Green Logistics Framework for Shippers

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Abstract

Multiple industries across the globe have a major role to play in decarbonizing their operations to achieve the Net Zero goal by 2050. One of the major contributors to environmental degradation is the logistics service industry. This research mainly focuses on one of the large players within this industry, namely the shippers, by investigating their involvement and activities that impact the environment. There is a vast literature on green logistics as well as guidance from the regulatory bodies to adopt greener logistics practices but high investments and challenges in identifying and assessing the cost and benefits emerged as major barriers. The research proposes a conceptual framework based on the literature review and researchers' understanding of the industry. The proposed Green Logistics framework adapts the DMAIC approach of Lean Six-Sigma in its broad spectrum. The framework is further verified through a Delphi approach, where experts from academia and industry were engaged to critically review and provide feedback for its further improvement. The framework has been modified/updated in light of the Delphi study's results. The framework is expected to assist shipping companies to reduce their emissions and achieve the decarbonization goal.

Keywords
Logistics, Shippers, Net Zero Carbon, DMAIC, and Supply Chain.

1. Introduction

In recent years, green logistics has gained considerable attention in supply chain management both from practitioners and academics (Nadeem et al., 2017), particularly with growing concern in terms of atmospheric and marine pollution (Martinsen, 2012). Ships release solid waste and ballast water which degrades the aquatic habitat and also emission of CO2. To overcome these environmental issues, many regulatory bodies such as IMO, Paris Agreement, United Nations' global shipping body and others have agreed on a treaty on greenhouse gas strategy dedicating the shipping sector to reduce emissions by 50% by 2050 compared to 2008 (Sarkis, 2011). Focusing on the complexity of shippers' logistics environmental impact, companies are moving toward the adoption of Green Logistics to mitigate the gap created by their logistics activities (Fahimnia, 2015).

This research aims to explore an understanding between current shipping activities and their impact on the environmental aspects and develop a framework to mitigate the gaps to benefit and protect the environment and society at large. The proposed framework is intending to provide well-defined and easy-to-follow guidelines for the Shipping

Industries to manage and mitigate the environmental impact caused by their operational activities. Thus, this framework aims to resolve the current global environmental issues and achieve carbon reduction by 2050 (Hashim, 2017).

2. Marine Shipping, Environmental impact and Barriers in its Decarbonization

Marine shipping is known for its cost-effective way to carry goods across the world, and despite a modest downturn in 2018, it still has its foundations strong in international trade i.e., more than 80% of world trade by volume is carried by shipping. Emission from water carriers is receiving more concern and attention as the knowledge of environmental problems and climate change is growing (UNCTAD, 2019). Marine shipping releases several pollutants and is responsible for the issues listed below:

- The major greenhouse gas (GHG) emitted by ship are carbon dioxide ($CO_{2)}$ and it is the primary cause of global warming,
- Acid rain is a result of sulphur oxides and nitrogen oxides which are particularly undesirable owing to their impact on human health.
- Human health has been at risk because of particulate matter, carbon monoxide, and volatile organic compounds. Particulate matter which also includes black carbon is not only unhealthy for humans but also considered the second most climate change agent after CO_2 (Santamaria, 2011).

Marine shipping is one of the world's biggest releasers of GHG and is also projected to be one of the fastest-growing industries of GHG (Lee, 2016). It contributes approximately 2.2% of global annual CO_2 emissions and this emission is expected to rise by 50 to 250% by 2050, owing to the expansion of global trade. It is also predicted by IMO that marine transport will account for 15% of overall CO_2 emissions (Gibbs, 2014). In addition, according to 2019 forecasts, there will be a 39% rise in demand for seaborne trade by 2050 (DNVGL, 2019). The water carrier is expected to add nearly 90% of global fleet CO_2 emission, therefore highlighting the significance of engaging in technical, economical, and environmentally friendly emission mitigating strategies for this sector (Davarzani, 2016).

Among the several international environmental agreements, approximately 195 countries have agreed to maintain the global temperature below 2°C and seek attempts to mitigate the temperature to 1.5°C (IMO, 2021). However, marine shipping has not been yet included in any international environmental agreement, it is expected to make the right amount of contribution to help in mitigating its emissions. The IMO has taken the initiation in controlling the marine shipping emission and forecasted, to begin with, this process (Lindstad, 2015) and to satisfy internationally agreed goal, the water carrier should make substantial improvements to its emission trajectory. It is the policymakers' and stakeholders' responsibility to identify and adopt strategies to reduce emissions from marine activities (Balcombe, 2019). The rising concern about the environmental effect of shipping has also been reflected in various freight environmental literature focusing on policies, strategies, and minimizing it. Moreover, there are many recent literature reviews emphasising sustainability issues in marine shipping (Lee et. al., 2019).

As per the reports, the measures taken to reduce the emission globally have not been met at their required level (Bouman, 2017). The cause for this moderate implementation may vary – this obstacle can either be intricated mixer of reasons that draws its decision-making process in sea transportation and taking sensible steps i.e., steps often seem to be favourable in executing but may face serval obstacles to adapt their emission reduction plan on a bigger margin (Gilbert, 2018). In addition, various reports show that few mitigation measures seem to be cost-effective but their implementation remains moderate, resulting in performance differences between the required level and expected level of implementation (Rehmatulla, 2015). The cost factor is the most critical aspect of the decision-making process but it is not the only component to consider; market, technological and operational factors must also be weighed. Moreover, the diverse and divided expectations of stakeholders further add to reducing the implementation process of emission mitigation (Halim, 2018). This section further addresses the key implementation barriers to decarbonization in various areas of shipping transportation, as shown in figure 1).

- **Economic Barriers:** According to industry forecasts, it was estimated that the new IMO legislation will increase shipping costs by nearly $60 billion per year. Currently, Marine gas oil (MGO) is 60% more costly compared to heavy fuel oil (HFO) (Wood, 2020). Customers will face around a 10% hike in transportation fares as an outcome of the increased costs, and the issue is who will handle this expense which is not small

(Nottenoom, 2009). However, fuel is not only the cost but operational and capital expense also plays an important role when estimating substitute energy resources (Christensen, 2014).

