MARITIME GREEN SUPPLY CHAIN MANAGEMENT (MGSCM) AND FINANCIAL PERFORMANCE: A MEDIATING EFFECT OF ENERGY EFFICIENCY AND LOW CARBON PERFORMANCE

MUHAMAD FAIRUZ BIN AHMAD JASMI

DOCTOR OF PHILOSOPHY

UNIVERSITI MALAYSIA PAHANG

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MUHAMAD FAIRUZ BIN AHMAD JASMI

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ABSTRAK

Atas kesedaran mengenai kesan negatif ekologi meningkat dikalangan industri, organisasi di seluruh dunia telah termotivasi untuk mewujudkan operasi yang lebih mampan. Ini telah menyebabkan perkembangan minat yang luas dalam bidang pengurusan rantaian bekalan (SCM) dan pengurusan rantaian bekalan hijau (GSCM) di kalangan sarjana dan pengamal industri sejak kebelakangan ini disebabkan isu-isu alam sekitar, kemerosotan bahan mentah dan pengeluaran sisa yang berlebihan. Walau bagaimanapun, kerja yang dilakukan dalam membangun dan menggabungkan langkah-langkah hijau ke dalam kesusasteraan rantaian bekalan maritim sedia ada agak terhad. Hanya beberapa artikel yang telah diterbitkan dalam literasi dekad yang lalu mengenai konsep hijau dalam konteks maritim. Matlamat utama dalam kajian ini adalah untuk menangani cabaran ini secara empirikal dan menguji langkah-langkah dan prestasi pengurusan rantaian bekalan maritim hijau (MGSCM) dalam konteks rantaian bekalan maritim. Berdasarkan tinjauan literasi, lapan soalan penyelidikan telah dicadangkan untuk untuk menangani jurang semasa dalam bidang ini. Oleh itu, kajian ini telah mencadangkan 5 pembolehubah MGSCM dan 3 pembolehubah prestasi yang boleh digunakan oleh organisasi untuk mengukur kesan MGSCM terhadap organisasi maritim. Walau bagaimanapun, 2 daripada tiga pembolehubah prestasi yang terdiri daripada prestasi kecekapan tenaga (EEP) dan prestasi karbon rendah (LCP) akan bertindak sebagai pemboleh ubah pengantara untuk mengkaji hubungan antara MGSCM dan prestasi kewangan (FP). Satu kaji selidik dalam talian telah dihantar kepada pelbagai syarikat rantaian bekalan maritim di Malaysia. 160 set soal selidik dianalisis dengan menggunakan kaedah kuadrat separa terendah (PLS) melalui pemodelan persamaan struktur (SEM) dengan perisian Smart PLS dan perisian IBMSPSS untuk analisis deskriptif. Penemuan itu mengesahkan bahawa dari perspektif rantaian bekalan maritim, beberapa amalan MGSCM tertentu (seperti GICS dan GSIP) memang mempengaruhi hasil prestasi kewangan. Hasil kajian juga menunjukkan sokongan kepada hipotesis bahawa EEP dan LCP memediasi kesan diantara GICS, GVALS, dan SDC terhadap prestasi kewangan. Hasil kajian ini juga membuktikan keberkesanan rangka kerja yang dicadangkan berdasarkan teori NRBV dan GSCM dalam memahami impak lestari dari perspektif rantaian bekalan maritim. Akhirnya, kajian ini telah membentangkan cadangan praktikal untuk para pengamal industri dan pembuat polisi yang menekankan perlunya mengamalkan amalan hijau dalam rantaian bekalan maritim untuk mencapai operasi mampan dan keuntungan berpanjangan.

ABSTRACT

As awareness and consciousness regarding the negative ecological impacts that industry bring to the environment increases, more organizations around the globe have motivated in establishing sustainable operations. As a result, a cross-disciplinary interest in the field of supply chain management (SCM) and green supply chain management (GSCM) has grown amongst scholars and practitioners in recent years due to environmental issues, deteriorating raw materials and excess of waste production. However, there has been little work done in developing and incorporating green measures into the existing maritime supply chain literature. Only a handful of articles has been published in the last decade on the green concept in maritime context literature. The aim of this study is thus, to address this challenge by empirically developing and testing maritime green supply chain management (MGSCM) measures and performance for the maritime supply chain. Based on an extensive literature review, eight research questions were proposed for this study to address current gaps in the body of knowledge. Hence, this study has proposed five (5) MGSCM variables and three (3) performance constructs that can be used by organizations to measure MGSCM impact on the maritime organization. However, two (2) out of three (3) constructs which consists energy efficiency performance (EEP) and low carbon performance (LCP) will act as mediating variables to study inter-relationship that might be influenced the single performance outcome construct of financial performance (FP). An online survey was administrated to various maritime supply chain companies in Malaysia. One hundred sixty (160) sets of questionnaires were analysed using the partial least squares method through structural equation modelling (SEM) with Smart PLS software and IBMSPSS software for descriptive analysis. The findings confirmed that from the maritime supply chain perspective, certain MGSCM practices (such as GICS and GSIP) facilitated financial performance outcome. The results also showed support for the hypotheses that EEP and LCP mediate the effect of GICS, GVALS, and SDC on financial performance. To a certain extent, the findings of the study validated the robustness of the MGSCM framework based on the extended natural resource-based view (NRBV) and GSCM theory to study the sustainability impact from maritime supply chain perspective. Finally, this study has presented a practical suggestion for practitioners and policymakers which highlighted a need to adopt green practices in the supply chain operation to achieve sustainable operation and long-term competitive advantage.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

AFS	International Convention on the Control of Harmful Anti-Fouling Systems on Ship
AGV	Automated Guided Vehicle
AMP	Alternative Marine Power
AMS	Auto Monitoring Systems
APEC	Asia- Pacific Economic Cooperation
APSN	APEC Port Services Network
AVE	Average variance extracted
BMW	International Convention for the Control and Management of Ships‟ Ballast Water and Sediments
CB-SEM	Covariance-based structural equation modelling
COLREG	International Regulations for Preventing Collisions at Sea
COP 15	United Nations Conference of Parties on Climate Change
CR	Composite reliability
CSR	Corporate social responsibility
EBIT	Earnings before Interest and Taxes
EDI	Electronic data Interchange
EEDI	Energy Efficiency Design Index
EEP	Energy efficiency performance
EMAS	Eco- management scheme and audit scheme
EMS	Environmental Management System
EnMS	Energy Management System Certification
EPA	Environmental Protection Agency
EPI	Environmental Performance Index
ETP	Economic Transformation Program
EUMCCI	EU-Malaysia Chamber of Commerce and Industry
FDI	Foreign Direct Investment
FMM	Federation of Malaysian Manufacturers
FP	Financial performance
GFF	Green financial flow

GHG	Greenhouse gas
GICS	Green information and communication system
GMP	Green management practices
GPAS	Green Port Award System
GPR	Greening and performance relativity
GPS	Global Positioning Systems
GSCM	Green supply chain management
GSIP	Green supply chain integration practice
GSM	Green shipping management
GSP	Green shipping practices
GT	Green technology
GTP	Government Transformation Programme
GVALS	Green value added logistic service
HTMT	Heterotrait-monotrait
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
ISM	International Safety Management
IT	Information technology
JIT	Just-in-time
LCA	Life-cycle costing analysis
LCP	Low carbon performance
MARDEP	Marine Department of Malaysia
MARPOL	The International Convention for the Prevention of Pollution from Ships
MATRADE	Malaysia External Trade Development Corporation
MGSCM	Maritime green supply chain management
MIDA	Malaysian Investment Development Authority
MLSP	Maritime Logistic Service Provider
NPE	National Policy on the Environment
NRBV	Natural resource-based view
OPRC	Oil Pollution Preparedness, Response, and Co-operation
PERS	Port environmental review system

PLS-SEM	Partial least squares structural equation modelling
PM	Particulate matter
RBV	Resource-based view
RFID	Radio Frequency Identification
ROA	Return-On-Assets
ROCE	Return-On-Capital-Employed
ROI	Return-On-Investment
SCM	Supply chain management
SDC	Shipping design and compliance
SDM	Self-diagnosis
SEEMP	Ship Energy Efficient Management Plan
SEEOI	Ship Energy Efficiency Operational Indicator
SEM	Structural equation modelling
SMSC	Sustainable maritime supply chain
SOLAS	International Convention for the Safety of Life at Sea
SOSEA	Strategic overview of environmental aspects
STCW	International Convention for Standards, Training, Certification and Watchkeeping for Seafarers
TEU	Twenty-Foot Equivalent Unit
UN	United Nation
UNCTAD	United Nations Conference on Trade and Development
UNFCCC	United Nations Framework Convention on Climate Change
VIF	Variance inflation factors
WEF	World Economic Forum

CHAPTER 1

INTRODUCTION

1.1 Introduction

Maritime supply chain is the most essential transportation mode for many countries as it facilitates the imperative role in catalysing global trade activities. Currently, about 80% of international trade by volume and over 70% by value is carried by the maritime operation (Balcombe et al., 2019; Lister, Poulsen, & Ponte, 2015) through globalization of open-market trade system. The commercial activities in which maritime sectors involved in have facilitated the tremendous growth of various global trades including small and medium industries, commodities, businesses as well as heavy industries. Additionally, most of the organizations prefer maritime supply chain for their global trade activities due to its reliable, steadfast and cost-effectiveness means of transportation in existence (Xiaowei Zhao, Yan, & Zhang, 2016). Thus, as a vital component of life-line trade for various manufacturing companies all over the world, the whole supply chains in the maritime industry have established new opportunities as well as unpredictable challenges.

The challenges faced by maritime supply chain dampened in the increased rate of marine pollution, climate change and global warming during the preceding decade (Davarzani, Fahimnia, Bell, & Sarkis, 2015; Jasmi & Fernando, 2018; Lun, Lai, Wong, & Cheng, 2014) as well as tightened environmental policy trend imposed by International Maritime Organization (IMO) (Chintoan-Uta & Silva, 2017; Kader, 2013; Parsotaki & Alexopoulos, 2017). Due to these concerns, greater importance has been placed on the environmental management issues within the maritime supply chain system to counter these raising ecological issues. Thus, green supply chain management (GSCM) and sustainability concept have become a subject of interest to the maritime field as well as various other fields of businesses, sectors, governments, and consumers (Lirn, Lin, &

Shang, 2014). Playing the pivotal role of global transhipment toward trade flows in the global supply chain, numerous shipping organizations and maritime businesses have begun to act in response to this environmental concerns by embracing "green" and "sustainable" operations (Fernando, Jasmi, & Shaharudin, 2019; Lai, Lun, Wong, & Cheng, 2011) in their supply chain.

As Malaysia is the fourth major greenhouse gases (GHGs) emitters in ASEAN behind Indonesia, Vietnam, and Thailand, contributing around 0.52% of the world's carbon emissions (Cheng, 2016), Malaysia's maritime supply chain sector needs to invest on environmental management approach in its entire supply chain operation (Jasmi & Fernando, 2018; Khalid, Tang, & Rajamanickam, 2010). Participation of stakeholders in maritime sectors as well as governmental authorities are a key factor in increasing significant discussion between maritime's industry players globally. Malaysia approach towards sustainability trend even though slowly, gradually shows stakeholders and governmental agencies commitment to achieve sustainability within the maritime industries to accomplish the sustainable goals in the future (Logistics and Trade Facilitation Masterplan Performance Report, 2016). Although sustainability is critically important for this maritime sector, it is vital to address the problem without sacrificing its commercial and economic values. In this respect, the maritime industry as a vanguard sector of import-export activities and domestic trades in Malaysia should balance its adoption of the green practice between environment and financial performance. By proving the long-term financial and economic gain of adopting the green practice to the stakeholders, it may encourage them to embrace and integrate the 'green' concept in their respective organizational activities and operation.

On the other note, despite the importance of this emerging green agenda to maritime supply chain sector, there has been little work done in developing, testing and incorporating green strategies and measures into the existing literature of maritime supply chain (Cheng, Farahani, Lai, & Sarkis, 2015; Jasmi & Fernando, 2018). There is also a lack of published empirical research in maritime green supply chain management (MGSCM) within the domain of maritime studies. The literature which exists both within the scholarly academic journals is fragmented, complex and focuses on just particular nodes or dimension within the supply chain rather than the entire supply chain. Therefore, the conceptual notion of "MGSCM" has been introduced in this study to become an imperative solution for maritime companies to enhance their operation and financial gain. In this respect, this study attempts to categorize the MGSCM dimension that can affect the functional operation and practical areas of the maritime supply chain to meet the end goal of improving financial outcome. MGSCM as an extension of GSCM concept is also focusing on measuring the capability of maritime companies and simultaneously improving the operational efficiency of their supply chain activities.

1.2 Background Study

The subject of sustainability in the context of supply chain management (SCM) has been discussed using numerous terms in many preceding kinds of literature. A number of current literature discussing on GSCM and sustainability have been widely published in this respect e.g., (Aalirezaei, Esfandi, & Noorbakhsh, 2018; Ahmed, Ahmed, & Najmi, 2018; Jafarzadeh-Ghoushchi, 2018; Mohamed, Hasrulnizzam, Mahmood, Muhamad, & Yusup, 2017; Susanty, Sari, Rinawati, Purwaningsih, & Sjawie, 2019; Trujillo-Gallego & Sarache, 2019). Early sustainability practices and concepts tended to stress on ecological impacts but, gradually, various latest studies adopted the triple bottom line impact and performance measurement that includes the environment, economic, and social dimension. Even though similar to the concept of SCM, the boundary of GSCM concept is dependent on the supply chain and production process; however, adding the term "green" and "sustainable" component to SCM involves further characteristic of addressing the influence and conceptual relationships between SCM and the environment. Subsequently, GSCM distinguishes the disproportionate of supply chain processes towards environmental impact in an organization. GSCM practices in this sense, are acting as an environmental and operational structure of improvement to catalyse operational planning that numerous of organizations nowadays are encouraged to tackle (Famiyeh, Kwarteng, Asante-Darko, & Dadzie, 2018).

Meanwhile, the broad definition of GSCM concerns on the integration of environmental concerns into supply chain management (Jasmi & Fernando, 2018a). This includes activities associated with the transformation and flow of goods or services from materials sources to the end customers, including the incorporation of internal and external activities to the organization. Likewise, GSCM can also be viewed at multiple levels that include external and internal GSCM perspectives. From external GSCM perspective, this include transactions with suppliers and customers as external supply chain activities; those activities without direct supplier or customer involvement such as eco-design, environmental management and financial policies within an organization's direct control can be considered as internal activities (Ahmed et al., 2018). These practices of internal and external GSCM and categories are further conceptualized and operationalized based on MGSCM viewpoint in the literature review section through five independent variables introduced in this study. It is worth to note that MGSCM connotation and dimensions in this study are a direct derivative from GSCM concept adopted from GSCM literature.

On the other note, general studies show that GSCM practices can improve environmental performance, but the linkage also depends on organizational capacity (Sun & Zhu, 2018) and industrial background (Fernando, Jasmi, & Shaharudin, 2019). In this sense, the linkage between GSCM (and other corporate environmental practices) and economic performance have been also studied but results are also conflicting (Kamatra & Kartikaningdyah, 2015; Marcus Wagner & Blom, 2011a). Meanwhile, limited work has also examined the relationship between GSCM and financial performance (Cosimato & Troisi, 2015). This deficiency of a clear result concerning the relationship between GSCM adoption and resulting in improved performance, whether it is environmental, economic, financial or operational, has become a barrier for general organizations that seek to validate and justify GSCM implementation.

Previous studies showed that the direct effects between GSCM and performance, especially financial performance improvement, are significant, but performance improvements are not always obvious and sometimes insignificant (Hafez, 2015). There may be numerous reasons for these inconsistent results reported by previous studies. For example, the non-linearity issue advocates that directionality of the relationship is not that simple and that there may even be a synergistic relationship or interceding variables between green practices and financial performance (Gómez-Bezares, Przychodzen, & Przychodzen, 2017). Supporting this view, this study has found that there is potential explanatory power of the energy efficiency performance (EEP) and low carbon performance (LCP) concerning financial performance relationship with MGSCM by the fact that EEP and LCP dimension is still under-investigated in maritime literature.

Due to other factors influencing the relationship are likely to present, this study has underlined the importance of analysing interrelationships with other variables (such as EEP and LCP) to further elaborate on the established tie between MGSCM-financial performance relationship. This imbalance between the adoption of internal and external MGSCM practices with other factors may explain why improvements in operational, environmental, and economic performance do not always occur. These complexities and uncertainties must be more carefully investigated in which motivate this study to test this assumption. For this reason, this study has proposed a theoretical framework that may help to explain why differences in performance outcomes (in this context; financial performance) in the complex GSCM environment may occur. The study especially focuses on the under-investigated domain of maritime industry and the possible mediating interrelationships of EEP and LCP as a mediator between the relationship of MGSCM and financial performance outcomes, which determine how the coordination sequence of these relationships should occur.

The study concluded that the dimensions of sustainability of MGSCM are needed to be drawn for successful completion of GSCM in a maritime context. The study defined MGSCM's notion in this study based on five dimensions of GSCM, that is, green information and communication system (GICS), green value added logistic service (GVALS), green supply chain integration practice (GSIP), shipping design and compliance (SDC) and green financial flow (GFF) which will be further explained in the literature review section in this study. Finally, based on the proposed theoretical framework, this study defined MGSCM conception as the extension of GSCM which is about integrating various environmentally friendly operations in every phase of maritime supply chain system to diminish environmental footprint and to achieve increased energy efficiency and financial performance (Jasmi & Fernando, 2018).

1.3 Maritime Supply Chain in Malaysia

Malaysia maritime supply chain has claimed a substantial share of trades in transhipment route for the South East Asia Region. Collected data by EUMCCI (2012) indicates that this promising sign of economic trade growth was achievable through Malaysia's strategic and deliberate location in the heart of Asia region as well as its relatively highly developed logistic road, rail network and exceptional maritime port system. Malaysia's sum of cargo volumes attained an estimated 495.29 million tonnes with an additional more than 90% of total freight traffic in 2015 alone shown a noteworthy development in this sector. Port Kelang as the busiest port contributed as much as 39.2 % of total maritime throughput throughout the years while Port Tanjung Pelepas contributed as much as 22.7% of total maritime trade in Malaysia (EUMCCI, 2012). The higher reliance on intra-Asian import-export trade, which has performed better than international long-haul trade routes as well as aggressive capacity expansion programmes succeeded in attracting and preserving the trade capacities of key maritime companies. As a result, the maritime supply chain stayed as the most progressive and developed sector in Malaysia respectively.

Meanwhile, a highlight of the maritime supply chain sector in Malaysia is outlined in Table 1.1. According to Ministry of Transport Malaysia (2017), maritime traffic for container vessels at the 10 main ports in Malaysia has risen to 24.5 million TEUs (20-foot equivalent units) from 13.3 million in the 10 years phase from the year 2006 – 2016. The Table 1.1 illustrates that Port Klang, consisting of Northport and Westport, as the busiest maritime port in Malaysia, with nearly half or 48.5% share of the total value of containers handled compare to the other entire Malaysian ports respectively. Port Klang as the busiest port and a key hub in the maritime logistic sector in this region has contributed as much as 108.8% of growing development in container throughput in the period of 2006 to 2016 with generated 13.20 million TEUs from 6.32 TEUs in the past. The substantial growth of the port is due to the technological improvement over the time as well as its competence and effectiveness in facilitating global import-export centre for South East Asia's sea route operations. Given its location in the Straits of Malacca, Port Klang has substantially benefitted from such a strategic location. Besides that, Table 1.1 shows that based on total value projected, Port Tanjung Pelepas (PTP) in Johor remained to be succeeding major container port after Port Klang with 8.02 million TEU of container throughput in 2016. Other ports also have shown significantly increased over the years except for Johor port due to competition from bigger and advanced Port Tanjung Pelepas as well as new developments cropping up along the Pasir Gudang coastline that hamper sea route passage for the large vessel to come. In summary, in the period of 10 years, the significance of ports as capable entities to propel economic gain can be seen from the overall uptrend growth of Malaysian ports over the years.

Table 1.1 Container Throughput (TEU) from the Year 2006-2016

PORT	YEAR 2006	YEAR 2007	YEAR 2008	YEAR 2009	YEAR 2010	YEAR 2011	YEAR 2012	YEAR 2013	YEAR 2014	YEAR 2015	YEAR 2016	GROWTH (%)
Port Klang	6,326,295	7,118,714	7,973,579	7,309,779	8,871,745	9,603,926	10,001,495	10,350,407	10,945,804	11886685	13209577	108.8
PTP	4,637,418	5,297,631	5,466,191	5,835,085	6,298,733	7,302,460	7,493,805	7,416,518	8,232,113	8798747	8028983	73.1
Johor	880,611	927,284	934,767	844,856	876,268	830,340	801,058	757,023	792,501	800524	827013	-6.1
Penang	849,730	925,991	917,631	958,476	1,106,098	1,202,179	1,165,733	1,237,713	1,265,712	1317352	1437120	69.1
Kuantan	124,834	127,600	127,061	132,252	142,080	132,796	136,101	126,548	131,244	140959	141639	13.5
Bintulu	199,704	251,800	290,167	248,390	251,296	215,451	231,053	250,353	270,495	243699	277111	38.8
Sabah	227,084	271,471	292,688	277,905	326,826	356,195	374,624	373,042	398,800	363185	357386	57.4
Kuching	152,394	163,338	171,943	161,091	190,642	214,820	231,826	249,690	227,660	225328	223788	46.8
Rajang	53,741	65,908	74,320	66,210	80,333	88,700	89,531	81,077	76,088	70456	62778	16.8
Miri	16,837	21,159	28,085	25,102	29,773	31,839	31,499	33,947	32,892	29377	30711	82.4
TOTAL	13468648	15170896	16276432	15859146	18173794	19,978,706	20,556,725	20,876,318	22,373,309	23876312	24596106	82.6

Source: Ministry of Transport Malaysia (2017)

Under 11th Malaysia Plan and Economic Transformation Program (ETP), the maritime supply chain in Malaysia has anticipated multiple growths in freight volume from 998 million tonnes in the year 2015 to around 1466 million tonnes in the year 2020. The eminent growth of this maritime supply chain industry is a positive sign from the trade and industry standpoint due to import-export activities and trading operations with shipping and airfreights related businesses, advanced technology, and capital-intensive project. The effective provision of container facilities, operational efficiency, and services is an essential attribute in deciding the competitiveness of ship operators to align with global growth.

Nonetheless, this economic growth indicator may also reproduce the off-putting implication from an environmental standpoint as it would contribute substantial implication on environmental impact. Maritime industries which heavily involved with chemical handling may also release an unwanted toxic compound that may damage the marine environment (Liu, Shao, Huang, & Li, 2019). The greenhouse gasses crisis regarding CO_2 emission related to shipping operations is a conjecture indicator that environmental initiatives and precautious step should be measured and executed accordingly to reduce its harmful impact on the environment. Moreover, this competitiveness in the maritime sector leads to the emergence of green practices, new carriers and the extension of value-added logistics services in this sector. Comprehensive control over the logistics and maritime supply chain and the quest for efficiency trend and increase financial control, call for massive capital investment and multimodal integration (Talley & Ng, 2013) to the organization that leads to the restructuring of the shipping industry (Lau, Ng, Fu, & Li, 2013) as a whole. Lately, shipping firms have been paying more attention to their environmental indicators or green performance, e.g., CO_2 emissions rate, energy usage, fuel efficiency, waste reduction, and recycling rate to achieve not only environmental performance but also higher financial performance (Lirn et al., 2014; Vivek, Singh, & Asolekar, 2019). Under these environmental issues, maritime supply chain encounters several new management challenges. Among them is concerning on implementing green operations to cope with various institutional pressures such as from regulators, policymakers and shippers, as well as balancing environmental performance and financial performance in their operation (Lun, Lai, Wong, & Cheng, 2013).

Numerous global organizations in the maritime supply chain community gradually utilized sustainable business routines as a part of their daily operations to mitigate the problem. In the broader context of a management issue, the extent of the sustainability awareness has also prompted the conception of green supply chain management (GSCM) in the maritime supply chain as well as in other industries (Lirn, Lin, & Shang, 2013). The significance of this "green" trend toward organizational dimension in the shipping community is imperative because of maritime supply chain a part of multimodal transportation chains along which the multiple involved parties need close operational linkages with one another to sustain and excel their operation in the long term. Moreover, the International Maritime Organization (IMO) also has been implementing a new chapter in its MARPOL Annex VI in achieving a comprehensive goal to reduce GHG emission in shipping operation (Kader, 2013). This annex is eventually become a blueprint for many maritime organizations in Malaysia to abide as it is obligatory to follow United Nation (UN) environmental regulation pertaining the international maritime law in order to perform global trade in the future. Current IMO declaration on these mandated nations is to collect data on emission so that reliable compliance measures can be included into IMO annex. This is due in part to congregate and implement the green requirement for Environmental Management System (EMS), Energy Efficiency Design Index (EEDI), Ship Energy Efficient Management Plan (SEEMP) and Ship Energy Efficiency Operational indicator (SEEOI) as a part of IMO annex that just been introduced for maritime operators.

Thus, in the course of appropriate sustainable control measure and encouraging input from the stakeholder, maritime supply chain could enhance its economic performance and sustainability in a long-term by embracing green practices through these initiatives (Khalid et al., 2010). Still, with small mitigation efforts and action added with weak policies execution, it is tough to forecast the outlook of Malaysian maritime industry in dealing with these rising problems. Even though the negative implication to the environment caused by maritime supply chain activities are considerably minor than any of other means of transportation, the maritime supply chain has persistently characterized by a lengthened history of tackling environmental problems (Benamara, Hoffmann, & Youssef, 2019). To take the edge off this critical problem, it is timely for Malaysian maritime supply chain sector to look for a better resolution to gain economic and environmental solution at the same time for future long-term business sustainability.

1.4 Research Gap

The goal of this section is to provide a general overview of the recent literature gaps which underpin this study by linking together the issues surrounding the discipline of logistics and maritime supply chain. This section reviews the gaps in the dimension of MGSCM, the mediating variables, the dependent variable as well as the theory chosen for this study's investigation. It provides a glimpse of the gaps found in a recent literature review. This sets the stage for the next section which discusses the problem statement to underpin this study’s inquiries respectively.

1.4.1 Research Gap on MGSCM

The increasing costs of environmental protection for organizations have amplified considerably since the 1970s and are predicted to increase in the near future (Ni, Tamechika, Otsuki, & Honda, 2019) due to strengthening regulations imposed by regulators. This significance trend implies that the cost-effectiveness of green practices will become a major determinant of a competitive organizational position in the future. Consequently, the research on green issues has extended from a narrow focus on the conception of pollution control, to broad green management practices (GMP) (Klassen & Whybark, 1999) and green supply chain management (GSCM). The preceding literature in GSCM has been rising as scholars and organizations start to understand that the management of environmental and green practices and operations do not end at the restrictions within the organization. In general, studies in organizational environmental management and its operations relationships have been budding in current years with a quantity of researches outlining these operational relationships (e.g. Chen & Ulya, 2019;

Fernando, Jasmi, & Shaharudin, 2019; Saade, Thoumy, & Sakr, 2019; Susanty, Sari, Rinawati, & Setiawan, 2019), including the recognition to investigate GSCM concept. As GSCM is an important construct toward achieving valuable benefit in term of organizational performance, this study attempts to extend the concept of GSM into the maritime dimension.

Prior literature, described GSCM as sturdily related to inter-organizational environmental subject matters that include industrial eco-systems, modern environmentalism, product lifecycle analysis, extended producer responsibility and product stewardship (Huo, Gu, & Wang, 2019). In a broader scope, GSCM also falls within the purview of the rapidly increasing literature of ethics, morality, and sustainability which incorporates additional social and economic dimensions. GSCM's general explanation has ranged from green purchasing to integrated supply chains and reverse logistics, which is "closing the loop" as defined by supply chain management literature (Zhu & Sarkis, 2004). The research in GSCM addresses a variety of issues ranging from managerial research and practice in GSCM (Geffen & Rothenberg, 2000; Theyel, 2001; Zsidisin & Siferd, 2001) to dogmatic models for assessment of GSCM practices and equipment (Handfield et al., 2002; Sarkis, 2003) equal to the concept of supply chain management, the boundary of GSCM is thus, reliant on the objective of the scholar. In reality, however, relatively few empirical and pragmatic studies have discussed GSCM capability in the context of the maritime supply chain.

Preceding studies have highlighted more toward general problems such as sewage pollution, air pollution, and greenhouse gas (GHG) emissions (Lirn et al., 2014) rather than the cause-and-effect relationship between GSM capability and firm performance in the maritime supply chain system. For example, Lai et al. (2011) propose only a conceptual framework for evaluating green shipping practices. The much more up to date reviews with some green focus have been more problem-specific but lacking comprehensive energy efficiency dimension or GSCM concept, such as the use of multi-objective decision methods in greening maritime transport (Mansouri, Lee, & Aluko, 2015a) or bunker consumption optimization methods to green the operation (Christiansen & Fagerholt, 2013; Wang, Meng, & Liu, 2013). Even though earlier studies have made significant contributions to the literature on environmental issues in an array of industries, much still remains to be learned about managing environmental issues in logistics and among logistics service providers (especially in the maritime supply chain) (e.g., Colicchia, Marchet, Melacini, & Perotti, 2013). Albeit, green performance monitoring and measurement have started to be perceived as a current essential study (Stechemesser & Guenther, 2012), there are still minimal studies associated to the green applications in the maritime logistics industry are available. Further, as the maritime supply chain is considered as logistic research, Flint, Larsson, Gammelgaard and Mentzer (2005) denote that logistics research has been largely ignored the concept of green innovation.

Despite such diminutive availability, significant questions have remained unanswered: what are the main contributions that the academician society has made to the maritime supply chain industry in term of global and regional economies in regards of green practices and efficiency? Have these contributions been tilted towards particular themes, directions, and geographical areas that it is so significant that it could change the outlook of maritime operation towards green movement and operational efficiency as well as its benefit in term of financial performance? What can the maritime academician society discover from the progression and trends of the maritime supply chain so that they can carry on to contribute to the well-being of the global and regional economies especially in term of sustainability perspective? To answer these questions, many maritime research only focusing on developed countries whereas developing country is still lacking in term of conceptual research and understanding regarding maritime "green" concept, especially in the Malaysian context. Even though there are some studies on GSCM relating to the manufacturing and another industrial sector in Malaysia context, studies on MGSCM in the maritime industry is still limited. Thus the correlation between sustainability and supply chains is the necessary step from latest assessment of "operations and the environment" and "operations and sustainability” (Kleindorfer, Singhal, & Van Wassenhove, 2005).

On the contrary, while numerous papers have focused on the thought of sustainability within the supply chain context (Seuring, Brix-Asala, & Khalid, 2019), there is very little work done to comprehend and investigate the role and importance of maritime supply chain sector in an organization's quest towards sustainability. In fact, Jazairy and von Haartman (2019) in their paper also signify that GSCM execution in the service industry is still relatively unclear and limited because of its vague nature. This is principally so concerning the maritime supply chain industry (which consider as service industry) in the Malaysian context itself (Khalid et al., 2010).

1.4.2 Research Gap on Energy Efficient Performance (EEP)

The term energy efficiency performance (EEP) has not received much interest in business and management studies although it might be an established concept within some branches of engineering sciences. However, the concept of energy that broadly defined as any usable source power (e.g., fossil fuels, electricity, wind, and solar power), has gained considerable attention in transportation (Halldórsson & Kovács, 2010) and maritime research (Acciaro & Wilmsmeier, 2015). To support this argument, based on maritime management literature, this study finds plenty of literatures on energy efficiency performance focusing on technical aspect (engineering) only such as achieving how shipping operation can achieve energy efficiency performance through decreased time in port (Hannes Johnson & Styhre, 2015), lowering vessel speeds (Lindstad, Asbjørnslett, & Strømman, 2011), hybrid engine technology (Dedes, Hudson, & Turnock, 2012) and ship design (Lai, Wong, Lun, & Cheng, 2013). From this apparent evidence, transportation and logistics can be seen as an imperative research for energy efficiency in the engineering context. However, an overview of supply chain management (SCM) literature reveals that energy efficiency is yet to be conceptualized into a more holistic framework (Halldórsson & Kovács, 2010) in term of managerial or theoretical value in the context of maritime logistics and SCM. The inadequacies of literature on EEP is further established when most of SCM literature in GSCM or green management usually focus more on 'traditional' sustainable three bottom lines of organizational performance and measurement (such as economic, social and environmental) focus (Ninlawan et al., 2010).

