities such as emission and energy consumption and invested in new technologies to upgrade the environmental performance is on the path to becoming a green port. Green Port Programme (GPP) in Port of Singapore, Vessel Speed Reduction (VSR) in Port of Long Beach, USA, and electrification of automated guided vehicles in Port of Hamburg are examples of such greening efforts initiated by seaport organizations in the recent past (Acciaro, 2015; Hossain *et al.*, 2019). The debate on climate change led seaport management in US ports to create port sustainability programmes in collaboration with wide range of stakeholders (Becker and Caldwell, 2015).

Social sustainability has been pointed out as the port's contribution to the direct and indirect employment, relationships maintained with the community, and the liveability condition of the surrounding area. Further, it has been divided into four categories as social capital, human capital, fairness, and health. Under them, details such as employment, training, gender equality, occupational health, and safety, and labor structure have been the focus (Laxe *et al.*, 2016).

The efficient use of port facilities, the profitability of investments, and the provision of facilities to upgrade the port's performance are indicators of the economic aspects of port sustainability. In addition, port cargo growth, tourism induced by cruise passengers, and port operational efficiency are also indicators of an economically sustainable port (Schipper *et al.*, 2017). Customers seek efficient and cost-effective port services. Those expectations cannot be

met without scrutinizing the economic sustainability of a port (Lam, J. and Van De Voorde, 2012). Port sustainability management systems are used for this purpose scrutinizing overall sustianability performance of ports even though deploying such systems is a costly endeavour (Kuznetsov *et al.*, 2015).

Social sustainability of ports had been given the least priority in the past literature (Shiau and Chuang, 2015). Only a few studies focused on the application of SDGs in seaports and the contribution of seaports towards SDGs. 24 SDGs targets were selected with a moderate to high appropriateness for seaports and aligned to Goals[1] 4,6,7,8,9,11,12,13,14 and 17 of the SDGs (Schipper, 2019). SDGs 3,7,9,11,12,13 and 14 were identified as the "core" goals, SDGs 5,6, 8, and 17 were categorized as "secondary" goals and the rest were in the category of "case-specific" (Sprott, 2017). Beleya *et al.* (2020) highlighted technology, financing, human capital, and suppliers are predominant challenges in attaining sustainable development goals. Under those broader categories, the lack of talent and expertise, poor financial assistance from the government, and bargaining power of suppliers were found significant. Concerning specific sustainable practices at seaports, Radwan *et al.* (2019) pointed out operational barriers such as frequency and voltage variations hinder ports' ability to green power generation and consumption at ports. Importance of regulation, policy and managerial key performance indicators when developing environmental and energy efficient ports are necessary and the absence of them limits the port sustainability (Di Vaio *et al.*, 2021). Stafford-Smith *et al.* (2017) found that the challenges concerning the key means of SDGs implementation such as discrimination among stakeholders about their roles and responsibilities, silo mentality and disconnection among regulators, public institutions, and international bodies hindered the development of an integrated sustainable development plan. Further, financial difficulty, rigidity in the existing system, poor collaborations, and ineffective monitoring process were identified as common barriers to any new development and activity implementation in seaports (Bergqvist and Monios, 2019; Schipper, 2019). In addition, the absence of a set guideline for business organizations in terms of SDGs is a major practical barrier (Moratis and Melissen, 2019). Even in the wider maritime industry, conceptualizing SDGs is at a very basic level (Wang *et al.*, 2020). Equally, proper understanding of the depth and the context of the SDGs also plays a pivotal role in acting towards them (Sciberras and Silva, 2018). Contributing towards sustainability concepts such as "circular economy" has also been limited in seaports because of the institutional barriers inside port organizations. 71% of ports in ESPO have faced

[1] These goal numbers are directly related to the UN published Sustainable Development Goals.

difficulties during the adaption of environmental practices due to the hardships in change management (Puig *et al.*, 2015; Lozano *et al.*, 2020). The same has been true when initiating new concepts such as lean management in seaports as well (Port Strategy., 2014). Therefore, this paper fills the void in the existing port and maritime research by exploring barriers seaports face in contributing to Sustainable Development Goals.