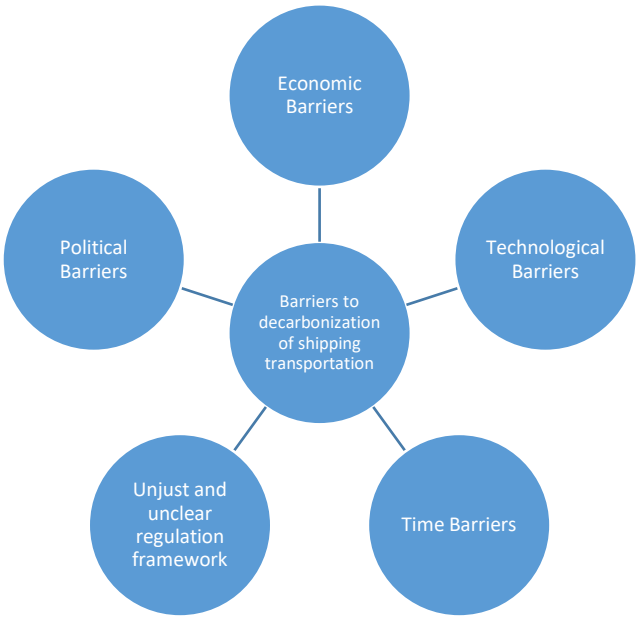


Figure 1 Barriers to the decarbonization of shipping transportation

- **Technological Barriers:** Nowadays' alternative options for energy substitutes are seen in limited quantities whereas Liquified Natural Gas (LNG) is the latest available green fuel that is economically and internationally scalable for water carriers in a short period (Jeong, 2018). Even though its advantages for mitigating emissions, many researchers believe that the desired IMO GHG depletion cannot be achieved due to its function as a marine fuel will last temporarily. It is predicted to be in the market for a while but the drawback of switching from conventional fuels to LNG will result in the limited opportunity of bunkering base at ports (Notteboom, 2014).

- **Time Barriers:** Implementing green practices consumes a lot more time and planning. The study undertaken by Styhre, L. and Winnes, H. (2013), states that the cause for limited implementation is due to energy efficiency steps being linked to time restrictions in the decision-making process, lack of planning, and limited incentives. For instance, the time taken to transform ships to LNG or design the latest LNG burning carriers and install scrubbers. Moreover, ship owners possess their plans and intentions which may result in disputes with IMO's aims (Sandia, 2021).

- **Barriers linked to the unjust and unclear regulation framework:** International environmental legislation and regulatory bodies must be in agreement (Tan, 2005). A fair playing ground must be assured across the international levels and if any country practices individually more stringent actions it results in distorted competitiveness (Kotrikla, 2017). For example, a proposal from the EU appealing to IMO for easing the rules on scrubber release. This was agitation on open-loop scrubbers and geographical limits forced on their usage (Bows-Larkin, 2015).

- **Political Barriers:** The implementation of market-based measures, and political barriers (due to needless fragmentation and uncertainty from international, along with political elements) are thought to limit the process of decarbonisation of shipping. Eradicating these barriers is deemed significant to ensure a smooth decarbonization process (Psaraftis, 2019).

This research focuses on reducing/mitigating the environmental impact of the shippers' logistics activities by adopting green logistics. The shipping industry emits around 940 million of CO_2 annually and is accountable for 2.5 % of GHG emissions (Mckinnon et. al, 2010), along with other gases such as black carbon, and SOx.

3. Methodology

This research deploys the inductive approach to build theory from the collected data (Saunders, 2018). The qualitative approach was adopted due to the scope and depth of this exploratory research project to create a piece of empirical information. The flexibility in qualitative research can enhance the generalizability of the findings by enabling them to incorporate new ideas/cases after initial findings are developed (Silverman, 2005).

The research utilizes the interpretivism approach in terms of its philosophical standpoint, where data/information might have the same meaning but would need to be decoded and understood (Silverman, 2005). The interpretative approach was believed to be appropriate for this study since environmental concerns such as greenhouse gas emissions, climate change, underwater ship noise, oil spills, aquatic life deterioration, and so on depend on human nature which can mostly be understood rather than quantified.

Both the primary and secondary data were collected. Primary data assisted in understanding what has been done so far in this area of study. Based on secondary information, a conceptual framework was developed by adapting the DMAIC approach of Six-Sigma. The framework's core aspects under DMAIC's five phases were developed based on the literature, and the author's understanding of the shipping industry. To validate the developed framework Delphi Study approach was deployed, as it engages experts who possess knowledge in the relevant subject (further discussed in section 4.2). The flexibility of anonymity in the Delphi Study avoids any bias and/or influence on expert's review/criticism. Delphi study provided primary data from experts in the field of shipping as well as from academia. This led to further improvements and validation of the conceptual framework through the Thematic analysis/synthesis approach to analyse the core subjects emerging from primary data (Saunder and Lewis, 2018) and the framework was further updated. As in the Delphi study, the consensus among participants must be reached, therefore a total of two rounds of the Delphi study were conducted before the consensus among participants was reached.

4. Development and Verification of the Green Logistics Framework for Shippers

To address the need for a framework to serve as a guiding torch for the shipping industry a two-stage approach was adopted (see figure 2), where a thorough literature review laid the foundation to develop a conceptual framework by adopting an established approach called DMAIC (see section 4.1). To ensure the academic and practical relevance of the conceptually developed framework, the Delphi study approach was deployed to critically review and recommend changes to improve the framework for its academic rigour as well as practical relevance (see section 4.2). The framework was updated based on the feedback provided (see section 4.3).

