Implementation Of Green And Sustainable Supply Chain Management Of Shipbuilding Sector In Bangladesh: A Case Study On Dockyard & Engineering Works Ltd.

Submitted by:

Md. Rasel
ID: MSCM2103024003
Program: MSCM
Major: MSCM
Semester: Spring-2023
Sonargaon University (SU)

Submitted to:

Department of Business Administration
Sonargaon University (SU)
Submitted for the partial fulfillment of the degree of
MBA in SUPPLY CHAIN MANAGEMENT



Sonargaon University (SU),
147/I, Green Road, Tejgaon, Dhaka-1205, Bangladesh.

Date of Submission: May 11, 2023

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Letter of Transmittal

May 11, 2023
Prof. Abul Kalam
Dean, Faculty of Business
Department of Business Administration
Sonargaon University

Subject: Submission of Thesis paper.

Dear Sir,
I am hereby submitting my Thesis paper entitled **"Implementation Of Green And Sustainable Supply Chain Management Of Shipbuilding Sector In Bangladesh: A Case Study On Dockyard & Engineering Works Ltd."** which was assigned to me as a requirement for the completion of the MSCM Program. I have discovered this paper very interesting, beneficial, and insightful.

The entire report is based on my practical experience. I expect this paper to be informative as well as comprehensive. This thesis paper will help me a lot in my future career life.

Thank You very much for your guidance and cooperation during the course without which this thesis paper cannot be completed.

Moreover, if you have any further inquiries concerning any additional information, I would be very pleased to clarify that.

Yours Sincerely

Md. Rasel
ID: MSCM2103024003
Program: MSCM
Semester: Spring-2023
Sonargaon University (SU)

Certificate of Supervisor

This is to certify that the Thesis report **"Implementation Of Green And Sustainable Supply Chain Management Of Shipbuilding Sector In Bangladesh: A Case Study on Dockyard & Engineering Works Ltd."** has been prepared as a part of completion of the MSCM program from Department of Business Administration, Sonargaon University (SU), carried out by Md. Rasel, bearing ID: MSCM2103024003 under my supervision. The report or the information will not be used for any other purposes.

Prof. Abul Kalam
Dean, Faculty of Business
Department of Business Administration
Sonargaon University (SU)

Declaration of Student

This is to notify you that, the Thesis paper on **"Implementation Of Green And Sustainable Supply Chain Management Of Shipbuilding Sector In Bangladesh: A Case Study On Dockyard & Engineering Works Ltd."** has been prepared as a part of my dissertation formalities. It is an obligatory part of my MSCM program to submit a thesis paper.

Moreover, I was inspired and instructed by my supervisor Prof. Abul Kalam, Dean, Faculty of Business, Sonargaon University.

I am further declaring that I did not submit this report anywhere for awarding any degree or certificate.

Yours Sincerely

Md. Rasel
MSCM2103024003
Program: MSCM
Semester: Spring-2023
Sonargaon University (SU)

Letter of Authorization

Certified that this Thesis paper titled **"Implementation Of Green And Sustainable Supply Chain Management Of Shipbuilding Sector In Bangladesh: A Case Study On Dockyard & Engineering Works Ltd."** is the work of Md. Rasel, bearing ID: MSCM2103024003 under my supervision. Certified further that in the best of my knowledge the work reported here in dose not from part of any other thesis paper or dissertation on the basis of which degree or award was conferred on an earlier occasion on this or any other candidate.

Prof. Abul Kalam
Dean, Faculty of Business
Department of Business Administration
Sonargaon University (SU)

Acknowledgment

I would like to express my gratitude to all the people that were involved both directly and indirectly in the preparation of this report. I apologize to the people whose names I haven't mentioned, and their contribution is highly appreciated by me.

First, I would like to thank Almighty Allah who made us able to finish this thesis at the perfect time.

I would like to thank our academic supervisor Prof. Abul Kalam, Dean, Department of Business Administration, Sonargaon University (SU) for guiding me and for giving me the opportunity to initiate this thesis. I am also grateful to those people without whom it was quite impossible to prepare the thesis. I am also grateful to some of the officials of Sonargaon University who help me to make this thesis by collecting data. They help me a lot for prepare this thesis and gave me much important information that is needed for preparing the thesis. Also more thanks to my Office Boss **Mr. K Mahbubul Haque,** Commander BN, DGM (Planning & Design Department) and, **Mr. M Tyebul Islam,** Executive Engineer, Naval Architect (Planning & Design Department) for helping to make this report.

Finally, my sincere gratitude goes to my family, office colleague and friends for supporting me and sharing their thoughts and giving me moral support during the preparation of this thesis.

Executive Summary

The core objective of the dissertation is to fulfill the requirement of the in MSCM program as prescribed by the Sonargaon University. I have been working as a planning & design department of supply chain professional of Dockyard & Engineering Works Ltd in the last 16 years. The main objective of the dissertation is to get the hands-on experience of the real-world organization. The dissertation was completed with the objective of getting practical knowledge in the Supply Chain Management department of Dockyard & Engineering Works Ltd. Green and sustainable supply chain management is the consideration of environmental issues in supply chain management. I have to participate a lot of supply chain management work of the organization. I realized that I was successful to gather a lot of significant learning experiences which would be helpful in my future career. The supply chain profession with planning & design department of Dockyard & Engineering Works Ltd. Offered me ample space and opportunities, not only to learn but also to exhibit my skills as a part of supply chain management planning & design department. I could use my theoretical knowledge of Green and Sustainable Supply Chain Management in real practice while participating in many discussions. I was actively involved in the department meetings where I shared my knowledge and views regarding Implementation of Green and Sustainable Supply Chain Management Practices of Dockyard & Engineering Works Ltd. I also attempted to gather more information on basic job functions of other departments to have better understanding of the relation between them and the supply chain management department. It was commendable to see how wholeheartedly they welcomed, acknowledged and appreciated new ideas and knowledge. I have provided few recommendations based upon my understanding and knowledge. I successfully completed all the assigned duties and handed them over to the senior supervisor at the end of the dissertation. I thoroughly enjoyed the challenges that came along

every single day. I could also bring some minor improvisations during my professional life which were able to leave their marks. These lessons that I have learned will be a valuable one for my future endeavors.

Abstract

With the development of shipbuilding industry, "Green and Sustainable Supply Chain Management of Shipbuilding Sector" design and construction will play the leading role in the future, to keep long-term and healthy development, we must carry out the green shipbuilding, and change the ship models. Environmental problems bring more and more restrictions on which. Therefore, to bring in the "green" concept into the shipbuilding industry is imperative. So, the paper Analysis the Mechanism of green shipbuilding supply chain and the construction of green evaluation index based on the view of society, economy and ecology.

List of Acronyms

SCM: Supply chain management
MRR: Material Receiving Report
PR: Purchase Requisition
PO: Purchase Order
COO: Chief Operating officer
SCLD: Supply chain logistics design
MILP: Mixed Integer logistics Programming
DHLx: Dalsey, Hillblom and Lynn Express
DPEx: Distributed Processing Executive Program worldwide
ABEx: Air Based Expressed
PRGs: Pearl River Glass Studio
MT: Metric Ton
COGS: Cost of Goods
TMS: Time Management System
L/C: Letter of credit
PI & CI: Proforma Invoice & Commercial Invoice
BL: Bill of leading
CR: Certificate of Origin
C & F: Clearing and Forwarding
Logistics: DHL, DPEX, ABPX, PRG, Bkrocks, Euroasia, Zhanjing cargo, KE-11, ARAMEX
Sipping way: Air, Sea, Road
Logistic price comparison: Excel sheet, pie chart, column etc.

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Chapter 01
Introduction

1.1 Introduction

In Bangladesh, shipbuilding industry is one of the first growing rising biggest heavy industries which are facing many challenging issues recently. The study aimed to analyses material, ship construction, and distribution system and recovery procedures of shipbuilding industry sector to apply green and sustainable supply chain management. The study used primary data source. The interviewees are selected based on some specific standards. Interviewees are selected according to their position in management and job experience in shipbuilding industry sector, production department engage, planning and design/design with shipbuilding industry sector and third party companies such as design house. The sample sizes are four respondents which selected from executive level. Three respondents had more than 10 years' experiences in shipbuilding industry sector and a respondent had 12 years' experiences in shipyard engage with shipbuilding industry sector. The dockyard had encouraged to find green designing of raw materials by using ecofriendly elements which not affect the environment. Moreover, the shipbuilding industry had proper use of the raw materials in their production process to minimize the waste of resources due to limited of natural resource. The shipbuilding industry is the most possible export earner business of Bangladesh. The study aimed to analyses material, manufacturing, and distribution system recovery procedures of shipbuilding industry sector to apply green and sustainable supply chain management.

At present, the green ship technology has become increasingly competitive in the green wave world widely. But, in recent years, International Maritime Organization introduces a series of new rules and standards, such as the International Ship Recycling Convention, new NOx/SOx emission standards, new-ship Energy Efficiency Design Index (EEDI), the new coating standard (PSPC), forced to raise the noise level of new vessels, and standard for corrosion Protection for tankers. Green shipbuilding is the trend in the future, so shipyards should speed up green transformation so as to seize the commanding height in the future competition

1.2. Objective of the Study

Green Supply Chain Management (GSCM) is modeled on traditional supply chain management practices, but integrating environmental criteria and concerns into all organizational processes and decisions. A GSCM aims to minimize wastes within a system to conserve energy and prevent the dissipation of dangerous materials into the environment. It recognizes the disproportionate environmental impact of supply chain processes to product outputs within a company’s operational processes. By integrating environmental thinking into supply chain management, these companies have the opportunity to optimize information and material flows within their value chains while minimizing costs. The diagram below illustrates a model of a green organizational and sustainable supply chain.

Source:

Traditional and green and sustainable supply chains differ in several ways. Traditional chains focus on **economic objectives** and **values**, while green and sustainable supply chains consider **ecological values** alongside a company’s business objectives. When a traditional supply chain takes ecological standards into account, it is often limited in its scope. For example, traditional chains actively consider human toxicological impacts, while leaving out the impacts on

the environment. They also often tend to focus more on the control of the final product, rather than on negative effects within the entire supply chain.

Green supply chains, however, extend the scope of sustainability beyond human toxicological effects, to consider the full environmental impacts alongside economic objectives. The summary table below highlights the differences between the features of traditional and green and sustainable supply chains.