Based on the reviewed literature, this study finds there is still a limited body of literature that investigates the link between green management study and energy efficiency performance. The majority of literature on GSCM only include the EEP dimension as an environmental dimension only (see the studies by Cosimato & Troisi, 2015; Diabat & Govindan, 2011; Ali Diabat & Govindan, 2011; Govindan, Khodaverdi, & Jafarian, 2013; Seroka-stolka, 2014; Wu, 2013; Yang, Lu, Haider, & Marlow, 2013; Zhu, Geng, Sarkis, & Lai, 2011). For that reason, there is a further need to measure the energy efficiency performance as standalone dimension due to lack of imperative stress on literature on how GSCM can improve energy efficiency performance as a single dimension. While from academia perspective, Halldórsson and Kovács, (2010) have urged that scholars and professionals in logistics and SCM should take undeviating interest on climate change and energy efficiency dimension; not as separate issues, but also more importantly as convergent agendas. Taking this motivation into consideration, it is timely to investigate energy efficiency domain from the perspective of the maritime supply chain. For this compelling reason, this study not only integrates the energy efficiency as a separate measurement model (to test the performance dimension) but also integrate it into interceding variable (mediator) in the theoretical model of MGSCM–financial performance relationship. Hence the conceptual term of energy efficiency performance is introduced in this study as a potential variable to investigate the proposed link (the relationship between variable). By doing this, this study not only expanding the body of knowledge by investigating how energy efficiency performance mediates the casual relationship between MGSCM and financial performance but also giving deep insight from mediator point of view as limited study is found to investigate this objective.

From other perspectives, technology and innovation also offer a promising opportunity to enhance energy efficiency performance in maritime supply chains (e.g., Acciaro et al., 2014 and Miola et al., 2011). Correspondingly to other industries, however, a number of measures that would improve fuel efficiency have yet to be fully implemented despite their known cost efficiencies, creating what is often referred to as the "energy efficiency gap" (Hannes Johnson, Johansson, & Andersson, 2014b). Although the term initially only referred to investments into energy-efficient technologies, it can also be expended to account for general adoption of energy efficient practices and improved operative procedures (Backlund, Thollander, Palm, & Ottosson, 2012). The term energy efficiency gap presents a conceptual domain to be further studied, for the fact that albeit the gains of improved energy efficiency are broadly recognized, distinctive measures are not executed despite their evident on profitability returns (Böttcher & Müller, 2016). Most of the business organizations fail to incorporate energy efficiency into their overall strategy and day-to-day business (Bunse, Vodicka, Schönsleben, Brülhart, & Ernst, 2011) due to lack of information and understanding (de Groot, Verhoef, & Nijkamp, 2001). Addressing this gap, this study has measured the EEP in the context of the maritime study is convivial for further expanding the accurate understanding of EEP concept for gaining economic advantage.

There is also emerging literature on the barriers to energy efficiency performance that explain the restricted adoption of some of the available measures (Acciaro & Hoffmann, 2013). Sorrell et al. (2006) cluster these barriers into risk, imperfect information, hidden costs, and access to capital, split incentives and bounded rationality.

The challenges in executing innovative technologies and the adoption of effective policy measure are an apparent case in point of the complexity of dealing with energy efficiency in maritime supply chains. Such complexity often requires incorporation of multiple perspectives view, including that of economics, political science, marine biology, engineering, naval architecture and management; thus, energy efficiency in maritime logistics chains certainly benefits from an interdisciplinary investigation (Acciaro & Wilmsmeier, 2015). Addressing this current gap, this study of MGSCM could expand the understanding of energy efficiency performance knowledge from the lens of industrial and management perspective. It can be done via applying the practical concept of MGSCM in the complex environment of maritime supply chain and how the relationship (the linkage in this study's conceptual model) could potentially gain significant economic benefits through measurement of financial performance.

1.4.3 Research Gap on Low Carbon Performance (LCP)

Due to the growing scarcity of fossil fuels and climate change caused by man-made carbon emissions, carbon efficiency is increasing importance for a business organization. In this regard, business organizations, in general, can improve their carbon performance either by decreasing energy usage or by substituting to energy sources that are more efficient to produce fewer carbon emissions. Reducing carbon emissions through cleaner technologies (e.g., fuel switching) and optimization of efficient operations are considered to be predominantly effective to reduce the industry's impact on climate change (Böttcher & Müller, 2016). Many academic papers suggest that energy management systems (e.g., ISO 50001) within companies help to improve energy and carbon efficiency (Ates & Durakbasa, 2012; Thollander & Ottosson, 2010). In the past, the research in management literatures have significantly growing to examine both conceptually and empirically, evaluate sustainable and green systems and the suitability for such systems to achieved LCP in manufacturing context (Backlund et al., 2012; Bunse, Vodicka, Schönsleben, & Brülhart, 2011; Stenqvist & Nilsson, 2012; Thollander & Ottosson, 2010). However, knowledge on the effectiveness of green management systems (such as MGSCM) would be of great interest to both academics that are interested in approaches to overcome barriers to energy and carbon efficiency (Ates & Durakbasa, 2012) in maritime context due to the scarcity of empirical research in maritime management studies.

In this sense, while there are research studies on environmental performance addressing emission dimension for managing the supply chain (Hsu, Kuo, Chen, & Hu, 2013), a literature search finds limited research studies on maritime supply chain context especially in term of addressing specific single dimension of low carbon performance (LCP) derived from green supply chain management studies. However, most of the studies in maritime literature only show low carbon performance measurement through engineering sciences perspective. For example there are studies about vessel optimization to achieve LCP (Armstrong, 2013), slow steaming and wind propulsion system for LCP (Mander, 2016), vessel optimization schedule to achieve LCP (Qi & Song, 2012) and renewable source for achieving LCP in shipping of Pacific ocean (Nuttall, Newell, Prasad, Veitayaki, & Holland, 2014). Addressing the literature gap, this study has extended the LCP notion in maritime management study and used the measurement aspects from LCP literature to be integrated into a conceptual notion of MGSCM and investigated through the lens of GSCM and management studies. Further, most literature on GSCM and low carbon performance include the LCP dimension as an environmental dimension. There are also limited empirical studies being executed on LCP as mediator. By intricately defined LCP dimension into a single dimension, this study seeks to find the "unexplored "correlation of relationship between MGSCM-LCP and LCP-FP (financial performance). Expectantly, this will bring new insight on how the relationship works and propel this study towards a novel investigation of robust MGSCM concept in maritime context as well as further understanding of LCP dimension in maritime supply chain management area.

1.4.4 Research Gap on Financial Performance

Being in a competitive environment, maritime supply chain ‘financial performance', ‘low carbon performance' and ‘energy efficiency' measurement is not only a comprehensive management tool for maritime sectors administration, but also constitute essential input for informing regional and national maritime planning and operations (Pantouvakis & Dimas, 2010). Based on its strategic role as a global movement of products and consumers goods, ‘efficiency' for example is importance for maritime sectors and has been the focus of intense research in recent years. For example, many scholars have devoted their efforts to measuring maritime sector efficiency (Lai et al., 2011a; Lirn et al., 2014). The development of an efficient and profitable maritime supply chain is critical, as emphasized in the literature, given the relationships between maritime supply chain sectors and their commercial clients, who put strongly on competition and lowering pricing issues for increase financial performance (Yeung et al., 2006).

Furthermore, due to various new trends in sea transportation and improvements in maritime infrastructures in recent years, maritime supply chain sectors are forced to meet ship operator and government requirements in order to maintain a competitive advantage (Pantouvakis & Dimas, 2010). For this reason, for maritime supply chain managers to deal efficiently with the demand of their customers, new process-focused practices and management conduct such as EMS ISO 14001, Energy Efficiency Design Index (EEDI), Ship Energy Efficient Management Plan (SEEMP) and Energy Efficiency Operational Indicator (EEOI) certification programmes have been adopted in the maritime supply chain sector. These process management practices cite the expectations of maritime supply chain managers to improve environmental quality and energy efficiency and in the long term are expected to increase higher revenue, reduce costs and ultimately higher profits. This directive of green practices and certifications are a series of international standards which sets out requirements and recommendations for the design and assessment of management systems in maritime supply chain and specifies how management operations must be conducted effectively. However, only a few maritime organizations and ports in the European Union have been fully certified due to the associated difficulties such as the rather complex characteristic of the maritime supply chain sectors.

Subsequently, it is very complicated to implement a green standard in a different layer of production units maritime supply chain. In the literature, the results from this adoption of green practices and certifications in the financial performance on business organizations have been equivocal. Besides the fact that green practices and certifications have been globally pursued and implemented, just a handful of studies in maritime sector have explored their impact on financial performance with unclear results (Earnhart & Lizal, 2007; Kamatra & Kartikaningdyah, 2015). While some scholars exhibit an improvement in the financial performance of maritime companies (Maletič, Maletič, Dahlgaard, Dahlgaard-Park, & Gomišček, 2016; Ramanathan, 2018), others have not found better business performance after adoption (Dobre, Stanila, & Brad, 2015; Lima Crisóstomo, de Souza Freire, & Cortes de Vasconcellos, 2011). In the Malaysian maritime supply chain sector, a significant issue arises since no recent research answers the question, is financial performance affected by the adoption of green practices and certification such as MGSCM? In this regards, little attention has been paid so far to the relationship between green practices and financial performance in the Malaysian maritime supply chain sector in term of the empirical or conceptual investigation. Accordingly, the main purpose of this research is to address the gap found by investigating the relationship between MGSCM, efficiency performance (EEP and LCP) and the outcome of financial performance respectively.

1.4.5 Research Gap on NRBV Theory

The underpinning theory of this study resides in the natural resource-based view (NRBV) to further understanding the MGSCM concept. The NRBV viewpoint allows for a further logical examination of the relationship between an environmental and financial performance by specifying the linkage between organizational resources and capabilities and potential strategic outcomes. NRBV stresses on the reliant nature of resources and capabilities in making specific links between environmental and financial performance (as it will be shown in the upcoming chapter). NRBV theory helps this study by providing a theoretical outlook through which the link between environmental strategies (MGSCM) and profit can be established. However, NRBV denotes that the relationship between environmental strategy and competitive advantage (in this case financial performance) depends on the form of environmental improvement being considered, as the mechanism of environmental strategies is very different based on the industry (Hart & Dowell, 2011). Most studies focused on the relationship between profit and environmental control or the stock market reaction to the disclosure of environmental liabilities (Berchicci & King, 2007). In accounting perspective, for example, a few studies concentrate on the degree to which an organization’s voluntary disclosure of environmental practices affected its market valuation.

From another perspective, there are still many GSCM practices that have not been explored in terms of the association and linkage with the NRBV and further yet, there is a diminutive study into the effects and role of NRBV-GSCM on performance measures (Shi, Koh, Baldwin, & Cucchiella, 2012). Further, the interactions between NRBV-GSCM have remained relatively unexplored, both theoretically and empirically. Looking from this perspective, the gap is also appearance in the context of maritime literature as the theory of NRBV is hardly used in explaining sustainability in maritime context compare to another context of industries. Based on prior maritime literatures examination, a quantity of researchers inclined to use more familiar and renowned theory of resource-based view (RBV) as main theory to explain sustainability concept in their studies (see the studies by Gordon, Lee, & Lucas, 2005; Hutomo, Haizam, & Sinaga, 2018; Lai et al., 2011; Yang, Lu, Xu, & Bernard, 2013).

This is due to the fact that not only has RBV arguably become the dominant theory in management strategy generally (Barney et. al, 2001), it is also a dominant theory when it comes to the 'adaptability' of its theory from management perspective that looks at broader operational and ecological issues (Fernando, Walters, Ismail, Seo, & Kaimasu, 2018). However, as NRBV is an expanded version of the (RBV) that relates an organization's key resources and competitive advantages on environment (through its relationship to pollution prevention, product stewardship, and sustainable development), this study finds that NRBV theory is more robust and comprehensive in explaining each dimension of MGSCM variables in this study. Thus, extending from this viewpoint NRBV is chosen for examination of theoretical investigation on MGSCM concept in this respective study.

1.5 Problem Statement

While the primary emphasis of the study is to investigate MGSCM effects on financial performance, this study finds that the effects of such proactive green strategies (such as GSCM and MGSCM) are somewhat inconsistence (Mao, Zhang, & Li, 2017; Martinez-Oviedo & Medda, 2018). Since the 1990s, scholars have continuously studied the green strategies concept and its relationship with financial performance (for an extensive review, Yang et al., 2013; Vachon and Klassen, 2008; King and Lenox, 2001; Hart & Ahuja, 1996) quite substantially. The concept of GSCM and MGSCM is a widely accepted instrument for capturing the organization's intention toward the competitive edge and economic gain (Jia & Wang, 2019; Yu & Huo, 2019). However, contradictory theoretical assertions and mixed empirical results indicate that the relationship between MGSCM (green practices) and financial performance may comprise more than a simple, direct link. This connotation can be further argued by Lin et al. (2009), Lisi (2015), Maletič et al. (2016), Ramanathan (2018) and Tarus (2015) which they find that it pays to be sustainable, that is, green strategies may contribute positively to the financial performance, while other scholars discover the opposite results, such as Brammer et al. (2006), Cordeiro and Sarkis (1997), Dobre et al. (2015), Filbeck and Gorman (2004) and

Lima Crisóstomo et al. (2011) and several scholars such as Earnhart and Lizal, (2007), Hafez (2015), Kamatra and Kartikaningdyah (2015), Margolis and Walsh (2001) and Wagner and Blom (2011) cannot accomplish a clear and definite conclusion. However, Wagner, Schaltegger, and Wehrmeyer (2001) have noted that preceding literature reviews show a more sensible or modest positive relationship between green practices and financial performance or that no systematic relationship subsists. Alternatively, Yildiz Çankaya and Sezen (2019) pointed out that prior empirical evidence has a propensity to find a short-term negative relationship, while the long-term effect emerges to be more promising. This argument is supported by Cosimato and Troisi (2015) which assert that while the implementation of green practices in the supply chain may eventually generate long-term cost reductions, many of these actions necessitate prior investments in technology, process innovation, and equipment, management change which may have the impact of increasing costs in the short term.

On the other note, there may be various reasons for these contradictory results reported by preceding studies. For instance, Konar and Cohen (2001) have found that prior empirical studies suffer from small sample size and limited dimension of environmental criteria. Mao et al. (2017) proposed that the reason for the contradiction may be the different definitions applied by the scholars. While Cohen et al. (1997) described that a lack of objective or dimensional green criteria to evaluate environmental strategy exists. Another factor on the inconsistency of finding with early studies is that they did not include significant moderating factors such as country location or firm size (Wagner et al., 2001) that may influence the studies' outcome. Others propose that the inconsistence findings are predisposed by the fact that green companies can be efficient and competent in other production processes but not on the managerial aspect (Carpenter, 1923). While Ermenc et al. (2017) argued that the difficulty in generalizing the findings may be due to the nonappearance of clear definitions of environmental dimension and financial performance dimension. Another problem may due to some studies omit certain variables that influence profitability (Elsayed & Paton, 2005). While other researchers like Derwall, Guenster, Bauer and Koedijk (2005) and Horváthová (2010) noted that different methodologies mainly explain contradictory research findings- such as; the content analysis technique used by that particular researcher (Sylvie, Denis, & Michel, 2003), research design (Patten Dennis, 2002), sampling and measurement inaccuracies along with stakeholder disparity (Orlitzky, Schmidt, & Rynes, 2003), chosen time horizon and sample of respondents (Eabrasu, 2015).

Further, there are also issues concerning causal direction and non-linearity. The issue of causal direction entails that it is not clear whether financial performance is the effect of or the cause for green activities (Gómez-Bezares & Przychodzen, 2017; Wagner & Blom, 2011). While, the non-linearity issue advocates that directionality of the relationship is not simple and that there may even be a synergistic relationship between green practices and financial performance (Chang & Kuo, 2008; Waddock & Graves, 1997). It can be further argued that non-linearity can also be achieved by bad or good management (Wagner & Blom, 2011). In this sense, other factors such as institutional and market-level forces may play a significant role as well (Rodrigo, Duran, & Arenas, 2016). Based on the comprehensive meta-analysis by Horváthová (2010), he argues that on the one hand business organizations are likely to benefit from sustainable strategies, while on the other hand, other factors influencing the relationship are likely to present, underlining the importance of analysing interrelationships with other variables to further elaborate on the established tie. Drawing from these arguments, this study introduces EEP and LCP dimensions as the mediator to test this assumption of non-linearity relationship to establish a more robust conceptual understanding of MGSCM and financial performance linkage.

Further, several investigations of interrelationships with other factors such as the external environment (e.g., Shi, Koh, Baldwin, & Cucchiella, 2012) and the internal organization (e.g., Stam & Elfring, 2008) provide meaningful insight for both research and practical practice. However, there is no systematic research addressing a potential explanatory power of the EEP and LCP concerning financial performance relationship with MGSCM by the fact that EEP and LCP dimension is still scarcely investigated in maritime literature. This argument draws on observation on prior research highlighting that EEP and LCP reflects a disposition toward, rather than actual involvement in cost reduction (e.g., Acciaro & Hoffmann, 2013; Acciaro & Wilmsmeier, 2015; Cosimato & Troisi, 2015; Govindan, Diabat, & Madan Shankar, 2014; Nuttall et al., 2014; Qi & Song, 2012; Seroka-stolka, 2014). In addressing the limitation of previous literature, this study aims to advance the literature by examining these gaps and using EEP and LCP as an interceding variable to fill the relationship between MGSCM and financial performance.

Finally, the study of the financial aspects of MGSCM and their influence on financial performance in the maritime context is relatively new and less established than the study of sustainability in other areas of supply chain. However, the concept is generating a growing body of maritime literature, noting especially that GSCM, in general, can lead to significant financial gain. Contradictions, however, can be found in the general literature, for example, Testa and Iraldo (2010) found that cost efficiency appears to be a weak driver of GSCM because the upfront investments are expensive and mostly turn companies off investing in these green practices. GSCM could be a costly activity and often results in increases in price in the short term. However based on the study by Gómez-Bezares and Przychodzen (2017), this study argues that connecting sustainability dimension such as MGSCM to financial performance is about addressing exploitative investment activities and maintaining a proper balance between different operating and financial policies in a long-term perspective. Therefore, this study postulates that maritime organizations should view the investment in MGSCM as a long-term organizational strategy as opposed to short-term strategy.

1.6 Research Objectives

1. To examine the extent of MGSCM practices adoption in Malaysian maritime supply chain.
2. To investigate the effect of maritime green supply chain management (MGSCM) on its financial performance in the maritime supply chain industry in Malaysia.
3. To examine the effect of maritime green supply chain management (MGSCM) to the energy efficiency performance (EEP) in the maritime supply chain industry in Malaysia.
4. To examine the effect of maritime green supply chain management (MGSCM) to the low carbon performance (LCP) in the maritime supply chain industry in Malaysia.
5. To investigate the effect of energy efficiency performance (EEP) on financial performance in the maritime supply chain industry in Malaysia.
6. To investigate the effect of low carbon performance (LCP) on financial performance in the maritime supply chain industry in Malaysia.
7. To examine whether energy efficiency performance (EEP) mediate the relationship between maritime green supply chain management (MGSCM) and financial performance.
8. To examine whether low carbon performance (LCP) mediate the relationship between maritime green supply chain management (MGSCM) and financial performance.

1.7 Research Questions

The principal focus of this study is to investigate the relationship structure of MGSCM and performance value (economically) generated among the main players in maritime supply chain networks. The research questions were derived from the gaps identified in the literature (Chapter 1.3) and developed deductively from the results of a comprehensive literature review in Chapter 2. Eight major research questions are proposed respectively:

1. **What is the extent of MGSCM practices adoption in Malaysian maritime supply chain?**

   According to Beleya, Raman, Kumar and Chelliah (2015) profits remain a prime objective of maritime supply chain management in which other prominent issues such as sustainability are considered less important. This unawareness has created a negative externality towards the environment and may hamper further innovative action in managing the maritime supply chain. However, with increasing international and regional regulations imposed by IMO to mitigate maritime pollution as well as intensified public debates, maritime communities and stakeholders can no longer steer clear of environmental concerns (Lun et al., 2014). Further with enhanced competition and pressure to increase services, modernize development, and enhance financial efficiency (L. Li, Wang, & Cook, 2015; Poulsen, Ponte, & Lister, 2016) maritime organizations are pushed forward to adopt sustainability in order to balance these competing needs. However, since the green adoption in Malaysia is still at the infancy stage (Yahya, Nair, & Piaralal, 2014), this study is expected to convey empirical verification on green adoption amongst companies in the maritime supply chain. Thus, if maritime companies have adopted these green practices (MGSCM), this study is determined to know to what extent does MGSCM being practiced by Malaysian maritime supply chain players? Answering this evitable question may help this study understand the stature of its adoption, suitability of the practices and its practicality, especially in the area of maritime management. As green activities are relatively under-researched in maritime literature (especially in the context of a developing country such as Malaysia), understanding the depth of current practices in maritime context may help policymakers and maritime stakeholders to develop robust understanding, policy-making and necessitate action for adopting green initiatives in the maritime supply chain in the future.

2. Does MGSCM have an impact on financial performance?

This study examines the deployment of MGSCM practices and evaluates financial performance as an outcome. Even though many green supply chain literature denote that green practices may increase financial performance (Böttcher & Müller, 2016; Laosirihongthong, Adebanjo, & Choon Tan, 2013; Wang, Li, & Gao, 2014), the green concept in maritime literature is still limited. Thus, the motivation for this rising question is twofold. First, as mentioned in the problem statement, although there are numerous studies that study the relationships between green practices and financial performance (Eltayeb, Zailani, & Ramayah, 2011) there is a dearth of studies that have considered these relationships finding is consistence (Earnhart & Lizal, 2007; Marcus Wagner & Blom, 2011b) within the context of organizational or business strategy. In this sense, this study is interested to know the nature of this relationship in the maritime supply chain context. Second, as Asian and its surrounding countries have become the dominant player in inter-continental trade (with China becoming world's dominant player as a catalyst in import-export trade), awareness of sustainable operation has become imperative in this region. However, relevant green studies in Asian countries (South East Asia particularly) is still limited in number (Laosirihongthong et al., 2013a), especially in the maritime context. In particular, within the context of South-East Asia, if MGSCM is to be widely implemented in the maritime supply chain, links between practices and performance-based study need to be identified to understand the nature of this relationship especially regarding green research in the sub-region country such as Malaysia (Rao & Holt, 2005).

3. Does MGSCM have an impact on energy efficiency performance (EEP)?

The essence of doing green relating to energy perspective is to enhance energy efficiency and clean energy structure as the primary objective (Zhuang, 2005). Further, according to Hong (2013), an energy revolution should be encouraged by using technological innovation such as adopting green practices and strengthen policy instrument to set up sustainable economic development.

The concluding remarks from manufacturing literature clearly stated that adopting greener practice may, in turn, bring significant advantage towards energy efficiency. However, with the lack of study in maritime literature, the question of green impact toward energy efficiency performance remains inconclusive. This has raised the interesting research question to this study of "does MGSCM have an impact on energy efficiency performance?". This study assumes that in maritime supply chain context, the core of achieving this is might be the same as other sectors; which adopting the energy technology innovation and system innovation (such as MGSCM) can lead towards the end goal of energy efficiency performance. In fact, a report by International Maritime Organization (IMO), estimated that this potential of enhancing energy efficiency performance may range from 25% to 75%, which can be achieved through more efficient operations of existing ships, enhanced energy efficiency in the design of new ships, and introduction of alternative fuels (Buhaug et al., 2009). However, despite this significant potential in increased efficiency, reducing total energy usage from shipping will become an impeccable challenge due to the rapid growth of the sector. The rapid global economic growth is expected to continue with an increased need for transportation by sea. The contribution of the maritime supply chain in terms of global emissions (about 3.3% in 2007) is expected to double or even triple by 2050 (Johnson, Johansson, & Andersson, 2014). Even though International regulation (such as Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plan (SEEMP)) directed at energy efficiency in shipping applies to all countries has now been moved in place, the adoption of this green measures and policies related to Malaysian context is still unclear. Interestingly, if Malaysian maritime supply chain sector is indeed has taken a proactive approach of abiding these regulations through MGSCM, this study is interested to investigate what kind of impact the green practices adopted by maritime companies towards energy efficiency performance.

4. **Does MGSCM have an impact on low carbon performance (LCP)?**

The compulsory change in industrial production systems is coupled with good opportunities for business organizations, both regarding green energy sources and technologies and concerning the appearance of new low-carbon or carbon-independent business models. The general economy and consumption model face the need to adapt to the negative consequences of climate change (Stern, 2006). Business organizations in the maritime supply chain have to be able to analyse to what extent their existing production facilities and value chains are exposed to physical climate change damages and must be engaged in corresponding countermeasures through adapting towards the more sustainable operation. In this respect, this research question such as this is important to fully understand what is the impeccable impact the green practices (such as MGSCM) towards low carbon performance. If the impact is positive, it may become a core capability which may enhance competitive advantage for the maritime organizations. By fully understand the advantages of MGSCM practices for maritime companies along the supply chain; they can extend new business opportunities by focusing on adaptation solutions providing low carbon exposure business concepts.

5. **Does energy efficiency performance (EEP) have an impact on financial performance?**

Shipping operation in maritime supply is a very energy-intensive activity, in which the potential for cost improvement could be immense. International Maritime Organization (IMO) has established in 2009 that roughly around 25% to 75% of CO2 emissions could be reduced approximately by energy efficiency measures (IMO, 2009a), a proclamation which has later been verified by the study by (Magnus S. Eide, Longva, Hoffmann, Endresen, & Dalsøren, 2011). However, the potential for energy efficiency improvement with significant economic impact is not widely studied, especially in management literature and maritime literature (Johnson & Andersson, 2011). Thus, the goal of this research question is to understand to what extent the impact of energy efficiency performance on financial performance in the maritime supply chain. In this regard, the study is also interested in investigating what prior studies have done on other sectors, in which can it be also applicable to shipping context (due to limited literature on this domain) and to give suggestion for further research with this as a basis.

6. **Does energy low carbon performance (LCP) have an impact on financial performance?**

The individual and organizational contribution towards climate change and the rising use of carbon-based fuels matters for organizations from an instrumental cost/financial perspective. Maritime companies which utilize big vessels transportations as their main freight transportation may use an abundance of fossil fuel (carbon-based resources) in their operations. This fact has raised the emerging problem of carbon constraints (Busch & Hoffmann, 2011). From a logical perspective, if maritime organizations can improve their low carbon performance this study assumes that it may, in fact, reduce the cost of operation which translates financial performance improvement in the long term. This study resides its assumption following Porter's (1980) work, which denotes that business organizations can relate three basic strategies to increase competitive advantage: the least-cost, the differentiation, and the niche market strategy. In the following assumption, the study is basing the arguments on his least-cost strategy. In the context of the natural environment, one major attribute of outcome-based screens is that they deal with performance changes achieved by end-of-pipe and production through integrated solutions (Hannes Johnson et al., 2014a). Operational cost savings can then be realized by "exploiting ecological efficiencies" (Shrivastava, 1995a, p. 195) through low carbon performance dimension, which signifies the possible improvement of financial performance. As this study defines low carbon performance as an ecological dimension of sustainability outcome, this significant cost-based advantages of financial performance can be obtained through a more proficient use of raw materials and energy, reduction of waste, and addressing of life-cycle costs (Porter & van der Linde, 1995a; Shrivastava, 1995b) of implementing MGSCM. By investigating of this relationship of low carbon performance and financial performance linkage, the imperative research question such as "What are the impacts of low carbon performance on financial performance?" can be answered correspondingly in term of maritime context.

7. **Does energy efficiency performance (EEP) have a mediating effect on the relationship between the maritime green supply chain management (MGSCM) and financial performance?**
8. **Does low carbon performance (LCP) have a mediating effect on the relationship between the maritime green supply chain management (MGSCM) and financial performance?**

The two imposing questions above are formulated in order to explore the channel of possible variables that might be the missing variable of relationship between MGSCM and financial performance linkage. The strengthen outcome of financial performance strategy would be examined by answering the question of the energy efficiency and low carbon performance effect as being the mediator or non-mediator variables. Since the inconsistence finding found in prior literature (refer in the problem statement) these two questions are relevant to be investigated to know other factors that might be a possible influencer of the dynamic relationship between MGSCM and financial performance linkage.

1.8 Scope of the Study

The scope of this study is to develop a green supply chain model that can estimate the impact of green practices (such as MGSCM) on financial performance patterns among maritime organizations with the aim to achieve long term competitive advantage. From a general management perspective, this study aims to investigate into the operation of Malaysian maritime supply chain system in order to develop a deeper understanding on how MGSCM could affect financial performance as well as identifying the mediating variables that influence the relationship between MGSCM practices and financial performance.

Due to Malaysia is not isolated from the global market and among the most important maritime hub in the South East Asia region, this will involve modelling and identifying the international and ocean transportation market, and the role of each maritime players in determining the patterns of green adoption and its impact on economic dimension. Specifically, as the maritime industry is a globalized industry, the green framework model proposed must accommodate both domestic and global characteristics of the Malaysian maritime supply chain industry. The proposed green model (MGSCM) can only then be used to examine the potential impact of changes in the overall profitable outcome of maritime organizations and other major players in the maritime supply chain system.

From MGSCM viewpoint, which an extension of the GSCM perspective to the maritime supply chain, several studies have emphasised sustainability within maritime operations and have used various definitions and dimension for conceptualizing different GSCM in the context of maritime study. However, regardless of the various investigations of studies undertaken of GSCM from diverse angles, a clear conceptualisation of MGSCM is still limited in the literature. Only a few of literatures have emphasized the managerial aspect on greening the maritime supply chain. To such extend, various areas of GSCM are yet to be explored. Thus, extending from this viewpoint, this study has proposed to five (5) measures of green practice based on internal and external practice of GSCM to be conceptualized as MGSCM practice based on actual operation of maritime industry which consist of two (2) organizational capabilities. The first one is rooted in organization business operation. These dimensions include the green proposition of green information and communication system (GICS), green value added logistic service (GVALS), green supply chain integration practice (GSIP), shipping design and compliance (SDC) and green financial flow (GFF). The second component is about organization's ability in converting inputs into outputs. MGSCM can be considered as inputs while financial performance measures as outputs. Therefore, to evaluate organizational capability in greening maritime supply operations, this study employs the input–output approach respectively.

Meanwhile, the introduction of two mediating variables (EEP and LCP) in this study answered a specific inquiry of the inconsistency result of the green impact on financial performance found in similar studies (as well as in different sectors) in extensive works of literature. Answering this question contribute to the existing body of knowledge the valuable findings that the casual relationship between green adoption and financial performance is not that simple, and there is an interceding variable that may influence this direct outcome. Drawing upon NRBV theory, this study aims to contribute to the literature in the maritime field by proposing NRBV as an effective mechanism to strengthen the impact of MGSCM on financial performance.

Finally, the rest of this study will first examine the overall maritime industry, operational structure of Malaysian maritime supply chain system, its environmental concerns, its challenges and regulations, as well as conceptualizing an appropriate green model framework of MGSCM based on NRBV perspective from operational maritime outlooks. The proposed framework will then be analysed from the data gathered in the data collection phase of this study. The results will clarify how the adoption of MGSCM in maritime supply chain sector will affect the mediating variables proposed as well as the final outcome of this study in term of financial performance.

1.9 Significant of Study

There are three substantial contributions of this study which is a theoretical contribution, practical contribution and social contribution.

1.9.1 Theoretical Contribution

Malaysian maritime shipping industry has transformed rapidly over the year due to extensive expansion of global trade. Due to global sustainability pressure and policy challenges, Malaysian maritime sectors need to mitigate this concerning issue accordingly. Therefore, it is worthy for scholars in the maritime field to establish conceptual understanding on the issue of green management for the industry. Although previous scholars have conducted the investigation on sustainability issues in the conventional supply chain (e.g., manufacturing, automotive, food, etc.) in the past; regarding the theory and practical contribution of green concept in various industrial backgrounds, there is still limited empirical study and evidence in maritime supply chain context. For examples, the concept of green management and sustainability have been widely researched in particular fields such as manufacturing field (Saade et al., 2019; Zhu & Sarkis, 2004), organizational management (Marcus & Fremeth, 2009), automotive (Fadzil & Fernando, 2019; Luthra, Kumar, Kumar, & Haleem, 2011), logistics (Jazairy & von Haartman, 2019) and other fields, however, there is still a lack of survey-based study available in literature to study the theoretical framework of sustainability maritime supply chain especially in Malaysian perspective. Since this is among the earliest studies in Malaysian maritime supply chain, this study contributes to the development model of MGSCM (green concept) and outcomes in the unexplored domain especially in maritime context.

The exploration of MGSCM in this study also contributes to the introduction of new management paradigm for maritime industry players to adopt. Despite this, the preceding maritime literature and scholars still give little attention toward theory and implementation of GSCM concept in the maritime supply chain. In this regard, there is still no consensus determination of the mediating effect and lack of consistency and empirical result of financial outcomes based on sustainability and green implementation in the maritime supply chain. Due to these adversities, the synthesizing previous literature which generated from conventional GSCM concept has been specifically analysed in this study in hope to give significant contribution to the development of the MGSCM model in in general body of literature. This theoretical model has extended the concept of GSCM in the general literature to test the causal relationship of the mediating effect of EEP and LCP, as well as MGSCM and the financial outcome.

On the other note, this study is also among the first empirical study investigating green concept in Malaysia maritime supply chain on carbon reduction and energy efficiency in developing country. It is vital for this study to look deeper into the maritime managerial perspective that might influence the sustainability of maritime supply chain practices from environmental performances (EEP and LCP) standpoint which is rarely investigated as an interceding variable in the maritime literature. Finally, the impeccable impact of this study will further give an insight into the applicability of the foundational concept of NRBV theory to support the theoretical model of this study. This study will also contribute robust and novel MGSCM model building based on extended NRBV and GSCM theory to study sustainability impact from maritime supply chain and management perspective.