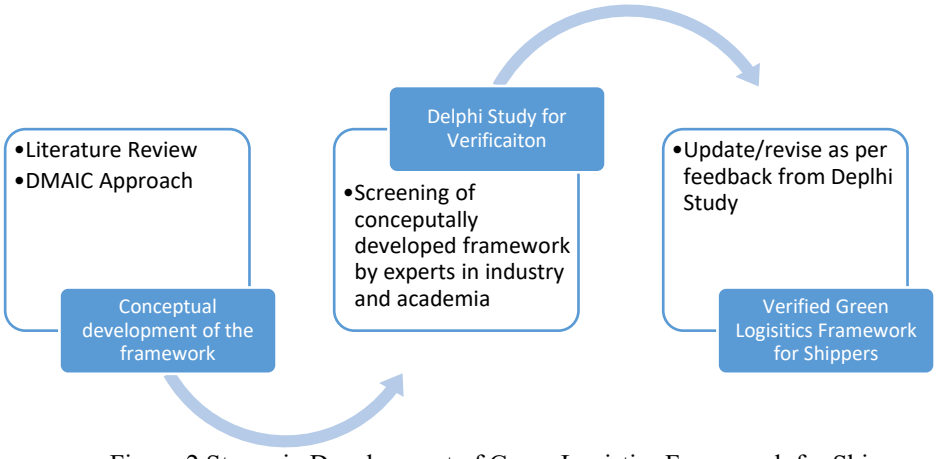


Figure 2 Stages in Development of Green Logistics Framework for Shippers

4.1 Conceptual Development of the Framework

To address the research gap a conceptual framework was developed. A thorough review of the literature was conducted to comprehend the broad spectrum of existing research and to inform the development of this framework to control the environmental damages and also benefit business productivity by practising green logistics specifically for shippers. The objective to develop this framework is to provide well-defined guidance (Anand and Kodali, 2010) for

the shipping industries to manage and mitigate the environmental impact and achieve carbon neutrality by 2050 (Hashim, 2017).

The proposed framework adopts the DMAIC (Define, Measure, Analyse, Improve and Control) approach in its broad spectrum. In each phase, there are steps for better understanding and a systemic approach to implementation to achieve the desired outcome effectively and efficiently. All phases in the conceptual framework consist of different tools/methods that are suggested for guidance. Users can choose the tools completely by analysing their organisational needs and circumstance. The phases also include steps to define a clearer approach.

4.2 Delphi Study – Verification of the Conceptual Framework

To verify the construct and practical relevance of the novel development, the deployment of the Delphi study is an appropriate method (Okoli and Pawlowski, 2004). A study was designed with open and closed-ended questions to get as much data as possible about the conceptually developed framework. The approach is further relevant as it engages experts with knowledge in the relevant subject and flexibility of anonymity to express their criticism, opinion and recommendations, without knowing and being influenced by other participants of the study (Okoli and Pawlowski, 2004). The process and flow of the Delphi study are presented in Figure 3.

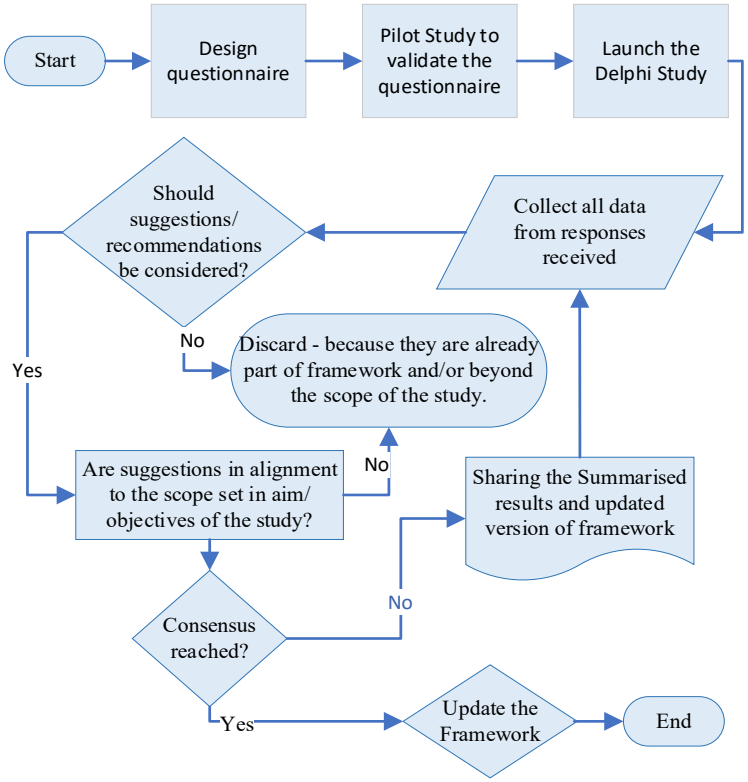


Figure 3 Process and flow of the Delphi Study

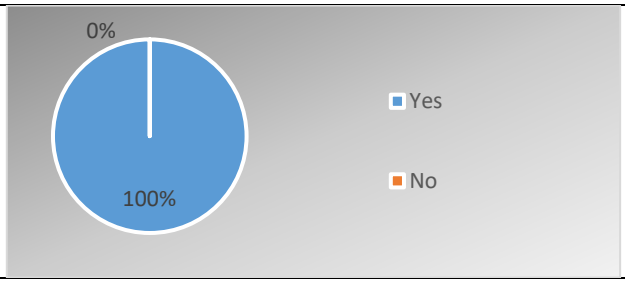
The study began with the development of a questionnaire which was pilot tested for its validity and updated. To choose the participants of the study, a purposive sampling approach was deemed appropriate to ensure that the participants have the right knowledge to critique the conceptually developed framework. Over 40 participants were invited, of which 15 participated in the study.

Participants were sent an online questionnaire along with the PDF version of the document containing the framework and its description. Upon second iterations of the Delphi study, a consensus (>80%) was achieved among the participants, whereby the study was closed and the framework was updated.