## 3. Methodology

The paper used mixed-method research design. Figure 1 presents the stages of research methodology. Global sustainability practices were identified through an extensive literature review at the first stage and at the second stage, sustainability practices of ports were identified from semi-structured interviews with port managers in Sri Lanka, and the content analysis of secondary sources. The basis for the semi-structured interviews was to identify the disparity between global sustainability practices and country specific practices. The third step was to identify the barriers to seaports in contributing towards SDGs using a questionnaire developed based on the findings of stage one and two.

At the fourth stage, the responses of the questionnaire-based survey were analysed using the Principal Component Method (PCA) in Exploratory Factor Analysis and the thematic analysis.

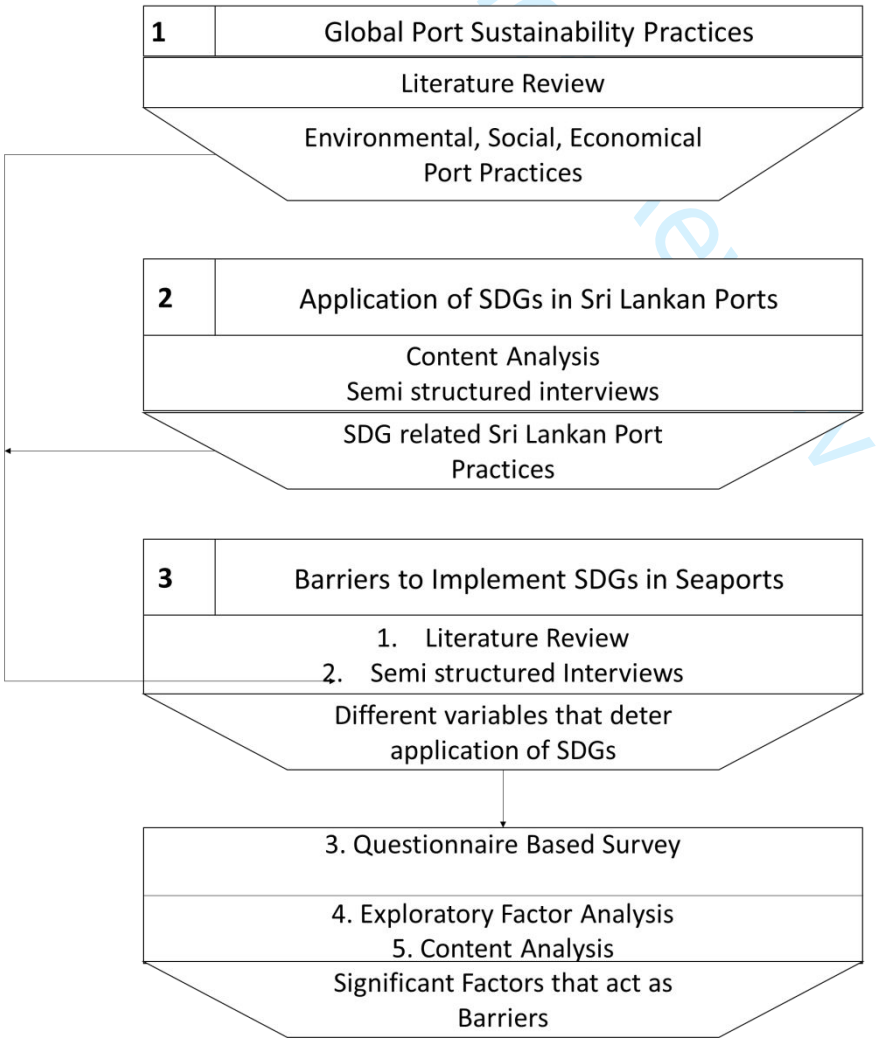

Figure 1: Research Methodology

Source: Authors' illustration

### *3.1 Sampling framework*

The population for the questionnaire survey included all the managers from seaport terminals in Sri Lanka. As the perception of port management in a particular port is detrimental to the success or the failure of that port's overall sustainability (Bjerkan and Seter, 2019), a sample of 60 port managers from 4 terminal operators (Port of Colombo and Hambantota International port) in Sri Lanka was selected for the questionnaire survey using non-random purposive sampling. The paper assumes that the port terminals and their management decision-making are more similar to any other terminal in a middle-income developing country as two terminals are jointly operated by global port operators whose operational, management and corporate models are similar. The minimum accepted sample size for Exploratory Factor Analysis is 50 under adverse circumstances (Costello and Osborne, 2005). Provided the fact that the individuals who are actively involved in sustainability-related port decision making are limited, only 55 responses were received out of 60 questionnaires that were sent out leaving a response rate of 91%. For semi-structured interviews at the second stage, five (5) strategic level port managers from the same port terminals were invited to take part and their view on port sustainability in Sri Lanka and the related barriers were obtained.