1.9.2 Practical Contribution

From practical contribution standpoint, this study aims to promote awareness and expected that more maritime organizations across Malaysian maritime sector and supply chain to adopt MGSCM comprehensively or at least to support MGSCM initiatives by the goverments and general stakeholders. This study also attempts to offer an insight outlook of sustainable maritime operation in Malaysia context as well as to instil awareness amongst maritime supply chain practitioners to be more attentive towards the sustainability practices and issues in managing their daily supply chain operations. It is necessary to look when more companies implement MGSCM in their organization; harmful ecological impacts could be potentially lessened, and increase the operational efficiency and financial performance at the same time. Furthermore, with the aid of industrial collaboration and awareness, the impacts could be eliminated through technology advancement as well as increase competitive advantage for the organizations involved. The ultimate contribution of this study hence is to investigate the suitability of MGSCM concept to be adopted by maritime organizations to lessen carbon footprint and at the same time increasing financial gaining capabilities in Malaysian maritime supply chain through compliance of government policies, stakeholders' supports as well as industrial collaboration effectively. In this regard, this study has formed the fundamental understanding of the green concept to increase competitive advantage as well as increasing needed responsiveness of adopting environmental based practices among companies supplying services for maritime supply chain system in Malaysia. Through the outline objectives involved, practically it would help the practitioner and policymaker to understand the green concept better and guided them to achieve a sustainable goal in the near future.

Besides, this study also helps the maritime sectors to evaluate its management performance through its suppliers and subsidiaries company under the maritime port system performance. On top of that, this study will be able to extend green practices implementation, understanding towards MGSCM body of knowledge as well as responsiveness act to the stockholders and companies involved for improvisation of future maritime businesses as well as to other sectors in Malaysia. Also, a practical contribution will be in term of shaping and suggesting required policy to achieve a sustainable maritime supply chain operation for policymakers in Malaysia. Finally, it is worth to note that, in the Malaysian context, the adoption of the new paradigm are different from developed countries and require time to shift to this new paradigm. This is because awareness level especially involving with the adoption of sustainability and green practices in Malaysia is still relatively infancy. In this sense, green adoption in Malaysia is frequently the consequence of conformity to fulfil specific global policies and regulations. Thus, practically, this study will promote a new paradigm thought, and assessment among corporate leader, stakeholder and industrial player within Malaysian maritime sector that greening their operation could enhance their business and financial performance in the long term.

1.9.3 Social Contribution

Greening the maritime industry has been widely disputed in environmental policy studies, and global energy resulted from relatively poor execution and awareness by stakeholders. From this point of view, this study persuades more organizations and business entities to implement MGSCM at the countrywide level or at least at the organizational level. From a societal outlook, when more maritime organizations implement an environmentally friendly operation in their organization, not only economic gain can be achieved, but harmful ecological impacts could also be potentially decreased substantially. Positively, in the long run, excellent environmental welfare and awareness achieved resulting from these sustainability actions, would eventually benefit the society in the long term. Even though there is still doubt and misconception view on sustainability practice, it is the precautious steps that remain imperative to do for the sake of broader benefit for sustainable businesses, communities, and region in the long run. For that reason, this study has challenged to dismiss such perception in today management society and provide evidence that MGSCM would show the way towards practicality of its sustainable objective as well as encouraging long-term performance. Malaysian maritime sectors could effectively translate the goal of this study into practice to be aligned with accepted Malaysian social values through MGSCM. For examples, the organizational social value through MGSCM viewpoint can be translated into providing financial and institutional benefit for its employees by improving the overall quality of service offered, building society/client trust and commitment, alleviating the community poverty as well as employee empowerment through sustainability practices. In a nutshell, from a societal point of view, MGSCM could potentially provide the foundation in making an organization's social mission a reality through sustainability efforts respectively.

1.10 Definition of Key Terms

The definitions of key terms used as the foundation of this study were adapted from previous literature and further improved to ensemble this study relevance. Key terms used are defined as follows:

1. **Green supply chain management (GSCM)** is concerning on assurance of smooth traditional supply chain deliveries while integrating the environmental, economic and social concern in each phase of supply chain system to ultimately lessen the ecological footprint (Jasmi & Fernando, 2018; Lee, Tae Kim, & Choi, 2012).

2. **Maritime green supply chain management (MGSCM)** is the extension of traditional green supply chain management (GSCM) which is about integrating

various environmentally friendly operations in every phase of maritime supply chain system to diminish environmental footprint and to achieve increased energy efficiency and financial performance (Jasmi & Fernando, 2018).

3. **Sustainable development** is a means for any organization to build up a sustainability business process and conduct to meet the need of the present without exceeding the capacity or capability of the future generations to meet their own needs. The three foundations of sustainable development are to achieve sustainability in term of economy, environmental and social dimension (Ramcilovic-Suominen & Pülzl, 2018; United Conference, 1992).

4. **Green information and communication systems (GICS)** is defined as information system that have been modified for systematic application of sustainability in various processes of IT and communication management in order to reduce related emissions and to improve energy efficiency as well as financial performance through synchronization of efficient information flow (Hasan Ali Al-Zu'bi, 2016; Jasmi & Fernando, 2018; Kehoe & Boughton, 2001; Mathiyazhagan, Diabat, Al-Refaie, & Xu, 2015; Prajogo & Olhager, 2012; Qazi, Quigley, Dickson, & Ekici, 2016; Swaminathan & Tayur, 2003).

5. **Green value added logistic service (GVALS)** is defined as the systematic application of sustainability in various processes value-added logistic (e.g., utilization of green material and handling, reduce waste, implementation of the environmental management system, etc) in supply chain to reduce ecological impact and to improve energy efficiency in order to achieve financial performance (Jasmi & Fernando, 2018; Sweeney & Soutar, 2001).

6. **Green supply chain integration practices (GSIP)** is defined as the systematic approach of integrating sustainability in various processes of supply chain system in order to improve information flow, decision making and cooperative action to achieve higher implementation of green practices to lessen the impact to environment, increase energy efficiency and financial performance (Jasmi &

Fernando, 2018; Frohlich & Westbrook, 2001; Van Der Vaart & Van Donk, 2004).

7. **Shipping design and compliance (SDC)** is defined as the systematic approach of sustainability in various processes of shipping design, construction and production phase to achieve conformity with sustainable compliance in order to reduce impact to the environment, gain energy efficiency and increase financial performance (Jasmi & Fernando, 2018; Chang, 2012).

8. **Green financial flow (GFF)** defined as the systematic approach of sustainability in various processes of financial management and accounting in order to reduce impact to the environment and to increase energy efficiency and financial performance (Jasmi & Fernando, 2018; Vincent, 2000).

9. **Energy efficiency performance (EEP)** is related to the ability of maritime companies to reduce energy consumption and the associated cost for energy consumption and resources through adopting green practices, technologies, and equipment (Zhu, Sarkis, & Lai, 2008).

10. **Low carbon performance (LCP)** is related to the maritime company's ability to reduce carbon emission in its operation and the associated cost for carbon emission discharged (Lun et al., 2015; Zhu et al., 2008).

11. **Financial performance (FP)** is related to the ability of the maritime company to reduce overall costs associated with purchased materials, energy consumption and operation costs as well as improve overall profitability and sales growth (Fan, Pan, Liu, & Zhou, 2017).

1.11 Organization of Thesis

This study comprises of five specific chapters. The first chapter described the background of the study, research gap, problem statement, research questions, research objectives, the scope of the study, significant of study and definition of key terms. Next, the second chapter offers a necessary review from related prior researches on the general overview of the maritime industry, sustainability concept, conceptualization of MGSCM and its components, the impact of MGSCM, financial performance and the theory used in this research. The conceptualization of each hypothesis and conceptual framework are also included in this chapter. Chapter three illustrates the methodology used in this research involving survey measures, sampling techniques and research procedure used in conducting this research. Chapter four in this research provides the relevant data analysis that was the result of descriptive statistics, confirmatory factor analysis, and structural equation modelling respectively. Ultimately, the conclusion drawn from research findings and data collection will be discussed further, and the implications for the maritime industry are examined thoroughly in chapter five.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Maritime supply chain transport merchandises and commodities between geographical places as well as facilitate the significance value of global trade activities. As one of the world's most internationalized sectors, the maritime supply chain deals with the movement of cargoes between diverse locations, which supports a cohesive global trade activity as the most cost-effective means of transportation. Although maritime supply chain is beneficial to global trade and a significant contributor towards economic development of many countries, the associated operation of its activities can cause substantial environmental pollution (e.g., CO_2 emissions, water pollution, and ballast water discharge). Moreover, environmental policies, regulatory pressures and consumer concerns about environmental problem and climate change pilot the way to the execution of green practices by various organizations.

Outside the public and individual-level efforts, many organizations and businesses in other industries started to integrate green practices into their supply chain management system because of the potential benefit gains of its financial performance. Thus, to balance the environmental protection and business performance improvement, the maritime industry should pay considerable attention to the environment and financial implications of their business routines in the supply chain context. However, most maritime companies are still struggling to gratify the needs to participate in green management routes to comply with international regulation and pressure from policymakers due to the complex nature of this industry.

Nevertheless, if green management practice is adopted, this study postulates that it may lead to financial performance improvement needed as a long-term goal for the maritime organization. Hence, for this entire body of chapter 2, this study has proposed the conceptual notion of MGSCM concept as well as conceptualizing the relationship between MGSCM and financial performance. The mediating effect of energy efficiency performance (EEP) and low carbon performance (LCP) is also conceptualized to investigate the dynamic effect of these variables with MGSCM-financial performance relationship.

It is worth to note that the flow of this chapter consists of 8 major sections starting with; 1) introduction of the overall maritime industry, component and its issues (Section 2.2), 2) the theory used in this study (Section 2.3), 3) introduction of GSCM in maritime context (section 2.4), 4) conceptualization of research model (section 2.5), 5) conceptualization of MGSCM and its hypothesis (section 2.6), 6) conceptualization of performance variables and its hypothesis (section 2.7), 7) the summary of hypothesis as well as 8) the chapter summary that summarize the entire chapter two.

2.2 General Overview of Malaysian Maritime Sector and Supply Chain

For this early section (section 2.2 to 2.2.9), this chapter starts with a glimpse of literature and a flow of overview on; global maritime industry, maritime shipping industry in Malaysia, its component, the rising issue of sustainability within maritime domain as well as underlying governance and regulation behind green practices and its role in improving supply chain performance in this growing sector respectively. In summary, the sections will provide a general understanding and in-depth review of the maritime industry before the study sets the stage for the theoretical discussion in Section 2.3.

2.2.1 Overview of Global Maritime Industry

In recent years, the value of shipping operation in the maritime supply chain has enlarged in the preceding decades as the trends of industrialization, globalization, e-commerce, and the implementation of outsourcing operations strategies emerged extensively. These situations have resulted in extensive improvements of service quality and cost efficiency in the maritime supply chain to cater increased cargo flow which in turn leading to further expansion in international merchandise trade (Yamazaki, 2018). In this regard, the trading performance of maritime supply chain in accordance to United Nation Conference on Trade and Development (2016) report, has outperformed the global economy with the increasing volumes estimated at 3.4 per cent in 2014, that is, at the same rate as in 2013 (Asariotis et al., 2015). In addition, the volumes also have surpassed 300 million tons taking the total to 9.84 billion tons.

Table 2.1 shows the development in international seaborne trade from the year 1970 to 2015; total cargoes have significantly increased over the year except the declining trend in the year 2008 to 2009 and 2012 to 2013. Table 2.1 shows for the first time in records world seaborne trade volumes have exceeded 10 billion tons respectively (UNCTAD, 2016). Even though the declining trend is spotted in prior years due to the volatility of world trade market, the significant growth of trade is still growing substantially due to developing countries (especially China and South East Asia) maintaining to fuel global merchandise in global trade flows. This performance also indicates a few contexts of slower developments in prior years, due to (a) a decelerate trade in large emerging developing economies; (b) reduce of oil price and new processing plant developments; and (c) a slow-moving and recent irregular recovery of trade in the advanced economies.

Table 2.1 Developments in international seaborne trade, selected years (millions of tons loaded)

Years	Oil and gas	Main bulk commodities (iron ore, coal, grain, bauxite and alumina and phosphate rock)	Dry cargo other than main bulk commodities	Total (all cargo)
1970	1 440	448	717	2 605
1980	1 871	608	1225	3 704
1990	1 755	988	1265	4 008
2000	2 163	1 295	2526	5 984
2005	2 422	1 709	2978	7 109
2006	2 698	1 814	3188	7 700
2007	2 747	1 953	3334	8 034
2008	2 742	2 065	3422	8 229
2009	2 642	2 085	3131	7 858
2010	2 772	2 335	3302	8 409
2011	2 794	2 486	3505	8 785
2012	2 841	2 742	3614	9 197
2013	2 829	2 923	3762	9 514
2014	2 825	2 985	4033	9 843
2015	2 947	2 951	4150	10 047

Source: UNCTAD (2016)

Despite the slowdown turn of global trade in the aforementioned year, developing countries continued to chip in larger shares to global seaborne trade respectively. In this sense, their significant contribution of trade regarding global goods loaded was approximately 60%, while their import trade as measured by the volume of goods unloaded reached 61% (Asariotis et al., 2015). The individual contributions of global trade usually differ by regions and type of cargoes shipped, varying in term of countries' economic structures, the trade's composition, level of development and urbanization, as well as the intensity of incorporation into worldwide trading networks and supply chains. Further, the implicit impact of the drop in oil price levels since the 2nd quarter of 2014 has also affecting shipping and seaborne trade especially tanker trade. Circumlocutory impacts of this matter are felt through the number of changes in the areas of operation and sectors that spawned more demand for maritime transport and maritime supply chain services. These include changes in manufacturing and operational costs, financial growth, income and purchasing power of oil manufacturers and consumers, provisions of trade, and investments in the exploration of oil and gas, as well as investments in substitute fuels and green technologies.

For the moment, the impeccable impacts on maritime trade are reflected in lower fuel and transportation costs of a cargo shipment. Ship bunker fuel costs have plummeted significantly over the year of 2015 with 380 centistoke bunker prices in Rotterdam dropped from $590 per ton in June 2014 to $318 per ton in December 2014, a drop of 46% (Asariotis et al., 2015). The relative effect of this trend has reduced ship operators' expenditure, cost, and rates paid by shippers. The resulting circumstances are expected to motivate further global demand for maritime transport and services as well as increasing seaborne trade and cargo flows in the incoming years to come.

2.2.2 Overview of Malaysian Maritime Industry

Malaysia's maritime aspect is painted by the very fact that it is a land fragmented by the vast prevailing ocean with the South China Sea separating Peninsular Malaysia from Sabah and Sarawak region. In accordance with Exclusive Economic Zone authority, Malaysia has an outsized maritime area in contrast to its modest land mass. This prevailing fact has indeed contributed to the significant impact of development in the maritime sector. In the past, the initial development of the maritime sector in Malaysia started back in the 15th century where Malacca at that time became the most prominent maritime port for both domestic and intercontinental trade (Wey & Harun, 2018). The importance of this era in terms of maritime activities was reflected through Malacca strategic location for trading in the heart of seaborne traffic of Straits of Malacca from the Indian Ocean to East Malaysia. Afterwards, the significance falls of Malacca Empire in the year 1511, consequently from the Portuguese invasion has made Malacca seaport to lose its dominant status as a trading port in the South East region. However, under British occupancy in the year 18th century, the three major ports were established in Penang, Melaka, and Singapore in which maritime trading activities started to take a more prominent role in maritime operation development. In the 1970s the Malaysian maritime industry started to develop rapidly due to government initiative in the Third Malaysia Plan to transform the country towards becoming an eminent player as the maritime nation (Jeevan, Ghaderi, Bandara, Saharuddin, & Othman, 2015). Throughout the Fourth Malaysia Plan period (it was introduced following the Third Malaysian Plan), the expansion of port facilities and interrelated maritime services have continued progressively, with the new establishment of shipping lines were undertaken to deal with the growth in freight traffic and trade development. Currently, maritime supply chain sector acts as one of the most prominent service industry in the maritime sector and has contributed a vital component towards Malaysia's economic development with almost 95% of its trade (by volume) is carried by seaborne transportation (Khalid, 2012). The significance operational activities contributed by maritime supply chain includes shipping operation, port operations, a wide range of supporting service activities; oil and gas exploration and production; as well as marine tourism provide the fundamental development of Malaysia's economic and prosperity.

The promising prospect of the maritime supply chain in Malaysia is continually broadened to this present time due to the strategic setting of its maritime pathway in the straits of Malacca. The Straits of Malacca in particular acts as an important route for international navigation shipping route and is vital waterway in the global trading for worldwide or domestic trade (Bartolomeu, Malhadas, Ribeiro, Leitão, & Dias, 2018). According to Rahman, Saharuddin, & Rasdi, (2014), more than 60,000 vessels pass through the Straits of Malacca each year by shipping diverse kind of global cargoes, from raw materials to finished products from around the world as well as approximately 80% of vessels passing through the Straits yearly to carry oil to Northeast Asia. In Figure 2.1, the entire figure of trading vessels navigating to the east-bound region from the west-bound region and vice versa that is reported to Marine Department of Malaysia, from the year 2000 until 2012 is showed accordingly. The significant number of vessels navigating through the Malacca Straits has risen from 2000 to 2017 with a minor decreased in the year 2009. In this regard; the sum percentage of vessel across the Malacca Straits from the year 2008 to 2009 has decreased by 6.57% from 76381 units to 71359. The result shows that even though there is decreasing in the number of vessels in the year 2009, the entirety number of vessels using Straits of Malacca is augmented each year rapidly. In 2008 alone, the country's total maritime trade was valued at US$335 billion, reflecting on the healthy growth of 6.8% from 2007 (Rahman et al., 2014). Exports trade activities have also increased by 9.6% to US$187 billion, while imports trading by 3.3% to US$147 billion, resulting in a significant trade surplus of US$40 billion respectively (Khalid, 2012b). This shows that the economic development of the maritime sector in Malaysia has been catalysed by the strategic location of the sea route of Straits of Malacca.

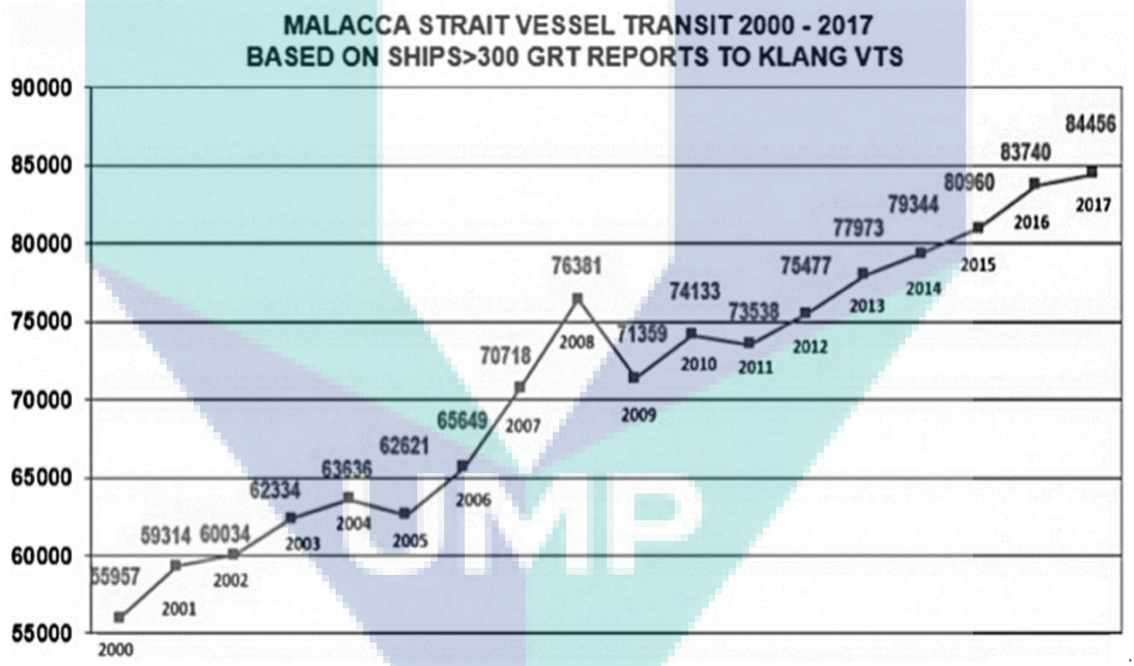

Figure 2.1 Vessel crossing Malacca straits from the year 2000 to 2017
Source: Marine Department Malaysia (MARDEP)

In recent years, Malaysia maritime port and maritime supply chain operations have also gone through numerous transformations in 1980 and 1990s resulting from rapid economic growth. For examples, the Global Competitiveness Report 2015/2016 released by the World Economic Forum (WEF), Malaysia has consolidated its spot among the world's most competitive economies at 25th place out of 138 countries. Despite descending seven notches from the 18th spot 2015, Malaysia continued to be the highest ranked among developing Asian countries. The progress of the country is due to enhancement in efficiency and competitiveness through its progressive Government Transformation Programme (GTP) and the Economic Transformation Programme (ETP). Malaysia also ranked 22nd spot on the World Bank's Ease of Doing Business Report for 2016 (MIDA, 2016). This progressive nature of economics is also a reflection of higher domestic industrialization resulted from high Foreign Direct Investment (FDI) in the country.

Meanwhile, a Review of Maritime Transport 2016 by UNCTAD, Malaysia was ranked 24th spot in the list of countries with the largest registered fleets (621 ships with a combined tonnage of 16,791,296 thousand DWT, contributing to almost 0.94% of the world's total fleet as of 2015 (UNTCTAD, 2016). Currently, there are about 100 registered shipyards which 39 are in Peninsula Malaysia and 61 in Sabah and Sarawak. The data gathered by Transport Statistic Malaysia 2017 report (see Figure 2.2) also indicates the substantial growth of the maritime sector in Malaysia has been translated from the significant increase in total cargo throughput by export and import at ports from the year 2010 to 2017. This growth in cargo volume is due to the substantial improvement of seaport capacity to accommodate more containers as well as Malaysia's transformation economy towards manufacturing and trade based (import-export) from agriculture and commodities dependent based economy in recent years (Jeevan et al., 2015). The outcome from this economic transformation has increased maritime supply chain operations to 78.4 % of the total Malaysian export in recent years that continuously facilitate national economic growth.

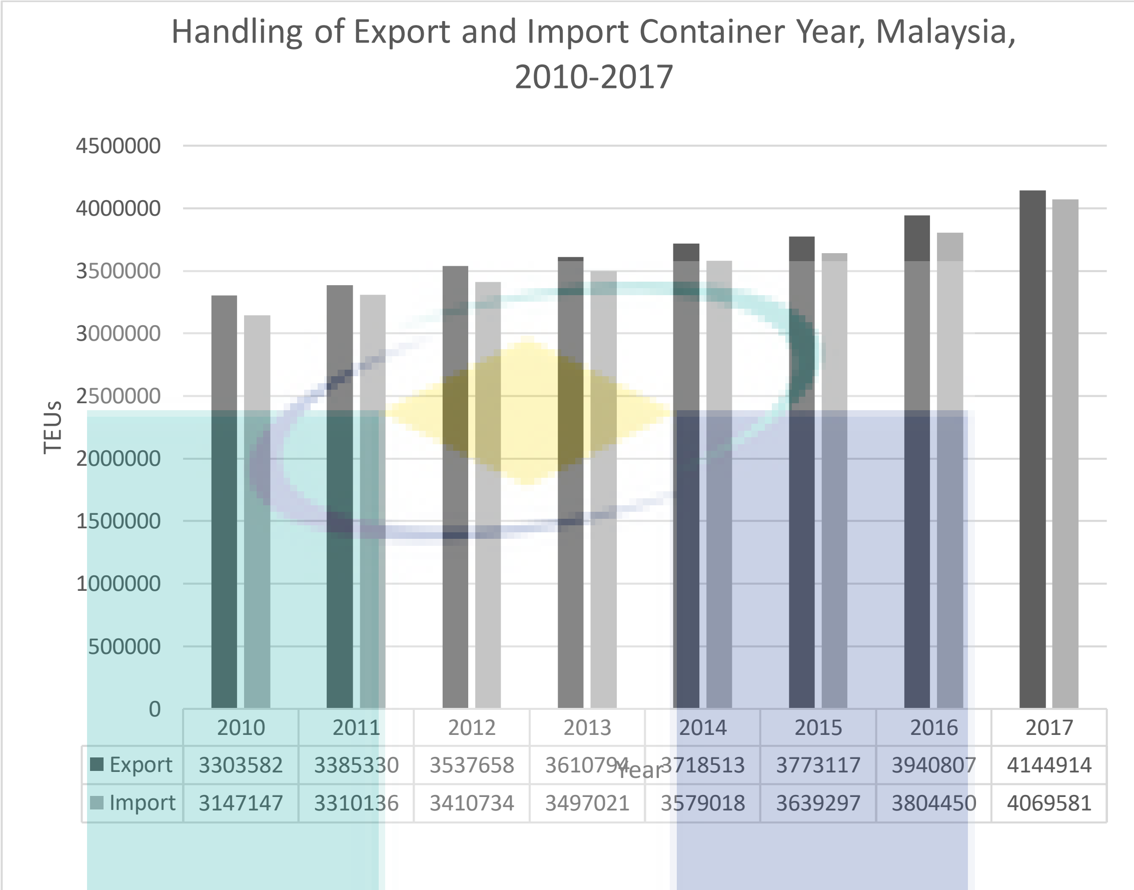

Figure 2.2 Handling of Export and Import Container Year, Malaysia, 2010-2017
Source: Transport Statistic Malaysia (2017)

On the other note, the rapid economic growth leads to the negative implication from an environmental standpoint as it would contribute substantial implication on environmental impact as the maritime operation grows exponentially (Khalid et al., 2010). The current greenhouse gasses crisis regarding CO_2 emission related to shipping operations, for instance, becoming a major concern for regulators (such as IMO) and maritime stakeholders. In fact, a few of maritime ports and stakeholders in Malaysia has been progressively moved towards this sustainable agenda in recent year. Northport, Westport, and PTP for examples were awarded Green Port Award System (GPAS) in 2016 by APEC Port Services Network (APSN) on sustainable evaluation and green agenda of ports in the Asia- Pacific Economic Cooperation (APEC) region. This initiative provides a valuable roadmap for stakeholders to develop green port plans, planning sustainable platforms for sharing best practices, encourage competitiveness as well as improving capacity for sustainable operation in the future.

Although the maritime supply chain undoubted importance to Malaysian economy development, there is still lacking in term of the countrywide master plan and adoption to broaden this sector into strategic and realistic planning (Jeevan et al., 2015). The sustainability and green agenda is still relatively underappreciated and not widely recognized by most small players in maritime sectors. The reasons for this drawback is due to the lack of credible and reliable measures of the economic value of this sector and its contribution to the economy by national authorities (Khalid, 2012). The lack of those factors also contributed to the industry being under-appreciated by policymakers and stakeholders. This poses a constant challenge on any effort aimed at quantifying the economic performance or contribution of the sector towards the national economy and hence impedes any effort to develop the sector comprehensively towards sustainability. For this reason, further research in the area of maritime sustainability is necessary (such as this study) and must be explored comprehensively further to address and asses the current situation posed by maritime supply chain sector.

2.2.3 The Components of the Malaysian Maritime Supply Chain System

Historically, general maritime operators include shipping lines, port terminal operators and freight forwarders that can be regarded as self-governing entities that exclusively provide specific sea transportation services. However, the rapid growth of current business environments has shifted this customary practice. Nowadays, as a vital element of centralize global logistics systems, maritime supply chain operators are now obligated to carry out both sea transportation services and other related logistical services and to be well inter-linked with other players in the whole supply chain flow efficiently and effectively (Weig & Schultz-Zehden, 2019). Such integrated demands of global logistics have contributed to the development of the maritime supply chain system. The complex and global nature of the maritime supply chain is well established by the assortment of many governmental regulations and policy-making processes related to global shipping industries (Jeevan et al., 2015). In general, within these complex supply chain system of shipping companies, port authorities, trading companies, and stevedores typically collaborate and cooperate with each other in the immense management of maritime logistics (Cheng, Farahani, Lai, & Sarkis, 2015).

In this regards, various stakeholders consisting of diverse nationalities are players in the daily business and trade of the shipping operations. These players are concerned in the design, production, ownership, construction, procedure, administration, crewing of maritime trader vessels and training as well as classification, investment, finance, liability and insurance aspects of shipping operations. Additionally, the remaining major stakeholders could be categorized as freight owners and definitive customers as well as ancillary services such as stevedore, pilotage, equipment maintenance service, vessel traffic services, towage, and consolidator. In general, Lee and Song (2010) underline three significant components of maritime transportation that make up the maritime supply chain system: 1) shipping, 2) port/ terminal operating and 3) freight forwarding. Table 2.2 presents the primary and supportive logistics functions involved in the maritime supply chain.

Table 2.2 Main function and supportive activities of the maritime supply chain system

	Shipping	Port/terminal operating	Freight forwarding
Main function	Moving cargoes between ports	Shipping reception; loading/unloading cargoes; stevedoring; and connecting to inland transportation Warehousing;	Booking vessels; and preparing for the requirement of site documents for ocean carriage and trade, on behalf of shippers
Supportive logistics activities	Documentation relating sea trade; container tracking and information; and intermodal service	Warehousing; offering a distribution centre; resting; assembly; repairing; and inland connection	Inventory management; packaging; and warehousing
Stakeholders Involved	Carriers, including operators and shipping linear (international and domestically operation), road haulier (conventional trucking, container truck transportation, and bonded truck), railway and airlines carrier	The terminal operator that includes maritime port, inland port system, freight terminal, and inland container depot	Cargo intermediaries, including freight forwarders, customs agents, multimodal transport operator, warehouse operator (bonded and non-bonded), private warehouse (bonded and non-bonded), International Procurement Centers and regional distribution Centers

Source: Adapted from Lee and Song (2010)

From Table 2.2, the most critical function of the maritime supply chain system is shipping which is to move the goods of shippers from one port to another port or place. Maritime supply chain includes other logistical services in order to effectively support the shipping and logistics flow of supply chain transhipments, e.g. pick-up service, delivery notification, a specific handling service for customers who necessitate particular service, inbound/outbound bill of lading (B/L), container tracking and information and intermodal services (Lu, 2000; Notteboom & Winkelmans, 2001). The primary function of port/terminal operation is loading and discharging cargoes into or from a vessel, and planning the arrangements for the cargoes to be ready and delivered to the destination via inland transportation. To ensure that the cargoes can be passed efficiently to the next phase of the logistical system, a port/terminal operation is needed to involve in other logistics functions, e.g., warehousing, storage and packing (Carbone & Martino, 2003; Roh, S Lalwani, & Naim, 2007). Occasionally, a third intermediate party must be involved in the process of sea transportation for coordinating the complex processes of global trade. For example, freight forwarders may reserve a vessel on behalf of shippers or arrange for necessary documents for ocean carriage (e.g., B/L) and other vital documents such as customs clearance and insurance requirements. In this regards, they may also coordinate other logistics services, e.g., inventory management, packing and warehousing (Murphy & Daley, 2001; Murphy, Daley, & Dalenberg, 1992) for efficient supply chain flow.

Meanwhile, Figure 2.3 shows the overall interaction of the maritime supply chain with other activities and operations in the entire logistics chain. As designated in Table 2.2, the maritime supply chain system is involved in maritime transport services as well as supplementary logistics services. Those supplementary logistics services are the most essential part of physical distribution operations in the maritime supply chain, e.g., packaging, goods inventory, warehousing, material handling, distribution planning, order processing, transportation, and customer service. For that reason, the performance of maritime supply chain operations does inevitably influence the whole performance of physical distribution management. As physical distribution is one of the two pillars of the whole maritime supply chain, successful management of maritime supply chain has a direct impact on the overall management and operations of both physical distribution and logistics (transportation) management.