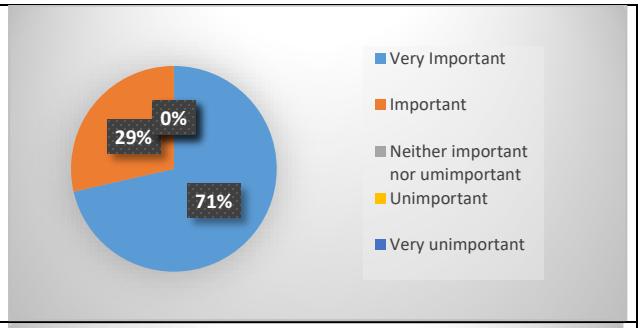
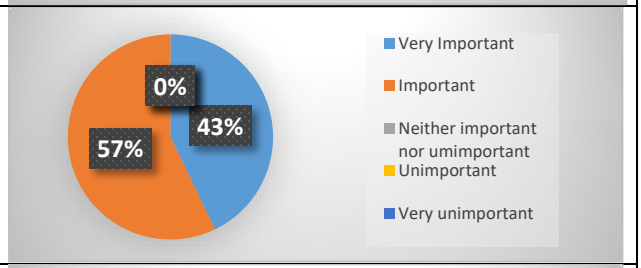
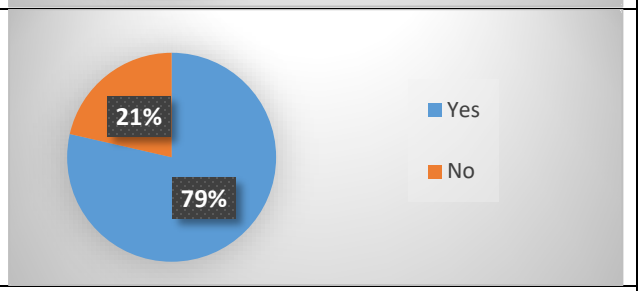
4.3 Delphi Study Results and changes made to the Conceptual Framework

During the first round of the Delphi study, participants provided their critical review and recommended additions, changes, and modifications to the conceptually developed framework. The questionnaire consisted of eight sections, section 1 describing the information about the research topic and seeking participants confirmation to participate. The responses are summarised as per each section and the below table presents responses to the questions in percentage terms. At the end of each section, responses to open-ended questions are analysed in the right column.

Section 2 – Overall Framework

1. Do you think the five-phase approach of DMAIC is suitable for this type of framework?	

Section 3 – Define Phase

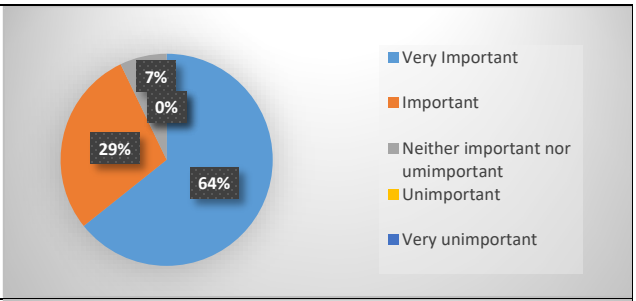
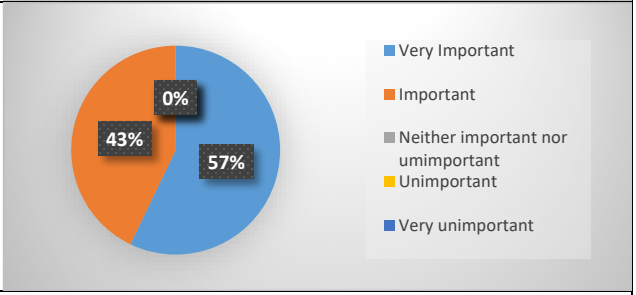
1. How would you rate the importance and necessity to analyse step 1 in this phase?	
2. How would you rate the importance and necessity to analyse step 2 in this phase?	
3. In your opinion are two steps enough to justify phase one in implementing the DMAIC framework?	

4. If No, please recommend/advise any changes, modifications, and improvements in this phase. If yes, please specify.

Responses	Analysis
Define the goal for the whole process	Promote green logistics practice for sustainable development in the shipping industry

Need for NPI (New product introduction) style approach to consider before step 1	Since the product is not within the scope of this research on greening the shipping industry, therefore, this suggestion cannot be incorporated.

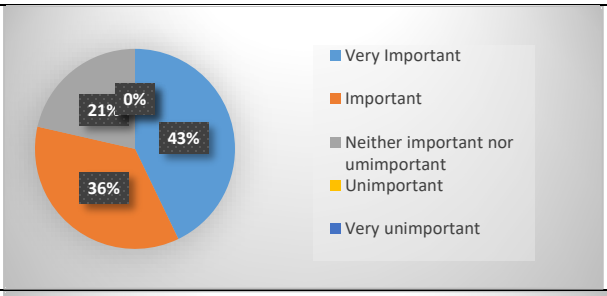
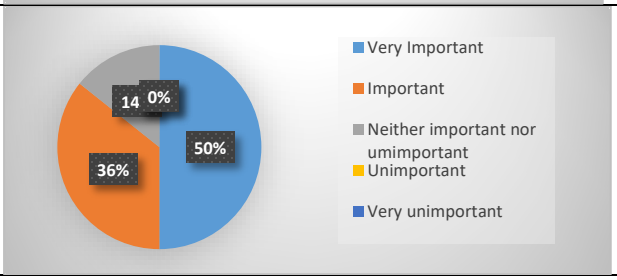
Section 4 – Measure Phase

1. How would you rate the importance and necessity to analyse step 3 (Understanding the environmental performance indicators) in this phase?	
2. How would you rate the importance and necessity to analyse step 4 (Classifying the environmental performance indicators) in this phase?	

3. Do you recommend/advise any changes, modifications, and improvements in this phase? If yes, please specify.

Responses	Analysis
Provide more details on the classification of environmental indicators	Detailed description of the framework is provided separately (see subsection Measure).
Add a step that has 'Measure'	New step added: Step 5. Measure the core areas of environmental impact which needs more attention.