1.3. Methodology of the Study

Despite the increasing interests in supply chain management (SCM) within the academy and industrial environment, there is still a lack of academic literature concerning topics such as methodologies to guide and support SCM evaluation. Therefore, most developed methodologies have been provided by consulting companies and present a restrict publication and use. This article presents a methodology for evaluating companies´ adherence degree to a conceptual model of SCM. The methodology is based on the Cooper, Lambert and Pagh original contribution and it involves eleven analysis referential axis established from key business process, horizontal structure, and initiatives and practices. It was pre-tested and supplemented with findings from interviews with academics and practitioners. Additionally, an illustration application was conducted in three relevant companies for refining and demonstrating its applicability. In general terms, the methodology can be considered as a diagnosis instrument that permits the companies to evaluate its status concerning the SCM. Keywords: Supply Chain Management, Supply Chain Management Models, Business Process, SCM initiatives and practices. INTRODUCTION Business management has entered the era of inter-network competition. This means that individual businesses no longer compete as solely autonomous entities, but rather as supply chains. In this emerging competitive environment, the ultimate success of the single business will depend on management's ability to integrate the company's network of business relationships. Supply chain management is a strategy through which such an integration can be achieved (SADEH et al., 2003) (CHRISTOPHER, 2001) (CHRISTOPHER & RYALS, 1999). Supply chain management (SCM) is a new and important area in the field of management research. Despite the increasing interests in this area and the proliferation of SCM within the academy and industrial environment, yet there is still a lack of academic literature concerning topics such as methodologies to guide and support SCM evaluation and implementation (AKKERMANS et al., 2004; CROXTON et al., 2000; LAMBERT et al., 1998). Specially, the absence of a methodology for evaluating supply chain management can be considered one the most critical lack in this area. Additionally, most methodologies related to SCM implementation have been provided by consulting companies and present a restrict publication and use. Therefore, before implementing SCM in a company, as any other concept, it is first necessary to evaluate its status concerning SCM related concepts and for that it is of utmost importance to establish measurement scales. Considering limitations in current literature and in SCM practical applications, the objective of this article is to present the development of a methodology for evaluating in what extent companies adhere to a conceptual model of SCM. A very important aspect of this development is that it should provide a framework for analysis, an efficient method for SCM field development and a clear explanations for practical applications, what can be considered of fundamental importance for researchers and practitioners (WACKER, 1998). In summary, it focuses on identifying and selecting a SCM conceptual model as a reference, identifying and defining the adequate research methodology and developing the methodology for evaluating companies' adherence degree to the conceptual model. The methodology was based on the conceptual model of Supply Chain Management proposed by Cooper, Lambert and Pagh (Cooper et al. 1997), and on SCM initiatives and practices. It involves eleven analysis referential

axis established from key business processes, SCM horizontal structure and initiatives and practices. The key business processes involves Customer Relationship Management, Customer Service Management, Demand Management, Order Fulfillment, Manufacturing Flow Management, Supplier Relationship Management, Product Development and Commercialization and Returns Management. The SCM initiatives and practices selected for the methodology are: Supplier and Customer base Reduction and Consolidation, Postponed Manufacturing, In Plant Representatives, Early Supplier Involvement, Electronic Data Interchange, Vendor Managed Inventory, Efficient Consumer Response, Collaborative Planning, Forecasting and Replenishment. Finally, the SCM horizontal structure considers which tiers of suppliers and customers, beyond first tier, are monitored by the focal company. In terms of its structure, this article consists of five major sections besides this introduction. In section two is summarized the theoretical framework of SCM. In section three is discussed the selection of the reference SCM conceptual model used to develop the methodology. In section four is presented the research methodology. In section five is presented the development of the methodology for evaluating companies' adherence degree to a conceptual model of SCM. In section six is pointed out the main conclusions. Supply chain management Nowadays most individual business no longer compete simply as autonomous organizations but rather as supply chains. Supply chain is referred as a set of companies involved in the upstream and downstream flows of products, services, finances, and information from a source to a customer (MENTZER et al. 2001). In brief, it can be understood that the supply chain constitutes a network of business relationships. Under this point of view, as stated in section 1, the success of a single business depends, primarily, on its ability to integrate the company's network of business relationships. Thus, what definitely matters is not the competitiveness of an individual company but that of the supply chain in which the company is inserted. Christopher (1992) pointed that currently the real competition is not company against company, but rather supply chain against supply chain. In this context, Supply Chain Management (SCM) has emerged as a form of achieving adequate integration of company's network of business relationships. Supply chain management extends the idea of integrating internal business functions, departments, and processes beyond the company's frontier to all the companies in the supply chain (Cooper et al. 1997). Hammer (2002), suggest that will succeed companies that are able to work in close association with its partners for the development of projects and for the management of processes that involves all the supply chain. There are many definitions for supply chain management. Taking into account all the above mentioned aspects and specific objectives and purposes, The Global Supply Chain Forum definition was adopted for the development of this article: "Supply Chain Management is the integration of key business processes from end user through original suppliers that provides products, services and information that add value for customers and other stakeholders" (LAMBERT et al. 1998 a; CROXTON et al. 2001). THE REFERENCE SCM CONCEPTUAL MODEL From a review of relevant literature, six SCM conceptual models that recognize the need of implementing business processes were identified (Cooper, Lambert, and Pagh 1997; Supply-Chain Council - SCOR 1996; Bowersox, Closs, and Stank 1999/Melnyk, Stank, and Closs 2000; Srivastava, Shervani, and Fahey 1999; Vollman, Cordon, and Heikkilä 2000; Mentzer 2001). According to Lambert et al. (2005) and Pires (2004), only two of those conceptual models provide enough information to support research development in this important area: Cooper, Lambert, and Pagh 1997, and the Supply Chain Council - SCOR models. In this context, Cooper, Lambert and Pagh SCM conceptual model (Cooper et al. 1997) was selected to support the evaluating methodology development proposed in this article, based on many reasons. One is its high frequency of inclusion in existing research, much superior than the SCOR model. Another is the fact that it is defined broadly and abstractly enough to facilitate its potential study (LUCAS, 1974 in LEWIS, 1998). Additionally it is of ample comprehensiveness, since encompasses eight main business processes involving at least six functional areas of the companies. It has a more academic and didactic base since it presents clearly a conceptual structure and provides detailed information about the business processes what amplify

the possibilities to theory development. Research methodology the research methodology adopted for this paper combines three different methodologies. Firstly, to define the basic model, it involves the use of Discovery Oriented Approach (Kohli & Jaworski 1990; Menon et al. 1999) to create a preliminary methodology and to complement the literature investigation with discussions in small groups of professionals from academy and industry, directly involved with the area. Secondly, it is complemented with an additional step that involves pre-testing the methodology by submitting it to a group of potential respondents and integrating the obtained knowledge to the preliminary methodology (FORZA, 2002). Finally, it is also supported by Lewis (1998) iterative triangulation. It employs systematic iterations between literature review, case evidence and intuition based on the researcher experience and judgment. Therefore, according to the research methodology adopted for this study, three stages were necessary for the development of the evaluating methodology; - Stage 1: development of the preliminary methodology based on an extensive review of diverse, relevant literature (Preliminary Methodology); - Stage 2: development of the adjusted methodology from academy and industry perspectives (Adjusted Methodology), and - Stage 3: development of the methodology for evaluating companies' adherence degree to a conceptual model of SCM by integrating knowledge obtained from the illustration application (Evaluating Methodology). The methodology is better detailed during the development of each stage, in next section. DEVELOPMENT OF THE EVALUATING METHODOLOGY In this section are detailed all the necessary stages for constructing the methodology for evaluating companies' adherence degree to a conceptual model of SCM. Development of the Preliminary Methodology Based on The Global Supply Chain Forum SCM definition, on conceptual model of Supply Chain Management proposed by Cooper, Lambert and Pagh and on some basic SCM initiatives & practices, the methodology establishes eleven analysis referential axis. The first nine analysis referential axis are related to key business processes and it should identify weather the company manages and integrates them within first tier key customers and first tier key suppliers. Key business processes proposed by Cooper et al. (1997); Lambert et al. (1998 a); Croxton, et al. (2001), are: - Customer Relationship Management; - Customer Service Management; - Demand Management; - Order Fulfillment; - Manufacturing Flow Management; - Supplier Relationship Management; - Product Development and Commercialization, and - Returns Management; In order to eliminate a possible source of confusion Returns Management process was separated in Returns Management from customers and Returns Management to suppliers. The tenth analysis referential axis is related to horizontal supply chain structure and should identify weather the company monitors the management of key business processes beyond first tier of key suppliers and first tier of key customers. The eleventh analysis referential axis is related to SCM initiatives & practices and should identify weather the company uses or intend to use these initiatives & practices to support business processes management. A defined number of requirements were associated to each analysis referential axis. From the analysis of each requirement in each one of the referential axis it is possible to establish the company's adherence degree to the conceptual model of SCM. It is important to note that the core of the methodology is related to the integration of key business processes. Requirements associated to the analysis referential axis related to key business processes Key business processes definitions, objectives and strategic and operational sub-processes stated in literature (Croxton et al. 2001, Lambert 2004, Bowersox & Closs 2001, Christopher 2001 and Lambert et al.1998b) were detailed, analyzed, and translated into evaluating parameters or requirements using the language of industrial environment. One hundred requirements were identified for key business processes. These requirements were submitted to a selected group constituted of a professional from industry, an academic and three professors/consultancy professionals. After a lot of discussions and many decisions meetings, were defined which requirements should be considered in the methodology. The final requirements are presented on Table 1 to 11.

1.4 Limitation of the Study

Going green helps in protecting the natural system of the earth but for business, it means bearing extra prices.

1. **Expensive:** Purchasing wind power electricity or switching to solar power can be costly for your corporation and may incur a premium price.
2. **Data risk:** Going completely paperless will directly risk your data Record Keeping. The system crash, theft of computers, viruses, and hacking of sensitive information can prove disastrous.
3. **Increased product prices:** Using green materials in your facility or production process can lead to a higher cost that is passed to the customers or have to be borne by the company's expense.
4. **Customer backlash:** If consumers get aware of a company getting involved in green washing then it may harm its credibility. Green washing is the process by which the company can make a false claim of their product being environmentally friendly

Our study has another several limitations. A generic limitation of this type of study is that typically the suppliers that are interested in GrSCM activities may have more readily agreed to fill out the questionnaire. The objective of our study was to investigate the drivers of supplier participation in GrSCM initiatives. Hence, insights about drivers from suppliers that indeed are interested in green practices are valuable for our purpose. Nevertheless, future studies may want to investigate obstacles to participation and therefore focus on suppliers that refrain from participating in green initiatives.