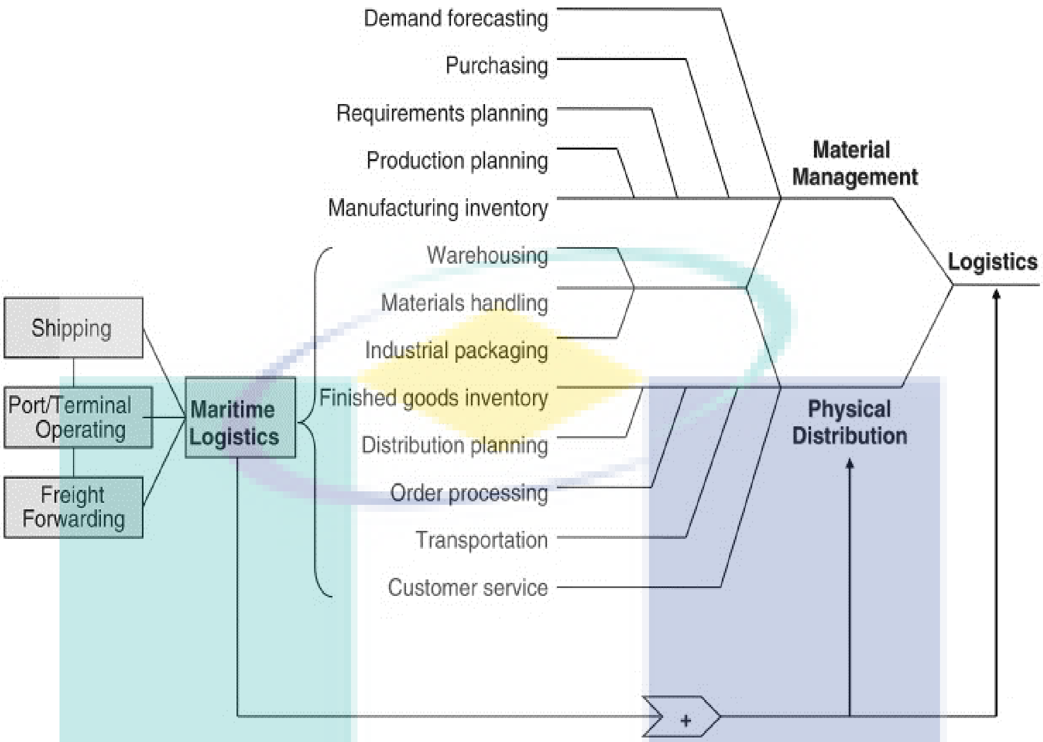

Figure 2.3 Maritime logistics in the whole logistics system

Source: Adapted from Coyle et al. (2015)

In a nutshell, based on the system above it can be concluded that maritime supply chain co-exists by many shore infrastructures such as port and warehousing facilities as well as the workforce for cargo handling and support services to ensure efficient operation. In Malaysia, the maritime supply chain is an essential linkage between international logistics supply chain and Malaysian domestic supply chain by moving cargo across the world to cater to global trade and economic development. Hence, every player in the maritime chain is mutually crucial to work cohesively in order to function efficiently. Figure 2.4 shows the structure of maritime supply chain members in Malaysia in general categorized by:

1. Carriers, including operators and shipping linear (international and domestically operation), road haulier (conventional trucking, container truck transportation, and bonded truck), railway and airlines carrier;
2. The terminal operator that includes maritime port, inland port system, freight terminal, and inland container depot;
3. Carrier intermediaries, including shipping agent, air cargo agent, off dock depot operator, non-vessel operating common carrier, ship broker and i-port;

4. Cargo intermediaries, including freight forwarders, customs agents, multimodal transport operator, warehouse operator (bonded and non-bonded), private warehouse (bonded and non-bonded), International Procurement Centers and regional distribution Centers;
5. Inland water transport, including barges, tugs and riverine vessels;
6. Ancillary services providers including cargo handler or stevedoring companies, packaging service providers, cargo consolidators and equipment maintenance and material handling suppliers;
7. Integrated Logistic Service Providers including third-party logistics providers (3PLs) and lead logistics providers (LLPs) often called as fourth party logistics providers (4PLs)

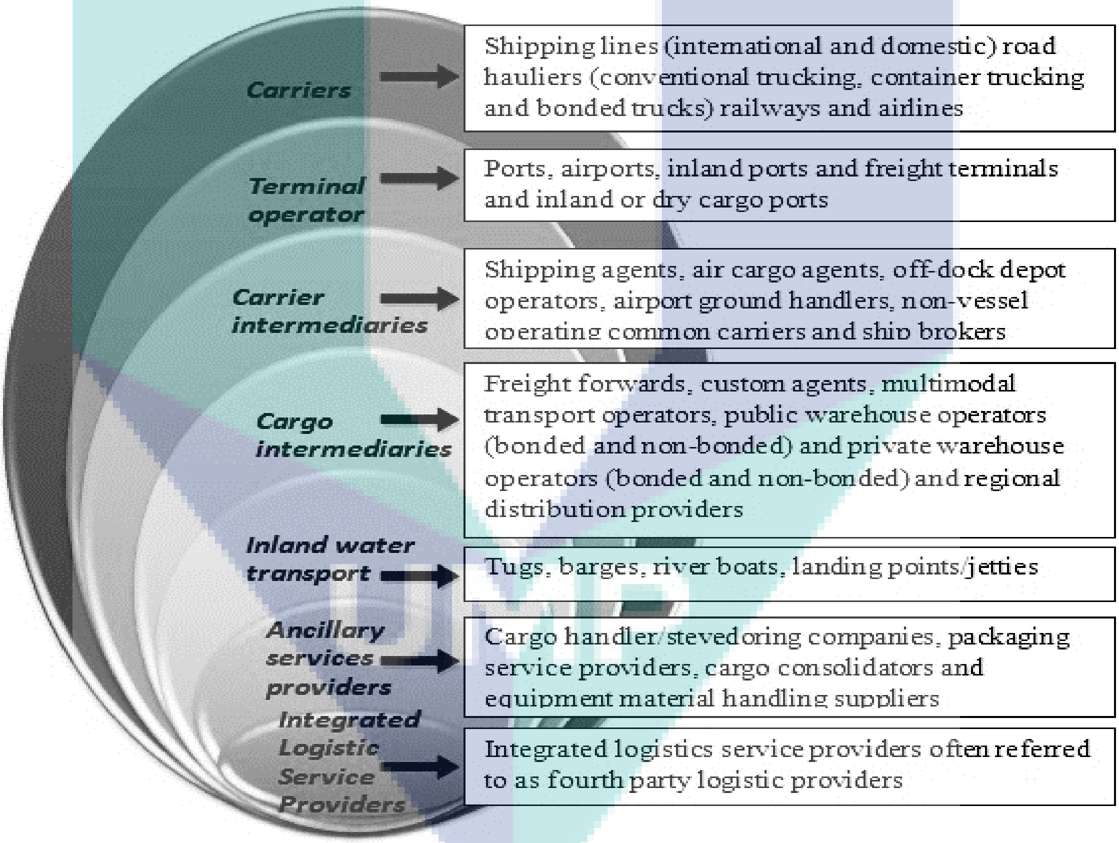

Figure 2.4 Structure of Freight Logistics
Source: Roadmap on the Freight Transport in Malaysia (2012)

Given these significant roles of each player in the maritime supply chain, many issues have been raised in term of integration between the players (Ascencio, González-Ramírez, Bearzotti, Smith, & Camacho-Vallejo, 2014). From an operational context, the maritime supply chain flow of operation proved to be a challenging task to operate efficiently. The problem lies concerning competitiveness amongst industry players, compliance with international and local regulations, health and safety issues as well as environmental problems. This complex structure of the maritime sector, in general, provides the fundamental idea to this study to determine the nature of its operation as well as identification of sustainability dimension that can be included in the line of its supply chain operation and its unique challenge to be overcome. Thus, in a few subsequent chapters, the sustainability in the maritime supply chain, regulations, and its challenges are briefly explained based on this context of the supply chain structure.

2.2.3.1 The Significance Role of Ports and Container Terminals in the Maritime Supply Chain

The maritime supply chain is closely linked with the port system to create a cohesive chain of conduct in the supply chain system. Transhipment traffic of logistical supply chain has been the motivating force behind the growth in each port system in the last decade. As this study research in the area of maritime supply chain, a port system, without doubt, plays a central role in the engagement of inbound and outbound transhipment of goods and information flow in the internal operational process. According to Fraser, Notteboom and Ducruet (2016), port system holds in a more involved role of activities and operational processes beyond its confinement of conventional system of the supply chain. Each of maritime value chain of conventional supply chain operation must go through the port system distribution centre for the general circulation of goods within the national boundary. This includes the facilitation of cohesive infrastructure of ship operations, overseeing loading/unloading activities, acting as transitory warehouse storage as well as managing the intra-port operation respectively (Panayides & Song, 2008). In this regards, Magala and Sammons (2015) has identifed that maritime supply chain commonly acts as a part of the logistical port system to enhance the supply chain process which has the capability to respond and pull the logistics' goods; and thus contributed towards the cutback of inventory levels along the supply chain pipeline, a drop in related costs, and the completion of strict customers' requirements through high service levels within short duration of lead times. Further, the role of the port in the maritime supply chain is about container handling and operations. Despite this multifaceted operation, the primary purpose of the port system is always the same as other conventional supply chains as its final goals are the added value creation in the maritime supply chain to ensure efficient logistical process.

Meanwhile, according to Bird (1980) and Hoyle (1988), the port models from operational perspective also includes the geography effect and the design of port itself to accommodate the port's purpose as well as the shifting needs of port requirement from the point of initial development to the new function of terminals building. As such, the role of the port system is always changing based on the needs of container ships and maritime activities and the diverse need of supply chain management in the maritime supply chain. Further back in 1990, Goss (1990) in his paper has emphasized that the primary economic definition of port system and maritime supply chain has much related to the concept of supply-demand relationship. He suggested that the sole purpose of ports in the conventional economic system is to make substantial surpluses for consumers and producers whose products pass through them and thus, he concludes the vital role of the port as a dynamic part in the maritime supply chain process.

Despite the intangible importance of ports system as an essential element within a logistics perspective and maritime supply chain framework, the empirical research is somewhat limited either in term of integration of port in the maritime supply chain or integration of port in maritime green supply chain process. Identifying and accepted the fact that ports have a critical role to play in the viewpoint of incorporated functions and operations in maritime supply chains (Panayides & Song, 2009), container terminals and ports in return must achieve an elevated level of integration within the supply chains they serve (De Souza Junior, Beresford, & Pettit, 2003) in order to be efficient. From this study perspective, it could be integration of "GSCM concept" or "sustainability conduct" in port operation and maritime supply chain system as suggested by (Lai, Lun, Wong, & Cheng, 2011a; Leonardi & Browne, 2009; Li, Wang, & Cook, 2014; Yang, Lu, Haider, & Marlow, 2013) to enhance operational efficiency and sustainability in a long term.

2.2.4 Maritime Supply Chain and Environmental Concerns

With the increasing rate of globalization, many nations have grown a significant dependency on water transportation (Hiranandani, 2014). Due to this accelerated dependency on maritime transportation as a catalyst of economic growth, there is mounting discourse and concern on the impact of climate change and environmental problem on the maritime supply chain sector (Khalid et al., 2010). A maritime supply chain sector has mostly under the radar of political influence and environmental analysts due to its globalized nature that has no specific home and tends to be "invisible" and ambiguous in people's lives. However, the sector's significance is rapidly discussed in recent time. Conventionally considered as an open, unregulated territory outside nation states, oceans and seaways are becoming more contentious and regulated space due to deep sea mining and fisheries rights, freedom of passage on increasingly crowded trade lanes, and access to new Northern (Arctic) trade routes (Lister, 2015). Environmental protection is gaining worldwide attention as ocean live stocks decline and collapse rapidly. Many advocacy groups are calling for greater accountability and regulation of the involvement of maritime operations to global climate change.

High efficiency and low cost have played a significant role in deflecting scrutiny of the maritime sector as a major role in economic growth and globalization (Jasmi & Fernando, 2018). The economic cost of shipping by maritime transportations as a percentage of the total cost of goods sold is quite minimal. To put into perspective, per ton of cargo basis, the emissions from water vessels are significantly lowered than from trucking, rail or air. Nevertheless, the spotlight is currently turning significantly. With expected rising in fuel costs in the near future, and with growing concerns of the air, land and water quality risks of expanding water vessel traffic, attention on shipping operation efficiency is also increasing exponentially. This is due to over 80% of worldwide trade by weight travels by ship, and the maritime sector subsequently carries a substantial output of total global environmental footprint respectively. Moreover, sea trade and operation has almost increased twofold the carbon footprint level of air travel and contributes around 2.7% to global CO_2 emissions (with container shipping contributing to 25% of this). A failure to take mitigation action to decrease GHG emissions from ships will eventually increase the sector's contribution to as much as 18% by 2050 (Lister, 2015).

Even though maritime vessels spend most of their period and time at sea, localized effects are also raising concerns. The Hong Kong government, for example, has identified maritime vessels as the largest contributors to their local air pollution problem (Yiqi Zhang, Loh, Louie, Liu, & Lau, 2018). While citizens in the United States, have labelled America's largest California ports as a ‘diesel death zone.' Diesel air emissions release from vessels burning low-grade bunker fuels contain high levels of harmful particulate and have a significant sulphur content that is 3,000 times higher than the fuel used in regular trucks. Moreover, according to Graham (2007), a single ship's emissions are comparable to 12,000 cars respectively. In coastal areas around the world, particulate and sulphur oxide (SOx) of ship and vessel emissions are estimated to be contributed for estimated 60,000 premature deaths each year (Lindstad & Eskeland, 2016). Public and policy attention towards the negative health effects from ship emissions is increasing with the World Health Organization's listing and considering outdoor air pollution as a harmful carcinogen. Shippers are also playing a pivotal role in motivating increased profile and attention towards maritime transport environmental concerns.

The increased demand for vessels and shipping services and the accompanying supporting equipment and services in the maritime supply chain is expected to foresee a considerable boost in the years to come as global seaborne trade and maritime-related operational activities grow. This will eventually increase the emission release of more harmful elements into the atmosphere and marine environment arising from the burning of fossil fuels from maritime supply chain activities. The maritime sector, which involves many supply chain and shipping operations that use entirely on hydrocarbon energy, releases harmful emission that contributes significantly to climate change (Benamara et al., 2019). Many vessels and ships use bunker fuel and diesel engines which release carbon dioxide (CO_2) into the atmosphere which contributes to the alarming global problem of climate change. Unfortunately, there is no effective or strengthen targets have been set to limit CO_2 emission from the ships (Khalid et al., 2010). In the absence of this critical regulation, CO_2 emission is expected to go up to 6% of the total global emission by 2020 (List, 2009). Other support activities in the maritime supply chain sector such as port operations, shipbuilding, ship repairing and other ancillary services also produce significance carbon and harmful gases into the atmosphere. Based on these arguments, it is crucial that urgent actions should be taken by the IMO, industry players, governments and other stakeholders to ensure that activities and operations in the maritime sector are carried out sustainably to mitigate this raising problem.

2.2.5 Maritime Supply Chain and Climate Change

Several tangible impacts of climate change include extreme temperatures, desertification, melting polar caps and glaciers; retreating levels of lakes and rivers; and eroding shorelines (Hay & Mimura, 2010; Verburg, van Asselen, van der Zanden, & Stehfest, 2013). These environmental impacts present surprising evidence of stressed earth reeling under incredible strain from growing human population, rapid industrialization of activities and unlimited utilization for resources. Currently, the world and public population have awakened to the negative prospect of a warmer world, which has been confirmed through scientific data collected by scientists globally (see Figure 2.5). There is also increasing concern of the adverse effects of climate change to the health, environment and economy (Watson, Zinyowera, Moss, & Dokken, 2000).

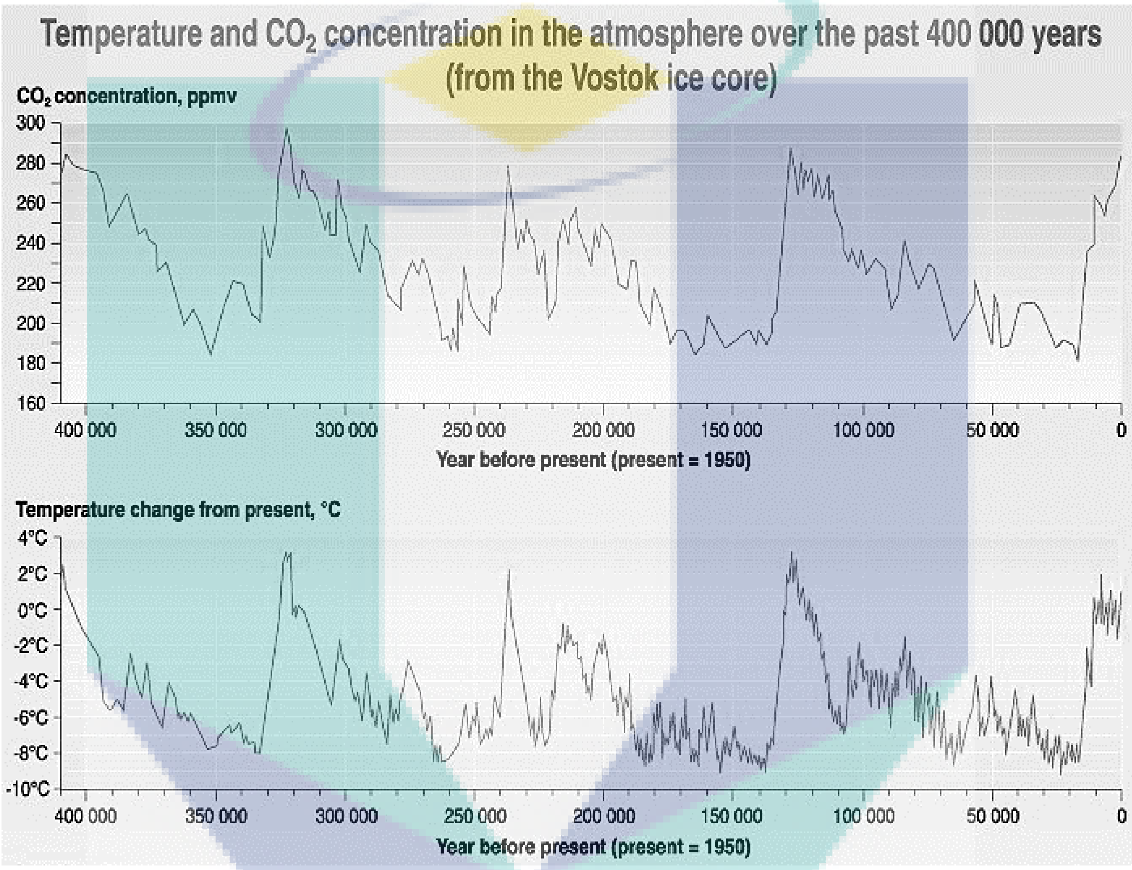

Figure 2.5 Variation in temperature and CO_2 over the past 400,000 years
Source: Petit, Jouzel, Raynaud, Barkov and Barnola (1999)

A 2014 report by the International Maritime Organization (IMO) found that between 2007 and 2012 the worldwide shipping and maritime activities have produced a yearly average of 866 million tonnes of CO_2 equivalent respectively. That translates 2.4% of worldwide greenhouse gas emissions over that period. In this sense, if the maritime supply chain industries were its own country, it would be the sixth largest climate polluter in the world, between Japan and Germany (Kader, 2013). Currently, carbon dioxide emissions from maritime vessels are currently unregulated (Hiranandani, 2014). Preceding efforts by the maritime industry to determine levels of carbon emissions released were based mainly on the quantity of low-grade fuel bought by the ship owners

(Kader, 2013). In this regards, the most recent UN figures are considered more precise because they are based on the known engine size and capacity of the world's vessels, as well as the amount of low-grade fuel sold to ship owners and time spend on the ocean. Nevertheless, the UN report also divulges that other pollutants (such as SOx and water pollution) from maritime activities are rising even faster than CO_2 emissions (Kwon, Lim, Lim, & Lee, 2019).

Various models forecast that as the world's population continues to consume more fossil fuel, greenhouse gas (GHG) concentrations will keep on rising, and Earth's average surface temperature will also increase with them in tandem. Based on this probable emission scenarios, average surface temperatures may elevate between 2°C and 6°C by the end of the 21st century if the trends continue (Bryndum-Buchholz et al., 2019). Moreover, some of this warming will happen even if the prospect of greenhouse gas emissions is reduced in the future due to the Earth system has not yet entirely attuned to environmental changes that are presently being experienced. In this case, the "greenhouse effect" is the warming phenomenon when certain gases in Earth's atmosphere trap heat generated by the sun. These GHG gases let in the solar light where it is absorbed but keep heat from escaping and radiates back into the atmosphere as heat, like the glass walls of a greenhouse (see Figure 2.6).

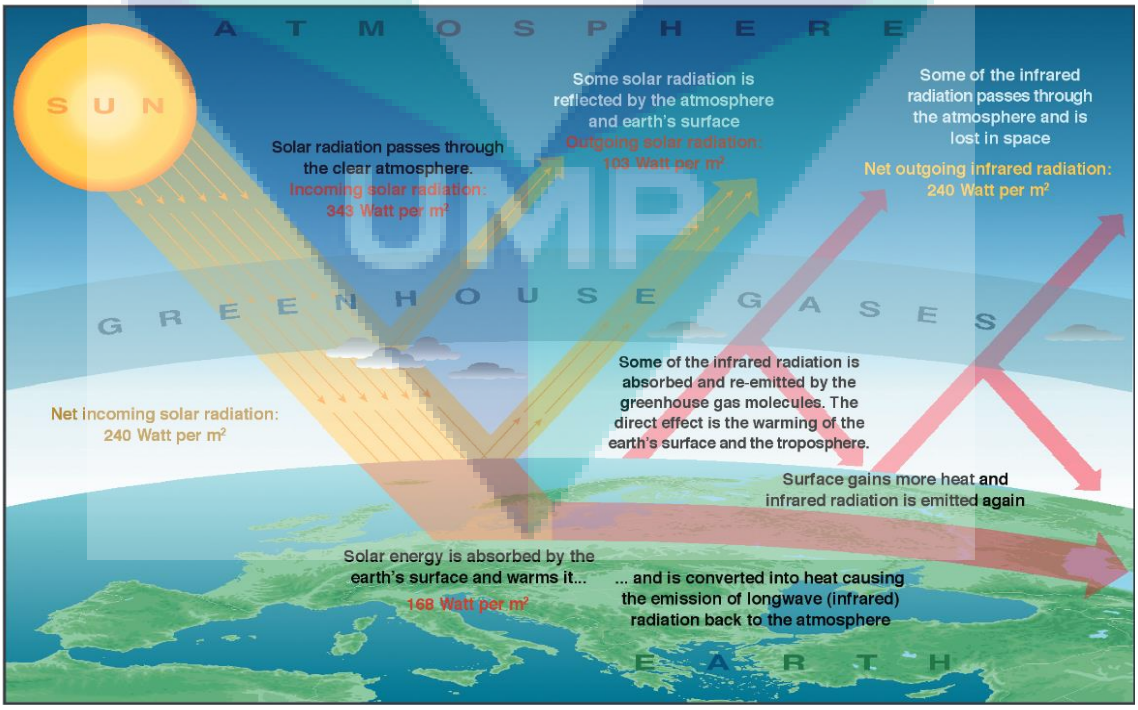

Figure 2.6 The greenhouse effect

Source: https://unfccc.int/

On the other note, these signs of distraught environmental problems demand that concrete actions are taken to mitigate their risks. The discussion during the United Nations Conference of Parties on Climate Change (COP 24) held in Poland in December 2018 and the failure for the global community to concur an agreement regarding the binding approach to tackle climate change painted an adverse outcome from the undesirable effects of climate change. Intergovernmental Panel on Climate Change (IPCC) declared that human actions and activities are the primary reason behind global warming around the world. Its harmful activities release GHG that have formed a significance layer in the earth's atmosphere that traps heat from the sun and contribute to global warming and climate change.

Despite noticeable adverse signs due to climate change, the world is still nowhere close to agreeing on a worldwide treaty to combat the concerning phenomenon. The world’s two biggest emission producers, the United States and China, failed to agree on binding legal treaty to cut down their emission, hence derailing hopes of commissioning concrete and imperative measure to come up with a legal framework to counter climate change (Bodansky, 2010; Christoff, 2010; Fisher, 2010). Ever since the beginning of the Kyoto Protocol in Japan in 1997, succeeding United Nations climate change conferences have unsuccessful in accomplishing any significant advances in breaking the deadlock to agree on curb emission (Cadman, 2019). Despite 187 governments (including Malaysia) having signed and ratified Kyoto Protocol, just 30 of the countries were committing themselves to a legally binding international agreement to undertake the issue of global warming and GHG emission to a severe level (Khalid et al., 2010).

Expectations of significant advances to precede the agenda of climate change and agreement on how to support adaptation to climate change in developing countries has failed significantly. Furthermore, significance funding pledges, technology and expertise transfer from developed nations have also failed to achieve any evocative agreement among developed and developing nations (Khalid et al., 2010). The world is yet to come for a concrete agreement that binds all its participating nations to take significant measures to counteract the adverse effects of climate change. In this regard, the various commitments made by governments through international mechanisms and policies through regional and national measures have not resulted in a noticeable impact in reducing global warming. Pressure for global action to tackle climate change is building as the status quo results in further carbon emission and GHG being emitted. The threat of global warming through concrete evident of rising global average surface temperature and sea level, and declining snow cover in the Northern Hemisphere is currently happening at a rapid rate (as shown in Figure 2.7).

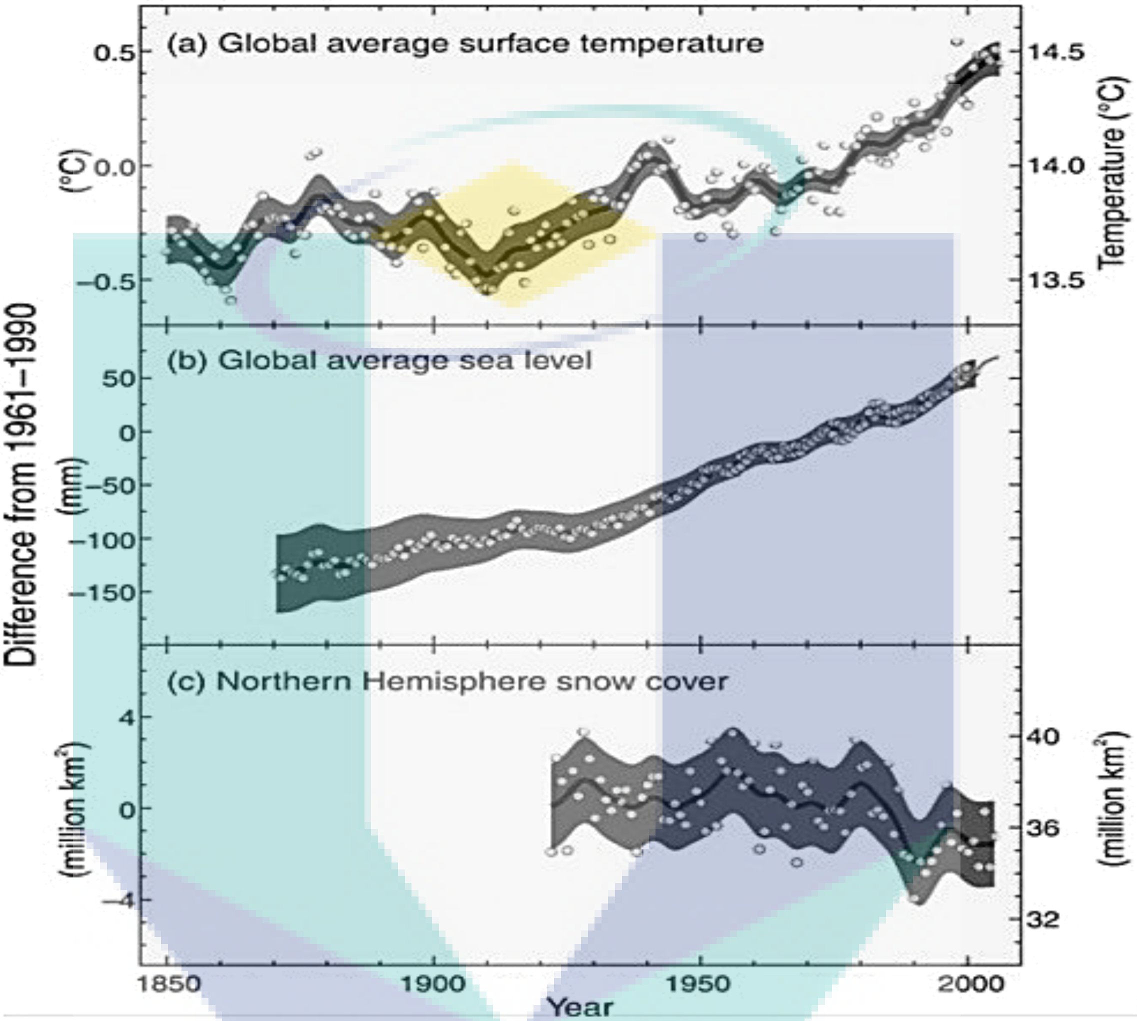

Figure 2.7 Changes in global average surface temperature, global average sea level and Northern Hemisphere snow cover

Source: IPCC (2007)

Arising from COP 24 discussion expectations are high for the maritime supply chain sector to act on dealing with climate change concerns. While various measures have been commenced by maritime industry players and related international institutions such as the IMO, many things need to be done for the maritime industry to notably reduce its pollution and carbon emission. It is evident that adjusting to a low-carbon future is impending and the maritime supply chain sector needs to do the proper solution to cap its carbon emission and play its part to concentrate on the issue of climate change. In this sense, IMO has also started the motion going to reduce carbon emission from shipping by way of introducing policies and laws governing the technical and operational measures and market-based instruments, all of which will be discussed in detail in later parts of this study. This study also would provide a feasible solution in term of organizational management through the green concept that can be adopted by maritime supply chain sector that can become a part of organizational capabilities and management to improve this raising concern of climate change respectively.

2.2.6 Carbon Emission from the Maritime Supply Chain Sector

The maritime supply chain sector, a key generator of worldwide trade and economic activities, is undertaking structural changes subjected by various trends, factors, and developments. They include economic, social, political, financial, environmental, technological and legal forces that have transformed and will continue to sway the landscape of the maritime sector in various ways. In addition to these factors, concerns over carbon emission have come forward as a critical driver which is shaping the way industry players and stakeholders think, plan and operate. There is a growing concern for the maritime supply chain sector to improve their sustainability conduct in the course of growing demand for maritime-related services. This is due to the fact emission from the maritime sector is predicted to be on the rise in the future (Taudal, Ponte, & Lister, 2016) due to increasing demand for services in the maritime supply chain sector. It is expected to grow in line with rising international seaborne trade, offshore oil and gas operations and other economic activities requiring ships, ports and other maritime components.

Although maritime shipping activities are contributing a mere 3.3% of the worldwide total of carbon emission (see Figure 2.8), however, it was estimated that carbon emission from maritime activities and operation had continued to double since 1990 (Kader, 2013). The level of intensity GHG emission emitted by international shipping was estimated roughly about 870 million tonnes of the global emission of carbon emission in 2007 and 1050 million tonnes for all shipping operations (Psaraftis & Kontovas, 2013). It has also been projected that carbon emission from maritime activities (mainly shipping) will grow significantly by a factor of two to three by 2050 from 2007, considering that no concrete regulatory measures are set in place to lower the rising emission level. The carbon emission is also forecasted to increase to 6% in 2020

(Kader,2013). If no improvement measures are taken, it can amplify to 250% in 2050 respectively.

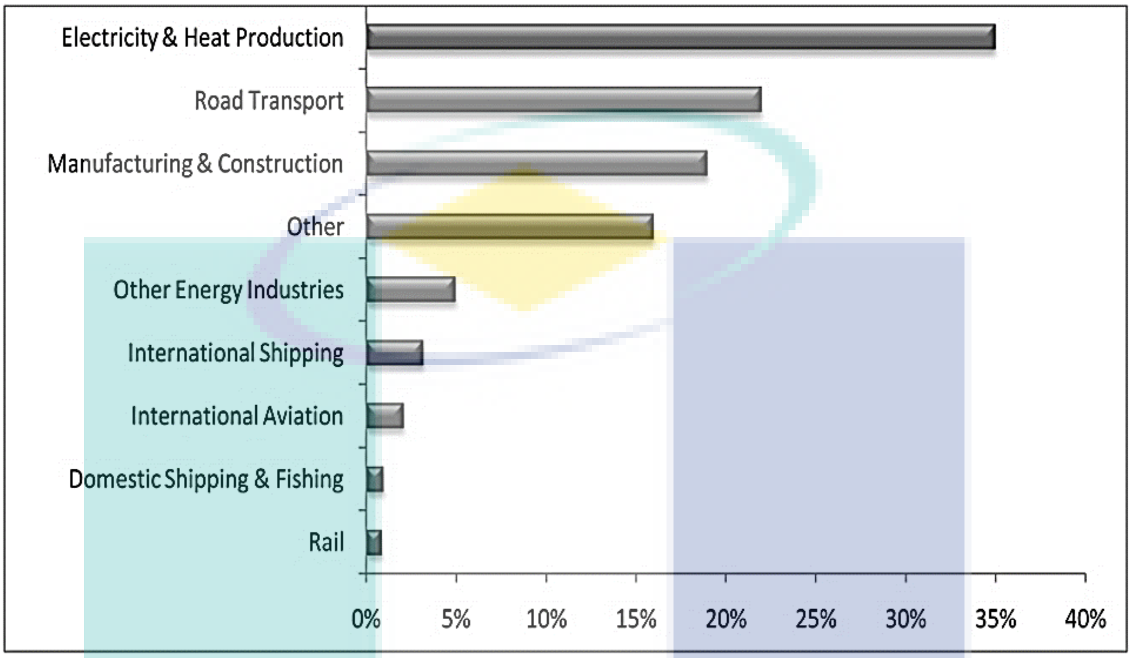

Figure 2.8 Percentage of industrial sectors to global carbon emission
Source: International Maritime Organisation (IMO)

Figure 2.9 shows the projected exhaust emissions from the shipping industry between 2013 until 2050 which showed the increasing upward trend relative to years with expectation of continued expansion in the future. In Figure 2.10, the figure shows the breaks down of CO_2 emissions from the world commercial fleet by ship type-size combination (Psaraftis & Kontovas, 2009). The data is gathered from the IHS Fairplay database based in the year 2007 (45,620 commercial ships accounted for). According to this detailed analysis, it can be concluded that container ships are the major CO_2 emitters in the world fleet. This is something to be expected, given the relatively important economic trade of import-export is depended on container shipping. However, the top tier category of container vessels (712 vessels of 4400 TEU1 and above) are seen to generate around 110.36 million tonnes of CO_2 emissions, which is quite higher than the 106 million tonnes generated by the total crude oil tanker fleet (2028 vessels) around the world.