### *3.2 Data analysis method*

Analysis methods used included descriptive statistics, thematic analysis, and Exploratory Factor Analysis (EFA). Descriptive statistics were used to present the profile of respondents and their views on the gravity of the listed barriers in the questionnaire. While the thematic analysis was utilized to explore managers' understanding of port sustainability and other influential deterrents to port sustainability. The practical aspect of the EFA is to reduce the dimensions of the original space to a new set of reduced factors based on the underlying latent principal (Finch, 2013). Identified variables in the questionnaire were reduced to a few significant factors using the Principal Component Analysis (PCA) method with varimax rotation. SPSS statistics 25 software was employed in the analysis. In addition, the possible barriers that were not covered from the questionnaire were also explored with open-ended questions, and the results were derived from a thematic analysis. Common terms related to the

sustainability concept were predetermined and the frequencies of similar terms were derived from open-ended answers given by the port managers.

## 4. Data Analysis and Results

### *4.1. Descriptive statistics*

The respondents' profile was scrutinized through descriptive statistics. The respondents' representation is presented in Table 1.

Table 1: The distribution of respondents to the survey

| | From private terminals | From public terminals (Port Authority) |
|---|---|---|
| Total no of responses | 24 | 31 |
| Top management | 8 | 10 |
| Middle management | 16 | 21 |
| Experience over 10 years | 14 | 15 |

Private terminals in Sri Lanka port system are mainly operated by global operators whose ownership composition takes as port consortiums. One private terminal is run by South Asia Gateway Terminal, is a shareholding entity of a local conglomerate, with the ports authority, a global port operator and a global shipping investment company while Colombo International Container Terminal (CICT) is a joint venture company between a listed port holdings company with several terminals and the ports authority. Hambantota Port is run by the same company running CICT whose operation results in a port network portfolio spanning 36 ports in 18 countries and 5 continents (HIPG, 2022). Thus, the views of the port managers represent the operational characteristics and managerial knowhow and the sustainability status of each port terminals.

Table 2 exhibits the descriptive statistics for the Likert Scale rating of the 20 identified barriers. All barriers had a mean value above 2.5 while B16 had the highest standard deviation of 1.264. Barriers B1: Absence of a port sustainability framework, B7: Lack of progress in the technology adaption, and B6: Outdated regulatory and legal framework was rated as salient barriers by respondents averagely rating them on the "4" of the Likert scale. On the other hand, as an average, respondents disagree that B14: Limited managerial capacity in the ports acts as a barrier for seaports contributing to SDGs.

Table 2: Descriptive statistics of barriers to seaports in contributing to SDG*s*

| | Variable | Mean | Std. Deviation | Skewness | Kurtosis |
|---|---|---|---|---|---|
| B1 | Absence of a port sustainability framework | 4.12 | 1.07 | -1.26 | 1.21 |
| B2 | Absence of a directive central body | 3.94 | 1.12 | -1.12 | 0.87 |
| B3 | Lack of collaboration between the regulator and other public institutions | 3.71 | 0.94 | -0.40 | -0.63 |
| B4 | Unclear responsibility allocation among stakeholders | 3.43 | 1.08 | -0.06 | -0.89 |
| B5 | Absence of accountability tracing directives and tools | 3.41 | 1.08 | -0.90 | 0.39 |
| B6 | Outdated regulatory and legal framework | 4.04 | 0.72 | -0.39 | 0.07 |
| B7 | Lack of progress in the technology adaption | 4.06 | 0.81 | -0.58 | -0.06 |
| B8 | Power of unions | 3.78 | 0.99 | -0.46 | -0.73 |
| B9 | Insufficient capital | 3.27 | 0.94 | -0.32 | -0.70 |
| B10 | High regional competition | 3.16 | 0.90 | -0.32 | -0.09 |
| B11 | Deficient sustainability knowledge of management | 3.61 | 0.98 | -0.31 | -0.27 |
| B12 | Perspective about sustainability as a non-mandatory costly endeavour | 3.51 | 0.86 | -1.02 | 0.50 |
| B13 | Disconnected stakeholders | 3.92 | 0.94 | -0.30 | -0.98 |
| B14 | Existing limited managerial capacity in the port | 2.69 | 0.99 | -0.04 | -0.59 |
| B15 | Lack of flexibility to change existing business models | 3.43 | 1.24 | -0.63 | -0.40 |
| B16 | Poor learning culture inside port organizations | 3.37 | 1.26 | -0.70 | -0.55 |
| B17 | Inadequate alignment of commercial principles with data driven decisions | 3.55 | 1.03 | -0.25 | -1.05 |
| B18 | Weak collaborations with shipping lines and international bodies | 3.25 | 1.09 | -0.53 | -0.12 |
| B19 | Fragmented public policy framework regarding sustainability | 3.92 | 0.74 | -0.18 | -0.40 |
| B20 | Loosely enforced rules in the region | 3.82 | 0.56 | -0.80 | 1.90 |