Second, we find a high correlation between GrSCM readiness and three other constructs in our sample, yet all correlations are less than the square root of AVE for the GrSCM readiness construct. Respondents apparently are aware of the needs of the other stakeholders, which is in line with stakeholder theory. In contrast, only moderate correlations are observed with customer requirements and green SCM participation. Further research could look into this matter.

Third, our study shows disconnect between customer requirements and green initiatives at the supplier side. Probably this lack of interest is related to the nature of the shipbuilding industry. In further research the model could be expanded using mediating factors such as customer supplier relationship intensity to study this issue more deeply.

Chapter 02
Profile of the Organization Details of Dockyard & Engineering Works Ltd

History of Dockyard and Engineering Works Ltd:

As a country with hundreds of rivers running through its veins, it's no wonder Bangladesh has ship building skills in its blood. Dockyard and Engineering Works ltd (DEW). began their humble journey as Narayanganj Dockyard Limited, as the first ever of the Indian Sub-Continent, on **1926**. And after an eventful journey of three different regimes including **British Colonial, East Pakistan** and finally independent **Bangladesh**, it has shunned its skills of shipbuilding for more than a century. Now under the expert hands of Bangladesh Navy from 2006, it has seen immense growth and success going forward.

Built over 22 acers of land area with a riverfront of 900 ft. It is capable to dock vessels up to 1500 ton (light weight) of 88.4m (290ft) length. The production capacity of the yard is 3000 tons steelworks per year. It has 27,220 sq. m. of open area and 3,000 sq. m. enclosed area for shipbuilding. 26% space is kept free for greenery to make it an environment friendly green industry.

Dockyard and Engineering Works ltd. specialized in constructing modern ships & craft for military, govt. organizations and for private owners including Patrol Craft (PC), Inshore patrol Boat (IPV), Fast patrol Boat (FPB), Harbour Patrol Boat (HPB), Gun Boat, Landing Craft Tanks (LCT), Tug, Oil Tanker, Passenger Ferry, Ro-Ro Ferry, Survey Vessel, Coaster, Composite High Speed Boat, Aluminium Speed Boat, Bay Crossing Barge, Self-propelled Cargo Berge, General Type Pontoon, Self-sustained Pontoon etc. We also provide Refit and Repair, Engineering and Manufacturing support of ships, craft and machinery components.

The country's first warship was built at Dockyard and Engineering Works Limited, Narayanganj in 1972. In 2012, DEW built a first of its kind water jet powered Aluminum boat for Bangladesh Coast Guard. Our valued clients are including Bangladesh Navy (BN), Bangladesh Coast Guard (BCG), Bangladesh Army, BIWTA, BIWTC, CPA, MPA and many other Private Organizations.

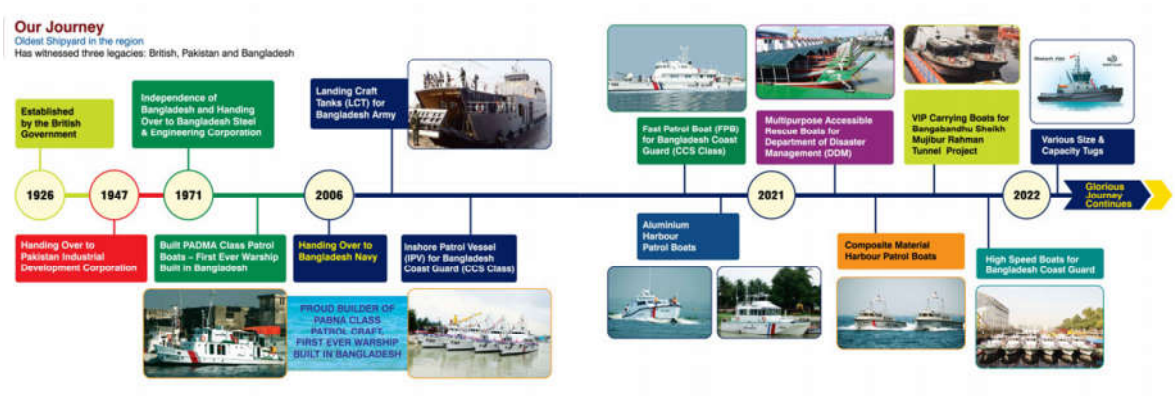
Dockyard and Engineering Works ltd. is an ISO 9001:2015 certified company, and maintains the philosophy of Total Quality Management (TQM) to ensure highest quality and support of our products and services to our valued clients.

Historical Chronology:

Shipbuilding is one of the earliest industries developed in Bangla. The golden period of shipbuilding of Bangla was in the tenure of the Mughal Emperors. The Mughal Naval Force had built a large number of ships at Chattogram. The British Navy used warships which were built here in Bangal.

In the time of British Government Narayanganj was one of the prominent business zones of this sub-continent. Well-connected river routes made Narayanganj port a potential business hub. Hundreds of ships used to berth here for goods transportation. Many of those harbored ships needed to be repaired because of long voyage. With this demand, then the British Government came up with the idea of establishing dockyard, here in Sonakanda, Bandar, Narayanganj, from their business perspective.

Dockyard was handed over to Pakistan Industrial Development Corporation **(PIDC)** from the ownership of Royal Indian Marine Services **(RIMS)** in**1947.**



1948-1956

In 1956, 'Narayanganj Dockyard Limited' was changed to 'Dockyard and Engineering Works Limited **(DEW)**'.

1957-1971

In 1971, the government of Bangladesh handed over this dockyard to the Bangladesh Steel and Engineering Corporation **(BSEC)**.

1972-1978

- The country's first warship was built at Dockyard and Engineering Works Limited, Narayanganj in 1972. It was named BNS PABNA.
- The second warship BNS NOAKHALI was built in 1972.
- The third warship BNS PATUAKHALI was built in 1974.
- The fourth warship BNS RANGAMATI was built in 1977.
- The fifth warship BNS BOGRA was built in 1977.

1979-2002

In 1979, DEW ltd. secured a contract with Food and Agriculture Organization of the United Nations to supply 08 food-grain carrying vessels to BIWTC. On 21st December 2002 DEW ltd. subsequently handed over to Bangladesh Privatization Board in an effort to revitalize the industry.

2003-2006

Finally in 2006 DEW was handed over to Bangladesh Navy (BN) to revive the old fame. The decision of handing over DEW to Bangladesh Navy was the major breakthrough in the history of its revitalization. Being an enterprise of Bangladesh Navy, this shipyard started its production by repairing naval ships for Bangladesh Navy.

2007-2012

Being an enterprise of Bangladesh Navy, this shipyard started its production by repairing naval ships for Bangladesh Navy. In 2012, DEW built the first ever water jet powered aluminum boat for the Bangladesh Coast Guard.

2013-2019

DEW has been awarded he Best Corporate Award in 2014 presented by ICMAB. DEW was awarded the Best Corporate Award again in 2015 presented by ICMAB, in special category. DEW again won the Best Corporate Award in miscellaneous services category, presented by ICMAB, in the year 2017. As a part of its marketing strategy, DEW participated in different marine EXPOs and events such as Bangladesh Institute of Maritime Research and Development (BIMRAD) seminar in the year 2018. The DEW participated in the marine exposition Bangladesh International Marine and Offshore Expo 2019 (BIMOX) in 2019.

2019-2022 In the financial year 2019-2020 DEW consumed approximately 2070 tons of steel. In the financial year 2019-2020, yearly turnover was Taka 1,611 crore, net profit was Taka 77.65 crore.

On 2nd September, 2021, DEW delivered 8 out of 60 Rescue Boats ordered by the Department of Disaster Management under the Ministry of Disaster Management and Relief. On 12th June, 2021, DEW delivered 10 out of 17 Tugboats ordered by Bangladesh Inland Water Transport Authority (BIWTA) which established a new milestone for the yard. At present a large number of shipbuilding projects are under progress. The steel consumption is expected to reach 3100 tons steel in financial year 2021-2022, which will be very impressive.

Shipbuilding:

Shipbuilding is synonymous with Bangladesh. Shipbuilding is a way of life in Bangladesh and stretches back over several centuries. DEW has a rich history of 100 years of building ships, crafts and boats. DEW is specialized in building Patrol Craft, Landing Craft Tanks, Harbor Patrol Boat, Cutter Suction Dredger, Tug Boat, Ferry, Survey Boat, Passenger Ship, Composite/ GRP High Speed Boat, Barge, Pontoon, Channel Buoy and many more. The first ever war ships built in Bangladesh are made by DEW for Bangladesh Navy.

It has the ship construction capacity of 3000 tons per year with slipways with capacity of 1500 tons and capable of docking vessels around 80 meters of length. There are around 700 workers who have great skills in welding, fitting and other engineering activities like lifting, and machine operating. DEW complies ISO 9001:2015 quality management system and have more than 30 professional engineers having good quality leadership and experience in shipbuilding.

Our clients include Bangladesh Navy, Bangladesh Coast Guard, Bangladesh Army, Bangladesh Inland Water Transport Authority, Bangladesh Inland Water Transport Corporation, Chittagong Port Authority, Mongla Port Authority, Payra Port Authority, Bangladesh Water Development Board, Sin hydro, Haripur Power Plant, North West Power Generation Company Ltd.

DEW is committed to make sure that its valued customers are satisfied by delivering high-quality products on time and providing a variety of service assistance during construction phase of the projects and to provide continuous after sales service throughout the life cycle of the product.

Services:

Repair maintenance to ensure uninterrupted services from a ship/vessel's machinery and other equipment, routine maintenance and timely repair is more important to enhance the longevity. Thus, quality repair and maintenance support are the first priority of DEW to your maritime assets. From the largest and most complex mechanical items such as engines, thrusters, propulsion systems and cranes to navigation, automation, IT and safety systems, together with our industry partners we provide a complete one-stop service that will ensure that your vessels leave our yards at peak efficiency and class-compliant.

We also offer a range of vessel maintenance solutions for regular customers that include predictive, preventative, and condition-based packages so as to all but eliminate the risk of equipment failure.

We offer the following repair and maintenance services are Hull surface treatment, Steel repairs and renewals, Machinery repairs, Ballast tank cleaning/coating and pipe renewals, Steering gear works, Propulsion system repair, Electrical, piping, and mechanical systems repairs, Scrubber installation, Engine repair, inspections and maintenance, large fabrications.

DEW have qualified resources and logistics support to provide service and solutions to the customer. DEW has a dedicated QC team, consists of qualified Naval Architects, Mechanical Engineers, Electrical Engineers and speciali zed personnel, to ensure the quality of purchased material and finished products of this organization.