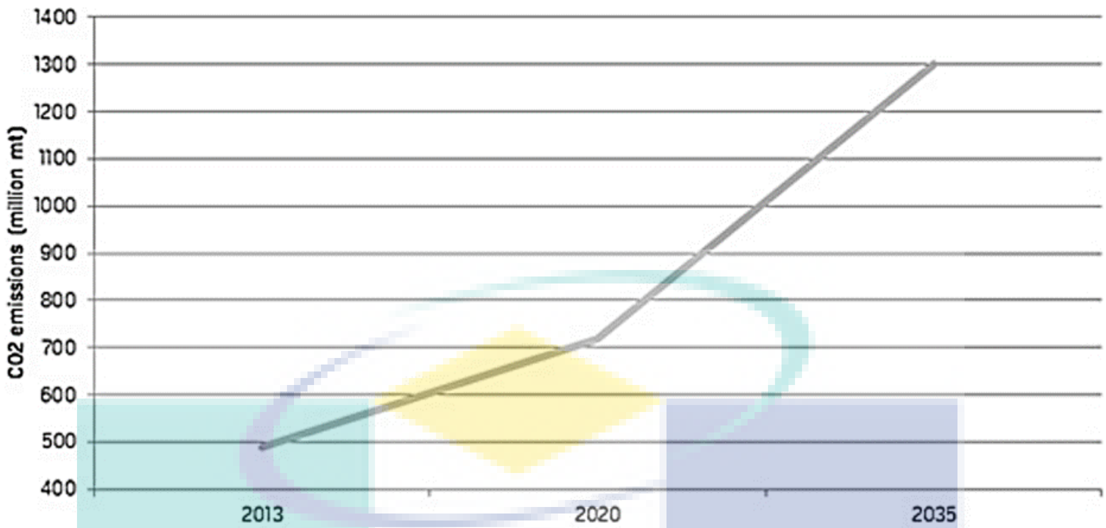

Figure 2.9 Projected exhaust emissions from the shipping industry between 2013 to 2035

Source: International Maritime Organisation (IMO)

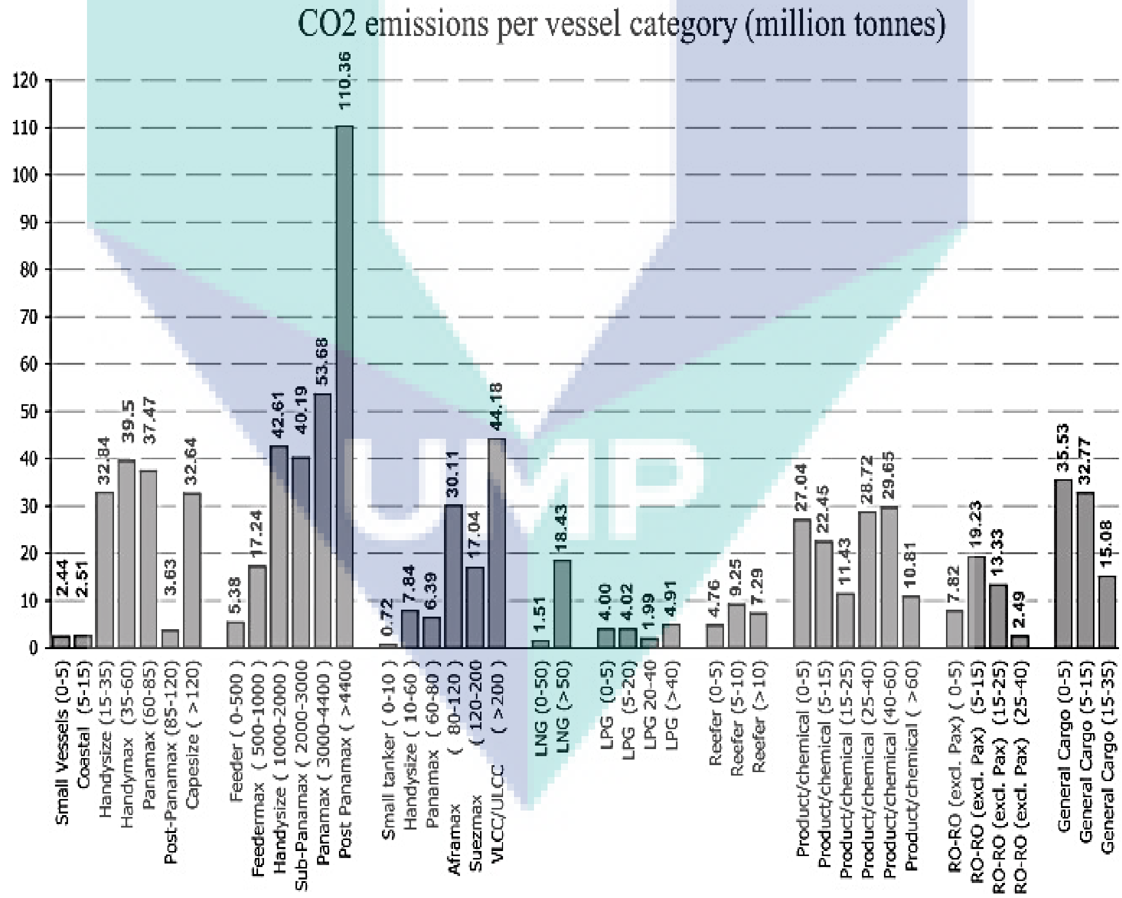

Figure 2.10 CO_2 emissions, world fleet, 2007

Source: Psaraftis & Kontovas (2013)

On the other note, the levels of sulphur oxide (SOx) also release by merchant vessels and ships which use standard high sulphur fuel are also quite significant, and immediate actions are required to reduce them respectively. Recent studies point out that the emission of carbon dioxide, nitrogen oxide, and sulphur oxide by shipping vessels correspond to about 3 to 4%, 10 to 15%, and 4 to 9% of worldwide anthropogenic emissions (Breitling & Leader, 2009). IMO study reveals that many other pollutants from shipping operations are rising even faster than carbon emissions. Sulphur oxide emissions for examples, which give rise to health problems such as lung cancers, acid rain, and respiratory problems, are expected to increase more than 30% for over the next 12 years (Breitling & Leader, 2009). Maritime shipping-related particulate matter (PM) emissions are also to blame for roughly around 60,000 cardiopulmonary and lung cancer deaths yearly, with the majority of deaths occurring close to coastlines in Europe, East Asia, and South Asia (Breitling & Leader, 2009). Under existing regulations and policies, with the expected intensification growth in maritime shipping operations, it is forecasted that yearly mortalities could increase by 40% until 2018 (Corbett et al., 2007).

Even though the contribution of the maritime supply chain sector to maritime pollution is lesser compared to other sources (see Figure 2.8), maritime industries must eventually be responsible for playing its emerging role as a shipping-trade hub to reduce its carbon footprint. Given the significance of maritime supply chain sector as primary facilitators of trade and increasing activities in search of offshore oil and gas, there is a necessity for major stakeholders in the maritime supply chain to involve in protecting the environment. With maritime trade and activities such as offshore oil and gas set to rise in the future, it is reasonable to expect carbon emission from the sector will also likely to increase in tandem. Infrastructure development and operational activities in the maritime sector are expected to add to existing environmental pressure. Serious efforts must be taken by maritime's industry players to lessen their carbon emission to diminish the risks faced by the environment. In this regard, many challenges such as short of resources, weak regulatory framework, lack of consensus and integration among stakeholders and technological boundaries must be overcome first before the maritime sector can considerably reduce its carbon emission and come up with a practical and feasible regime to address its climate change issue.

2.2.7 Environmental Regulation in Maritime Supply Chain

Operation in the maritime supply chain is a firmly regulated activity due to the fact its global nature of the sector and the various parties involved along its chain. This complex nature of these sectors can only be effectively managed with a set of well-documented and stringently enforced laws and regulations. This is well established that as merchant ships navigate around the globe and load and unload all kinds of cargoes at a various port system, the transhipment of goods can only be managed with a set of protocols, agreement, and policies restricted to its operation that cross beyond the boundaries. In this regards, the earliest global bodies concerning with the need for standardization and association of transportation mean came into being in the nineteenth century (Koseki, Murasawa, Iwata, & Sakamoto, 2012). With this kind of understanding and awareness, eventually, it sparked a need to institute a global body dealing with the overall safety aspect of maritime shipping operation.

Currently, the central agreement of policies and protocols amongst countries is regulated through involvement from the United Nation's International Maritime Organization (IMO). In general, IMO is the primary source of about 60 legal mechanisms that funnel the laws and regulatory development of its member states to develop a comprehensive safety and security dimension at sea as well as facilitate trade among maritime states and keep the marine environment protected. The most important regulation is the International Convention for the Safety of Life at Sea (SOLAS), as well as the International Convention on Oil Pollution Preparedness, Response, and Co-operation (OPRC). IMO also functions as a depository of yet to be approved treaties, such as the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996 (HNS Convention) and 2007, Nairobi International Convention of Removal of Wrecks (Hao,2008).

IMO frequently endorse maritime regulations, which are broadly enforced by international and domestic maritime authorities by member countries, such as the International Regulations for Preventing Collisions at Sea (COLREG). In making an environmentally sustainable effort in maritime sectors, IMO has been mandated by The United Nations Framework Convention on Climate Change (UNFCCC) to the forefront of the green efforts in the shipping sector. In this regard, Khalid et al. (2010) have deposited that IMO has commenced several instruments and initiatives to restrain harmful emission from maritime supply chain operations that include:

1. Encouraging industry players by adopting guidelines and procedures for environmentally-friendly ship recycling, ballast water management and curbing of GHG emission.
2. Allocating sensitive environmental maritime areas as Particularly Sensitive Sea Areas (PSSA) and Special Areas.
3. Instill the awareness on the need to protect the environment to industry players and the public stakeholders

The list of important IMO conventions to prevent and control pollution from ships and moderating the effects of any harm arising from maritime operations and accidents are listed in Table 2.3.

Table 2.3 Key IMO conventions on pollution and environmental protection

Convention/code/ law	Explanation
Pollution prevention	
International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)	It concerns with accidental occurrence in regards to oil pollution in operation as well as pollution by chemicals, consignment in packaged form, sewage, rubbish and air pollution.
International Convention on Prevention of Marine Pollution by Dumping of Waste and Other Matters 1972	It was restructured in 1996 by the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea.
Oil pollution	
International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC)	It is a comprehensive international framework for structural co-operation in dealing with huge incidents of maritime pollution
International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969	It is a law adopted to guarantee that sufficient payment is available to persons who undergo oil pollution harm resulting from naval casualties involving oil-carrying transportations. It puts a considerable liability for such harm on the possessor of the vessel from which the pollution of oil coming from.
Safety and security of merchant ships	
International Convention for the Safety of Life at Sea (SOLAS) 1974	The major convention that includes all worldwide treaties concerning the global safety and security of trader's vessels.
International Convention for Standards, Training, Certification and Watchkeeping for Seafarers (STCW) 1978	It deposits the global standards of competence that is accepted by the international regulatory body for seafarers globally.
Convention on the International Regulations for the Prevention of Collisions at Sea (COLREG) 1972	It provides ample guidance and guidelines concerning safe sailing speed, collision risk as well as the conduct of vessels operation in or close to traffic separation schemes.

Table 2.3 Continued

Convention/code/ law	Explanation
Protection of the marine environment	
International Convention on the Control of Harmful Anti-Fouling Systems on Ship (AFS) 2001	It prohibits the utilization of hazardous organotins in anti-fouling paints used on vessels and ships as well as establishing an instrument of actions needed to prevent the possible upcoming usage of other hazardous substances in anti-fouling systems.
International Convention for the Control and Management of Ships" Ballast Water and Sediments (BWM) 2004	It is divided into Articles; and an Annex which consists of practical standards and requirements in the Regulations and Laws for the control and administration of ships' ballast water and sediments.

Source: International Maritime Organization (2015)

Concerned with current environmental declination, IMO has also begun to tighten up its regulation imposed on maritime operations by introducing new sustainability regulation through the implementation of Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plan (SEEMP) (Tzannatos & Stournaras, 2014) to mitigate the problem. The International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI established by IMO was also revised in 2008 to reduce Sulphur Oxides, Nitrogen Oxides, and Particulate Matter. More amendments are made in 2011 to decrease potential harmful greenhouse gas (GHG) emissions in the maritime sector (Jafarzadeh & Utne, 2014). These regulations requirement set by IMO ought to be fulfilled in the future by maritime sectors in order to do a transnational operation.

Accentuating the importance, it puts on in highlighting the marine environment protection while facilitating shipping activities, Malaysia has adopted a few of its conventions as its maritime policies. Of the conventions established, there is none significant than the International Convention for the Prevention of Pollution from Ships, or better known as MARPOL 73/78 as the central international convention covering the hindrance of pollution by ships from its operational or unintended accident causes. It is solely created to eradicate the undesirable impact of shipping operations of every type of vessels on the environment by regulating the discharge of pollutants. MARPOL 73/78 enclosed six annexes which institute the release standards for six key groups of pollutants, as summarised in Table 2.4.

Table 2.4 MARPOL 73/78 Annexes

Annex I	**Regulations for the prevention of pollution by oil**
Annex II	Regulations for the control of pollution by noxious liquid substance in bulk
Annex III	Regulations for the prevention of pollution by harmful substances carried by sea in packaged forms, or in freight containers, portable tanks or road and rail wagons
Annex IV	Regulations for the prevention of pollution by sewage
Annex V	Regulations for the prevention of pollution by garbage from ships
Annex VI	Regulations for the prevention of air pollution from ships

Source: International Maritime Organization (2015)

Collectively, both Annexes I and II are obligatory while Annexes II, IV, V, and VI are voluntary. Malaysia has agreed to MARPOL 73/78 on 31 January 1997 which entered into force in respect of Malaysia on 1 May 1997 (Khalid et al., 2010). As Annexes I, II and V were endorsed, Malaysia is also lawfully bounced to act by the provisions of these annexes. The introduction of these conventions highlights the significance of IMO, its Member Governments, the shipping industry players as well as stakeholders to participate and play their part to lessen the environmental impact of the maritime supply chain. Additional to these conventions, Maritime Department of Malaysia (MARDEP) has taken a preliminary step in establishing a safe, secure and systematic sea communication system, by adopting International Convention for the Safety of Life at Sea (SOLAS) 1974 to ensure marine conservation towards quality development of national maritime policy. The adoption of this convention includes:

1. International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78, Annexes I, II and V
2. International Convention on Tonnage Measurement of Ships, 1969
3. International Regulations for Preventing Collision at Sea (COLREGS), 1972
4. International Convention on Load Lines, 1966 or as amended
5. International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969, Protocol of 1992
6. International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969, Protocol of 1992
7. International Convention on Load Lines, 1966 or as amended
8. International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969, Protocol of 1992

9. International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969, Protocol of 1992
10. International Regulations for Preventing Collision at Sea (COLREGS), 1972
11. International Convention on Load Lines, 1966 or as amended
12. International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969, Protocol of 1992
13. International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969, Protocol of 1992
14. International Convention on Load Lines, 1966 or as amended
15. International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969, Protocol of 1992

MARDEP as one of the regulatory bodies of Malaysian maritime sector has embraced these international policies to ensure safe navigation of international merchant vessels, providing services to merchant vessels such as ship inspection, certification, registration and licensing, providing unparallel services to ships navigating in Malaysian waters and ports as well as supervising examinations of seafarers to help smoothen the flow of maritime supply chain operation. Highlighting the importance of maritime sectors to the country, these conventions and policies are needed to ensure environmentally sound and efficient operation in the maritime supply chain complex system. The broad scope of its mandate means that IMO is well placed to support the cohesion and proper functioning of the maritime supply chain system and to contribute to its sustainable development throughout the world. The potential of the organization to make a real difference lies with capacity-building measures aimed at developing and strengthening the maritime transport sectors in developing countries in particular (Fernández-Macho, González, & Virto, 2016).

While IMO's mandate is principally focused on vessels engaged in international trade, there are real opportunities for the organization to play a significant role in facilitating coordination of relevant policies at the national and regional levels as well. This is because of its standing in the world as the most respected competent body in all technical matters on shipping. Thus, it can assist with the coordination of the different players in the maritime supply chain system. IMO can also provide valuable feedback on the effects of measures as they are implemented throughout the supply chain system.

2.2.8 Malaysia and Environmental Stewardship

The pressure from stakeholders, consumers and the organization's need to enhance the organizational image are compelling reasons for the companies to institute more environmental friendly programmes in their operation (Namkung & Jang, 2017; Shaw, Irfan, Shankar, & Yadav, 2016). Additionally, the effects of rivals' capacities and the strains from governmental policies are also vital to the course of a company's management intentions and policies. Thus, considering the Malaysian maritime supply chain perspective on green issues, there are a few keys national affecting directions of companies concerning environmental aspects. As Malaysia plans to widen its intention into a sustainable advanced nation by 2020, green technology (GT) has been recognized as a driver of the potential economy for the sustainable nation that would contribute to overall Green Growth and Sustainable Development. The National Green Technology Policy (GTP) for example, is based on four principal pillars which are Energy, Environment, Economy, and Social. Under this policy, the green technology is cross-sectoral aim which a focal point mission to sustain four major sectors namely energy, building, waste management and transportation (MIDA, 2016). Focusing on this objective, Malaysia has put absolute efforts which foresee a reasonable placement among the top South East Asia countries in regards to the environmental performance index. According to Malaysia's Performance in Environmental Performance Index 2016, Malaysia ranks 63rd out of 180 countries compared to 51st in 2014. However, the 2016 environmental performance index (EPI) ranks put Malaysia 2nd position behind Singapore among South East Asian countries (Malaysia Productivity Corporation, 2016). The overall performance of Malaysia versus selected countries over two year's period is shown in Table 2.5.

Table 2.5 Malaysia vs selected countries in the Environmental Performance Index (EPI) for the year 2016 and 2014

COUNTRY	Year 2016 (n=180)		Year 2014 (n=178)		CHANGES IN RANK
	RANK	SCORE	RANK	SCORE	
Finland	1	90.68	18	75.72	17
Iceland	2	90.51	14	76.50	12
Sweden	3	90.43	9	78.09	6
Denmark	4	89.21	13	76.92	9
Slovenia	5	88.98	15	76.43	10
Australia	13	87.22	3	82.40	-10
Singapore	14	87.04	4	81.78	-10
Switzerland	16	86.93	1	87.67	-15
Luxembourg	20	86.58	2	83.29	-18
Malaysia	63	74.23	51	59.31	-12
Philippines	66	73.70	114	44.02	48
South Korea	80	70.61	43	63.79	-37
Thailand	91	69.54	78	52.83	-13
Brunei	98	67.86	37	66.49	-61
Indonesia	107	65.85	112	44.36	5
Mongolia	114	64.39	111	44.67	-3
Vietnam	131	58.50	136	38.17	5
Cambodia	146	51.24	145	35.44	-1
Laos	148	50.29	127	40.37	-21
Myanmar	153	48.98	164	27.44	11
Afghanistan	176	37.50	174	21.57	-2
Niger	177	37.48	142	36.28	-35
Madagascar	178	37.10	166	26.70	-12
Eritrea	179	36.73	168	25.76	-11
Somalia	180	27.66	178	15.47	-2

Source: Malaysia's Performance in Environmental Performance Index (2016)

In the maritime supply chain context, in order to fulfil these visions, the Malaysian government has dedicated to numerous worldwide maritime policy conventions which it has ratified accordingly such as IMO policies and regulations. The commitments to protect its environment are shown with well-established adoption of several internal policies. In this regard, the National Policy on the Environment (NPE) has been drafted in the Seventh Malaysian Plan which stresses out a wide-ranging strategy to protect the environment and its natural resources as well as accomplishing the sustainable goal of green consumption and production. As articulated in the NPE, Malaysia has acquired a positive and active approach to provincial and worldwide ecological and green issues by cooperating with neighbouring countries and relevant organizations on trans-boundary maritime issues and environmental concerns. The sustainable actions taken by Malaysian government are reflected through several major steps that accentuate its seriousness to embrace sustainability principles that include several national environmental policies and regulations which apply to the maritime sector, as listed in Table 2.6 below:

Table 2.6 Key policies and governances on pollution and environmental protection

Act/Law	Remark
Merchant Shipping Ordinance 1952	Merchant Shipping Ordinance 1952 (MSO 1952) is the act that controls the global and international merchant shipping in Malaysia. It is in the course of numerous amendments since its establishment. This is due to the governments' effort to reinstate new Merchant Shipping Act with MSO 1952. This new Act will integrate numerous amendments to conform with the international conventions to which Malaysia is a part of its collective member. Being a close associate to the United Nations Convention on the Law of the Seas (UNCLOS) 1982, Malaysia has to adjust some maritime environmental norms as noted in the Convention to be fully integrated into the Malaysian local law.
Environmental Quality Act 1974	The Environmental Quality Act 1974 (EQA 1974) is a legislation system to administer environmental security. The Act is only applicable within the territorial waters of Malaysia, which may widen up to 12 nautical miles from the baseline. However, the Act does not apply to the Exclusive Economic Zone (which may broaden up to 200 nautical miles from the baselines) and the Continental Shelf of Malaysia. Further, the EQA 1974 has only two provisions related to marine pollution.
Merchant Shipping (Oil Pollution) Act (amended in 2005)	The Act was fully revised in 2005 to be an accomplishment with the 1992 Civil Liability Convention and 1992 Fund Convention for oil pollution. The Act is the extension of its territorial appliance to include the Exclusive Economic Zone in regards to maritime pollution. This in return had effectively filled a few loopholes of the Environmental Quality Act 1974 and the Merchant Shipping Ordinance 1952.
Exclusive Economic Zone Act 1984	The EEZ Act establishment has incorporated some aspects of the UNCLOS 1982 while providing authorized rights to Malaysia which may broaden to 200 nautical miles from the baselines and also manage maritime operation to the continental ridge of Malaysia. The Act deals with fortification and conservation of the ecological marine life and environmental concerns. The Act also has established the independent rights of Malaysia to utilize its natural resources in the EEZ area.
Malaysian Maritime Enforcement Agency Act 2004	Malaysian Maritime Enforcement Agency (MMEA) is a principal organization involving in the maintenance of law, policies, regulations and order of safety and security in the maritime zone. Malaysia has also established the National Policy on Climate Change (NPCC) which provides structural and regulatory support to pull together and guide numerous governmental agencies, industry players, communities and other vital stakeholders in addressing the dispute of climate change and environmental concerns. The NPCC, managed by the Ministry of Natural Resources and Environment, offers direct guidelines of premeditated thrusts and solution for the country to take momentous conduct as well as recognizing the prospect towards sustainable development within the industries.

Source: Adapted from Mustafa & Ariffin (2011)

Despite these endless efforts, Malaysian maritime supply chain still confronts with threats and challenges. While much attempt has been taken by the government of Malaysia to address the sustainability issue up till now, there is a pressing necessity to obtain stock of sustainable approaches in which they have been undertaken. This is because the active policies and existing regulations in maritime sustainability were designed a relatively long time ago when the situation of environmental resources was in a far better and in healthier circumstances (Khalid et al., 2010). However, new challenges and constraints require for more practical, definite and sensitive actions and policies to convey sustainability approach for Malaysian maritime activities. The required judgments of course of actions must be prepared based on a significant understanding of the possible contribution and effect of these activities to the environment and its economic structure in accordance of the present improvement of maritime and environmental issues. Underlying these severe issues, the subsequent chapter would briefly explain the challenge faced by the Malaysian maritime supply chain industry.

2.2.9 The Challenge of Malaysian Maritime Supply Chain

The challenge of the Malaysian maritime supply chain lies in the quests for an efficient fuel friendly and energy saving to the environment. According to Kader (2013), this quest for environmental efficiency has been recognized in the maritime industry for a long time. The imperative need for improvements of gasoline and diesel by chemical reformulation that can lead to decrease in GHG release and ozone-forming pollutants and carbon monoxide emissions have grown to be issues of the time in the maritime arena (IMO, 2009). Emission from vessels combustion impacts generation of fossil fuel crisis and scarcity, photochemical smog as well as dependent on oil. To such extent, the aggressive quest for alternative and renewable energy, international and domestic regulation build-up, as well as re-evaluation and revolution work on a plan to decrease emission of the existing and new engine, are faced with the new challenge of matching energy efficiency at minimum emission requirement set by IMO. Pollution control of emission can be linked to traditional factors of reliability, fuel economy, capital cost and maintenance for the maritime supply chain. The issue of emission compliance for shipping vessels is an incentive opportunity and definite prospect for the maritime supply chain to develop complete combustion efficiency for shipping vessels and reduces emission as well as enhancement in managerial operation (Rehmatulla, Calleya, & Smith, 2017).

On the other note, the challenge of maritime supply chain also lies in the regulatory bodies itself concerning the development of environmental regulations

(Johnson, Johansson, & Andersson, 2014). Ever since the 1950s, there is an increasing number of environmental rules and regulations in position at different government levels to manage environmental effects by maritime supply chain operations (Hofmann, 2019). In this regard, the most prominent rule-making authority is the International Maritime Organisation (IMO), which administers more than 20 global conventions concerning environmental issues related to maritime operations. The green initiatives regimes established by the IMO are nevertheless defective in quite a few respects. Even though the implementation and updating of IMO conventions have accelerated in recent years, the procedures and processes of bilateral resolution making are very time-consuming. Many years may go by between agenda-setting up, approval, implementation, and entry-into-force of a particular convention (Wuisan, Van Leeuwen, & Van Koppen, 2012). Besides, incentive and encouragement for maritime organizations to act following the conventions are lacking and efficient enforcement of instruments to deal with non-compliance parties are limited and inadequate (Karahalios, Yang, Williams, & Wang, 2011). For that reason, it is uncertain whether the IMO can make specific and effective action in avoiding further environmental degradation from maritime supply chain operation.

Furthermore, the Malaysian maritime supply chain, as part of a cross-border distribution system of cargoes from solitary place to another, frequently over vast distances, is subjected to a complex issue of policies, laws, and regulations. In this sense, before the cargoes being transhipped to Malaysian soil, it will first be subjected to the regulations and policies of naval infrastructure (port system), economic, societal and environmental setting of their respective country of origin (Acciaro, Vanelslander, & Sys, 2014). The goods then travel across a port system into the global carriage, where various set of different rules apply. This is where the critical international policies are imposed on the respective system. The policies and regulations are based on globally accepted commercial regulations as well as international standards, rules, and regulations developed by the International Maritime Organization (IMO). Once the goods finally reach at their intended destination, in a different country, they are yet to land at ports which have their own set of domestic infrastructure, regulation, and policies. Commencing from here then, they may be further distributed to multiple destinations, where, in turn, other laws and policies may affect. This complex nature of multiple successive phases of the distribution chain adding up to the individual whole and interconnected operation where the reality of this chain goes beyond diverse interests and priorities of involving players in each phase of the maritime supply chain.

On the other hand, this complicated system of this maritime supply chain is required for the wide-ranging of global transhipments to function. Unnecessary competition could disturb this global cohesion which, in turn, impact adversely on the efficiency of moving freight around the globe (Khalid et al., 2010). However, with cohesive integration and communication amongst maritime supply chain players, this challenge can be overcome eventually. It is crucial at this point that maritime supply chain system remains as a significant business endeavour and ventures, which carry an essential public service at a rather low cost while functioning under many changing sets of laws and regulations in different national jurisdictions. However, the underlying problem is not always about the regulations but the implementation of those set of law and policies (Jeevan et al., 2015; Khalid et al., 2010). Besides, these set of laws are not inert and depended on the proactive action of regulatory bodies in its jurisdiction area. For example, International freight transporter may be subjected towards IMO set of regulations but the domestic partner of its operation is not subjected to the regulation standard set by IMO, but rather depends on domestic regulations on the country jurisdiction.

Since Malaysia only implement several of IMO regulation and its own set of laws, the problem lies with weaker or non-comprehensive environmental law implemented by Malaysian maritime supply chain players (Fernando et al., 2019). This has proved to be a challenge for the sustainability agenda as domestic players are not bound with strict international regulations of environmental protection. However, the changes are always introduced to hold new challenges and adversities in the industries, such as technological and industrial advances in the maritime industry as well as augmented public expectations for collectively improved safety, protection and environmental performance but the time needed to respond to this change is slow in the Malaysian context. For that reason, the shipping industry in Malaysia must continuously strive to enhance its measures and be equipped to adjust to varying regulatory and compliance requirements with extra supervision and intervention from governmental bodies. Nevertheless, if regulations grow to be too onerous, it might eventually increase the cost of shipments to operate as many regulations and policies need to be. This would not be in general public and country's interest and would negatively impact development and prosperity in society.

Besides, to these contemplations concerning the equilibrium between expenditure (cost) and benefit (Panayides, Lambertides, & Savva, 2011), it is imperative that value creation and the flow of value in Malaysia's maritime supply chain system, which contains a chain of industry players all of whom must allocate and distribute values, should be protected. In this sense, if each player in the Malaysian maritime sector fulfils their diverse functions and work collectively in mutual support of this value chain, the maritime supply chain will not only operate efficiently for the entire stakeholders concerned but also to the society and the country. To summarize, the movement of cargoes by the maritime supply chain is subjected towards economic goal, social well-being as well as environmental responsibilities and mutual requirements on many different levels (Lam & van de Voorde, 2011). The challenge here lies in how maritime supply chain complex system can be translated into justifiably, equitably and comparatively fair across the chain of players in order to put together the whole supply chain system in sustainable order. This is predominantly a difficult task to do in the Malaysian context since coordination and integration involving shore-side maritime players, and the international shipping sector is not well-established as far as policies are concerned. This problem is due to the inclination towards profit orientation by every player in the industries, who may be successful in shunting costs to other players, might give long-term negative implication to the end customer in term of cost. This could be translated into a loss of flexibility as well as sustainability in one linkage in the chain that could risk degrading the whole supply chain throughout times (Lam & van de Voorde, 2011).

Also, all players in the maritime supply chain system are subjected to peripheral and external costs. Nevertheless, several of these costs will eventually involve all players. In this sense, if the costs affect specific parts within the maritime supply chain system, inevitably it will also affect the whole maritime supply chain system or just a link in the respective supply chain system. A coherent approach is needed to overcome this problem through comprehensive regulation and policies as well as educating the players by overseeing governmental bodies regarding this predicament issue (Jasmi & Fernando, 2018b). Thus, a noteworthy mention should be made of the role of the maritime supply chain in Malaysia, where an efficient and coherent system is a precondition for facilitating import-export growth and development in this industry. The additional progress of maritime industries in Malaysia is a necessity that must be met in order to enhance its efficiency. Therefore, it is imperative for Malaysia to participate and embrace new trading patterns around the world. Sustainability agenda and more comprehensive policies and regulations should be adopted concurrently to align its domestic maritime industries with global needs and the requirement for gaining competitive advantage respectively. For Malaysia, incredible opportunities are arising from a more comprehensive engagement with the shipping sector and Malaysia should play its role as a part of the global chain.

Due to these problems, there is mounting pressure on Malaysian maritime supply chain sectors to align their operational practices in an environmentally friendly manner, integrated operation as well as cohesive function of all players following the global sustainability trend and improvement in regulatory requirements. In this regards, the Malaysian maritime supply chain sector needs to invest in an environmental approach in its operation (Fernando, Jasmi, et al., 2018) to address the abovementioned issues. This study postulates that adopting green concept can give a valuable contribution in term of addressing those challenges. Even though sustainability is crucial for this sector, it is imperatively vital to address the problem without sacrificing its commercial and economic values. For this reason, the maritime industry as a vanguard sector of import-export activities and domestic trades in Malaysia should balance its adoption of the green element in its operation to ensure stable economic and sustainability performance.

Hence, the proposition of MGSCM concept in this study can become an imperative solution for maritime companies to enhance their supply chain operations. Drawing on original empirical evidence and archival data, MGSCM in this research focuses on measuring the capability of maritime companies and simultaneously improving their financial efficiency as well as reducing the negative ecological impacts of their supply chain activities through improvement in energy efficiency performance (EEP) and low carbon performance (LCP) respectively. In the latter part of this literature review, this study will emphasize on solutions of these underlying problems on how to achieve sustainability performance and financial effectiveness through integration, financial flow, design for green as well as value added service.