### *4.2. Results of the Exploratory Factor Analysis*

Table 3 exhibits the rotated component matrix derived from the EFA. B7 variable was removed in the final factor extraction stage because of the low communality derived. None of the other variables had a communality value below 0.3 and act as significant barriers for seaports contributing to SDGs. Further, removing B7 increased the total variance explained by the factor construct to 74%.

Table 3: Rotated Component Matrix from EFA

| Barriers for seaports in contributing to SDGs | Component 1 | Component 2 | Component 3 | Component 4 |
|---|---|---|---|---|
| Weak collaborations with shipping lines and international bodies | 0.877 | | | |
| Lack of flexibility to change existing business models | 0.807 | | | |
| Fragmented public policy framework regarding sustainability | 0.783 | | | |
| Poor learning culture inside port organizations | 0.778 | | | |
| Absence of accountability tracing directives and tools | 0.765 | | | |
| Outdated regulatory and legal framework | | 0.880 | | |
| Power of unions | | 0.785 | | |
| Disconnected stakeholders | | 0.775 | | |
| Perspective about sustainability as a non-mandatory costly endeavour | | 0.731 | | |
| Unclear responsibility allocation among stakeholders | | 0.605 | | |
| Deficient sustainability knowledge of management | | 0.552 | | |
| Insufficient capital | | | 0.799 | |
| Existing limited managerial capacity in the port | | | 0.746 | |
| High regional competition | | | 0.737 | |
| Inadequate alignment of commercial principles with data-driven decisions | | | 0.570 | |
| Absence of a directive central body | | | | 0.915 |
| Lack of collaboration between the regulator and other public institutions | | | | 0.710 |
| Absence of a port sustainability framework | | | | 0.684 |
| Loosely enforced rules in the region | | | | 0.606 |

Factor 1 with 5 variables accounted for 24% of the total variance and mainly indicated deficient collaborative policies in the main. The highest loading variable of the factor was deficient collaborations with shipping lines and international organizations. Factor 2 with 6 variables and 21% of the total variance indicated the structural and management constraints of the port. The outdated regulatory and legal framework of the port had the highest factor loading. Variables in Factor 3 associated with the market constraints of the port recorded 15% of the total variance. The variable with the highest factor loading was the insufficient financial capital of the port. The last factor with 4 variables indicating the absence of a globally established framework regarding SDGs for seaports had 14% of the total variance and the absence of a central body had the highest factor loading. Cronbach's alpha testing the internal consistency

of variables in a specific factor recorded values above 0.7. Thus, all extracted factors are reliable (Costello and Osborne, 2005). Table 4 displays the output of Cronbach's alpha test.

Table 4: Reliability Test Results of the Factors

| Factor | Cronbach's Alpha | Cronbach's Alpha Based on Standard Items | No of Items |
|---|---|---|---|
| Deficient collaborative policies | 0.885 | 0.887 | 5 |
| Structural and managerial constraint | 0.826 | 0.838 | 6 |
| Market constraint | 0.801 | 0.801 | 4 |
| Absence of an established framework | 0.742 | 0.748 | 4 |

Table 5: KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | 0.590 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 987.643 |
| | df | 171 |
| | Sig. | .000 |

The total variance explained by the extracted factors was 74% which is at an acceptable level which is well above the minimum adequate requirement of 50% for it to be qualified as a reasonable factor extraction (Streiner, 1994). Table 5 displays the KMO value which is 0.59 and the sample is adequate to conduct a factor analysis (de Winter *et al.*, 2009).