Section 5 – Analyse Phase

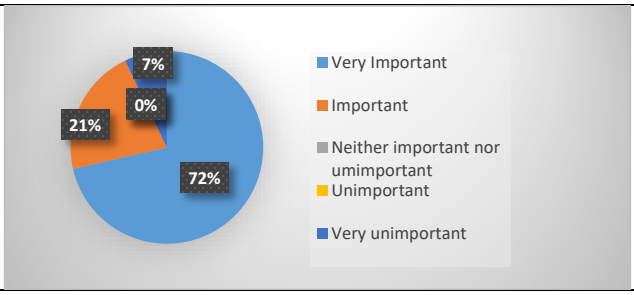
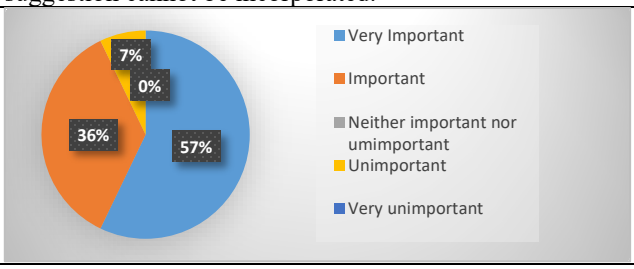
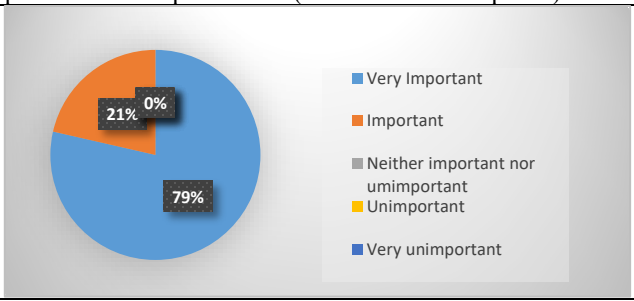
1. How would you rate the importance and necessity of step 5 (Identifying the key environmental performance indicators) in this phase?	
2. How would you rate the importance and necessity of step 6 (Approving the key environmental performance indicators) in this phase?	

4. Do you recommend/advise any changes, modifications, and improvements in this phase? If yes, please specify.

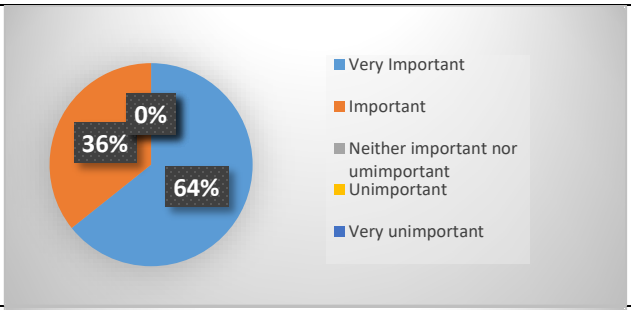
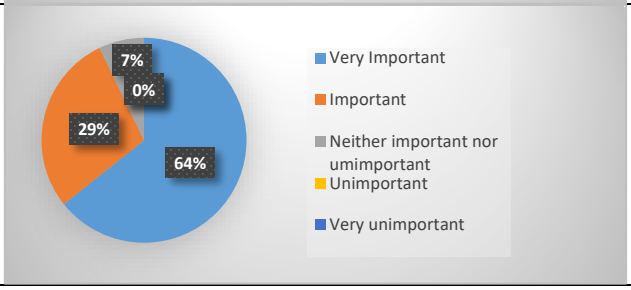
Responses	Analysis
Few analyses were done in this phase	Step 6 was revised to attract more analyses for environmental gaps.

	Before: Identifying the key environmental performance indicators. **After:** Identify/analyse the root causes of the factors contributing to negative environmental impact.
Steps 5 and 6 are seen similar by the wording	Both steps 5 and 6 have been rephrased (see figure 5.1)
Time-consuming activities – A streamlined process required	The steps have been revised and streamlined (see figure 5.1).

Section 6 – Improve Phase

1. How would you rate the importance and necessity of step 7 (Classifying the team/work allocation) in this phase	
2. If your answer is unimportant or very unimportant, please provide your reason for the answer.	
Responses	**Analysis**
The classification should be done earlier for lean/NPI (New product introduction) process flows.	Since the product is not within the scope of this research on greening the shipping industry, therefore, this suggestion cannot be incorporated.
3. How would you rate the importance and necessity of Step 8 (Embedding the environmental performance indicators into practice) in this phase	
4. If your answer is unimportant or very unimportant, please provide your reason for the answer.	
Responses	**Analysis**
This doesn't lend itself to the improvements section of the project.	A detailed description and improvements tools are provided for improvement (see subsection Improve).
5. How would you rate the importance and necessity of Step 9 (Add/improve environmental performance indicators as required) in this phase	
6. Do you recommend/advise any changes, modifications, and improvements in this phase? If yes, please specify.	
Responses	**Analysis**
Rephase 7 and 9, make them clearer	**Before:** Step 7. Classifying the team/work allocation **After:** Step 8. Selecting the right individual/team to implement the process. **Before:** Step 9. Add/improve environmental performance indicators as required **After:** Step 9 Choose the most appropriate environmental performance indicators.

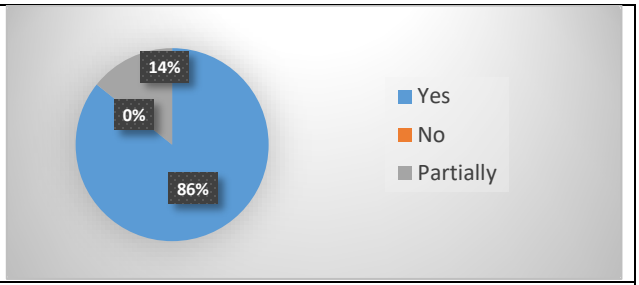
Section 7 – Control Phase

1. How would you rate the importance and necessity of Step 10 (Monitoring the associated environmental performance indicators) in this phase?	
2. How would you rate the importance and necessity of Step 11 (Control the Process) in this phase?	