We follow in TQM (Total Quality Management) principles in our work and maintain the quality as per International Classification Society rules and Marine standard for which we have certified for the works. Our Certification authority consists: LR, DNV, BV, RINA, CCS, and ClassNK. Additionally, we are also 9001:2005 Certified.

We provide following Services are Ship Building, Ship Repairing, Re-generating and Re-powering, Engine and Machinery Overhauling, All types of Engineering Works, Civil Construction Works (Steel Structure), Supply of marine engine, machinery and equipment, Addition to these services we also provide civil works and Engineering solutions which includes Foot-over Bridges, Civil Infrastructures, River Embankment, River Dredging, Construction of Causeways & Baily Bridges as well as Shore Bollards.

Re-Engining:

Routine Maintenance and Engine Repairing is one of the most important task to ensure smooth and efficient operation of the Marine Vessel. Engine parts needs to check on regular basis and repair and replacement must be done in timely manner to avoid failure and breakdown of the ship. Re-Engining involves replacement of Engine and engine parts, Propulsion system maintenance and improving the overall efficiency of the ship. Marine Engine repair is categorized in two parts electrical and mechanical. Re-Engining includes maintenance and repair work on the mechanical parts of the engines as well as replacement of various electro-mechanical equipment.

DEW ltd. is capable of various kinds of Re-Engining works which can improve speed acquisition, lower fuel consumption, weight optimization, advanced electrical power and control system installation for engine etc. Our marine engineers carry out the re-engining works with their years of expertise, sound troubleshooting knowledge and correct techniques used for testing and overhauling.

We are specialized in re-engineering works of all kinds of marine engines, jet propulsion, out board engine and regeneration of diesel generators. All kinds of service tools, special tools and equipment related to engine lifting, engine removal, new engine installation, engine alignment, shafting works, propeller trueness checking are effectively carried out in our dockyard.

DEW ltd. is committed to provide its customers high quality re-engining works by the support of its qualified engineers and skilled workers. It has dedicated team of engineers and skilled workers to carry out your re-engining related works. We have the infrastructure and manpower for all your re-engining works in maritime sector.

Civil Works:

DEW ltd. not only build and maintains ships and marine vessel, it is also engaged in various civil works and engineering solutions as well. DEW provides different types of engineering solutions for repairing and maintenance of components of machinery and equipment like road and bridge, Civil Infrastructures, River Embankment, River Dredging, Construction of Causeways & Baily Bridges as well as Shore Bollards. DEW also takes part in various nation building projects entrusted by the government of Bangladesh. Below are some highlights of our major civil and engineering works:

List of Ship New Building:

With 100 years of history of building ships and marine vessel, we have a rich portfolio of various ocean going vessel, War ships, Passenger and Naval ships, Barge, Pontoon and marine boats. DEW constructs modern ships & craft for military, govt. organizations and for private owners. These products include Patrol Craft (PC), Inshore patrol Boat (IPV), Fast patrol Boat (FPB), Harbour Patrol Boat (HPB), Gun Boat, Landing Craft Tanks (LCT), Tug, Oil Tanker, Passenger Ferry, Ro-Ro Ferry, Survey Vessel, Coaster, Composite High Speed Boat, Aluminium Speed Boat, Bay Crossing Barge, Self-propelled Cargo Berge, General Type Pontoon, Self-sustained Pontoon etc. The country's first warship was built at Dockyard and Engineering Works Limited, Narayanganj in 1972. Ships built in the role of Riverine Patrol Crafts were called under the name "PABNA CLASS". Total of five ships were built and they are as follows: BNS PABNA (1972), BNS NOAKHALI (1972), BNS PATUAKHALI (1974), BNS RANGAMATI (1977), and BNS BOGRA (1977). The principal particulars of these PABNA CLASS ships is Displacement: 75 tons, Length: 75 feet, Breadth: 20 feet and Draught: 5feet, Personnel Carrying Capacity: 33 persons and Fire Power: One 40 mm Bofors gun. All these ships are still in service in Bangladesh. DEW also pioneers building patrol boats such as 08X HIGH SPEED PATROL BOAT (HSPB) (COMPOSITE) 10X HIGH SPEED PATROL BOAT (HSPB) (COMPOSITE) They are delivered to Bangladesh Navy and Bangladesh Coast Guard respectively.

Resources:

DEW ltd. has the best resources and infrastructures available for all kind of marine engineering works related to any kind of marine vessels.

Skilled Manpower:

DEW has a dedicated and highly qualified management body, consists of high-ranking naval officers from Bangladesh Navy, involved in decision making, forecasting and planning all activities. Managing Director organizes the shipyard, implements all business decisions by discussing with key personnel. It has a dedicated team, consists of qualified Naval Architect, Mechanical Engineer, Electrical Engineer and specialized personnel, to ensure the quality of purchased materials and finished products of this organization. A large team 700 skilled workers ensure on time delivery and efficient workmanship.

Infrastructure:

It has 22 acers of land area with a riverfront of 900 ft. It is capable to dock vessels up to 1500 ton (light weight) of 88.4m (290ft) length. The production capacity of the yard is 2070 tons steelworks per year. It has 27,220 sq. m. of open area and 3,000 sq. m. enclosed area for shipbuilding. 26% space is kept free for greenery to make it an environment friendly green industry.

Overall area of the yard is harmoniously distributed among production area, infrastructure and free spaces. Two shipbuilding fabrication shed of 5,400 sqm (approx.) and 4,800 sqm (approx.) respectively. North yard area of 17,000 (Sqm approx.) It has a Central Warehouse having 1200 sqm. (approx.) and other stores (old) having 1600 sqm. (approx.) space for storing all types of goods necessary for shipbuilding.

For shipbuilding and other production, DEW has Slipways & Wet Basin, Docking Section, Shipbuilding Shop, Composite Boat Building Shop, Outfitting Shop, Machine Shop, ICE Shop, Electric Shop, Carpentry Shop, Paint Shop, Foundry Shop and Maintenance Shop. For Heavy lifting DEW has 01x Portal Jetty Crane (20 ton at 30m distance), 02 x Mobile Crane (30 tons) and 02 x Fork Lift (05 tons).

Machinery and Logistics:

01x 100 Ton Crane, 01x Portal Jetty Crane (20 ton), 02 x Mobile Crane (30 tons), 05 x Fork Lift (05 tons), 03x CNC Plasma Cutting Machine, Hydraulic Press Machine, Angle Bending Machine, Bevel Shearing Machine, Hydraulic Shearing Machine, Hydraulic Press Break Machine, Overhead Crane Centre Lathe Machine, Heavy-Duty High-Speed Lathe Machine, Heavy Duty Lathe Machine, Vertical Boring & Turning Machine, Horizontal Boring & Milling Machine, Double Ended Grinding Machine, Bend Saw Machine with Accessories, Overhead Cranes (20 ton), 03 x Diesel Generators (400 kW, 380 kW & 250 kW), Slipway is consisting of 13 x Rails etc.

2.1 Vision:

To be the leading shipbuilding industry in the region and trusted global partner in shipbuilding and engineering works.

2.2 Mission:

To support our valued customers in easy acquisition and efficient operation & management of maritime assets and assists them to face future challenges in maritime sector:

Our Mission is to provide all support in shipbuilding effective maintenance of vessels equipment and fabrication of hull and machineries providing engineering solutions and timely delivery to meet the expectations of the clients with satisfaction.

2.3 Core Values:

Trusted, Reliable, Capable, Reputed Values that drive each member of DEW to meet expectations of valued Client. Our motto (Trust Tradition Craftsmanship)

- **Passionate:** Our passion reflects in our actions to keep upgrading quality of our products and services, setting challenging goals and chasing them, and continuous learning.

- **Caring:** Our people are biggest asset. Being sensitive and caring to their needs and expectations is the basis on which our people policies are decided. We go extra miles to ensure that an environment of understanding, support, community, and mutual respect is created and sustained.

- **Innovative:** We keep critically examining our processes and approaches, in product and service offerings, internal processes, and people aspects. We recognize that innovation is the way to address future, create a differentiation, and deliver stake holder value.

- **Courageous:** Courage to us is dreaming big and taking bold decision. This has been the cornerstone of our journey so far. This defines how we envision our future, and determines how we will reach there, howsoever difficult and challenging it may seem.

- **Accountable:** Once we take a responsibility we own it completely. We recognize that when a promise is made, there are no excuses. This is accounting for us.

Head Office: Bangladesh Navy Headquarter, Banani, Dhaka.

Industry: Dockyard and Engineering Works Ltd, Bangladesh Navy, Sonakanda, Bandar, Narayanganj-1410, Bangladesh.

Chapter: 03
Literature Review

Traditional supply chain is chain structure models. It connect the suppliers, manufacturers, distributors, retailers and the user together by control of the information flow, logistics and capital flow (Huang, P.S. et al, 2009). It begins from procurement of raw materials and finally until distribute the users. To some extent, green supply chain management includes all the enterprises related to the production progress. It is not only the financial chain, the material chain and the information chain that connect the suppliers, the manufacturers and the users together, but also a value chain. Because of the value of material increases during the processing, packaging, and transportation process in the supply chain, the enterprises benefits from it (Lu, L.Y. et al, 2007). In the supply chain, generally there is a core enterprise. It is the organizers that organize and joint the production, distribution, retail process together. Because of this, the core enterprise plays an important part in the supply chain management. Supply chain management mainly includes four basic elements: plan, procurement, manufacturing and distribution (Zhu, Q.H. et al, 2005). We will introduce it in detail below.

Plan:

This is a strategic part of the SCM. A good strategy is needed to manage all resources to meet customer demand. By good plan, it is able to establish a method of monitoring the supply chain, enabling it to deliver high quality and high-value products or services effective.

Procurement:

It is the step to choose suppliers of goods and services, to establish a set of pricing, delivery and payment processes and to create methods of monitoring and improving management, also it is essential to combine the suppliers' goods and services together, including delivery, verification of invoices, transfer of goods to your manufacturing and approved payments to suppliers (Huang, P.S. et al, 2009).

The Mechanism of Green Shipbuilding:

Green ship manufacturing technology considering have minimal impact on the environment in ship manufacturing process and have the highest resource utilization rate. Through using the advanced technology, which can meet the user requirements, can save resources and energy, can reduce the pollution of the environment and give the workers good protection.

Manufacturing:

Arrangements for the production, testing, packaging and delivery preparation are included in the progress. It is the largest part of the SCM progress, including testing the level of quality, product yield and productivity of workers and other measurements (Drumwright, M.E. 1994).

Distribution:

It is usually known logistics, which includes adjusting the user's order receipt, the establishment of warehouse network, delivery, the establishment of invoicing system and receive payments.
The progress of achieving an integrated supply chain can be seen in figure 1.