### *4.3. Thematic Analysis of the Open-Ended Questions*

The knowledge and understanding of port managers about port sustainability were examined and the results of the thematic analysis of answers given to the open-ended questions are summarized in Table 6. The results indicated that port managers' view on port sustainability is more biased towards the economic and environmental aspects while less focus has been given to the social aspect. Overall results indicated an over-emphasis on the concepts such as efficient use of port resources, excellent customer service, continuous improvement, and taking proactive actions to capture additional demand. Thus, the highest frequencies in responses were recorded under commercial and economic themes.

Table 6: Thematic Analysis Results

| Respondent | View on Port Sustainability | Additional Barriers |
|---|---|---|
| Respondent 1 | "Eco-Systems", "Service", "Port Users", | "Attitude", "Regional Influences" |
| Respondent 2 | "Port Resources", "Efficiency", "Commercial Principals" | "Archaic Legislation", "Fear of change", "Attitude" |

| | | |
|---|---|---|
| Respondent 3 | "Continuous Improvements" "Public Interests" | "Attitude", "Fear Change" "Government Intervention" |
| Respondent 4 | "Customer Service" "Fair trade", "Environmental stewardship" | "Political Influences", "Attitude" "Culture" |
| Respondent 5 | "Management", "Environmental", "Social", "Economical", "Proactive" | "Political Influences", "Attitude" |
| Total (*f*) | "Environmental" - 3<br>"Social" - 2<br>"Economical" - 4<br>"Commercial" - 3 | "Attitude" – 5<br>"Change Management" – 2<br>"Government Interventions" - 5 |

Port managers' view on port sustainability can be summed up as "optimum management of economic, social and environmental aspects while implementing a proactive approach to satisfy the demand by delivering a smooth service to the port users". Thematic analysis of the responses revealed attitude, fear of change and government interventions as additional barriers.

## 5. Discussion

Descriptive analysis results indicated the absence of a port sustainability framework, lack of progress in the technology adaption, and the outdated regulatory and legal framework with a higher gravity among barriers. Interestingly, the technology adaptation is included as one of the main categories in UN sustainability implementation strategy (Stafford-Smith *et al.*, 2017). Having the lowest ranking for "Existing limited managerial capacity in the port" stipulates respondents' differences of opinion concerning the barrier. Nevertheless, capacity building is one of the key methods in contributing to SDGs (Fleming *et al.*, 2017). Four factors were identified as significant system-based barriers for seaports' contribution towards SDGs namely, deficient collaborative policies, structural and managerial constraints, market constraints, and the absence of an established framework.

### *Deficient collaborative policies*

Numerous factors affect port operations including demand for the port, port competition, port governance model, human resource management and labour relations, political and institutional issues, human error-related incidents, and natural barriers such as wind and cyclone. Therefore, port sustainability cannot be the sole responsibility of port organizations. Further, having a dedicated goal for the collaborations (related to Goal 17) proves the importance of different means of partnerships for seaports contributing to SDGs. When

individual organizations make efforts in isolation, there is a high chance of occurring contradictions with other institutions. Hence, unanimous understanding among policymakers, stakeholders, and institutions is essential for achieving sustainable outcomes in port operations. Ports depending on their ability to deal and negotiate may exercise their outreach. Weak collaborations with shipping lines and international bodies, lack of flexibility to change existing business models, fragmented policy framework regarding sustainability, poor learning culture inside port organizations, and the absence of accountability tracing directives and tools hinder the ability of ports to align their operations to SDGs. Ports are considered strategic assets of a country. Thus, the government is often involved in the decision-making related to ports at the policy level (Lam, J. and Van De Voorde, 2012). The level of intervention varies upon the management model of the port as management decisions are affected by the ownership model, regulatory frameworks, and the legal structure (administrative) model. Nevertheless, the deficient collaboration among policymakers can deter the adoption of SDGs in the absence of appropriate policy direction. Building an inter-organizational network to achieve economic, social, and ecological dimensions for cleaner production is found to be vital to improve the dimensions of sustainability (Langenus and Dooms, 2018). Evidence from US port system suggested that coordination of activities and collaboration among port authorities, the government, industries, and community groups help implement sustainable seaport business models (Cheon and Deakin, 2010). Further, developing relevant communication tools, programs, training, motivation, and exchange of personnel ensure employee engagement that consequentially leads to a corporate strategy oriented towards environmental sustainability (Kravchenko, 2012).