2.3 Underpinning Theory

Environmental concern has increased rapidly over the recent years; further, a variety of environmental regulations and policies have motivated organizations to implement environmental strategies/activities in their operation (Zhang, Cao, Tang, He, & Li, 2019). Also, a body of growing literature on sustainable management emphasizes the convergence between SCM and environmental management (Woo, Kim, Chung, & Rho, 2015). In this section, many underlying theories could be used to explain the intricacy concept of maritime green supply chain management (MGSCM) in this study. According to Shi, Koh, Baldwin and Cucchiella (2012) as integration of economics, environment, and society, become overwhelming concerns in society, green supply chain management (GSCM) concept is seen by many researchers and industry players alike as a competent organising concept, which takes environmental elements into consideration when managing the supply chain. While in this study, the conceptual theory of MGSCM should be identified as an extension of GSCM concept as explained in prior literature. In this sense, the fundamental concept of Green Supply Chain Management (GSCM) should be closely knitted and evaluated in explaining the MGSCM concept respectively. After all, the foundation basis of MGSCM and GSCM is derived from the basic underpinning concept of SCM. As the prior literature cultivates the new directions of finding based on GSCM concept, this study by far would critically be evaluating the research and identifying potential directions to advance in this field of MGSCM knowledge. In this regard, via identifying organizational theories to categorize the literature, it provides a critical prospect to ponder on both the objectives of understanding where the maritime field presently stands and identifying research opportunities as well as the directions. Within this underlying theoretical section, the study identified the natural resource-based view (NRBV) theory that can be associated with the constructed framework and further explain the MGSCM research questions that are worthy of investigation. The extant literature on the NRBV and GSCM concept are reviewed in the following sub-sections.

2.3.1 GSCM and Organisational Theories

Many previous studies on GSCM have provided several established theoretical constructs, such as stakeholder theory, stewardship theory, institutional theory, transaction cost theory, resource-based theory and other theories related to management and operation. They have been widely used in GSCM literature in explaining various field of study based on capturing theoretical suitability of the studies from the researcher lens point of view. Touboulic and Walker (2015) conduct a structured literature review of organizational theory and aims at mapping the use of theories in the GSCM literature. This provides opportunities for this study to address both the objectives and understanding of where the field currently stands and identifies research opportunities and future direction. In summary, Touboulic and Walker (2015) categorize GSCM under five core principal organizational theories (Table 2.7).

Table 2.7 GSCM Organizational Theory

Theory	Description	Unit of analysis	Typical GSCM Challenges	Original Reference
Resource Based View (RBV)	A firm's sustainable competitive advantage emanates from its valuable, rare, inimitable, non-substitutable resources and the unique way they are utilized through core capabilities.	The firm as a bundle of resources and its internal processes to manage these resources.	Identification and development of key resources contributing to ensure achievement of environmental, social and economic performance in the supply chain.	(Barney, 1991)
Natural RBV (NRBV)	Harnessing environmental and social challenges within business capabilities is a source of competitive advantage. The imperatives of sustainable development create opportunities for differentiation and increased market power.		Inter-organizational resources as important as intra-organizational resources to stimulate supplier engagement with GSCM practice.	(Hart, 1995)
Stakeholder Theory	The activities of companies affect both internal and external parties. Corporate social responsibility can be understood as the responsibility for a business to meet the expectations of its various stakeholders. Firms can ensure their long-term survival and preserve their license to operate by considering the broad network of actors into their strategy	-The firm as embedded in a network of stakeholders. -Firm activities and decisions as shaped by external stakeholders' pressures.	-The extent of inclusion of SC stakeholders (suppliers, customers, etc.) in organizational environmental and social practices. -Identification and role of specific stakeholder influences on GSCM practices.	(Freeman, 1984)
Institutional Theory	External social pressures (coercive, mimetic and normative) influence organizations in adopting socially responsible behaviours and transform their practices to gain social legitimacy. By responding to regulations and imitating their competitors, firms ensure the alignment of their corporate practices with society's expectations.	Individual or collective (industry, national) organizational practices are adopted or diffused as responses to institutional drivers.	-Motives and circumstance of adoption and diffusion of environmental and social standards. -Role of government regulation in driving GSCM practice. -Imitation between organizations as the driver of the adoption of GSCM practices.	(DiMaggio & Powell, 1983)
Transaction Cost Theory	Two organizations involved in an exchange or activity incur costs and efforts. In order to sustain the exchange, the parties must find appropriate modes of governance and safeguards (i.e. in contractual arrangements).	Transaction or exchange between buyer and supplier(s) and the governance of this exchange.	-Modes of governance and organizational action in buyer-supplier relationships to implement social and green practices. -The impact of transaction costs on the adoption and of sustainability practices across SC.	(Williamson, 1981)

Source: Touboulic & Walker (2015)

Thorough evaluation from Table 2.7, the RBV and NRBV are particularly relevant in the context of this study as they tie together the issues and barriers which surround GSCM/MGSCM. Firstly, RBV, inter-organizational learning, knowledge and capability are crucial to the development of GSCM and MGSCM practices in developing a competitive advantage. Business organizations that have a robust learning and innovative culture will be the first to evaluate and adopt green practices such as MGSCM. They act upon this information and benchmark this against competitors to ensure rare, valuable and non-substitutable ability to employ GSCM practices for gaining competitive advantage.

Secondly, NRBV highlights the fact that GSCM can attain competitive advantage through environmentally sustainable economic activity. Originated from Hart (1995), he introduces two interconnected strategies for a business organization that can be implemented to effectively achieve competitive advantage, i.e., pollution prevention and product stewardship. Adopted by Maas et al. (2014), in the context of logistical perspective, pollution prevention refers to internal operations while product stewardship can be applied to service operations concerning service stewardship that extends the scope of the sustainability initiatives across organizational boundaries. As the maritime supply chain is a part of logistic, both strategies related to this study in term of the ability of maritime supply chain companies to provide environmentally sound service offerings through MGSCM practices. As such, this study tries to extend past research on GSCM with a focus on the maritime industry by drawing on the NRBV of the company through an in-depth review in the next section.

2.3.2 Natural-Resource-Based View as an Extension Concept of Resource-Based View

The origins of the resource-based view concept can be traced back to much prior research in the last decades. In this regards, elements of NRBV can be found in works by Chandler (1962); Coase (1937); Penrose (1959); Philip (1957); Stigler (1961); Williamson (1975), where a much more emphasis discussion has been put extensively on the importance of organizational resources and its impacts on organizational performance (Conner, 1991; Mahoney & Pandian, 1992; Rugman & Verbeke, 2002; Rumelt & Foss, 1984). Other concepts that were later integrated into the resource-based framework have been articulated by Lippman and Rumelt (uncertain imitability 1982), and Dierickx and Cool (inimitability and its causes 1989). Barney's framework proved a solid foundation upon which others might build, and its theoretical underpinnings were strengthened by Conner (1991), Mahoney & Pandian (1992), Conner & Prahalad (1996) and Makadok

(2001) who positioned the resource-based view with regard to various other research fields. More practical approaches were provided for by Amit and Schoemaker (1993), while later criticism came from among others from Priem and Butler (2001) and Hoopes, Madsen, and Walker (2003).

Historically, stemming from Penrose's (1959) discussion on the antecedents of organizational growth, the natural resource-based view (NRBV) philosophical thought could be traced back based on the resource-based view (RBV). RBV according to him has become a fundamental theoretical viewpoint in strategic management as being mentioned by the works of Barney (1991); Dierickx & Cool (1989); Wernerfelt (1984). The explanation of key elements of the RBV concept is its focal point on internal factors to the organization that may lead to sustained competitive advantage. In accordance to this concept, it marked a different departure from the conventional analysis at the industry or strategic group level, which had conquered strategy research of management and teaching before the emergence of RBV concept (Barney, 1996). In this sense, the new theoretical thought at that time concerning RBV marked a revisit to the organizational roots of strategic thinking by placing the emphasis back on the organization's own decisions and competencies rather than on its surrounding environment (Hoskisson, 1999).

The RBV concept emphasizes the function of resources and capabilities in forming the basic foundation of competitive advantage for an organization. In a broad perspective, a resource is something valuable that an organization possesses, which can consist of physical and financial assets as well as employees' skills and organizational (social) processes (Hart & Dowell, 2011). The RBV argues that it is an organization's bundle of collective resources rather than product exploitation of those resources that established an organization's competitive advantage (Wernerfelt, 1984). Correspondingly, if the strategic aspect of the market is perfectly competitive, even if organizations employing planning strategies that generate an imperfectly competitive product market, those strategies cannot be categorized as a source of economic rents (Barney, 1986). On the other hand, a capability is something an organization is capable of performing, which branched from valuable resources and routine activities upon which the organization can accumulate (Karim & Mitchell, 2000). The RBV in that particular point of view stressed that in order to give an opportunity for sustained competitive advantage, a resource must be inimitable, valuable, rare and supported by tacit skills or communally complex organizational processes (Hart & Dowell, 2011).

In this sense, the value of resources can be translated into customers' willingness to pay or lowers their cost. Rareness, inimitability and scarcity give the organization the potential to demand a premium and keep away from the perfectly competitive market as well as give the sustained advantage. Resources and capabilities within an organization are embedded in the organization, and the amount to which they can insert value may depend upon the existence of complementary assets and supporting routine activities (Christmann, 2000) While, Hart (1995) proposed that the existing RBV concept had a severe omission. The first one, while it considered an array of impending resources and had a logic that was compelling and more absolute than preceding attempts to describe competitive advantage, it ignored the relations between an organization and its surrounding natural environment. Although such an omission might have been logical in the earlier period, it was clear by 1995 that the ecological environment could produce a serious limitation on the organization's attempts to produce a sustainable advantage. In this sense, the NRBV viewpoint allowed for a more methodical and systematic examination of the connection between an environmental and financial performance by specifying the linkage between resources and capabilities as well as its strategic outcomes.

The NRBV's stresses on the contingent nature of capabilities and resources that assisted researchers in making precise connections between environmental and financial performance dimension. In the 20 years since the NRBV was first outlined, researchers have identified some resources and capabilities that help organizations profit from prevention of pollution. Currently, researchers are now attempting to investigate categories of capabilities that affect the organization's abilities to gain significance profit from pollution prevention efforts. The concept of NRBV argues that there are three significant strategic capabilities which are sustainable development, prevention of pollution and product stewardship (see table 2.8).

Table 2.8 A NRBV Theory: Strategic Capability and Environmental Driving Force.

Strategic Capability	Environmental Driving Force
Pollution Prevention	Minimize emissions, effluents, waste
Product Stewardship	Minimize the life-cycle cost of the product
Sustainable Development	Minimize the environmental burden of firm growth and development

Source: Hart (1995)

Each one of these has diverse and distinctive environmental driving forces, builds upon unique key resources, and has a different basis of competitive advantage. In this particular, pollution prevention, which looks for prevention of waste and emissions rather than cleaning them up "at the end of the pipe," is associated with lesser costs (Hart & Dowell, 2011). For instance, eliminating pollutants from the production and operational process can enhance efficiency by (a) dropping the inputs required, (b) simplifying the entire process, and (c) reducing the cost of compliance and liability costs. In this sense, product stewardship develops the scope of pollution prevention to comprise the total value chain or "life cycle" of the organization's product systems. Throughout stakeholder commitment, the "environmentally friendly" can be successfully incorporated into the product design and planning as well as in development phase procession. Product stewardship inevitably creates the impending prospect for competitive advantage achievement through planned pre-emption, for example by securing limited access to valuable resources (e.g., green raw materials) or by instituting the required standards that are advantageous and beneficial to the focal company.

Finally, a sustainable development approach has two noteworthy differences from pollution prevention or product stewardship strategies. First, a sustainable development strategy does not purely look for to do a reduced amount of environmental damage but, to create planning in a way that can be maintained for the foreseeable future. Subsequently, sustainable development, by its very explanation and definition, is not limited to ecological concerns only but also entails on economic and social focus. Since economic activities in developed countries are closely associated with issues of poverty and social degradation in under-developed countries, a paradigm that considers sustainable development must identify this interconnected linkage and act to lessen the environmental burden and enhance the economic gains for the lesser developed markets affected by the organization's activities.

In short, various significant progress has been made in identifying the extensive capabilities and resources that affect an organizations capacity to simultaneously pursue financial and environmental benefits (Yu & Huo, 2019). A review of the "pays to be green" literature bring to a close theoretical thought that the greatest promising potential for future research in this area lies in progress to identify the capabilities and contingencies that affect the linkage between environmental and financial performance (Berchicci & King, 2007). This study concurs that while there has been a body of literatures investigating how pollution prevention can direct to positive financial outcomes, there is still impeccable need to work on concerning recognizing the origin of critical resources and the link between resources and capabilities, as well as environmental and financial performance links. From this study perspective, research thus far has already identified two types of factors that affect the organization's capacity to increase significant financial benefits from prevention of pollution strategy which are organizational capabilities and managerial cognition or framing. However, for the investigating purpose of this research, the MGSCM dimension falls within the organizational capabilities and pollution prevention. This study explains this factor in the subsequent chapter.

2.3.3 MGSCM Concept as a Form of Organizational Capabilities and Pollution Prevention

As being elaborated before, the natural-resource-based view (NRBV) of a firm (Hart, 1995) is a revision of the original theory resource-based view (RBV) of the organization (Wernerfelt, 1984) which asserts that the idiosyncratic resources and organizational capabilities of organizations with environmental or pollution prevention considerations are among the primary sources of sustained competitive advantage. Quite a few studies have investigated organizational capabilities that appeared to influence the degree to which organizations profit through pollution prevention strategies. Empirical evidence and studies of the environmental and financial performance linkage have found that profiting and gaining potential benefit from pollution prevention is more likely if the organization possesses enhance innovation capabilities, particularly those related to continuous improvement in their organization (King & Lenox, 2002). In this regards, pollution prevention strategies also urged the organizations to develop and expand new competencies, as Russo and Fouts (1997) revealed in a cross-industry analysis of the environmental and financial performance of 243 American firms. Their significant finding that investment in environmental capabilities is especially advantageous for the period of industry growth, apparently because growth helps to reorganize the risk that accompanies in such green investment.

The assumption of RBV identifies that resources may not generate rents in separation; instead, bundles of collective resources may together generate a configuration that signifies the competitive advantage (Grant, 1996; Hoskisson, 1999). In addition, bundled of collective resources create complexity in which it will increase the significant importance of appropriate organizational configuration as well as impedes duplication (Rivkin, 2000). These features come into sight as the organizational attempts to derive earnings and financial benefit from pollution prevention. Having a significance dedication to pollution prevention solely is unlikely to create profit by itself, but in mixture with the broader innovative capabilities noted above, along with required skills in the implementation of new projects and businesses, profit may be derived eventually (Christmann, 2000). Innovative capabilities and commitment to pollution prevention in this particular case can be implied as complementary assets of MGSCM (Teece, 1986).

MGSCM in general aims to capitalize on environmental profit and financial benefit by adopting a green life cycle approach and innovation through product design, material selection, manufacturing, and sales and recovery, financial flow, and therefore helps the maritime organizations to realize its sustainable development and improvement. This is aligned with the theoretical concept of NRBV which denotes that NRBV considers firms development relies on the natural environment, and firms' future competitive advantages are embedded in economic capabilities that are helpful for sustainable development (Hart, 1995). NRBV puts forward three strategic capabilities: pollution prevention, product stewardship and sustainable development which focus more on the environmental aspect to accomplish competitive advantage.

In this regard, these three strategic capabilities are successive rather than parallel which denotes that every dimension represents a different element. Pollution prevention for example in this study focuses on waste and emissions prevention that reflect the LCP and EEP dimension. Product stewardship expands the scope of pollution prevention to include the entire life cycle into consideration, such as designing products/services for environment and adoption of green technologies to create competitive advantages (via increase efficiency) from sources of production and management capabilities which reflect the MGSCM (GICS, GVALS, GSIP, SDC, and GFF) dimension. Meanwhile, sustainable development is the ultimate goal that not merely seeks to reduce environmental impacts, but provides a management pattern for long-term development which reflects the economic dimension of this study (financial performance dimension). NRBV provides not only a more systematic theoretical support on testing the relationship between resources, capabilities and environmental performance and financial performance, but also studies that confirm the promotion effects of environmental practices on organizational performances have provided validation for NRBV.

Conversely having a significance dedication to pollution prevention entirely is unlikely to create profit by itself, but in mixture with the broader innovative capabilities noted above, along with required skills in the implementation of new projects and businesses, profit may be derived eventually (Christmann, 2000). Innovative capabilities and commitment to pollution prevention in this particular case can be implied as complementary assets (Teece, 1986) of doing MGSCM. In this context of the study, MGSM dimension can become a strategic competitive weapon to increase organization's superior performance in a long run because those capabilities are valuable, scarce, and hard to imitate and replicate and eventually provide a valuable competitive advantage in the future. Therefore, the theoretical assumption of NRBV and MGSCM dimensions could be categorized as ‘one' unique organizational capabilities and pollution prevention that can increase organizational performance and competitive advantage. Thus, this study applies the NRBV of an organization to investigate the connection between performance and MGSM capabilities, focusing especially green supply chain integration practice (GSIP), green information and communication system (GICS), green financial flow (GFF), green value added logistic service (GVALS), shipping design and compliance (SDC).

2.4 GSCM in Maritime Supply Chain

The goal of this section is to give a general overview the recent background literature which underpins this study by connecting the issues surrounding the discipline of supply chain management (SCM), green supply chain management (GSCM) and maritime green supply chain management (MGSCM). This section reviews the definitions of logistics and supply chain management in this context of this study (in maritime context), providing a glimpse over the last decade of how the discipline has evolved and discusses the future issues and challenges expected. This sets the stage for the next section which discusses the conceptual development of the proposed theoretical framework.

2.4.1 The Historical Development of GSCM Concept

The operations management (OM) field has developed as an essential academic discipline in recent years through the growing number of academic journals that focus on it. To put into perspective, the study of OM and management of industrial environmental impact has been a critical issue for society and academician since the industrial revolution day. In this regards, the industrial revolution management perspective was sparked by Adam Smith's policies of the specialization of labour and organizations (Sarkis, Zhu, & Lai, 2011). Out of this interest in the field, it raised the necessity to develop detailed supplier and distribution chains. Consequently, due to the impeccable implications of marketing and distribution chains, and subsequently SCM, the important discussions have been raised in the early economics literature. In this sense, supply chains management concept gained an important concept in practice as evidenced by organizational management and engineering literature in the last century (Svensson, 2001).

Some of the earliest best practices of modern supply chains management, such as lean and just-in-time (JIT) manufacturing concept can be linked to Henry Ford's thoughts to vertically integrate the management of automotive supply chain and organizational operations in a single operation (Sarkis et al., 2011). The initial concept of JIT and SCM at that period are more focused on enhancing operational activities, increasing efficiency and minimizing unwanted waste respectively (Green, Inman, Sower, & Zelbst, 2019). The primary purpose of the minimization of waste at that time was not for environmental, but for economic and financial reasons. In that sense, waste can be generally considered as an outcome that leads to greater economic loss (Lai & Cheng, 2009). Subsequently, during these periods, industrial pollution and environmental concern was not a chief concern worthy of investigation for academicians. However, in economic management, the conceptual used of taxes for managing externalities such as industrial pollution and impact was briefly proposed at that time (Pigou, 1932, 2013).

Nevertheless, the ongoing debate of taxing for environmental impact caused by organizational operations was the limit of the thought at that time. Philosophical developments during this period were occurring with the discussion on whether the natural environment deserved its own rights and had its own intrinsic value (Leopold, 1933; Sarkis, Zhu, & Lai, 2011). The importance of environmental issues and ecological stewardess became evident to the public with Rachel Carson's Silent Spring (Sarkis et al., 2011). As a result, both economics and environmental management had started to established on the more critical role in the industry as well as in operation (Sarkis et al., 2011).

Several of the original studies that can be linked to the recent tendency in GSCM taking place even earlier than the development of the U.S. Environmental Protection Agency (EPA and can be traced back to late 1960s (Ayres & Kneese, 1969). Ayres and Kneese (1969) have presented a few of the earliest issues related to the unification of industrial metabolism and resources balancing as well as the roles of production and general consumption in the supply chain. Even though their preliminary study focused on a linear relationship from extraction to disposal, several loops were included into the investigation, and there were concerns about the prospect and opportunity of incorporating the 'residuals' back into the system. In their research, not only solid and water pollution waste were included in the study's discussion, but the warning on global climate change and environmental problems due to carbon and other greenhouse gas emissions were also established in the argumentation on assessing the roles of inter-organizational relationships.

Additionally, further improvement of the concept of industrial metabolism and material flow balance ideas occurred throughout the 1970s (Harris & Ayres, 2006). Debate on how to develop the mass balance for organizational and governmental assessment and decision making was also established at the beginning of the year 1970s; throughout "a process-chain assessment model calculates approximately the collective costs (direct and hidden) of a range of processes that structured the 'chains' leading from a set of unprocessed material inputs to a produced marketable output such as semi-finished or consumer products" (Ayres, Cummings-Saxton, & Stern, 1972). This work incorporated the integration of inventories and resources of pollutants and their impacts on the decision modelling software, contrasting most of today's life cycle analytical tools.

In the 1980s several initial technical advancements in this arena around various 'industrial ecology' principles have been occurred (Erkman, 2002) with new concepts like life cycle assessment (Molina-Besch, Wikström, & Williams, 2019). In this regards, a defining moment was opened with the incorporation of attainment of competitive advantages and financial benefits from environmental practices later in the decade (Frosch & Gallopoulos, 2010). Simultaneously, further refinement of the industrial eco-systems (Jelinski, Graedel, Laudise, McCall, & Patel, 1992) has been established, and advance acknowledgement of the supply chain concept as a strategic competitive weapon (Bhote, 1989) was also occurring extensively. A further managerial aspect, less technicality as well as coverage of GSCM began with an emphasis on specific, deconstructive, aspects of SCM such as logistics (Szymankiewicz, 1993), purchasing (Drumwright, 1994), and reverse logistics (Pohlen & Theodore Farris, 1992) has also established. In due course, many early efforts on conceptually and systemically integrated the purchasing, operations, marketing, logistics, and reverse logistics within an environmental focus have been integrated into the GSCM concept. Following these early contributions in the GSCM domain, a number studies also outlined the early acknowledgements of industrial metabolism, with pollutions, waste and even global climate change caused by greenhouse gas emissions (Harris & Ayres, 2006). From the abovementioned literature review, Schaper (2002) has also summarised the maturity and progress of green issues over the past 50 years according to years, as shown in Table 2.9.

Table 2.9 The development of green issues

Time	Development
1960s	Environmental concern was emerging from some developed countries.
1970s	Government policy initiatives and businesses excluded initially.
1980s-1990s	Sustainability acceptance and innovations from senior business managers and entrepreneurs.
2000s	Fast growing and more systematically research from the scholar.

Based on: Schaper (2002)

As early as the 1990s, the rise of global competition pressured some of the large multinational enterprises to commence the need to work collaboratively with their suppliers and end customers throughout the supply chain (Roy & Whelan, 1992). Frankel, Bolumole, Eltantawy, Paulraj and Gundlach (2008) have deposited that a rising number of business organizations even attempted to accept more proactive and practical initiatives in their line of supply chains to foster environmental sustainability. Concurrently, the relationship between SCM and environmental concerns has begun to draw the awareness of more scholars, and substantial research was conducted to recognize the relationship between green issues and SCM (Schaper, 2002). In this regards, the early development of GSCM studies has focused mainly on industrial ecological (Common & Perrings, 1992). Later investigations are more towards managerial inclination in focus, and concerned with diverse perspectives through the supply chain, including socially responsible purchasing (Drumwright, 1994), reverse logistics (Pohlen & Farris, 1992) and green/environmental logistics (Szymankiewicz, 1993).

In conclusion, these preliminary developments were primarily anecdotal and conceptual developments introducing various concepts and practices related to GSCM. However, as the field has established maturity, the anecdotal study has further evolved into theoretical exploration and investigation. This eventually results in analytical testing and empirical studies along with more advanced and established modelling tools for evaluating GSCM constructs (Sarkis, Zhu, & Lai, 2011; Seuring & Müller, 2008). Several reviews of the GSCM literature have provided useful non-theoretical but somewhat technical (e.g., practice, systems, prescriptive) frameworks that can be used to develop the GSCM concept further.

2.4.2 The Conceptual Notions of Sustainability, GSCM and MGSCM

The conceptual notion of "sustainability" has been a unique area to be understood first. Sustainability can be commonly defined as proper utilization of resources to meet the needs of the present without compromising future generations' ability and capacity to meet their own needs (Ahi & Searcy, 2013; WCED, 1987). It was a thought which gained notable discussion with the publication of the Brundtland Report in 1987 and was further ingrained into public awareness and discussion at the Rio Earth Summit in 1992. To further strengthen the agenda, the World Summit for Sustainable Development held in January 2002 called for the attention of the world to the various challenges of sustainability issues. According to Meadows and Meadows (1972), sustainable development seen from the perspective of limits to global growth has been an issue for decades. In recent years, the conception of sustainability is diverted from that anticipated early concept in the seventies. ‘Limits to Growth' concept is no longer be acknowledged by societies and industries in recent years.

Recently, the constant challenge to industries towards sustainability is to make sure that particular industries could potentially sustain economic growth while at the same time ensuring environmental protection (Lun, 2011). The crisis of climate change can also be perceived as one portion of the broader sustainability issues. Consequently, climate change emerges to be in the midst of the most prominent sustainability issues of this century and the greatest challenge facing civilization nowadays (Schultz & Williamson, 2005; van Vuuren et al., 2007). Thus, the conceptual notion of sustainability can be linked to GSCM as an emerging organizational philosophy to lessen the environmental impact.

Since the GSCM contemplates the product from preliminary processing of raw materials to the deliverance phase to the end-user, a focal point on supply chains is a subsequent step toward the wider implementation and development of sustainability. The subject of sustainability in the context of SCM has been widely discussed using various terms in the prior literature. In this regards, the two terms mostly used that directly link sustainability, are GSCM and sustainable supply chain management (SSCM) (Ashby, Leat, & Hudson-Smith, 2012). GSCM is a promising field that distinguishes itself from the traditional SCM perspective. In fact, there is a substantial growing body of prior literature have discussed the environmental issues and management in the supply chain field (Jia & Wang, 2019). Early sustainability practices and concepts tended to stress on environmental impacts but, recently, they are increasing focus on the triple bottom line approach (e.g., environment, economic, and social).

Adding the term ‘green’ concept to the ‘supply chain’ concept opens a new paradigm outlook, the GSCM, with a direct relation to the environment. According to Susanty et al. (2019), GSCM is the practice of integrating environmental concerns into managerial purchasing decisions and sustain long-term relationships with suppliers by including those green dimensions. There are three approaches to GSCM according to them which are the environment, strategy, and logistics. Additionally, GSCM can also be linked to the conceptual notion of green productivity (GP) that shows, for any sustainable improvement or development strategy to be implemented, it needs to have a focus on the environment, profitability and quality, which form the basis focus of triple GP's dimension (Ali Diabat & Govindan, 2011; Hwa, 2001). While, the explanation of GSCM given by Zsidisin and Siferd (2001) as “the set of SCM policies held, actions taken and relationships formed in reaction toward sustainable concerns related to the ecological environment with regard to the design, acquirement, assembly, distribution, use, re-use and disposal of the firm’s goods and services”. Tseng, Islam, Karia, Fauzi and Afrin (2019) describe GSCM practices as any action performed across the supply chain operation, either within the organization or with external partners, to abolish or decrease any harmful effect of environmental degradation.

While, the foundational concept of GSCM from Srivastava (2007) denotes the integration of environmental thinking into SCM, including product design, raw material sourcing and selection, manufacturing processes, final product deliverance to the customers as well as end-of-life management of the product after its useful life (cradle-to -cradle lifecycle). More definition by Rettab and Brik (2008) defined the GSCM as an organizational approach that seeks to decrease a product or service's footprint, environmental as well as social impacts. While Sellitto, Hermann, Blezs and Barbosa-Póvoa (2019) GSCM can be defined as collective ranges of green purchasing (GP) practices to integrated life-cycle flow of managing supply chains from supplier to manufacturer, end customer, and closing the loop with reverse logistics. According to Sarkis et al. (2011), various distinctions of GSCM and its meaning over the years have been developed extensively. In general, Table 2.10 indicates the definitions exemplifying the whole concept of GSCM by various researchers that consist of:

Table 2.10 Conceptual definitions/notions in GSCM literature

Conceptual Definitions/Notions	**Source**
Network management of sustainable supply chain	Cruz and Matsypura (2009); Young (2001)
Lean and green supply chain management	Azevedo, Carvalho, Duarte and Cruz-Machado (2012); Carvalho, Azevedo and Cruz-Machado (2010)
Corporate social responsibility (CSR) network in sustainable supply and demand	Cruz and Matsypura (2009); Kovács (2008)
Eco-efficient supply chain management	Michelsen, Fet and Dahlsrud (2006); Moreira, Alves and Sousa (2010)
Environmental management of the supply chain	Sharfman, Shaft and Anex (2009)
Green procurement and green purchasing	Günther and Scheibe (2006); Min and Galle (1997)
Environmental purchasing	Carter, Kale and Grimm (2000); Zsidisin and Siferd (2001)
Sustainable and environmental logistics	González-Benito and González-Benito (2006); Murphy and Poist (2000)
Sustainability in supply chains	Bai and Sarkis (2010); Linton, Klassen and Jayaraman (2007)
Green logistics in the supply chain	Cosimato and Troisi (2015); Dekker, Bloemhof and Mallidis (2012); Lai and Wong (2012)

Source: Tabulated by author

In most cases, a literature review of GSCM usually capitulates various studies linking green concept, environmental, or sustainability concepts within the traditional supply chain management practices, demonstrating how particular GSCM practices, definitions, concepts, theories and decision frameworks affect daily business operations of organizations (Hervani et al., 2005; Zhu & Sarkis, 2004). Thus, based on GSCM definition mentioned, GSCM is a valiant effort throughout the organization and is more than plainly putting some green dimensions in place, but rather an unswerving, consistent and holistic enhancement and improvement of the environmental dimension in all levels of management, logistics and on the shop-floor. Most studies highlight reduction, re-manufacturing, recycling product design, process design, manufacturing practices, procurement, and some combination of items across managerial levels as a core concept of GSCM. Integration of these environmental concepts into organizational business functions ameliorates environmental pollution.

This situation is predominantly apparent for external GSCM practices on operational activities such as providing design specification to suppliers involving environmental requirements, auditing suppliers' green management systems, cooperating with customers for eco-design, and handling product returns from customers. A more cohesive approach towards GSCM has been suggested by Poole and Simon (1997) through life-cycle assessment as a means of investigating the general environmental impact of a product life cycle. Tuni and Rentizelas (2018) also have extracted environmental attributes from every phase of a product's lifecycle, including raw-material extraction, product manufacturing, packaging, transportation, logistic, use and service as well as final disposal. This approach of GSCM sees production life cycle from supplier to consumers as a cohesive flow of supply chain to reduce waste and environmental impact. Nevertheless, further elaboration and systematic analysis allow effective and efficient implementation of various GSCM strategies at any organizational level.

On the contrary, several studies have also emphasized developing GSCM strategies from an overall organizational and management perspective. Shaharudin, Fernando, Chiappetta Jabbour, Sroufe and Jasmi (2019) for example, have observed the increasing importance and demand of GSCM as a supply-chain strategy for management point of view to increase operational efficiency for general organizations. Effectively, attaining organizational green goals means linking an environmental strategy with every practical business strategy, thus eradicating obstacles to environmental integration.

Decision-makers and managers should properly adjust the contents and end goals of environmental practices to match changes in business development. Many organizations have just begun discovering environmental concerns and implemented environmentally-friendly activities, so they have not yet identified many environmentally-related factors. Thus, rethinking the relationships between each factor of environmental practices is therefore essential. The critical ingredients for every successful organizational strategy depend on whether resources or capabilities are rare, durable, or challenging to imitate (Chen, Shih, Shyur, & Wu, 2012). This study extends this concept, utilizing the GSCM viewpoint to choose business functions related to this process (design, purchasing, manufacturing, and marketing and service), and constructing a fundamental decision-making framework for ‘‘green" practices in the maritime supply chain.

This study also extends the GSCM concept into the term of MGSCM that refers the integration of GSCM in the maritime context, and define it as integrating environmental concerns into the inter-organizational practices of SCM in maritime context to ease the flow of operation in a supply chain system. As GSCM concept itself, is associated with an inter-organizational ecological subject as industrial eco-systems, industrial ecological unit, product life cycle investigation, extended producer responsibility and product stewardship (Zhu et al. 2005), GSCM can also be used virtually in any industrial context within the structural management framework. Thus, conceptualizing from GSCM concept and understanding, GSCM connotation can be extended into MGSCM.

In this sense, several works of literature on maritime sustainability and GSCM concepts are worth mentioning. Cheng, Zanjirani Farahani, Lai and Sarkis (2015) for examples defined MGSCM as sustainable maritime supply chain which means the integration of maritime organizational units (ports, shipping companies, etc.) in a supply chain system and organization of materials (container, bulk and general cargoes), information, and monetary flows in order to (a) accomplish customer needs while at the same time improving the competitiveness in the system profitable and subjected to conformity with regulations to control (b) social and (c) environmental impacts. Psaraftis (2016) used the term green maritime logistics which can be intrinsically defined as an attempt, effort and action to achieve adequate ecological performance in the maritime supply chain, while at the same time fulfilling traditional economic performance dimension.