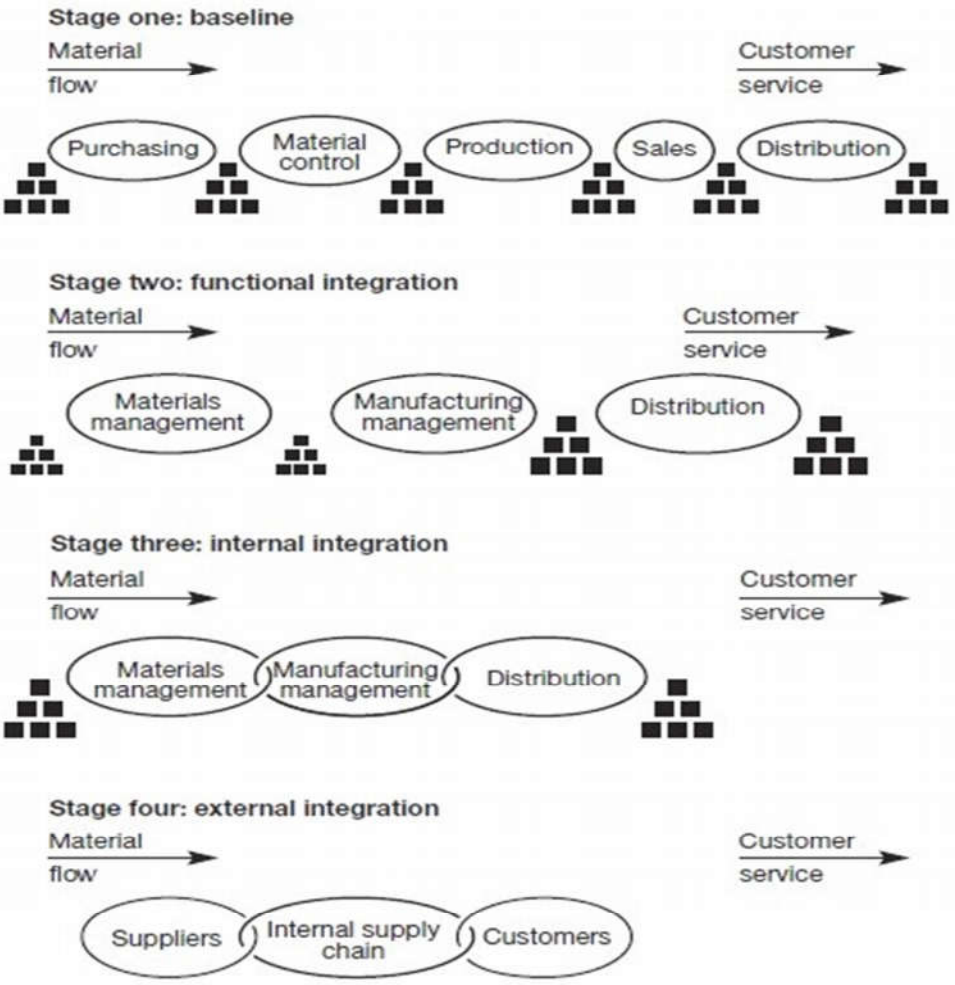


Figure 1: Achieving an integrated supply chain

Source:

Stevens, G.C. 1989. In Christopher, M. 2005.In the figure above, there are 4 stages in the development of supply chain management. That's to say, this figure directly show us an image of supply chain. Stage 1 is an ordinal state, in this stage, every part of supply chain including purchase, material control, production, sales and distribution are separate. Then companies gradually realize the importance of cooperate so integrate in some parts, which forms stage 2. In stage 3, a supply chain is preliminarily formed. And then the supply chain continues to develop, gradually external integration forms that are stage 4 in the figure.

A survey research study was chosen in order to gain better understanding about drivers effecting supplier participation in GrSCM. The survey method was employed because it allows to collect a large amount of standardized data from a sizable population in an economical way and the collected data can easily be analysed and compared (Saunders et al. 2007). Several research methods can be used by using a survey strategy, such as interviews, structured observation and questionnaires (Saunders et al. 2007). In this study the questionnaire was chosen to collect the data needed to test the above mentioned hypotheses, because of

(1) the large amount of structured data needed,
(2) the large number of respondents needed,
(3) the limited time available and
(4) the relative little information needed from respondents.

According to Cooper and Schindler (2003) some of the most important advantages of questionnaires are:

- Cost-effectives.
- It can be administered remotely via the Web, mail, e-mail, telephone, etc.
- A questionnaire is perceived as more anonymous.
- It allows respondents time to think about the questions.
- A questionnaire allows contact with otherwise inaccessible contacts.
- Efficient at collecting information from a large number of respondents.
- The data can easily be worked out used for analyzing and testing.
- A wide range of information can be collected. Although, for this study, a questionnaire is the most appropriate method to collect the data, there are some disadvantages to be mentioned:
- Respondents may not be motivated to give accurate answers.
- The questionnaire may not be too long, so the measurement items are limited;
- Preparation time is higher.
- Low response rate
- No interviewer intervention available for explanation;
- Preparation time is higher.

Chapter: 04

Analysis of the Study

Material management was major factor for implementing the green and sustainable supply chain management in shipbuilding sector of Bangladesh. Raw material was key factor for any shipyard to produce the final product. The shipyard have encouraged finding green designing of raw materials by using eco-friendly elements which not affect the environment. These eco-friendly raw materials are produced from mine and mild steel produced using for ship hull or body.

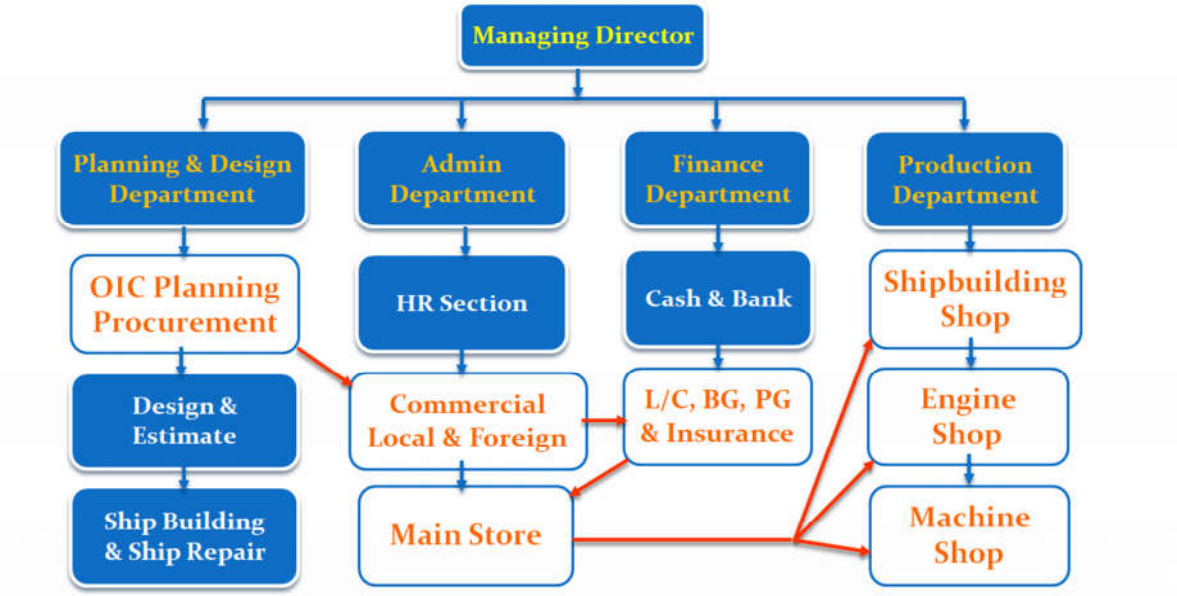
Dockyard and Engineering Works Ltd (DEW) was established on 22 acres of land on the eastern bank of the river Shitalakhya in Narayanganj in 1922. It was one of the oldest dockyard of British era, thus has a long history of ship building and repair works involving a wide range of vessels. DEW was a profitable business entity during the British colonial period and the later Pakistani days and until some years after the independence of Bangladesh. In 1971, the dockyard was run by Bangladesh Steel Engineering Corporation **(BSEC)** of the Ministry of Industries. However, despite some commercial **success in 1980s**, the dockyard was unable to continue with financial viability had to be **laid off in 2002**. In **2006 Bangladesh Navy** (BN) under the Ministry of Defense took over the administration and management of DEW from the (BSEC) to run the Dockyard as a commercial enterprise. DEW is consists of 4 departments, there are 1. Planning & Design Department, 2. Production Department, 3. Admin Department, 4. Finance Department, but this department is consists of many sub section and workshop. Every workshop is play main roll of route level on the production of job.

Planning & Design Department:

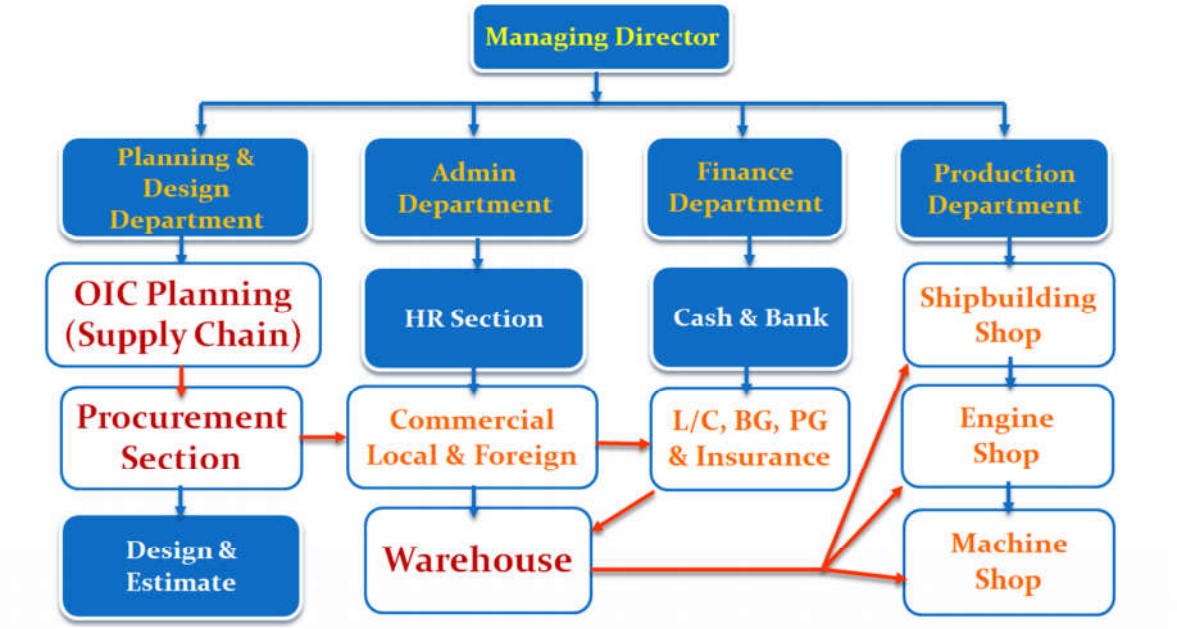
DEW has a dedicated & highly qualified management body, which is involved in decision making, forecasting and planning. Managing Director organizes the shipyard, implements all business and production decision by discussing with key personnel. The management practices democratic values in policy implementation system. The supply chain don't strongly established in this organization now. Because **British era, Pakistan era, Bangladesh era (BSEC)**, supply chain function apply traditionally. In **2006 Bangladesh Navy era** try to green and sustainable supply chin function apply in the business organization.