3. Do you recommend/advise any changes, modifications, and improvements in this phase? If yes, please specify.

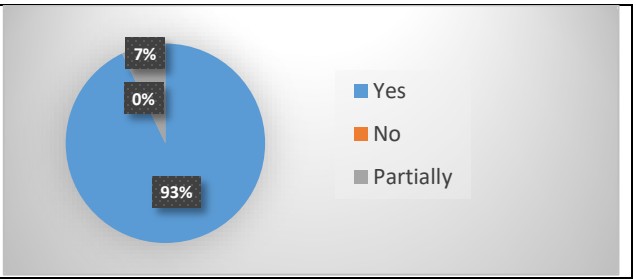
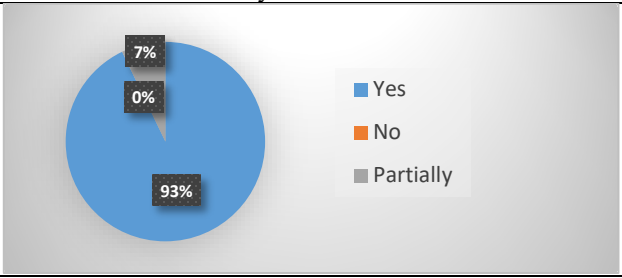
Responses	Analysis
Step 11. Very general, the control phase already says "control". Please be more specific in this step for example, "establish medium values or acceptance levels for each indicator".	**Before:** Step 11. Control the process. **After:** Step 11. Instil the process into the company's culture and document the procedure. New step added – Step 12. Transfer the ownership and maintain periodical gate review
Maybe you can add "return to define phase if necessary" If the goals didn't achieve in the first round of DMAIC	A loop is added from step 10 to step 1if the goal is not achieved.
Innovation and improvements are necessary and often projects are initiated with these topics/aims in mind. The hardest step is often sustaining the new processes/methods. Having a feedback loop is vital to ensure the process can evolve and be fully integrated into the day-to-day workings of a company.	A continuous communication loop is added for all five phases to encourage smooth working.

Section 8 – Overall Framework

1. In your opinion, is the framework easy to understand?	

2. If No OR Partially, please provide your suggestions for improvement

Responses	Analysis
A short video to show the flow will help better understand	No amendment required
Please see the comments in the previous questions.	A continuous communication loop is added for all five phases to encourage smooth working.

3. Does the framework contribute towards the purpose it has been developed for?	
4. If No OR Partially, please provide your suggestions for improvement	
Responses	**Analysis**
Can be worked on to make it 100%	Consider in further analysis
5. Does the phases and steps represent a systematic approach for mitigating environmental gaps in the shipping industry?	
6. If No OR Partially, please provide your suggestions for improvement	
Responses	**Analysis**
As pervious	A continuous communication loop is added for all five phases to encourage smooth working.

Overall the framework has been reshaped with a few new elements and a couple of new steps. Changes made are discussed below and the final verified framework is presented in section 5.

Phase 1 – Define

Experts suggested having a goal defined for the entire process and being specific with the depth of environmental impact within the shipping industry. Therefore, step 1 has been redefined and the following changes were made:

Before: Identifying the environmental gaps (understanding the supply chain flow).

After: Identifying all the environmental gaps that are related to the shipping activities (understanding the supply chain flow).

Phase 2 – Measure

In this phase the respondent recommended that steps 3 and 4 are not sufficient to measure the environmental gaps and provided a suggestion to add another step that can 'measure' the gaps of the environmental impact therefore the following step was added:

Step 5. Measure the core areas of the environmental impact which need more attention

Phase 3 – Analyse

It was recommended by the experts to rephrase the steps due to limited analysation of environmental gaps, similar wordings for steps 5 and 6 and streamline the process. The following changes were initiated:

Before: Identifying the key environmental performance indicators.

After: Identify/analyse the root causes of the factors contributing to negative environmental impact.

Phase 4 – Improve

This phase was suggested with the least changes. Experts recommended making steps 7 and 9 a bit clearer. In a way, step 7 was rephrased and steps 8 and 9 were combined. The following changes were made:

Before: STEP 7. Classifying the team/work allocation

After: STEP 8. Selecting the right individual/team to implement the process

Before: STEP 9. Add/improve environmental performance indicators as required

After: STEP 9. Choose the most appropriate environmental performance indicators and embed them into practice.

Phase 5 - Control

New steps and a few elements were added to the last phase upon the recommendations made by the experts. It was suggested to be specific in step 11, define goals achieved or goals not achieved and draw a communication loop. The following changes were made in light of the feedback:

Before: Step 11. Control the process.

After: Step 11. Instil the process into the company's culture and document the procedure.

- New step added – Step 12. Transfer the ownership and maintain periodical gate review.
- A feedback loop is added from step 10 to step 1 if the goal is not achieved (see figure 4).
- A continuous communication loop is added across all five phases to encourage smooth working (see figure 4).

5. Verified Green Logistics Framework for Shippers

The Green Logistics Framework for Shippes (see Figure 4) adapts DMAIC in its broad spectrum consisting of five phases (i.e. Define, Measure, Analyse, Improve, and Control) and develops 12 Steps within the five phases, and further sub-steps under each of the 12 Steps. All phases utilise different tools/methods under each step that are suggested for guidance purposes only. Users can choose the tools based on the analysis of their organisation's needs and the scope of change they plan to implement within their context.

It is noteworthy that the strategies must be embedded across the organisation to build a strong and integrated system that ensures that the best results are achieved at each level of this framework's implementation.