***Structural and managerial constraints***

Managing stakeholders and precisely defining their responsibilities and maintaining a good relationship with employees can avoid any adverse consequences from trade unions. Creating a positive job climate and providing managerial support motivate port employees to involve with environmental programs (Kravchenko, 2012). The other key managerial constraint is the management's perception and knowledge about port sustainability. The response for open-ended questions revealed port managers' awareness regarding port sustainability is not at an acceptable level. Also, outdated legal and regulatory frameworks act as a structural barrier when keeping pace with the highly volatile industry. Thus, assuring managerial and structural agility enhances the seaport's contribution towards SDGs. Fostering further collaboration with stakeholders and establishing networks and a well-shaped new business model including

sustainability indicators ascertain port sustainability. In the case of the US and Canadian port system, sustainability awareness and training programs, sustainability reporting, and sustainability initiatives and standards such as Green Marine (GM) and ISO 14001 certification led to higher stakeholder relations with government/policymakers, customers, local communities, and industry associations (Ashrafi *et al.*, 2019). More specifically, Canadian ports performed well in GHG emission reduction, waste management, spill prevention, community engagement, and environmental leadership to GM (Hossain *et al.*, 2019). Therefore, the governments and the responsible organizations in other developed, industrial and middle-income countries also can assist their ports to move towards achieving sustainability.

***Market constraints***

Market constraints included limited managerial capacity and insufficient finance to invest in costly sustainable initiatives like renewable energy. Achieving overall sustainability in port operations requires streamlining and identifying the sources of unsustainable practices and their adverse impacts. Such efforts demand developing and deploying a port sustainability management system to assess the potential impact of their operations on sustainability. This requires large financial resources and technical expertise, which is currently insufficient in many ports, even in developed country ports (Kuznetsov *et al.*, 2015). Further, the absence of managerial key performance indicators for port authorities regarding air pollution and waste management processes in seaports hinders achieving port sustainability (Di Vaio *et al.*, 2018). Market constraints such as regional competition discourage ports to impose strict regulations on sustainability. Inadequate alignment of commercial principles with data-driven decisions in ports leads to budgetary issues and hence unsolicited commercial decisions which are isolated from data and statistics also negatively affect port sustainability. On the contrary, most of the research advocated the ways of incorporating market positions to stimulate port sustainability (Monte and Moreira Campos da Cunha Amarante, 2017), yet, failed to recognize market constraints such as competition discouraging port sustainability in certain port regions. Enforcing strict environmental regulation in a port could drive away the demand from certain shipping lines with lower standards on their fleet while attract shipping lines that appreciate port sustainability.

***The absence of a globally established framework***

Primarily assuming seaport as a general business organization (Moratis and Melissen, 2019), it can be argued that not having industry-specific guidelines is a general barrier in seaports as well. Di Vaio *et al.* (2018) established the same idea by highlighting the importance of regulations and policies to achieve environmental sustainability and energy efficiency in the port sector. Even though, International Association of Ports and Harbours (IAPH) recently established the World Port Sustainability Program (WPSP) as an effort to integrate SDGs into seaports, the global reach of such programs has been marginal. Further, there is a vast disparity among different regions in terms of their ports' contribution to SDGs. Port managers have an over-emphasis on economic sustainability over overall sustainability. This tendency has also been revealed by Becker and Caldwell (2015) that port decision-makers are overly focused on short-term economic goals rather than long-term sustainability benefits.

***Attitude, fear of change and government interventions***

The port organization's attitude towards sustainability and undue political influence exists as barriers. Smith *et al.* (2017) explained that the public attitude towards sustainability differs from country to country and as a result, the political partisanship changes accordingly regarding sustainability-related matters. In the context of European port system, social acceptance and legislation significantly act as barriers for the development of ports in future including sustainability (Kanellopoulos, 2018). Thus, among internal barriers categorized as informational, emotional, behavioural, and systematic, most of the barriers belongs to managerial category's emotional attitude (Lozano *et al.*, 2020). Therefore, the main theme prompted from the thematic analysis is that the attitude towards shifting the port as a business organization to comply with operational and system changes and contribute to sustainable development goals ratified the past literature on organizational attitude as a barrier for achieving sustainability.