DEW of a planning and design department main role of supply chin function but cannot be able to organized way supply chain established. This supply chin function and all activities conduct is traditional way in this organization. But in recently management body feel need integrated green and sustainable supply chain in the organization. DEW's is management team try to change and newly arranged material demand flow, foreign purchasing and logistics received and user department material use by sequence **flow chart.** DEW's before that means British era, Pakistan era, Bangladesh (BSEC) era old system materials purchasing and production system flow. When a takeover Bangladesh Navy (BN) then try to integrated green and sustainable supply chain management implement in DEW's organization. In recently ERP softer system try to implement in DEW's organization for ship or boat production. The management body try to waste and energy use reduce and awareness all employees.

Existing Organogram of Supply Chain Process Flow Chart



GAP Analysis & Proposed Organogram of Supply Chain



Procurement Section:

DEW is mainly procurement function execute Planning and Design department by executive officers. This department is main role tender document prepared, tender submit, contract agreement signing and project start and allover project monitoring before delivery and warranty period. Planning and design department executive officers is ship new building project related all materials and machineries items demand and procurement function involve. Other hand

production department executive officers is ship repair project related all materials and machineries items demand and procurement function involve.

Production Department:

DEW is mainly production related activates production department under sub section or workshops by complete. This department before cannot consider waste management and lack of knowledge lean idea. When a takeover Bangladesh Navy then ship or boat production radically increase. In recently computerized CNC machine used for plate cutting and flow nesting plan for much production as a result production capacity so first.

This paper presents a systematic approach for lean supply chain management in shipbuilding industry based on analysis of the unique characters and processes of shipbuilding. The approach constantly improves productivity and retains low costs. The system that covers seven sub-systems on three different levels is created based on the lean thinking and supply chain management theory. In the lean supply chain management procedure, the operational data of the shipyard and suppliers are timely collected, monitored, and analyzed, and weaknesses in the supply chain are identified through performance measurement to suggest improvements. With this approach the entire shipbuilding supply chain can be continuously optimized and controlled. This approach is concluded and proofed functional with actual operation in a leading shipyard in China, Shanghai Waigaoqiao Shipbuilding Company, guided by Shipbuilding Modeling 2.0 Program of China state shipbuilding corporation.



Dockyard & Engineering Works Ltd of Finish Product Photo



Lean:

Lean thinking is about determining how to deliver more value to society, individuals, and the environment; more specifically, the methodology includes determining how to align with value-creating actions in the best possible way, perform activities without interruption whenever someone requests them, and perform them more and more effectively [1]. Lean Principles and Practices claim to create value for customer with growth in every type of organization in which they are implemented [2].Lean supply chain originate from the just-in-time philosophy, which was first adopted by many American and European firms in the late 1980s and applied at Toyota's Takaoka facility [1, 3]. Since then, lean supply chain management (LSCM) has played a crucial role and reached a matured stage with the development of new IT technologies in most manufacturing industries such as the automobile, electronically communication, and aviation [4].

Although shipbuilding technology differs from that applied in, for example, automotive products [5] and can be considered in many aspects similar to construction technology in which the product is place-bound and the site itself is a resource [6]. The processes and working flow differ from those of most manufacturing methods studied in both LSCM and supply chain management (SCM). According to Aslesen and Sigmud [7], "The available literature on implementation of lean in shipbuilding environment is quite restricted due to novelty and the restriction of the concept. Lean shipbuilding is very specialized one and its application is considered to be one of the extensions beyond lean construction". Nevertheless to say, the SCM for shipbuilding can be summarized and simplified by analyzing the shipbuilding characteristics.

Leading shipyards such as Kawasaki in Japan and Daewoo in Korea implement lean shipbuilding by successfully applying lean principles and total quality management. SCM is essential for improving the efficiency of shipyards in the I4.0 technologies [8, 9] and lean manufacturing; how to combine SCM and lean manufacturing to improve the efficiency of shipbuilding has become increasingly important.

SCM in the leading shipyard of China [i.e. Shanghai Waigaoqiao Shipbuilding Company (SWS)] is part of the lean-thinking-based of Shipbuilding Modeling 2.0 Program [10] of the China State Shipbuilding Corporation (CSSC). The program has improved the building efficiency and business

performance of the company. The LSCM system presented in this paper represents the worldwide shipbuilding development in leading shipyards and is based on shipbuilding experts' knowledge.
The following sections of this paper presents a background analysis of the SCM characteristics in shipbuilding, lists the difference between this and other industries, and explains why LSCM has been chosen for shipbuilding and how this unique method can be implemented. Based on these factors, a systematic approach for LSCM implementation and pursue perfection with lean thinking and endless circulation is presented. Finally, the key points and important problems of this study are discussed, and its contributions are summarized.

Characteristics of SCM for shipbuilding:

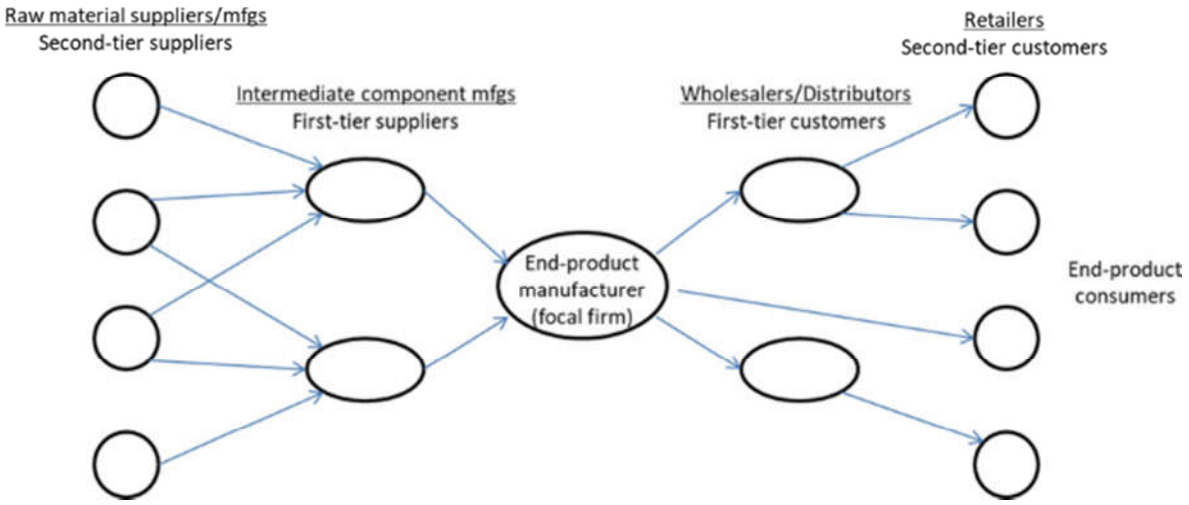
One of the major differences between shipbuilding and most other manufacturing is that the ship or the offshore product is designed, developed, and built during the project development stage instead of being ready before the production. In mature manufacturing processes, the material, technical details, type, suppliers, and components are selected during the design stage; thus, the new design product is trial-manufactured and tested before the actual production [11]. Shipbuilding does not include such trial manufacture and, is therefore similar to construction projects [6]. The shipbuilding industry is largely characterized by the application of project-based approaches for the building of ships, offshore products, submarines, and their repair and overhaul [12].

Saved for the requirement from the client, the shipbuilding project normally starts from the basic design stage compared with the complex final product. The basic design briefly specifies the major technical scope, performance, function, and systematic working method. Subsequently, the shipyard signs the contract with the client [11]. The shipyard normally produces and delivers the ship within approximately two years (the processes includes detail design, engineering, procurement, construction, and test and trial).

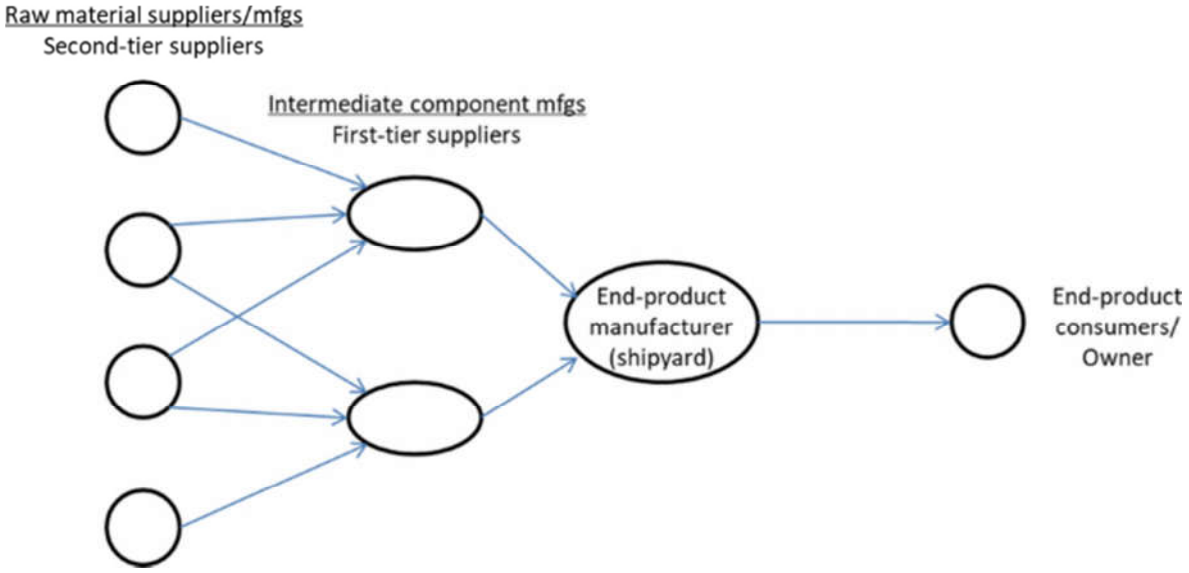
2.1 Short supply chain:

Figures 1 [13, 14] and 2 compare the general supply chain with that of the shipbuilding industry; the latter is typically shorter because it does not contain the distribution of products to the customer; the supply chain ends with the completion of the project. For example, the SCM processes for a floating production storage and offloading unit (FPSO) (which is used in the offshore oil and gas industry for the production and processing of hydrocarbons and for the storage of oil) for a certain client includes managing a series of activities along the supply chain. Finally, all materials and components (e.g. steel plate, outfitting, cable, piping, machinery, etc.) from the suppliers must be delivered to the correct place of the yard at the correct time with the correct price; in addition, the quality of products must meet the requirements of the building process in the shipyard. All these factors are not included in the management plan for the delivery of FPSO unit to the client. The shipyard functions as a turnkey contractor that delivers the final product directly to the end-user or owner [15] when all scopes in the contract have been met.