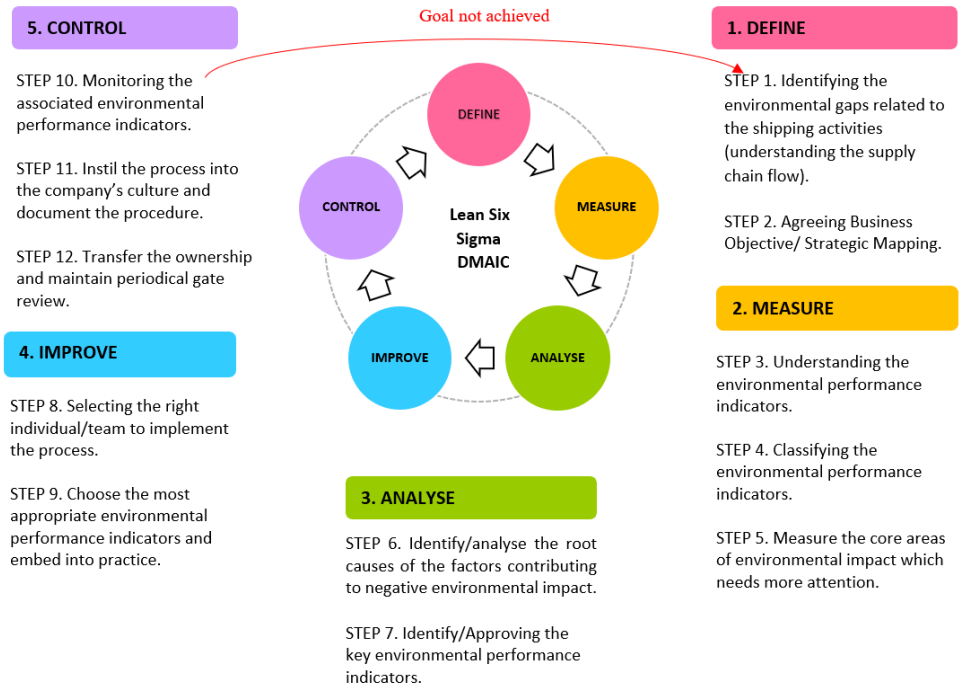


Figure 4 Green Logistics Framework for Shipping Industry

5.1 Phase 1 – Define – Define is the first phase of the Lean Six Sigma improvement process and plays important role in identifying the success of the entire approach. As the name states Defining is entirely about finding the problem and determining the project aim. In the case of this framework for the shipping industry the two steps under the Define phase are identified as follows:

Step 1 Identifying all the environmental gap(s) that are related to the shipping activities (understanding the supply chain flow):
This step helps organisations to locate the environmental gaps within the supply chain flow of the company to understand and mitigate their shipping acts that are degrading the environmental ecosystem. Companies can begin by defining the following sub-steps to obtain the change:

D1: Develop a business case for the project to identify the environmental gaps.
D2: Identify the related stakeholders.
D3: Establishing and emphasizing customers' requirements and needs.

Step 2 Agreeing Business Objective/ Strategic Mapping: This step acts as a bridge between the remaining other steps in the framework as it ensures the accomplishment of the company's objective i.e., mission and vision. For analysing this step, the following sub-steps are to be considered:

D4: Define the environmental objectives of the business that aims to improve environmental performance through its Environment Management System.
D5: Develop a strategic map to achieve the earlier defined objectives

For this step, organisations can apply the following tools as stand-alone or in combination or with any other similar tool.

- SIPOC
- Strategic Planning Gap

5.2 Phase 2 – Measure – Measure is the second phase in the DMAIC process. At this step, organizations analyse the depth of the gap to identify the feasibility i.e., financial, and other resources required. Moreover, this phase acts as a baseline for the current process and can be measured by the following substeps:

M1: Determine the process capability
M2: Validate the measurement system
M3: Data collection

To understand the critical to quality (CTQ) indicators, steps 3 and 4 are developed to determine the performance measures for obtaining the best environmental results.

STEP 3 Understanding the environmental performance indicators (EPI): In this step, various environmental management systems (EMS) such as the International Organisation for Standardization (ISO) ISO 14001:2004,14031:1999, European Union's eco-management and audit scheme provide organisations with guidelines on outlining, identifying, selecting, and implementing the EPI and further divides this into three classifications which are discussed in step 4.

STEP 4 Classifying the environmental performance indicators: The three EPIs are classified as management performance indicators (MPI), operational performance indicators (OPI) and environmental condition indicators (ECI).

- **MPI** – An indicator of a company that helps in determining its environmental operations; for example, expense or budget for an environmental cause, percentage of environmental objectives accomplished, and time invested in analysing environmental incidents.
- **OPI** – An indicator of a company's operational environmental measures; for example, raw material used in shipping building, the average fuel consumption of a fleet of ships and hours allocated for preventive maintenance.
- **ECI** – An indicator that supports the global situation of an environment and is beneficial in calculating the impact of an organisation on the environment at large; for example, the smog events, contaminant concentration in the ocean, and land rehabilitation.

For this phase, organisations can choose any of the following tools as stand-alone or in combination:

- Cause and Effect Matrix
- Process Map
- Spaghetti Diagram

- Value Stream Mapping

Step 5. Measure the core areas of the environmental impact which need more attention: At this step, the focus is to understand/measure the activities that are causing a significant impact on the environment such as pollution exposure, causing damage to marine life, and the environment as a whole. The following goals would help achieve the core purpose of this step:

- Establish baseline performance of the process
- Identify the process performance indicators
- Develop a data collection plan and then collect data
- Validate the measurement method
- Determine the process capability

5.3 Phase 3 – Analyse – In this phase, the aim is to discover and test the primary issues to ensure that further development occurs from deep down where the root issues stem from. To verify the hypotheses the following sub-steps can be considered:

A1: Identify the possible factors influencing the environment
- Chemical accidents during the transport of dangerous goods
- Packaging deficiencies
- High fuel consumption
- Fleet maintenance
- Regulative issues

A2: Determine the main causes that impact the environment by shipping activities
- Five major forms of pollution – air, water, underwater noise, plastic and thermal
- Greenhouse gas emissions
- Release of ballast water
- Oil and chemical spills
- Dry bulk cargo and garbage release

A3: Update the project charter

STEP 6. Identify/Analyse the root causes of the factors contributing to negative environmental impact: Once the potential root causes are identified, the respective managers/teams can identify the most suitable indicators as discussed in phase two – Measure.