Seaports like any other business organization have established cultures, operational practices, and bureaucracy in decision making. Being sustainable and the outcomes of being sustainable are not reflected in the port's financial accounts but could be a strategic asset in branding and marketing. In an established corporate organization, corporate social responsibility (CSR) is well integrated into their managerial and financial decision making, yet the focus is lack on the aspect of sustainability such as social, and environment improvement programs such as poverty reduction, social upliftment, and social capital development which

are not directly attributed to aftereffects of their operational environment or business processes. In manufacturing organizations, practices such as measuring wastage and environmental impacts, lean practices are being practiced. However, large service sector operations such as in seaports, applying and implementing lean practices are constrained by long-established operating cultures and procedures (Port Strategy, 2014). Like lean practices, any new initiative such as sustainability practices has an inherent resistance from the organization at the initial stage of implementation. Hence change management is a difficult endeavour for seaports to adopt and implement practices, and strategies that help ports to contribute SDGs (Puig *et al.*, 2015). Lack of motivation to change, and inadequate capital allocation under tight budgetary accounts in seaports may equally act as constraints for port management to seriously consider in their role contributing to SDGs (Lozano *et al.*, 2020).

Barriers identified can be applied to any port of any country, irrespective of their port region, size, or the development level of the country. Deficient collaborative policies, structural and managerial constraints, market constraints, the absence of an established framework, attitude, fear of change and government interventions are system-based organizational barriers, and any port must reengineer its managerial and operational activity implementation processes aligning to SDGs. Deficient collaborative policies and managerial constraints can be addressed at the individual port level while the absence of an established SDG framework for ports needs to be directed at the global level. Certain market constraints such as unhealthy regional competition cannot be easily removed at the individual port level. Elimination of these system-based barriers is possible and that would lead all ports to be more efficient, environmental, and people-centric entities.

## 6. Conclusion and Future Research

Ever since the introduction of SDGs, many industries attempted to incorporate activities contributing to SDGs into their strategic plans. The paper identified deficient collaborative policies, structural and managerial constraints, market constraints, and the absence of an established global framework deter the contribution of seaports to SDGs as system-based barriers. While it is mandatory to perceive collaboration with all port stakeholders in the vision of promoting overall sustainability, it is also equally important to have a unanimous policy regarding port sustainability. Extensive regional competition can act as a marketing constraint. Having a mutual agreement in every port region is vital concerning their policy direction towards port sustainability. There should be a policy and regulatory guideline for ports

depending on the size, location, region, and type of operations. Moreover, establishing a central body dedicated to port sustainability providing directives for ports beyond the roles played by the organizations such as ESPO and WPSP, and empowering its roles to ground-level monitoring and evaluation ensure ports' adherence to support and achieve SDGs. Further, at the national level, establishing a dedicated organization in the form of a regulatory authority for monitoring and evaluating port activities related to port sustainability can have much influence on directing ports towards sustainable business practices. Further, the overall attitude (reluctant to change) of the port organization and the country towards sustainability largely affects the sustainability aspects of port operation. Further, this paper contributes to the knowledge on change management in terms of maritime sector organizations' ability to contribute to achieving sustainable development goals.

There are some limitations to this paper which future work on the topic can focus on: a) unavailability of data regarding sustainability indicators b) the reliance of the research on the perception of the port managers. c) the relatively small sample size is due to the limited number of managers who are aware of and involved in port sustainability. Since EFA requires a large sample size for accurate results future research may focus on exploring the capabilities of ports to overcome the barriers and examining the regional disparities, if any, in port sustainability and the underlying reasons for them. Further, exploring how ports could incorporate SDGs in their daily operations and developing master plans may be considered in future research.