Generic supply chain Fig:



Shipbuilding supply chain Fig:



Admin Department:

DEW is mainly HR section newly modernize system setup. This department every officers and workers official benefits flow to get. This department is all area CCTV setup and all time monitoring any unwanted occurrence try to stop. The recently DEW is ETP plant setup and use ship bilge water and oil purify. This system is water cleaning and helpful green environment.

Purchase Section:

DEW's is all type purchasing activities by commercial section. This section is local and international tender offering, tender opening, tender evaluating, purchasing and hiring etc. This related function is execute by commercial officer in section. This section supply chain function all activities conduct traditional way. But recently some change in the official activities of purchase

section and involve day by day supply chain. DEW production capacity increase and raw material and goods import amount huge. So supplier must be performance evaluating, controlling, monitoring etc. and supply chain rules flow by the evaluate supplier performance.

Warehouse:

DEW hade old system main store and bulk store. This storing system is backdated system follow. But when a takeover Bangladesh Navy this dockyard the main store instead a modern technological rich warehouse and modernized bulk store storing procedure. This warehouse vertical storing system as a result huge amount storing capacity and shipbuilding related equipment. This warehouse supply chain rules flow when a storing and product delivery.

Finance Department:

All department are activities output result show financial statement. So this department some modern software use for accounting and financial calculation so easier and hundred percent accuracy. As a result management time can be quick decision. A financial state reflect our business up or down. So this department financial calculation so very important.

The shipbuilding industry is one of the essential links in the maritime industry, which significantly affects the national logistics system. PT. Waiame Dock and Shipping have a supply chain supporting all their operations. Implementing physical distancing and work from home rules pressure the existing supply chain. SCOR is a process reference model that combines concepts in business process reengineering, benchmarking and process measurement. Applying the SCOR model within certain limits is quite flexible and can be adjusted to increase productivity to meet consumer needs. The purpose of this study is to obtain the level of performance of PT. Waiame Dock and Shipping, which can further be used as measurements for similar companies. The results showed that the supply chain performance of PT Dok dan Perkapalan Waiame was good.

Logistics:

Transportation plays important role in whole supply chain system. The transportation system also needs combined (inter modal) transportation system in order to make effective use of all three routes (air, sea and roads). Sustainability of product base business mostly depend on the efficient use of inter modal transport system. Moreover, the vehicles used in transport system for delivering goods also make impact on green supply chain system. Besides, the gas emission also increased the global warming which was harmful for human life as well for entire eco system. Green transportation has brought electric vehicles into their fleets which are less harmful for environment and required less fuel oil to transport goods.

Reverse logistics is important factor for implementing green supply chain management. There is process of recapturing value from defected or return goods and further utilize in order to minimize the wastages and resale them in market.

Meanwhile, Respondent 2 mentioned that reverse logistics is important for any garments to ensure green supply chain process. Many defective items are produced in production process because of less skilled workers and lack of effective machines outputs. The ship fitter and welder have managed these defected products in cost efficient way and make further improvement in order to recapture value from them and resale them in foreign or local market.

In general, recovery meant repairing process on any defected product for further use. In recovery system, there are two main factors such as recycling and reuse. These two factors are important for implementing green and sustainable supply chain system.

The recycling procedure started with the sorting of gathered materials as per there condition. The materials are possible to recycle in manufacturing process that items are sold to the flocking industry for rebuild and reuse purpose.

Reuse meant use any waste item for same or different purpose with no physical or natural change. Reuse has both ecological and financial benefits for any organization. Some shipbuilding industry materials did not decompose with the soil which affected fertile system of land as well as the entire environment. In shipbuilding industry, various types of hazardous chemicals are left behind for producing material.

These chemicals are harmful for entire eco system. The shipbuilding industry had reused these hazardous chemicals in ship hull or ship structure manufacturing process and made proper disposal of these chemicals if these had no value to make eco-friendly environment and increased sustainability in production process by effective use of waste materials.

The Construction of System of Green Shipbuilding Supply Chain:

System of Green shipbuilding supply chain covers all the nods associated with shipbuilding industry chain, which includes green procurement, green shipbuilding, green marketing and green recycling, etc. As show in Figure 1. To realize the Green Shipbuilding supply chain, the designer must have a good awareness of the environment, choose the green materials from the design and improve material utilization in the design process we should adopted green materials widely and consider material utilization during the processing. Green shipbuilding place the core role in green shipbuilding supply chain, which including non-traditional machining techniques, rapid prototyping technology, agile manufacturing technology, green welding and cutting technology, green coating technology, green heat technology, green casting technology, surface modification technology, and green packaging technology, etc.

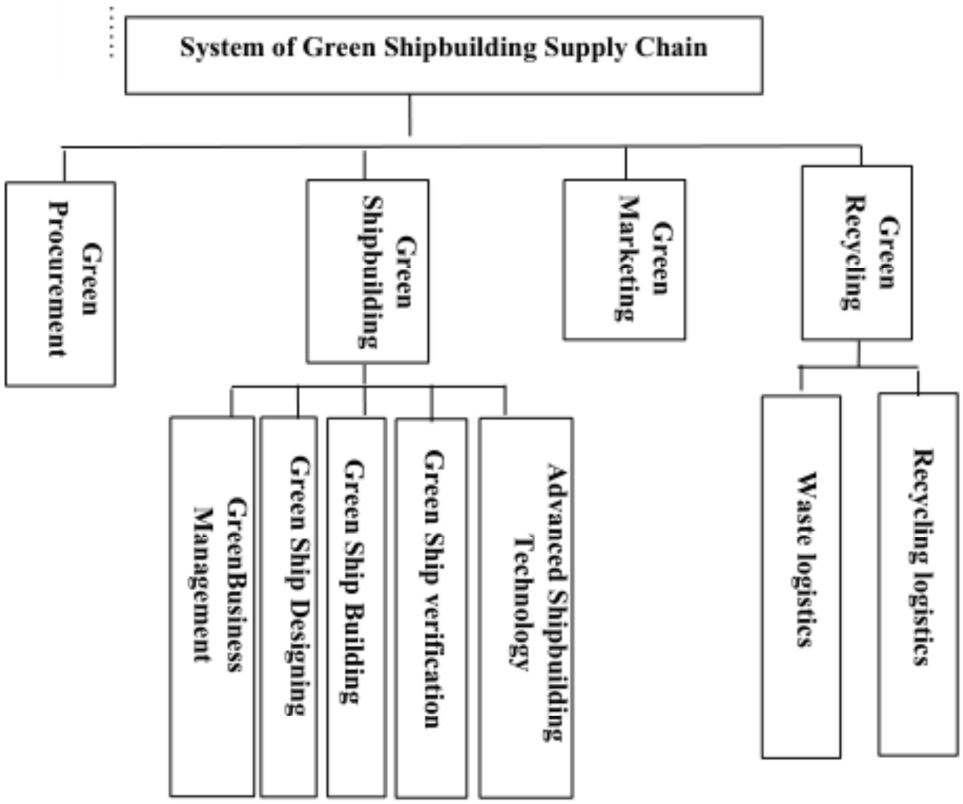


Fig1 Green Shipbuilding Supply Chain Operation System

Table 1 Green Grade Evaluation

The green grade evaluating indicators for the green shipbuilding supply chain management	Economy evaluation system	Income increase indicator	rate of profit increase
			rate of sales proceed increase
		Productivity enhance indicator	the capability of enterprise innovation the capability of science and technology transform to productivity The extent of green technology using
		Cost expenses indicator	line operation expense and cost reclaim expense and cost drain contamination and reprocessing expense and cost
		Asset expenses indicator	financial net present value rate of return on investment turnover of inventory stock net worth average accounts receivable turnover ratio The ratio of monetary assets loan and total investment
	society evaluation system	Enterprise influence indicator	market share market popularity customer loyalty index
		Enterprise contribution indicator	The ratio of socially useful activity The ratio of green contribution Tifu educational expenditure
		Enterprise culture indicator	enterprise green culture the green consciousness staff staff quality and age structure
	Ecology evaluation system	environmental indicator	Cleaning productivity the three wastes drain contamination Achievement Ratio the percentage that environmental protection investment occupies in total value of out-put
		Resources indicator	Resource economy ratio Resource synthetical utilization ratio Resources cycle utilization rate
		Energy indicator	Energy yield ratio Energy conversion ratio average energy consumption everyday

Green Evaluation Index

The green evaluation index quantize the harmonious extent of society, economy and ecology. It quantizes the extent of the human resources investment, the extent of the production, the extent of the environmental influence from the aspects of socioeconomic performance, resource and environment. The green evaluation index of the green shipbuilding supply chain measures the action of every node and the influence for the natural ecology synthetically in the whole society macroscopic view. The green evaluating indexes system for the green shipbuilding supply chain not only measures the influence of the shipbuilding individual action to the economy and society, but also considers the influence of the shipbuilding individual action to resource and environment.