Extended from the view of sustainable development he argued that societal criteria must be embedded in the above definition, either on their right or as part of economic criteria while others defined GSCM notion in the maritime supply chain as business processes, approaches and actions that meet the present and future needs of the maritime sectors and their stakeholders while at the same time conserving and sustaining human needs and natural resources (AAPA, 2007). Denktas-Sakar and Karatas-Cetin (2012) define MGSCM as business approaches and actions that meet the current and future needs of the maritime sector and its stakeholders while protecting and sustaining human and natural resources. Other researchers have also used the term green management to link sustainability in the maritime supply chain in prior literature. Hock (2000) deposited that environmentally sustainable management, or the so-called 'green management,' has also become known as an imperative management topic for organizations to attain profitable operation and market share while at the same time commit towards environmental protection.

The green maritime operation is also a term used to refer an environmentally sustainable management approach to perform maritime activities and operation in the shipping industry, where the environmental governance mechanism implemented by a shipping organization is considered an essential part for the greening effort (Cheng, Farahani, Lai, & Sarkis, 2015). The study of Lun, Lai, Wong and Cheng (2013) suggests and empirically validates an integrated model to study how various environmental and GSCM governance mechanisms (i.e., contractual, relational, and organizational) are endorsed by maritime companies and their influence on organizational and environmental performance.

Conceptualizing from conventional GSCM perspective, many studies on green practices in maritime context also have used different term in conceptualizing MGSCM dimension such as greening and performance relativity (GPR) (Lun, Lai, Wong, & Cheng, 2015), green shipping practices (GSPs) (Lun, Lai, Wong, & Cheng, 2014), green management practices (GMP) (Lun, 2011) green shipping management capability (Lirn et al., 2014) and green shipping network (Lun, Lai, & Cheng, 2013). They, in particular, have introduced many dimensions of green practices (e.g., green policy, green shipping, green marketing, green integration, green design, etc) that aligned with the conventional concept of GSCM in maritime context to specifically measure improvement in environmental and organizational performance. The more recent studies with some sustainability and GSCM focus within maritime supply chain have been more problem-specific orientation, such as the use of multi-objective decision methods in sustainable maritime transport (Mansouri et al., 2015a) or bunker consumption optimization methods (Christiansen et al., 2013).

Despite the fact of various investigations of studies undertake the GSCM perspective from a different angle, a comprehensive review of MGSCM literature is still scarce and limited. In this sense, there is many areas of GSCM dimensions are yet to be explored especially in maritime context. Taking from this assumption this research assumes sustainability in the maritime supply chain in additional literature review encompasses the need to understand the necessary conceptual ground of GSCM to be integrated into the maritime industry. Thus, in this study, based on previous definition mentioned, this study uses the term MGSCM that combines the concept of green practices (GSCM) into maritime context and includes five GSCM capabilities of GFF, GICS, GSIP, GVALS and SDC respectively. In the next few sections, this study elaborates the motivation of adopting GSCM/MGSCM and the conceptual development of MGSCM at a theoretical level that leads to the development of this research's framework.

2.4.3 Motivations and Benefits from GSCM Practices

Numerous researchers have presented various useful insights into the relationship between GSCM and economic performance committed by organizations and industries in diverse contexts with significant implications for practice and policy (Cosimato & Troisi, 2015; Geng, Mansouri, & Aktas, 2017; Woo, Kim, Chung, & Rho, 2016b). Originally penned by Porter and Linde (1995), they noted that green practices could generate pioneering innovation that lower the total cost of product or value improvement in the long term. Such pioneering innovations permit business organizations to use a variety of inputs more productively; from raw materials to energy to labour, thus compensating the initial costs of improving environmental impact and ending the stalemate. Eventually, this enhanced resource productivity makes business organizations more competitive but not less.

Although several studies based on Porter’s hypothesis support the view that well designed environmental regulations do not erode competitiveness, this still leaves a controversial point as to whether business organizations can maintain a competitive position when implementing voluntary green initiatives (Schaltegger & Wagner, 2006). However, Bacallan (2000) also argued that green strategy could lead to enhanced competitiveness; in which social and environmental performance add to the improvement in economic performance accompanying sustainable business competitiveness. Recently, many researchers have tried to establish how sustainability initiatives can influence competitiveness in diverse contexts and different industries. Figure 2.11 describes the relations of sustainability performance with business competitiveness.

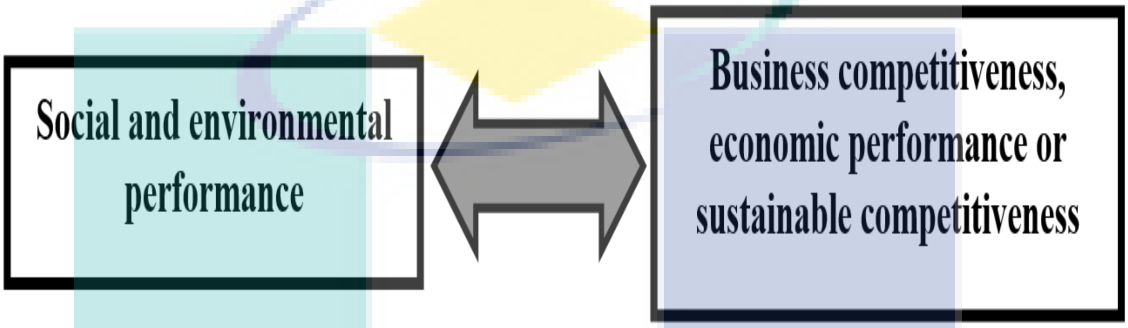

Figure 2.11 Interaction of sustainability performance with competitiveness
Source: Adapted from Wagner and Schaltegger (2003)

Prior studies on the drivers of sustainability practices (Hoejmose, Brammer, & Millington, 2012) suggested the motivation for, and benefits from, GSCM are (Madan Shankar, Kannan, & Udhaya Kumar, 2017; Shahbazpour & Seidel, 2006):

1. **Legitimization** – to improve the suitability of the organization's actions within a recognized set of regulations, norms and values (Hatanaka & Konefal, 2017; Yue & Sims, 2016);
2. **Moral responsibility** – an organization's social obligations occurring from its self- perception as a purposeful business entity within the macroeconomic, social and natural environments (Jianu, 2016; Riaz, Farrukh, Rehman, & Ishaque, 2016); and
3. **Competitiveness** – the aspiration to improve the potential for profitability through developing resources and capabilities that are hard to imitate (Jansson, Nilsson, Modig, & Hed Vall, 2017; Menguc & Ozanne, 2005; Porter & Linde, 1995).

Conversely, Zhan, Tan, Ji and Tseng (2018) strongly argued that, apart from the motives, organizations can improve their competitiveness through improvement in environmental performance to conform to environmental regulations and to lessen the environmental impact of their production and process. Wagner and Schaltegger (2003) reviewed the relationship between sustainability performance, business competitiveness, and economic achievement. They commenced a phenomenological relationship between sustainability performance and economic success from which multiform economic standpoints can derive different predictions about the relationship, as shown in Figure 2.12.

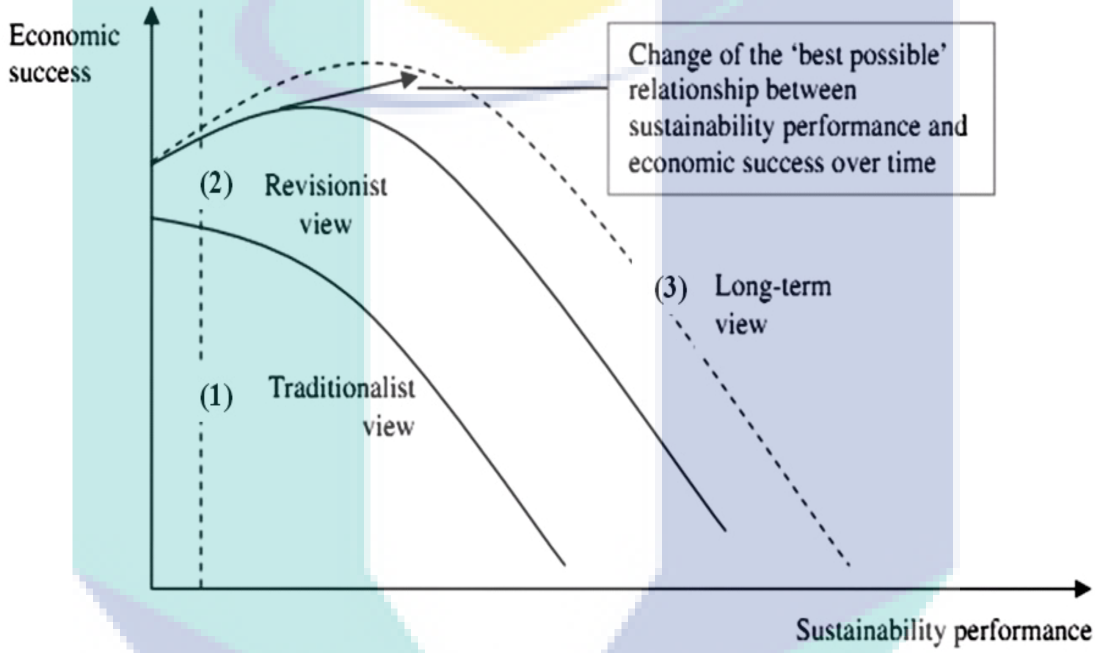

Figure 2.12 Sustainability performance and economic success

Source: Drawn based on Schaltegger & Wagner (2006); Tan, Shen, & Yao (2011)

In the case of Figure 2.12, the declining curve indicates the first view of 'traditionalist' form neoclassical environmental economics perspective (Schaltegger and Wagner, 2006). Tan et al. (2011) argued that the traditionalist view asserts "environmental protection activities and regulations would reduce economic success, and the companies in industries with higher environmental impacts will face disadvantages if we burden them with higher environmental compliance costs" (p.226). However, these restricted views are more associated with a limited or minimum level of compliance, rather than the quest for more competitive advantage from environmental practices by organizations.

On the contrary, the second inverse U-shaped curve in Figure 2.12 represents the 'revisionist' view. The concept asserts that sustainability practice has a beneficial influence on economic success. Schaltegger and Wagner (2006) noted that "improved environmental performance is a potential source of competitive advantage leading to more efficient processes, improvements in productivity, low costs of compliance and new market opportunities" (Porter & van der Linde, 1995; p.10). For instance, pollution can be signified as waste and loss of resource productivity in the business process. Pollution prevention including reducing the amount of waste generated and the usage of resources and recycling can reduce pollution and result in lower costs of compliance (Schaltegger and Wagner, 2006). Therefore, process innovations to reduce pollution can improve resource productivity and competitiveness.

Lastly, the third dotted line describing the expanded inverse U-shaped curve in Figure 2.12 (the longer-term dynamics) describes ‘the efficiency frontier development' over a longer period. With organizations demonstrating the ability to innovate and adopt new technologies, Tan et al. (2011) argued that operational management approaches would be more important for sustaining competitiveness than traditional competitive factors. Consequently, the two views described above (the ‘traditionalist' and the ‘revisionist') can be universalized to the association between sustainability performance and economic performance from different economic outlooks, and the longer-term dynamics as suggested in the third U-shape curve implicates the efficiency frontier development in order to help enhance competitiveness and promote their innovative capacity on longer run. Paradoxically, this view aligns with this study postulation that when the environmental management issues are in line with increased competitiveness and increased economic performance, successful management of sustainability performance (such as LCP and ECP) can also be achieved in the long-term perspective.

On the other note, expanding from those three economic views, GSCM has also provided advantageous effects on SCM practices. Integration of environmental and supply chain management can enhance supply chain efficiency, productivity and flexibility of its operation. In general, the adoption of GSCM in the supply chain may lead to potential leanness due to minimization of the amount of waste generated by supply chain operation. According to Nikbakhsh (2009), other effects include:

1. **Improving agility of the organizations:** GSCM helps lessen the risks and speed up innovations and technology adoption.
2. **Increasing adaptability of the organizations:** GSCM investigation often leads to innovative processes and pioneering continuous improvements.

3. **Encouraging the organization's alignment:** GSCM practices involve bargaining policies and negotiation with suppliers and customers, which effect in better alignment of business processes and operational principles.

From a macro-level standpoint (see Table 2.11), GSCM may lead to environmental products, which in turn creates new potential markets to grow. This benefits the green companies that adopt GSCM a competitive advantage. At the same time, GSCM can also create incentives for business organizations to implement better green practices.

Table 2.11 Organizational advantages of GSCM practice

GSCM practices advantage	Sample advantage
Reducing costs	Raw material and energy costs, insurance costs
Reducing risk	Waste bills and pollution fines, water and/or energy shortages
Improving productivity	Using natural light and ventilation
Increasing property value	Lowering operating costs
Improving public image	Increasing sales, better public perception and community support, proving the company seriousness
Creating healthier environments	Fewer toxins and cleaner air, less hazardous production processes

Source: Nikbakhsh (2009)

On the contrary, the key barriers of GSCM can be divided into four major groups including high environmental requirement costs, lack of green awareness, lack of green technological advancement, and deficient in environmental information, knowledge and green training. Concerning GSCM barriers, different organizations and institutions are responsible for eliminating these barriers (Nikbakhsh, 2009). Fernando et al. (2019) for example have argued that high initial environmental requirement costs and investments are the major obstacle to any green programs in organizations. Customers/suppliers partnership in the green project and governmental loans can begin various projects which in turn will be advantageous in the long term. However, that is not always the case, since the lack of green awareness leads to other barriers such as lack of government participation, and lack of top-level management support. While breaking technological barriers can only be accomplished via inter-organizational cooperation and investment from both governments and large organizations. Finally, to overcome these barriers (lack of environmental information, knowledge, and awareness) can be resolved through environmental information databases, knowledge transfer networks and providing more training and educational classes for government and organization's personnel.

2.5 Research Model and Theoretical Framework

To construct a foundation of hypotheses development, the previous section reviewed the relevant theories and conceptual knowledge associated with this study objectives. This section presents a conceptual research framework and a research model which hypothesizes possible relationships. Firstly, the research framework is conceptualized to achieve research objectives which aimed to examine the role of MGSCM on the relationships between financial performance (FP) based on prior literature. The following section presents a research model hypothesizing the relationships among constructs; MGSCM, energy efficiency performance (EEP) and low carbon performance (LCP) is utilized as a mediator, independent variables (MGSCM constructs) and dependent variable (FP), respectively. Lastly, the items to measure each construct are investigated and chosen to analyse the possible relationships.

2.5.1 Introduction: Conceptualization of Research Conceptual Framework

This study aims to examine the role of MGSCM practice (GICS, GVALS, GSIP, SDC and GFF) on the direct relationships between MGSCM and financial performance in maritime supply chain operations conceptualized based on prior literature. However, prior works linking sustainability practice and maritime supply chain operations were focused on more developed countries such as European, North American (see the study by; Daamen, 2007; Peris-Mora, Orejas, Subirats, Ibáñez, & Alvarez, 2005; Wegscheidl et al., 2017; Yan et al., 2017) and China (see the study by; Chang & Danao, 2017; Chen & Pak, 2017; Wan, Zhang, Yan, & Yang, 2017; Zhang et al., 2017; Zhu, Li, Shi, & Lam, 2017). Moreover, the attributes of GSCM and sustainability practice were not directly discovered and verified within the unique structure of the maritime supply chain in the region of South East Asia such as Malaysia. Given the paucity of prior studies, whether the attributes identified from the literature apply to the maritime industry in Malaysia is critical for further empirical investigation which validates and generalizes the findings in this study.

At first, the concept of MGSCM is initially derived from the extant literature on GSCM (see Section 2.4.2). Based on knowledge gained from the existing knowledge in maritime literature and GSCM literature, the construct of sustainability practice of MGSCM is conceptualized. Thereafter, based on literature, the constructs are operationalized for empirical investigation, which is the process of moving from the idea of MGSCM practice to the set of independent variables measuring sustainability practice adoption in Malaysia. Secondly, based on critical literature review (see Table 2.12) on GSCM from maritime literature the structure of MGSCM underlying five constructs are conceptualized accordingly.

Conceptualizing from the perspective of MGSCM extended from GSCM perspective in the maritime supply chain, a wide variety of studies have tried to highlight sustainability within maritime operations using various terms and definitions. Psaraftis (2016), used the term green maritime logistics that emphasize the capability, effort and action to attain adequate ecological performance in the maritime supply chain, while at the same time fulfilling traditional economic or financial performance dimension. Extending from this view of sustainable development, he argued that environmental criteria must be embedded in the above definition, either on their right or as part of economic criteria. Aligning with the MGSCM dimensions of this study, Table 2.12 shows the critical literature review of the primary studies of GSCM in the maritime context that align with the conceptual notion of MGSCM in this study.

Table 2.12 Main studies of MGSCM in maritime literatures

Concept	Definition	Green Dimension	Performance measurement	Source
Sustainable maritime supply chain (SMSC)	It is defined as the integration of maritime organizational units (ports, shipping companies, etc.) in a supply chain system and organization of materials (container, bulk and general cargoes), information, and monetary flows in order to (a) accomplish customer needs while at the same time improving the competitiveness in the system profitable and subjected to conformity with regulations to control (b) social and (c) environmental impacts	-Integration practice -Information flow -Monetary flow	None (conceptual paper)	Cheng, Zanjirani Farahani, Lai and Sarkis (2015)

Table 2.12 Continued

Concept	Definition	Green Dimension	Performance measurement	Source
Green shipping practices (GSPs)	It is defined as being environmentally sustainable in the performance of shipping activities.	-Shipper cooperation -Shipping design for -compliance -Shipping document -Shipping materials -Shipping equipment -Company policy and procedure	-Environmental performance -Financial performance	Lun et al. (2014)
Green management practices (GMP)	It is defined as a green management tool for shipping sector oriented towards both economic and environmental aspects by applying ecological criteria.	-Cooperation with supply chain partners -Environmentally friendly operations -Internal management support	-Firm performance (profitability, cost-efficient operation, efficiency)	Lun (2011)
Sustainable maritime	It is defined as business approaches and actions that meet the current and future needs of the maritime sector and its stakeholders while protecting and sustaining human and natural resources	None (conceptual paper)	None (conceptual paper)	AAPA (2007)
Green maritime logistics	It is defined as an attempt, effort and action to achieve adequate ecological performance in the maritime supply chain, while at the same time fulfilling traditional economic performance dimension	None (conceptual paper)	None (conceptual paper)	Psaraftis (2016)
Green shipping management (GSM)	It is defined as green capability in container shipping to achieve competitiveness in environmental and financial performance	-Greener policy -Greener ships -Greener suppliers	-Environmental performance -Financial performance	Lirn et al. (2014)
Green supply chain management capability	It is defined as the GSCM concept aims at improving environmental performance and competitiveness in the container shipping industry	-Green policy -Green marketing -Green collaboration with supplier -Green collaboration with partner -Green collaboration with the customer	-Environmental performance -Firm competitiveness	Yang et al. (2013)
Greening and performance relativity (GPR)	It is defined as a concept to establish the relationships between green and performance. It is derived from the GSP dimension to assess firm performance	-Shipper cooperation -Shipping design for compliance -Shipping document -Shipping materials -Shipping equipment -Company policy and procedure	-Environmental performance -Financial performance	Lun et al. (2013)

Source: Tabulated by author

From the summary of Table 2.12, studies on the green concept from engineering and technical analysis are not included since this study focus on the business management perspective. In Table 2.12, despite the various investigations of studies undertaken of the GSCM perspective from different angles, a broad review of the literature of MGSCM is currently still limited. In this regard, only a handful of studies emphasize the managerial aspect of greening the maritime supply chain. Many areas of GSCM are yet to be explored. Thus, based on the summarized concept and definition above, this study outlines a few critical criteria for conceptualizing MGSCM and further defines each MGSCM construct in the next table in Table 2.13 respectively. Interestingly a few of these criteria can also consider as the gap found for shaping the MGSCM dimensions in this study. Hence, based on Table 2.12, the preliminary conceptualization of each MGSCM dimension is presented below:

1. The conception of the sustainable maritime supply chain by Cheng, Farahani, Lai, and Sarkis (2015) emphasizes three important conceptual criteria to achieve sustainability namely: 1) integration practice, 2) information flow, and 3) monetary flow. While integration and information flow are broadly discussed in the literature, this study finds an unexpected gap in term of monetary/financial dimension in maritime and GSCM literature being neglected. Further examination found a limited study on financial flow for greening supply chain in the maritime context. Conceptualizing from the green accounting perspective, this study believes it is timely to extend specific measurement of green financial flow (GFF) as a part of MGSCM dimension. This is based on the fact that financial capability often discussed as a major driver in green practices adoption in other sectors of industry (Lau & Wang, 2009).

2. Although greening the information technology (IT) is extensively investigated in wide-ranging sectors of GSCM study, it is often neglected in maritime literature whereas many GSCM studies emphasize the significance of IT in increasing supply chain efficiency. This study finds that green information and communication system (GICS) must be included in MGSCM dimension due to the current trend in the rapid development of IT and its common adoption among general business organizations. Based on GSCM reviews from literature, this study postulates that GICS can become a significance green capability in

enhancing sustainable business performance in the maritime sector. Due to this sector complexity of its supply chain system, GICS not only can encourage coordination of supply chain players through reliable, fast and efficient use of IT but also decrease the traditional dependency of paper sheets documents which are currently not sustainable.

3. Based on the analysis of literature, numerous studies have highlighted shipper cooperation and collaboration as a major dimension in greening the supply chain (see the study by Lun, 2011; Lun et al., 2013, 2014; Yang, Lu, Haider, et al., 2013a). Extending from those perspectives, the integration of maritime players/partners be the most imperative criteria to achieve sustainable supply chain due to the complex nature of this industry which has multiple layers of stakeholders. From this examination, this study conceptualizes green supply chain integration practice (GSIP) as a key dimension to be included in MGSCM dimension to achieve sustainability and to increase financial performance.

4. From the analysis of literature in Table 2.12, in order to give value services to the end customer and greening the supply chain, a few studies suggested integration of GSCM procedures in the process flow of supply chain operation. This includes for example, using greener ship (Lirn, Lin, & Shang, 2014), the adoption of green marketing (Yang et al., 2013), adopting greener shipping equipment (using greener engine, energy-efficient rudder and ship) and the usage of greener shipping material (use reusable and recycle equipment) (Lun et al., 2013, 2014) in supply chain processes. Taking into account all of these green activities aim at improving service quality (to give value added services) to the customer, enhance efficiency and flow of maritime supply chain operation, this study conceptualizes all of these dimensions as a single dimension of green value added logistics services (GVALS).

5. As being elaborated in the previous sections, stringent regulations imposed by IMO such as SEEMP and EEDI require new ships to conform with green compliance standardization starting on the year 2013 onwards (Rehmatulla et al., 2017). These regulations promote shipping innovations in term of greener ship design development and adoption of energy efficient equipment for compliance.

Various studies in maritime literature have suggested the ship design and compliance (SDC) as green capability that improve energy efficiency which results in decrease environmental impact (Lai, Wong, Lun, & Cheng, 2013; Lun, Lai, Wong, & Cheng, 2013b; Lun et al., 2014; Lun, 2011). In this regard, SDC in this study is a direct conceptualization from the literature based on those maritime studies.

Table 2.13 MGSCM dimensions and definitions

Construct	Definition
Green financial flow (GFF)	It is defined as the systematic approach of sustainability in various processes of financial management and accounting in order to reduce impact to the environment and to increase energy efficiency and financial performance (Jasmi & Fernando, 2018; Vincent, 2000).
Green information and communication system (GICS)	It is defined as information system that have been modified for systematic application of sustainability in various processes of IT and communication management in order to reduce related emissions and to improve energy efficiency as well as financial performance through synchronization of efficient information flow (Hasan Ali Al-Zu'bi, 2016; Jasmi & Fernando, 2018; Kehoe & Boughton, 2001; Mathiyazhagan et al., 2015; Prajogo & Olhager, 2012; Qazi et al., 2016; Swaminathan & Tayur, 2003).
Green supply chain integration practices (GSIP)	It is defined as the systematic approach of integrating sustainability in various processes of the supply chain system in order to improve information flow, decision making and cooperative action to achieve higher implementation of green practices to lessen the impact to environment, increase energy efficiency and financial performance (Jasmi & Fernando, 2018; Frohlich & Westbrook, 2001; Van Der Vaart & Van Donk, 2004).
Green value added logistic service (GVALS)	It is defined as the systematic application of sustainability in various processes value added logistic (e.g. utilization of green material and handling, reduce waste, implementation of environmental management system & etc.) in supply chain to reduce ecological impact and to improve energy efficiency in order to achieve financial performance (Jasmi & Fernando, 2018; Sweeney & Soutar, 2001).
Ship design and compliance (SDC)	It is defined as the systematic approach of sustainability in various processes of shipping design, construction and production phase to achieve conformity with sustainable compliance in order to reduce impact to the environment, gain energy efficiency and increase financial performance (Jasmi & Fernando, 2018; Chang, 2012).

From the above definition, this study concludes that the applicability of MGSCM dimensions is aligned with the current practice of the maritime supply chain to achieve sustainability and financial performance. Meanwhile, based on critical literature review and literature review, the supporting argument of MGSCM dimensions is discussed in the next section from the strategic aspect of maritime literature to achieve sustainability.

2.5.2 Theoretical Development of MGSCM Attributes

The subject of sustainability focusing on the operations of the maritime supply chain has been gaining increasing interest lately. Some prior contributions discuss the impact of logistics outsourcing on maritime supply chain sustainability (Facanha & Horvath, 2005; Jumadi & Zailani, 2010); others examine the maritime supply chain companies commitment to environmental sustainability (Murphy & Poist, 2003; Zailani, Amran, & Jumadi, 2011); still others attempt to analyse factors that may influence the adoption of green practices by logistics maritime supply chain companies (Lin & Ho, 2008) or whether environmental issues represent a selection criteria when buying logistics services from companies (Wolf & Seuring, 2010). However little attention has been paid to the adoption level of specific environmental initiatives align from GSCM perspective by maritime supply chain context and the reasons, both strategic and operative due to the complexity of this industry.

Hence, before developing this study's theoretical framework (MGSCM constructs), it is important to extract the attributes of sustainability practices in general maritime operations, reviewing different outlooks encompassing several aspects of operational, environmental, and relational dimension. In the next section, this study has further conceptualized each perspective based key attributes of sustainability practice from GSCM lens practice to be adapted in the maritime supply chain operational context. Hence, derived from direct conceptualization of sustainability attributes from Kim (2014), his study has divided the strategic aspect of MGSCM attribute based on three dimensions to achieve sustainability based in the maritime literature review, namely:

1. **Long-term operational viability and sustainability** (Adams, Quinonez, Pallis, & Wakeman, 2009; Mongelluzzo, 2012) ***(see sub-section 2.5.2.1)***
2. **Continuous monitoring and upgrading** (Dinwoodie, Tuck, Knowles, Benhin, & Sansom, 2012b) ***(see sub-section 2.5.2.2)***

3. **Active participation and cooperation** (Cheon & Deakin, 2010; Perrini & Tencati, 2006; Joseph Sarkis, Gonzalez-Torre, & Adenso-Diaz, 2010) ***(see sub-section 2.5.2.3)***

In the next section, this study elaborates these three attributes and summarizes it to further conceptualize MGSCM dimensions for proposed framework development.

2.5.2.1 Long-term Operational Viability and Sustainability

Maritime supply chain assets are relatively long-term, expensive and sluggish to be replaced (e.g., vessels, tanker, port assets) because of the capital-intensive nature of its industry. Thus, the long-term operational viability is an important consideration before adopting any new sustainable strategies (Mongelluzzo, 2012; Sofian, Tayles, & Pike, 2017). In order to conduct business in ways that are sustainable in the longer term, the thought of capacity lifecycle helps to understand the long-term operational viability over time (Fain, Wagner, & Kay, 2018). Epstein and Josée (2001) have argued that the decision for long-term operational viability could contribute to the long-term positioning equipment and mechanisms that can stimulate the development of new resource-saving technologies for organizations.

First, as argued by Zhou, Hou and Zhang (2018), new green technologies as a strategic asset for gaining sustainability can avoid environmental severity, and ensure economic growth. Meanwhile, green technologies can be defined as equipment, methods and procedures, and delivery mechanisms that conserve energy and protect the environment. The technologies are significance in term of delivering more efficient in resource usage and tend to be more environmentally friendly, improving technical efficiency of the production process, reducing environmental impacts and health risk (Mongelluzzo, 2012).

Secondly, improving flexibility as an operational process innovation can also improve sustainability, achieving long-term financial viability in the face of economic uncertainty accompanying low environmental and social impacts (Kim, 2014). Hakam and Solvang (2009) analysed interdependency between sustainability and flexibility and argued that flexibility in maritime operation could improve sustainability operation. Table 2.14 shows the recommended measures that include:

Table 2.14 Measures of maritime flexibility and sustainability improvement

Flexibility and Sustainability Improvement	Measures
Improving the maritime/port system multimodal interface increases its flexibility	-integrating a rail interface will allow for a smoother modal shift from road to rail or coastal route
Tracking and coordinating of freight movements through Information Technology (IT);	-using Electronic Data Interchange (EDI), Global Positioning Systems (GPS), and Radio Frequency Identification (RFID) allow for increased efficiency and sustainability by reducing delivery time
Reducing the vessel's turnaround time	-berth assignment loading and unloading operations, yard management, crane scheduling, and Auto Monitoring Systems (AMS);
Reducing carbon emissions	-using Alternative Marine Power (AMP) when hosting vessels, alternative fuels used for terminal tractors or Automated Guided Vehicle (AGVs) -providing incentives to ship owner/operators to reduce emission
Increasing labor and supply chain flexibility	-through motivation and cross-training in green knowledge -providing incentives to supply chain players to collaborate

Source: Hakam and Solvang (2009)

From the above table, this study concludes that in order to achieve flexibility and sustainability improvement, information technology is an important driver that acts as a catalyst for organizational improvement. Not only the improvement is on organizational dimension, but the new integrated technology such as IT can improve efficiency and at the same time act as an environmental solution (reducing carbon emission) for achieving economic performance and gaining competitive advantage.

Moreover, Lun (2011) argued that maritime supply chain could benefit from further opportunities for achieving competitive advantage from continual environmental and organizational improvement. For examples, Environmental Management Practices (EMP) in shipping operation can offer an excellent opportunity to jointly assess all aspects of maritime operations for reducing environmental harms and help accomplish greater operational efficiency. Accordingly, the maritime supply chain can also enhance their sustainability by improving operational effectiveness (Kim, 2014). Gupta and Benson, (2011) analysed these growing sustainability initiatives to explain how such practices can be a source of their unique position that allows them to outperform competitor consistently in a maritime supply chain through the lens of corporate strategy principles. They suggested three influential contributors to operational effectiveness are shown in Table 2.15.

Table 2.15 Contributors to operational effectiveness

Contributor to Operational Effectiveness	Explanations
Leveraging sustainability to improve Operational Effectiveness	benefits related to firm's operational effectiveness including efficient use of resources, cost savings from waste reduction, and the advantage of sustainable SCM; strategic benefits of sustainability that help to differentiate the products and processes through innovation, improved positioning, and strategic "fit", requiring a deeper integration within a firm,
Improving Operational Effectiveness through Eco-efficiency	simultaneously reducing the ecological impact and use of resource while producing and delivering goods; the opportunity costs represented by pollution and waste streams generated in business processes (e.g. wasted resource, wasted effort, additional abatement and disposal steps, potential health and safety liabilities, and diminished product value to the customer (Porter and van der Linde, 1995),
Improving Operational Effectiveness through sustainable SCM	A significant source of improved operational effectiveness (Rosenbloom, 2010); additional benefits by coordinating with suppliers and customers to implement interconnected cost savings and efficiencies across a large sustainable supply chain (Mefford, 2011; Wilkerson, 2005).

Source: Gupta and Benson, (2011)

Therefore, environmentally friendly technologies and management can be considered as new process innovation accompanying long-term operational viability (Porter and van der Linde, 1995). Such innovations allow maritime organizations to use a range of inputs more productively and to lead to a more effective value chain of organization implying resource productivity, abiding by environmental law and regulations. This enhanced resource productivity makes maritime companies more competitive and sustainable (Porter & van der Linde, 1995) as well as reducing the adverse effect on the natural environment.

2.5.2.2 Continuous Monitoring and Upgrading

Sustainability in the maritime supply chain means a constant process of improvement in all parties of maritime operation and activities. With increasing awareness about the environmental problems related to maritime operations, the maritime industry needs to capably respond to stakeholder concerns and to show the result achieved (Dinwoodie, Tuck, Knowles, Benhin, & Sansom, 2012a). This is due to this complex industry needs to find constant innovative solutions to react to pressures from competitors, customers, and regulators. Maritime industry needs to play a reactive role that includes developing an accessible generic business process framework for existing and new maritime facilities, measuring and reporting on continuous improvement in environmental solution as well as addressing community concerns (human health, environment and quality of life).