STEP 7. Approving the key environmental performance indicators: To have a smooth proceeding, the managers must ensure that the top management is on board and kept informed/involved throughout the earlier phases. This will help to seek their approval, a key element of this step, and to continue further.

To ensure the above steps (steps 6 and 7) are achieved, organisations can deploy the following tools either individually or in combinations:

- The Five Whys
- Regression Analysis
- Root cause hypothesis
- Project Charter

5.4 Phase 4 – Improve – The improvement phase helps organisations to refine their countermeasure ideas, improvement opportunities are further brainstormed, and an improvement plan is documented and implemented. In this phase the core aim is to:

I1: Develop revised process maps and plans
I2: Define a pilot test on improvement actions
I3: Communicate the plan to relevant stakeholders and senior management.

To implement the improvement plan, the organisation can adopt the following sub-steps

STEP 8. Selecting the right individual/team to implement the process: Once the revised process map is in place to mitigate the identified environmental gap, it is vital to identify the right individuals/team to implement the process. A few characteristics to consider while selecting the individuals/team are:

- Availability of the person (select internally or recruit external staff)
- Skills, knowledge, and ability to take the responsibilities
- Valid experience requirement for the role

STEP 9. Choose the most appropriate environmental performance indicators and embed them into practice: At this step, the implementation process should begin. Managers must ensure that they provide full support and ensure that all the procedures are in place while keeping the record from time to time for reference. Once the plan has been embedded and begins with its practice, the team can move on to the next phase.

5.5 Phase 5 – Control – In this phase, managers must ensure that the solutions are properly implemented, documented, and maintained. The team must develop a monitoring and response plan tracker to measure the success of the new process and craft the response if there is a change in performance. Once in place, managers/teams must track and update the ongoing maintenance. In case the defined goals are not achieved, it is recommended that the team/manager move on to the Define phase again. To ensure success in controlling, the following sub-steps must be followed:

STEP 10. Monitoring the associated environmental performance indicators: This step implements the ongoing monitoring of the process performance. The major goal in this step is to establish a well-developed monitoring plan and teams must be trained to ensure that all areas are closely monitored, and updates are provided to managers/top management. Moreover, the responsibilities include monitoring or locating environmental gaps as well. The tools that can be adopted for this step are:

- Control Plan
- Control Chart

Step 11. Instil the process into the company's culture and document the procedure: In this step, it is assumed that the goals are achieved. Managers must ensure the following sub-steps to sustain the improvements made:

a. **Transfer Improvement:** The main idea behind this sub-step is to expand innovation rapidly. This transfer of improvement plans can be either from large or small efforts made, to help in similar future developments.
b. **Continuously Improve the Process:** The control phase is not the end of the phase or the improvement stage but a milestone in the development process. The word "C" in DMAIC not only stands for "Control" but "Continue" (Psaraftis, 2019). To continuously improve, it is best to reflect on four principles of Lean – Value, Flow, Pull and Perfection, elaborated as:
    - **Value:** Determine the steps that are required (are of 'Value') for obtaining the goals.
    - **Flow:** Remove wastage from the process to enhance the system to achieve an easy pace.
    - **Pull:** Ensure the process responds to the purpose of the project.
    - **Perfection:** Continuously pursue "perfection" within the system.

Step 12. Transfer the ownership and maintain periodical gate review – In this step, the documents and procedures are handed over to the responsible personnel for further continuation of the implementation process. The procedure of transferring the ownership must be documented for future reference. Furthermore, the team can proceed to the final check of the periodical gate review.

Building on the above phases successfully will ensure stronger problem-solving skills and strengthen the capability of the managers/teams to provide better results in mitigating the environmental gaps. The overall accomplishment of this framework's phases would motivate the implementation of this framework in shipping industries as well as other industries emphasizing adaptation of Green Logistics.

6. Conclusions, Limitations, and Future Research Directions

This research project has undertaken a thorough study into the obstacles and the issues related to the environmental impact caused by the shipping activities. It has looked into all aspects of how, why, and when the shipping industries have failed to mitigate the environmental impact. The significant learning found within this study is that few aspects

of the shipping activities and the norms are respected however, the greater portion is often neglected and not implemented as required. This appears that the shipping activities have become a threat to the environment by emitting harmful gases and also endangering marine life. Therefore, there is a need for the implementation of frameworks or strategies in the shipping industries to aid in mitigating the environmental impact. And to achieve this, green logistic practices have received substantial attention from practitioners and academics to incorporate into their businesses.

This research proposes a framework by adapting the DAMIC approach with five phases Define, Analyse, Measure, Improve and Control. There are twelve sub-steps within those five phases for better understanding and a systemic approach in implementation to achieve the desired outcome effectively and efficiently. This conceptually developed framework was further verified using the Delphi technique by taking consensus from experts (practitioners and academics) on its construct and efficacy. This technique included two rounds of the Delphi study to obtain consensus from the participants. The feedback, constructive criticism and suggestions provided by the experts extensively helped in streamlining the developed framework by ensuring academic and practical importance are abided.

A major limitation of this research is the small sample size during Delphi Study. Participation of a greater number of practitioners, also from the large shipping industries might have resulted in a broader and in-depth understanding of the shipping industry's operations. Similarly, leading academics from supply chain and logistics backgrounds participated, however, the breadth of knowledge could also be challenged.

Another limitation of this research is that it relies on an online data collection approach. A face-to-face interview with shipping industry experts/practitioners could have helped to gather data and further scrutinize the framework. As this research is majorly qualitative, thus the future research with a quantitative approach and/or mixed-method would benefit to strengthen the analysis and validate the reliability of the framework developed. In addition, a complete implementation of the developed framework could ensure a better understanding of the areas requiring rectification or improvement in further development/adaptation of the framework.

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