Chapter 05

Finding of the Study

The common barriers to implementation of GrSCM in various industry sectors are: Lack of integration of IT system, Lack of acceptance of advancement in new technology, Poor organizational culture in GrSCM, Lack of skilled human resource professionals in sustainability and GrSCM, Uncertainty and competition in market, Lack

It appears to be that Competitive Advantage, Social Responsibility & Stakeholders and Supplier Readiness are significant drivers for the supplier's willingness to participate in GrSCM, while no significant effect was found for Customer Requirement and Regulations & Governmental involvement. When comparing our finding with those of some of the current literature both similarities and differences were found

Competitive Advantage and Supplier Readiness are statistically significant predictors, in line with non-maritime related studies of Lee (2008), Lee & Klassen (2008), Holt & Ghobadian (2009), and thus confirm the findings of these studies, namely that environmental activities in a firm can be partly explained by the specific resources and capabilities that they own (Lee, 2008). In this study, Competitive Advantage is the most important driver for suppliers to start greening their supply chain. Apparently, many firms foresee business benefits from these activities and are motivated to adopt them. It also confirms the non-maritime studies of Zhu et. al, 2004, namely that Environmental management could result in an efficient working process so costs could be saved in the long run. Companies simply cannot afford to lag behind their competitors.

Regulations & Governmental involvements and Customer Requirements are of little importance in our research, while results Lee (2008), Holt & Ghobadian (2009), Lee & Klassen (2008), Zhu et. al (2004) and Khidir et. al (2009) are showing the opposite. Multiple explanations can be given. First, this remarkable finding can be explained by the differences in location and industry type in which the studies were performed. The research of Holt & Ghobadian (2009) is focused on manufacturing industry in the United Kingdom with mainly respondents from the utilities and public sectors, Lee & Klassen (2008) is focused on manufacturing firms in Malaysia and Khidir et. al (2009) focuses on the Korean automobile industry. Compliance, support and maintenance of law and government regulations regarding environmental issues can differ between these countries and industries. For instance, when we look at the automotive industry, there are nine major regions around the world who have implemented or proposed various fuel economy and Green House Gas (GHG) emission standards. All of these standards have differences in policy approaches, test drive cycles, and units of measurement (Oberthür, 2003). In addition, when compared to GHG emission standards in the shipbuilding industry, the first regulations are expected to enter into force on 1 January 2013 (IMO, website, 2012), while the first regulations within the automotive industry were introduced in the 80s (An & Sauer, 2004). Therefore, Regulations & Governmental involvement in the shipbuilding sector compared to the automotive industry, are far behind and they also develop much more slowly. Second, these differences can be explained by specific product features. For example, when comparing container ships to family cars, the approximate lifespan is 20 to 30 years (Bearden & Hearn, 2011) versus 5 to 10 years of a car. Third, seagoing vessels have less direct impact on the air quality and human health than motor cars in the centre of a crowded city. Fourth, others have also argued about the importance of differences between organisation responses in different sectors around the world. For example, Zhu et. al (2008) and Holt & Ghobadian (2009), found that industries have different environmental effects by emissions (toxic, harmful, and ozone depleting) and resources (electricity or fuel) used. Differences in drivers and pressures has caused manufacturers in different industrial sectors to adopt GSCM practices at a certain level. In this study, the importance of different industrial sectors is confirmed because the results show that, within the Dutch Shipbuilding industry, suppliers are experiencing less pressure and motivation from Regulations & Governmental involvement to implement proactive environmental strategies

such as GSCM than for instance the automotive or electronic industry. - Another factor in our study working differently in previous studies is Social Responsibility & Stakeholders which appears to be important in contrast with the results of Holt & Ghobadian (2009) and Khidir et al. (2009). Khidir found that social responsibility is not important, because GrSCM activities require considerable costs and capabilities, which do not seem to outweigh the benefits. Nevertheless, the results of the current study indicates the opposite. Apparently, maritime vendors still want to uphold their image to society. This difference may partly also be explained by the small response rate of the other studies (Holt & Ghobadian had a response rate of 13% vs. 27% in our study). Otherwise we have no obvious explanation for the discrepancy.

Another remarkable finding is the relationship between Customer Requirements and Regulations & Governmental involvement. This result is explainable because focal companies are experiencing pressure from Governmental bodies to comply with certain environmentally concerned rules which subsequently lead to action from these focal companies towards their relations with their suppliers. Preuss (2001) describes this as "the green multiplier effect', that results from the extension of green management practices from focal companies to immediate suppliers and second tier suppliers. Delmas & Montiel (2009) also identified significant correlation between regulatory pressures and customer pressures and indicates that suppliers who already were subjected to regulatory pressures, already have taken necessary arrangements, making it only a small effort to comply to additional requirements of the customers. Therefore, the relationship between Requirements & Governmental involvement and Customer Requirements seems to be understandable. - Finally, firm size, which is used as a control variable, has a significant impact on the willingness to participate in GrSCM practice. This is in line with finding of Lee (2008) and indicates that larger firms are more likely to participate in GrSCM practices than smaller firms, which is understandable because larger firms are more likely to have financial and human recourses which are required to conduct the green initiatives.

Chapter 06

Conclusion

In conclusion, shipbuilding sector was main exporter of Bangladeshi product to foreign market. This study had elaborated basic instruments of a well-established green supply chain management system in shipbuilding sector of Bangladesh. Moreover, many businesses are shut down their activities since high production cost. Hence, there is important for shipbuilding sector to apply green activities in their supply chain system to use effectively resource and save the nature from uncertain pollution which leads to sustainable business and eco-friendly world.

Sustainable and green technology that can be changed the future of ship manufacturing industry of Bangladesh and suggested for Dockyard & Engineering Works Ltd and take a green and sustainable supply chain based standard Shipyard. Mentioned above are several important technology and steps which may help to change the future of shipbuilding convert to a green and sustainable supply chain based on Shipbuilding in Bangladesh.

The results of the assessment are to derive a several steps implementation strategy for the model development of a green and sustainable supply chain. The DEW project was the redevelopment use of the modern technology is take a green and sustainable supply chain standard based. The recently DEW take a yard modernization project is the redevelopment of a new shipbuilding hall setup & another side a new large ship construction yard with a new modern slipway. The Green Shipyard is model developed & assessment of results such as ISO standard shipyard, NOC certify by Department of Environment, green electricity produce, less consume electric device, indoor grid blasting plant, indoor spray painting plant, long assembly and erection hall, high capacity overhead and gantry cranes, block lifting and shifting vehicles, sufficient store area and stockyard, fire fitting and fire hydrant equipment, facilities of hospital, follow by safety rules and regulation, follow by waste management system as a reduce, re-use and recycle etc. The results of the assessment follow in this model then DEW will be yard developed and production capacity is improved & surrounding environment is clean and pollution of null. This results of the assessment is follow then DEW will be a green and sustainable supply chain shipyard.

The paper researched the structure of green shipbuilding supply chain and constructed green evaluation index based on the view of society, economy and ecology. The purpose is to play a guiding role for the shipbuilding enterprises, so as to promote the sustainable development of marine industries.

Although the importance of GrSCM is increasingly being recognized by many enterprises, there still seems to be a lack of motivation for firms to participate in these initiatives. Current literature highlights several drivers which may affect the choice of participating in GrSCM initiative, but little of them validate these drivers into practice. In order to clarify this problem, this study identifies 5 major factors based on existing literature who have resulted into 5 hypotheses. By using PLS path modeling these hypotheses were empirically tested, making use of supply chains of two of the largest shipbuilding companies in the Netherlands, namely IHC Merwede and Damen Shipyards. A through methodology was applied to validate scales for constructs pertaining to all six variables. The results show that 3 out of the 5 hypotheses are strongly supported, namely (1) Supplier Readiness, (2) Social Responsibility & Stakeholder and (3) Competitive Advantage. In general terms, the following can be concluded: - This study adds two important drivers to the previous conducted study of Lee (2008), namely Competitive Advantage and Social Responsibility & Stakeholder. - Competitive Advantage is the most important driver for the willingness to participate in GrSCM. This is consistent with Khidir et al. (2009), Rao (2006), Sarkis (2003), Lee & Klassen (2008) and Hol & Ghobadian (2009). - This study reflects the importance of different industries sectors, nationalities and product features. The results found for Regulation & Governmental involvement and Customer Ruirements are different in the non-maritime study of Lee (2008) and Holt & Ghobadian (2009). This can be explained by (1) differences in location and

industry type, (2) differences in product lifespan, (3) differences in direct impact on air quality and (4) differences in levels of pressure and motivation between industries. - There is a direct link between Regulations & Governmental involvement and Customer Requirements which is explainable by 'the green multiplier effect' and by the small extra effort suppliers have to do, in order to comply with additional customer requirements.

6.1 Theoretical implications

This work is the first effort to investigate GSCM practices in the shipbuilding industry. The theoretical added value of this paper is threefold. First, two new variables are adduced, both of which are of significant influence on the willingness to participate in GrSCM, namely Competitive Advantage and Social Responsibility and Stakeholders. Second, the current study indicates the importance of different nationalities and industry sectors, because differences were found when results were compared to previously conduct non-maritime papers. Third, in the current study a significant correlation between Customer Requirements, Regulations and Governmental involvement was demonstrated, which has not been empirically demonstrated before.

6.2 Managerial implications

In order to improve GrSCM practices some managerial recommendation are included: - This research shows that Customer Requirement is not a significant driver. Therefore, focal companies should be more active to change this. For instance, they could increase their level of GrSCM practices by increasing the level of investment in the customer-supplier relationships. They should reach out to support suppliers in a proactive and collaborative manner. This is because suppliers were found to be more responsive to their customer environmental performance requirements where increasing levels of relationship-specific investment occurred (Simpson & Power, 2007).

6.3 Limitations and Future research

Limitations: In arriving at these overall results, we must mention the limitations of this study. First, the conduct of this research is limited to the Bangladesh shipbuilding enterprises and its constituents. Although this industry is populated by a number of global assemblers and many organizations supplying internationally, the participants operated and resided in the Bangladesh. Therefore the findings of this research should be interpreted with respect to this context. Second, the findings describe the results of an analysis based on 93 respondents which is a relative small sample. A relatively small number of samples can is at risk of lack of power and type II errors. Third, each questionnaire was answered by only one respondent, making it unassessed for intra-individual reproducibility.

6.4 Future Research

The model could be expanded using mediating factors such as customer-supplier relationship intensity. This study shows a low level of Customer Requirements regarding environmental issues which may be explained by suppliers who are simply not aware of the environmental needs of the customer. Be adding this additional factor this phenomenon can be studied in larger depth. - The importance of differences in the industry sectors is reflected in this research because the findings in this study are different from those of previously conducted studies, such as Khidir et. al (2009) and Lee (2008). In order to confirm the importance of this difference, future research could be focused on other industries. In doing so mediating factors such as cultural differences, financial risks, effect of economic volatility, political conditions, etc. can be taken into consideration. Its importance is highlighted by an example Sarkis et. al (2010): "companies in less developed Countries may be more concerned about economic growth and thus may not Implement environmental programmers here if additional training is not provided."

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