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Referee(s)' Comments to Author:

Referee: 1

**Thank you for reading through the manuscript and providing very critical feedback to fine tune the paper.**

Comments:

The paper is interesting and original. However I have an issue with the use of interviews based on ports in Sri Lanka, on the basis of which general claims are derived. While the port system in Sri Lanka is similar to port systems in other parts of the world, the authors should discuss the limitations and the specific characteristics of the port system under study. I would imagine that if the survey had been carried out among port professionals in a least-developed economy or in a high-income economy, results might have been different. The authors are clearly aware of the importance of local conditions in ports, but do not adequately qualify their study, maybe as they fear that it could limit the validity and generalisability of its findings. I believe, on the contrary, that a good qualification of the results in the context of the port system in Sri Lanka would strengthen the paper. For example, what are the issues in terms of sustainability that characterise Sri Lanka? and could these have impacted the respondent's perception of the barriers to sustainability?

**The sustainability issues cited in the questionnaire survey are derived from a semi structured interviews of port managers- in Sri Lanka. Hence, we agree that the issues are more related to Sri Lanka port system. However, the same issues were also found in literature that focused on sustainability issues in different port regions.**

**A text has been added explaining how port system in Sri Lanka is not distinctive in terms of operation, management as terminal operators are mainly global level players (highlighted in yellow in page 7 and page 9).**

In addition, while the discussion section is interesting, it it not always clear what are the results of the analysis carried out by the authors, what are their views and what are the results of research published elsewhere. This contributes to some vagueness in the definition of the main contribution of the paper. I would recommend making an effort in structuring the discussion section, and providing maybe as a way of summary at the end a short overview in tabular form of the main contribution of the study.

**The finding is the barriers (4 from EFA and 2 from Thematic analysis). There was no extant literature on sustainability barriers in seaports, but there is research on frameworks using which sustainability assessment can be carried out in seaports, and generic barriers in ports in developed country context, which are in agreement with the results from this paper. Authors' view on the results were now included.**

The paper is in general well written, however there are a few typos: for example, pg. 3 line 14-15 "cariteria" instead of criteria. Line 43-44, "is paramount important as", I assume either paramount or important, line 48-48 "The next section carried out", I guess the authors carry out the review, not the section. Pg. 4, line 10-11 " such as found Long Beach"... etc. This is only a sample of errors and the authors should ensure the paper is free from typos and syntax errors before resubmitting.

**The manuscript was re-read for language and typo issues.**

In addition there are a few points where the text needs clarification.

The literature review is comprehensive and informative. Please clarify on pg. 4 the following sentence: "The most alarming and debatable topic of climate change led to developing certain port sustainability programs such as those found in the United States - Port Resilience Planning by engaging a wider range of stakeholders (Becker and Caldwell, 2015)."

**The idea we wanted to establish was that the debate on climate change led seaport management in US ports to create port sustainability programmes in collaboration with wide range of stakeholders. The sentence was revised.**

Please clarify on pg 12: " Interestingly, having “technology” as the main category of UN implementation strategy verifies the above finding (Stafford-Smith et al., 2017)."

**The sentence was revised to get more clarity in the idea.**

Pg. 16: " Moreover, establishing a central body that is dedicated to port sustainability beyond the roles played by the organizations like ESPO, WPSP, which only provides directives for ports,..." You mean directions maybe? directives are generally hard forms of regulation that neither ESPO not WPSP can provide.

**The sentence was revised to get more clarity.**

Additional Questions:

1. Originality: Does the paper contain new and significant information adequate to justify publication?: Yes, the paper carries out an empirical analysis on original data. It finds out that substantial barriers deter the contribution of seaports to SDGs, and provides a taxonomy of such barriers.

2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Yes, the authors are clearly familiar with the literature.

3. Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: Yes, the methodology is sound and appropriate for the study. The only point I make on the research design is that while data is collected in a specific geographical context (Sri Lanka), the authors do not

qualify sufficiently the specific characteristics of this context and how it might provide have biased the perception of respondents.

**This was now substantiated by providing a justification on the generalizability of the responses from Sri Lanka Port System.**

4. Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Yes, the results are clear and detailed and derive from the application of the methodology. I recommend strengthening the significance of the contribution in the discussion section.

**Contribution of the work has been now established in the discussion section.**

5. Practicality and/or Research implications: Does the paper identify clearly any implications for practice and/or further research? Are these implications consistent with the findings and conclusions of the paper?: Yes, the paper provides a set of recommendations for port managers and some light policy recommendations.

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: The paper is in general well-written although there are some minor typos.

**The manuscript was corrected for typos and language issues.**