The ESPO Green Guide (2012) has identified the importance of continual environmental monitoring and improvement, which helps the maritime supply chain industry to be more sustainable by implementing good environmental policy and monitoring system. Roughly around 73% of the port authorities and maritime supply chain in Europe in 2012 have an environmental policy, which aims to improve environmental standards beyond those required under legislation, and 80% of those have carried out environmental monitoring in a maritime supply system. To such extent, environmental monitoring in the maritime supply chain system can enhance sustainability attributes by addressing the growing environmental and social concerns. Some tools (see Table 2.16) to assist the maritime supply chain system in managing environmental risk and to improve their performance have been introduced in recent year.

Table 2.16 Tools to assist environmental management in the maritime supply chain

Initiative	Aims to:	Implementation
Self-diagnosis (SDM)	Identify environmental risks and help the agenda for action and compliance	Completing checklist, EcoPorts guidance, and strategic advice
Port environmental review system (PERS)	Assist ports to carry out EMS for raising their effectiveness	Offering independent review including guidelines and example documents
Strategic overview of environmental aspects (SOSEA)	Identify important environmental aspects from port operations; develop guidance to port operations for enhancing long-term viability and increase environmental awareness	Indicating to EcoPorts for each significant aspect further questions on management and actions taken
ISO 14001	Encourage ports to adopt EMS; promote continual improvements, assist systematic development and evaluate the effectiveness of port activities in or around	Assisting risk management, continuous monitoring for systematic development
Eco-management scheme and audit scheme (EMAS)	Identify significant environmental aspects and related risk; achieve scale economies	Preparing an environmental review and statement, providing standardized procedures for multi-site applications

These tools act as a formal system to proactively manage the environmental footprint of the maritime supply chain system, provide a guideline and strategic advice for environmental management for maritime organizations. Further, these tools can assist maritime sector by encouraging full commitment towards natural environment protection based on three principles: pollution prevention; continuous improvement; and voluntary participation (Bansal & Hunter, 2003; Dinwoodie et al., 2012a; Murillo-Luna & Ramón-Solans-Prat, 2008). Utilizing these tools, maritime stakeholders can mitigate potential environmental risks and manage sustainable development of maritime operations through an accessible business process framework, highlighting the importance of educational dimensions, commercial missions and stakeholder engagement for sustainable development of maritime operations.

2.5.2.3 Active Participations and Cooperation

A large number of stakeholders engagement play a significant role in the governance of the maritime supply chain cluster and having a considerable impact on its operations. Sarkis, Gonzalez-Torre and Adenso-Diaz (2010) proved that increased stakeholder pressures in environmental management significantly affect the adoption of sustainability practices. Therefore, the maritime supply chain sector should effectively coordinate and cooperate with general stakeholders in order to respond to the increased pressures from competitors, customers, and regulators (Dinwoodie et al., 2012). As visibility to achieve sustainability in the maritime sector increased, various literature maintained that the sustainability of maritime supply chain system depends on the sustainability of its stakeholder's relationship which can be achieved through active engagement of all stakeholders of the maritime supply chain infrastructure (Cheon & Deakin, 2010; Perrini & Tencati, 2006; Herman Wold, 1974).

Improved stakeholders' engagement and communication among supply chain players are a compelling aspect for achieving long-term sustainability. Their collaboration may assist the maritime supply chain network to respond quickly to stakeholder expectations and react to changing business environment. Participation and cooperation may also improve the operational performance of their business and distribution network with higher operational efficiency and service differentiation (Aydiner, Tatoglu, Bayraktar, & Zaim, 2019). In this regard, Sarkis et al. (2010) and Cheon and Deakin (2010) denote that government authorities and other maritime stakeholders including among same industries and commodity groups should coordinate and work together to achieve sustainable maritime operation. Emphasizing this coordinated activities and collaboration are crucial to carry out a sustainable model of seaports and cargo movement services because of the complex organizational and technical structure of maritime supply chain, particularly in order to manage the ever-increasing competitive environment and enhance overall competitiveness.

On the other hand, stakeholder pressures on sustainability practices from internal stakeholders (e.g. employees, tenants and manager) may differ from external stakeholder pressures (Sarkis et al., 2010), in which employee participation is defined as "enthusiasm for work" and "satisfaction with work" (Harter, Schmidt, & Hayes, 2002). Comtois and Slack (2007) emphasized the importance of employee participation, in that the employees are essential and proactive players in the environmental management initiative in the maritime supply chain system, and many works of literature illustrate that sustainability can result from employee participation in environmental management (Daily & Huang, 2001; Sarkis et al., 2010).

The internal stakeholders including employees, tenants, and managers will require training and education in order to be competent in their work and improve environmental awareness for long-term sustainability (Teixeira, Jabbour, de Sousa Jabbour, Latan, & de Oliveira, 2016). Supported by Longoni, Luzzini and Guerci (2018), employee engagement and green training not only helps to achieve low environmental impacts on operations and encourage cost saving by reducing resource consumption (eco-efficiency) but also has the potential to enhance the 'green' image of the organization, which is a competitive attribute within the maritime industry. In addition, sustainability practices for education and training help to gain the potential benefits of providing a specific "sustainability strategy" through improving environmental awareness, knowledge, skills, and motivations towards the eco-friendly management (Kim, 2014).

2.5.3 Conceptualization of MGSCM from Three Key Attributes of Sustainability Practice

In summary, considering diverse perspectives including operational, environmental and relational aspects, this study has further extracted four critical attributes from three attributes of MGSCM in previous section to further conceptualize/expand comprehensive sustainability practice in maritime operations from the review of the literature (section 2.5.2.1, 2.5.2.2 and 2.5.2.3). The summarized of expanded four attributes and associated MGSCM dimensions categorized under the sustainability attribute in Table 2.17 includes:

Table 2.17 Summary of sustainability attributes and associated MGSCM dimensions

Attributes	Sources	MGSCM dimensions/constructs
Environmental technologies: Equipment, methods and procedures, and delivery mechanisms that improve energy, cost, and resource efficiency	*(Yang et al., 2013; Dinwoodie et al., 2012; Lun, 2011; Cheon and Deakin, 2010; Murillo-Luna and Ramon-Solans-Prat, 2008; Porter and van der Linde, 1995; Shrivastava, 1995)*	`Shipping design for compliance (SDC) Green Value Added Logistic Service (GVALS)
Monitoring and upgrading: A continual process of improvement in all parties of maritime supply chain activities	*(Dinwoodie et al., 2012; Cheon and Deakin, 2010; Murillo-Luna and Ramon-Solans-Prat, 2008)*	Green Information and Communication System (GICS)
Internal strength: Internal strength through operational, managerial and organizational improvements	*(Dinwoodie et al., 2012; Cheon and Deakin, 2010; Barney, 1995)*	Green Financial Flow (GFF)
Communication and cooperation: Effectively coordinate and cooperate with stakeholders including competitors, customers, and regulators	*(Yang et al., 2013; Dinwoodie et al., 2012; Lun, 2011; Sarkis et al., 2010; Cheon and Deakin, 2010)*	Green Supply Chain Integration Practice (GSIP) Green Information and Communication System (GICS)

Source: Tabulated by author

Identifying sustainability attributes of MGSCM by maritime supply chain companies and assessing their impact on the companies' financial performances, this study has developed five primary MGSCM constructs as shown in Figure 2.13. The constructs are: (1) GICS (2) GVALS (3) GSIP (4) SDC (5) GFF. These studies develop the construct based on relevant justification as follows:

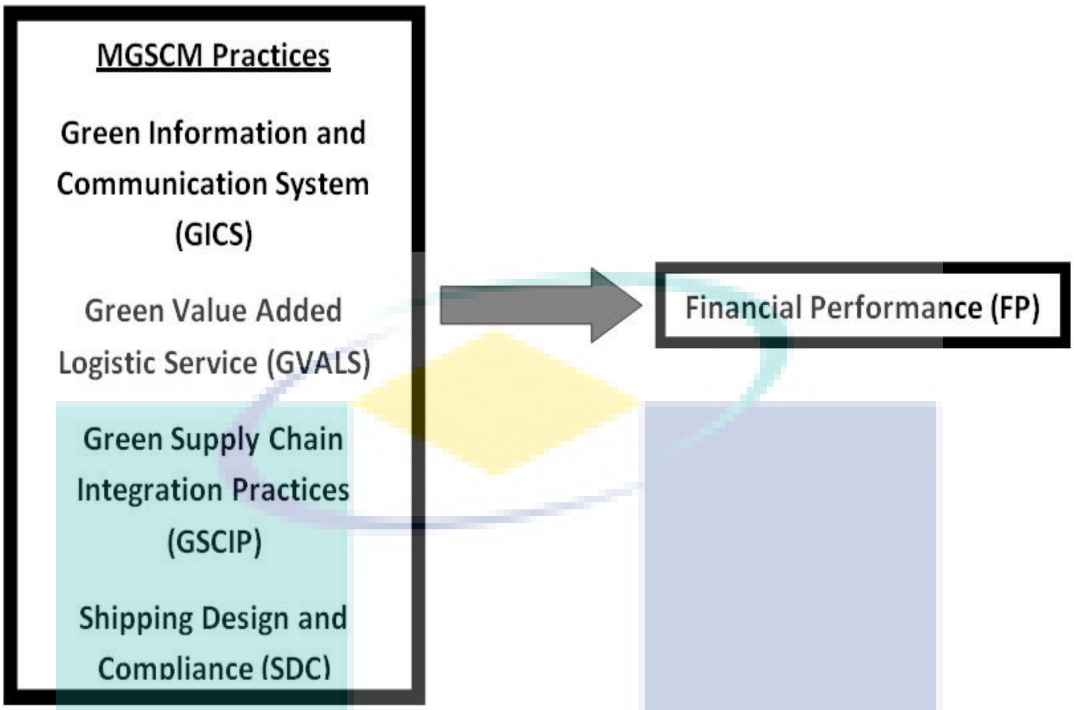

Figure 2.13 The basic tenet of conceptual constructs of MGSCM practices towards financial performance
Source: Drawn by author

1) Environmental Technologies

Based on Table 2.17, this study conceptualizes SDC and GVALS under environmental technology attributes. In order to do that, the study first analyses the environmental technologies from GSCM perspective to be integrated into the maritime supply chain. From the GSCM perspective, environmental technology attributes are a necessary first step in the process of characterizing an environmental technology portfolio, monitoring changes, and assessing implications for performance in maritime context. In this regards Shrivastava (1995) proposed classifying environmental technologies into five themes based on their general management orientation: design for disassembly, manufacturing for the environment, total quality environmental management, industrial ecosystems, and technology assessment. Some examples concern (1) technologies that reduce pollution at the end-of-pipe, such as scrubbers for use on industrial smokestacks or catalytic converters for automobiles, (2) technologies that increase user value for consumer products (e.g. medicines) by introducing new production methods that use materials that are less harmful for the environment and (3) implementation of technologies that are targeted to changes in production processes that improve energy efficiency.

However, these themes are difficult to measure (Klassen, Whybark, & Klassen, 2013) especially in a complex industry such as the maritime supply chain. Nevertheless, generalized finding by Lai, Lun, Wong, & Cheng, (2011) indicates that environmental technology for sustainable shipping can be materialized through shipping design for compliance (SDC). This is concerned with minimizing the life-cycle environmental damage of shipping activities by taking measures in compliance with regulatory requirements. Examples include the design of shipping activities and equipment for reduced consumption of materials and energy, the design of shipping activities for reuse, recycling and recovery of materials, and design of equipment to avoid or reduce the use of polluting energy. Adopting technological advancement such as optimized voyage planning or Voyage Efficiency System (VES) is an essential tool for fuel savings to reduce energy usage. Other approaches such as propeller re-design anti-fouling measures for hulls and improved engine operations to increase ship energy efficiency are also widely adopted for compliance. Lam (2014) also argue that the use of Green Design Ships, Engines, and Machinery (GDSEM) is a vital step in which maritime shipping lines can take by working with shipyards to address the technical and engineering aspects of the environmental solution.

Secondly, green value added logistics services (GVALS) is included in environmental technology as it is associated with a new or modified process, technology and products, which are eco-friendlier and enable the company to avoid or mitigate environmental damage (Kemp, 2000; Porter & Linde, 1995). Such activities may include the use of environmentally friendly shipping equipment and facilities. Examples include eco-labelling of resources such as shipping crates and totes for reuse, cooperation with equipment suppliers on environmental objectives, an environmental audit of suppliers' internal management, suppliers' ISO 14001 certification, and evaluation of second-tier equipment suppliers' green practices (Lai et al., 2011). As maritime supply chain is closely associated with the logistics network, Franceschini, Faria and Jurowetzki (2016) argue that GVALS are more suitable with network oriented activities, especially that fulfilment of stakeholders' expectations is mentioned as one of the most crucial success factors for sustainable innovation (Lin et al., 2013). Based on this stakeholder viewpoint, GVALS activities may further give value to the supply chain by providing an alternative solution in enhancing the supply chain capability and efficiency to the customers and end users. This, in return may improve service quality which bring increase value added service to the end customers.

2) Monitoring and Upgrading

In the maritime supply chain context, monitoring and upgrading can be defined as a repeated process of continuous improvement in all parties of maritime supply chain activities (Šećerov et al., 2019). Adopting this view on the maritime supply chain, this study conceptualizes green information and communication system (GICS) as MGSCM dimension in sustainability attribute of monitoring and upgrading. From GSCM perspective, Tseng et al. (2013) argue that monitoring and upgrading involve coordinating the material, and information flows among suppliers, manufacturers and customers, and implementing product postponement and mass customization in the supply chain**.** From this point of view, GICS or information systems technology can facilitate organizations to standardize, monitor, capture, and utilize data and metadata that help evaluate economic, environmental, and social impacts of business activities (Melville, 2010). In fact, many literature suggest the important of GICS to increase efficiency in supply chain by providing integrated green information flow between partners and paperless transaction that reduce the use of resources to make the supply chain leaner (Chunguang Bai, Kusi-Sarpong, & Sarkis, 2017; de Camargo Fiorini & Jabbour, 2017; Green, Zelbst, Sower, & Bellah, 2017).

As maritime operation involves complex documentation to perform shipping activities, such as booking request, booking confirmation, shipping instructions, invoice, and remittance advice (Xing, Drake, Song, & Zhou, 2019), GICS can become a valuable strategy to facilitate integrative processes of documentation by simplifying the required documentation process and monitoring. For example, to reduce the use of paper and simplify the shipping processes, Maersk (one of the biggest shipping liners in the world) adopted an “End-to-End EDI Solutions” to automatically synchronize the sharing of data across its customers and business partners, significantly cutting down paperwork, reducing processing speed, and decreasing the possibility of errors by transferring data without manual intervention. The adoption of GICS in return may enhance the efficiency of the maritime supply chain operation in general.

3) Internal Strength

The development of a green strategy can be categorized as a process within the internal processes of an organization, which in turn are embedded in a supply chain processes to achieve desired organizational performance outcome of environment, economic or operational efficiency (Wee, Lee, Yu, & Wang, 2011). In this aspect, it can be achieved via successful internal management through operational, managerial and organizational improvements (Susanty, Sari, Rinawati, & Setiawan, 2019). Derived from this view, this study conceptualizes green financial flow (GFF) as internal strength. In general, business organizations can attain substantial cost reductions by adopting a broader approach to whole life costing measures internally. Business and operational sourcing should take into consideration all costs related to products and services throughout their lifetimes (purchase price, usage, maintenance, and disposal costs), incorporating additional evaluation cost metrics such as carbon and water footprint, raw material composition, energy intensity or usage, packaging score, and transportation parameters through GFF.

The extent of GFF in term of applicability in maritime processes can be associated with production inputs and outputs. The core activities of GFF assessment in maritime operation must include life cycle costing, accounting, inventory analysis, impact analysis, and environmental auditing or green improvement analysis (Fernando, Jasmi, et al., 2018; Ninlawan et al., 2010; Joseph Sarkis, 1998) to enhance operational efficiency. From green accounting and life cycle analysis (LCA) viewpoint, this study conceptualizes that GFF dimension in MGSCM would mean that investment decisions in managing supply chain are made by comparing the overall private and social costs against the private and social benefits. Energy-consuming products such as vehicles, IT equipment, lighting, and buildings provide a few examples of resources costing evaluation that can be achieved via internal top management support (Lai et al., 2011) and GFF measurement. While the emphasis of other MGSCM dimensions are initially on technical improvements (e.g. GICS, SDC, GVALS and GSIP) that can be undertaken to both products and processes to reduce environmental costs, environmentally proactive organizations have now recognized that it is critical to develop green strategies based on internal strength and awareness within the organization (Zhu & Sarkis, 2004). Hence, procurement scorecards and subjective selection criteria such as GFF that consider life-cycle costing and internal procurement strategy become a necessary tool and internal strength to the maritime organizations to achieve effective green management strategy.

4) Communication and Cooperation

In a complex supply chain system such as the maritime sector, which involve many supply chain players, communication and cooperation among players are vital to ensure efficient flow of information and operational process. Farahani et al. (2014) argued that it is utmost important for managers to consider the competition from other supply chains in the market when designing a sustainable supply chain. In this sense, integration for smooth workflows becomes a crucial factor as maritime supply chain processes constantly exposed with uncertainties that are generated as a result of the constant restructuring of supply chains to cater to changing globalized or regional manufacturing and consumption patterns. To overcome this problem, the integration of processes and operation can be effectively achieved via coordinative and cooperative processes with stakeholders including competitors, customers, and regulators. This study conceptualizes this sustainability attribute of communication and cooperation via the adoption of green supply chain integration practice (GSIP).

This integration process of GSIP includes collaboration, which is a cooperative and supportive process of making decisions to accomplish efficient flows of resources among supply chain players, and competently produce strategic alignment, which refers to consistency in strategic development or policy implementation to increase organizational performance involving buyers and partners (Maditati, Munim, Schramm, & Kummer, 2018; Narasimhan & Kim, 2002). In maritime supply chain context, when new environmentally friendly strategies (such as MGSCM) are introduced in the logistic process, close cooperation and integration with suppliers are needed for maximizing the environmental capability of their suppliers (Caniëls, Gehrsitz, & Semeijn, 2013). From this viewpoint, it is evident that environmental goals can only be reached when suppliers are involved and are dedicated to greening their processes as well, as suppliers may play a significant role in design, operation and production processes of the maritime organization. For example, productivity can be improved, and wastes can be reduced along the maritime chain via GSIP through the integrative flow of information. This implies that maritime supply chain companies via GSIP should perceive, anticipate and act timely on stakeholder requirements through effective collaboration and information flow between them. Essentially these stakeholders extend to key decision makers along the entire supply chain. A key decision maker is that of shippers and hence, GSIP is crucial in that they set the broad overtone for the effective flow of information and operational processes.

2.5.3.1 Performance Measurement as Mediator and Dependent Variable

From performance measurement viewpoint, balancing economic and environmental performance has become increasingly important for organizations facing competitive, regulatory, and community pressures (Guide and Van Wassenhove, 2009). There is a mounting body of preceding studies have discussed the GSCM and performance measure in the supply chain (Mumtaz, Ali, & Petrillo, 2018; Pourjavad & Shahin, 2018). The most emphasis, has been on investigating the relationship between GSCM/environmental factors and environmental and organizational performance (Feng et al., 2018a; Tuni, Rentizelas, & Duffy, 2018) as well as financial performance (Hazen, Cegielski, Hanna, & Hanna, 2012; Kannan, Beatriz, Sousa, José, & Jabbour, 2014; Laosirihongthong & Tan, 2013; Lirn, Lin, & Shang, 2013; Shaw, 2013; Wang & Sarkis, 2013; Zhu, 2012).

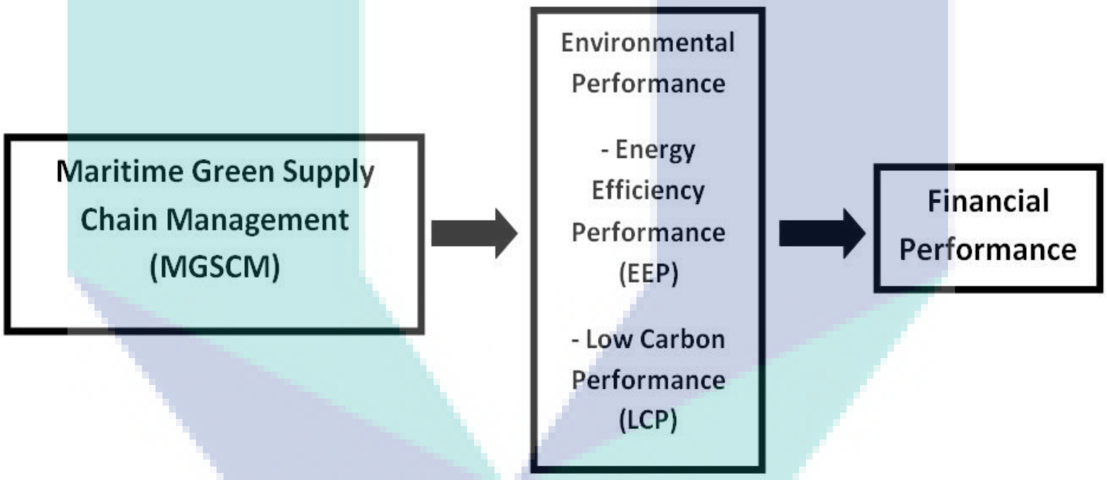

Figure 2.14 Performance measurement linkage with MSCM

Conceptualizing performance measurement in literature, performance measurement in this study (see Figure 2.14) is divided into two which is environmental and financial performance. Financial performance is chosen because it is a primary organizational goal in the maritime industry. According to Bang, Kang and Martin (2012), shipping companies always strive to achieve high levels of operational and financial efficiencies for survival. Achieving higher financial performance reflect the organization ability to enhance cost efficiency which in return translates into lower cost of shipment and operation to the end customers. Due to cost-intensive nature of maritime industry and volatile rate of fuel resources (shipping operations depend on fuel price for the cost of operation), maritime shipping companies strive to accomplish higher levels of operational and financial efficiencies for survival (Bang et al., 2012). Thus, conceptualization and adoption of MGSCM have to be economically viable, cost-effective and, in particular, possess the capability to increase profitability in the long run (Lam, 2014). Based on the literature review (later in the next section), this study postulates that MSCM can become a strategic capability of the maritime companies to achieve the economic gain in the long term.

Nevertheless, achieving financial performance alone is insufficient for long-term sustainability. Business organizations that characterized by higher environmental awareness are pursuing their supply chain partners to attain eco-efficiency in delivering effective services as well (Lee & Lam, 2012) to lower the cost of shipment and increase efficiency. Green shipping practices (GSPs) and MGSCM concept in this study are a great example of environmental management practices undertaken by shipping companies with an emphasis on waste reduction and resource preservation in handling and distributing cargoes (Lai et al. 2013) to achieve an environmental solution. Implementing GSP and MGSCM requires internal functional coordination within the shipping company as well as external integration with upstream shippers and downstream consignees in the physical cargo movement process to ensure efficient flow of maritime operation.

Hence, this study postulates that the concept of implementing MGSCM in maritime supply chains can lead to environmental performance successions such as energy efficiency performance (EEP) and low carbon performance (LCP) in this study. Yin, Fan, Yang and Li (2014) have noted that slow steaming practiced by liners contributes to both bunker cost savings and environmental protection via energy efficiency and low carbon operation. In a broader sense, Lirn et al. (2014) also found that green capability improves not only maritime supply chain environmental performance but also their financial performance. Based on this view this study suggests that there is a mediating linkage between MGSCM and financial performance relationship and thus conceptualize EEP and LCP as a mediator in this study as suggested in Figure 2.15 below. However, for further understanding, additional exploration of performance EEP and LCP as mediator variable as well as financial performance as the dependent variable have been discussed in depth in the next section of this study.

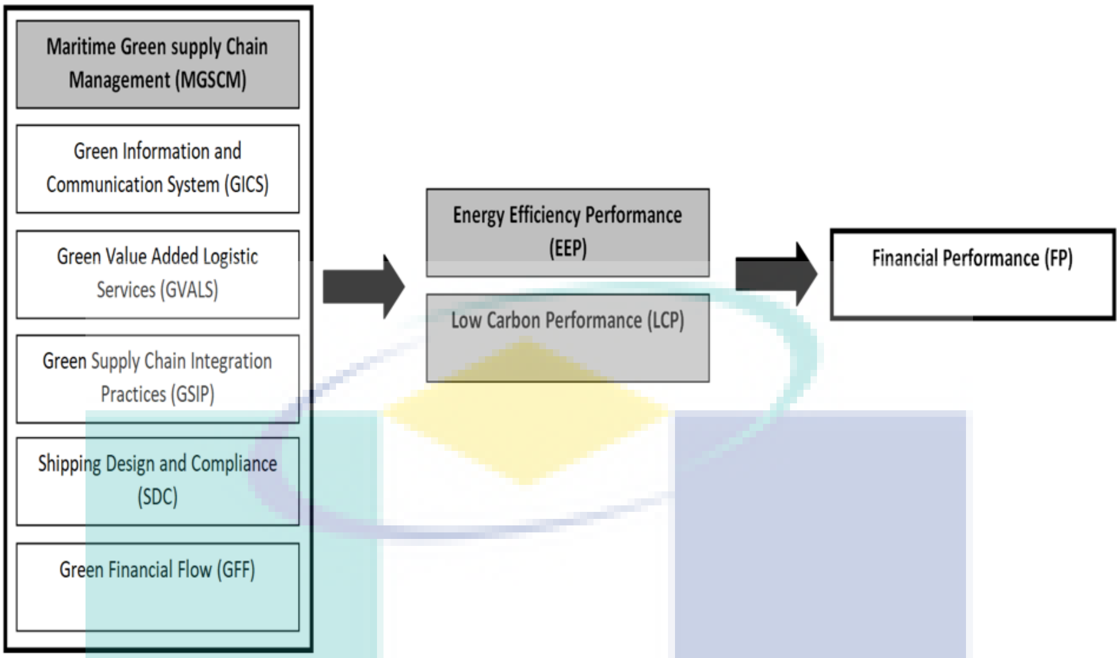

Figure 2.15 Research conceptual framework (simplified)

Source: Drawn by author

2.6 MGSCM as The Novel Concept in Maritime

In this section, this study has emphasized five (5) sustainability MGSCM dimensions. In this regard, the study further conceptualized in depth 5 elements that lead toward MGSCM namely green information and communication system (GICS), green value added logistic services (GVALS), green supply chain integration practices (GSIP), shipping design and compliance (SDC) as well as green financial flow (GFF) paradigm. In order to support the proposed framework constructed regarding MGSCM items, the study emphasized each item of MGSCM dimension comprehensively based on the understanding of conventional SCM, GSCM as well as related maritime literature respectively. Each dimension of variables in this study has been conceptualized based on the framework's order in accordance with each interlink relationship to develop hypotheses assumption for data analysis in chapter 4.

2.6.1 Green Information and Communication System (GICS)

In the era of globalization, it is inevitable that corporate spanning, culture and national boundaries have become shrinking due to the ever-increasing technology advancement. The advantage of the current information system has helped the organizations make great resource planning for added competitive advantage (Cao, Duan,

& Cadden, 2019). Green et al. (2012) suggest that the survival of supply chains entirely depends on the creation and maintenance of information technology (IT) in managing the smooth flow of the supply chain process and operation. Due to this reason, many researchers and practitioners have been paying more attention to the role of IT in sustainability. However, the role of IT in sustainability is not clearly defined. Recent conceptualization of ‘‘green IT" or GICS has primarily aimed at reducing carbon footprints via reductions in energy consumption of companies' technical IT infrastructure (Yang, Sun, Zhang, & Wang, 2019). Other research has started to realize the substantial contribution of IT towards sustainability beyond energy consumption reduction. For example, recent research has started to recognize the potential of IT in improving firms' operational processes towards more sustainable objectives (Aydiner, Tatoglu, Bayraktar, Zaim, & Delen, 2019; Cao et al., 2019; Yang et al., 2019).

This study defines GICS as the systematic application of sustainability in various processes of IT and communication management in order to reduce related emissions and to improve energy efficiency. The motives behind GICS practices include reducing the use of hazardous materials, maximizing energy efficiency during the product's lifetime and promoting the biodegradability of unused and outdated products. Additionally, GICS can be seen as a part of the system that supporting the critical processes in supply chains management, that include sourcing of resources, procurement planning, and order fulfilment (Aloysius, Hoehle, Goodarzi, & Venkatesh, 2018; Melián-González & Bulchand-Gidumal, 2016; Prajogo, Toy, Bhattacharya, Oke, & Cheng, 2018). The benefit of implementing the GICS helps the organizations to synchronize supply chain process and close collaboration with partners through the integration of data related to the production schedules, managing item in inventory, demand forecasting, as well as managing the production quality (Li et al., 2009).

MGSCM can only become a strategic sustainability capability for the organization if it could simultaneously monitor manufacturing, purchasing and selling process collectively together. From the perspective of global marketing strategy, Zou and Cavusgil (2002) distinguished that one of the seven dimensions of global marketing strategy includes synchronization, incorporation, and integration of business activities and processes across borders convey the most significant contribution to financial and operational performance. The impetus of his research, thus supports that IT and communication flow is vital to catalyst businesses performance. This increase performance can be achieved via IT utilization which enhances a smooth stream of operation process, efficient supply chain management system as well as effective operational activities; and in return provide long term advantage over the traditional way of doing businesses. The importance of GICS not only act as the "bridge" to connect and enhance the "smoothness" of collective component in green supply chain flow, but also it can be used to improve the commitment and trust among supply chain partners (Hashim & Tan, 2015; Mao, Liu, Zhang, & Deng, 2016).

While in maritime supply chain context, GICS can be conceptualized as being energy efficient and ecologically-sustainable information system, computers, network and telecommunications hardware (Rahim & Rahman, 2013) that react as an instrument to “control, steer, and communicate the success” towards achieving environmental sustainability (Schmidt, Erek, Kolbe, & Zarnekow, 2010). From just in time (JIT) perspective, effective GICS can maintain the efficiency of information flow and transfer amongst maritime partners in term of integrated JIT schedules and set up the effective and valuable information links that help to reduce the shipment discrepancies time (Gillespie, Howells, Williams, & Thwaites, 2018; Wang, Gong, & Wang, 2017). The advantages of this system would provide the maritime organizations with well management mechanism of storing, accessing, sharing as well as analysing the information needed in real time. In that sense, GICS can become management aspects for controlling and monitoring the effectiveness of implemented measures of organizational capabilities, processes and marketing strategies by which it can communicate successful outcomes to achieve increase business performance.

2.6.1.1 The Relationship Between Green Information and Communication System (GICS) and Financial Performance (FP)

In general, information and communication systems have been the most significant organization capability for catalysing productivity improvement (Pierce, Snow, & McAfee, 2015). Adoption of GICS primarily involves the successful and effective use of information technology, as organizations that can successfully adopt IT are able to integrate technology with people and processes flow of supply chain operation (Beloglazov, Banerjee, Hartman, & Buyya, 2015). At the organizational level, adoption of GICS can bring various advantages to supply chain operation such as reduced energy consumption, overall cost reduction and revenue growth (Nishant, Teo, & Goh, 2013). A few prior studies reported that the quality of information and communication sharing has significant influences on the performance of supply chains (Yeniyurt, Wu, Kim, & Cavusgil, 2019). In this regard, GICS could be organizational capabilities to improve supply chain activities. From green concept viewpoint, GICS capable of supplying the information needed to make decisions about green purchasing, the level of cooperation and collaboration with customers, the design of the product, as well as investment recovery to ease the flow of supply chain efficiency. Whereas, the low quality of information system, could potentially present inaccurate and delayed information, hurts the performance of the members in the supply chain because of information asymmetries (Munasinghe et al., 2019). In this regard, changes made on green capabilities in the organization as a result of GICS will impact the ability to implement green supply chain practices which ultimately affect organizational performance. This, in turn, might affect the financial performance. Drawing upon NRBV to examine the relationship between GICS and financial performance, this study examines whether the extent of the adoption of GICS characterized by the adoption of several dimensions of sustainability (pollution prevention, product stewardship, clean technology, and sustainability vision) has a positive impact on financial dimensions of organizational performance. Based on this view, the maritime organization that has adopted GICS more comprehensively will positively impact different organization's functions of process flow and different drivers of costs and revenue (Li, Chow, Choi, & Chan, 2016). Consequently, the extent of adoption of GICS can be seen as a pollution prevention system that should have a positive relationship with profitability which in turn affects the financial performance.

H1.a. Green Information and Communication System (GICS) positively affect financial performance

2.6.1.2 The Relationship Between Green Information and Communication System (GICS) and Energy Efficiency Performance (EEP)

According to Bai et al. (2017), the successful implementation of the green practices depends on the capability of the organization's GICS to capture data electronically associated to the green efforts and outcomes of the organization's manufacturing, purchasing, selling, and logistics processes. The data and information flow can then, be analysed to generate the information necessary to make decisions that lead to improved environmental and organizational improvement throughout the supply chain (Fernando, Chiappetta Jabbour, & Wah, 2019) which translated into efficiency and cost-saving energy. In this sense, GICS acts as a supply chain process of decision making and passing the green information flow internally and externally to improve efficiency using real-time information among supply chain player. From another perspective, Lun, Lai, Wong and Cheng (2013), deposited that GICS could be translated into shipping documentation practices that diminish the used of conventional practices by using paper-less transaction data flow to handle maritime supply chain operation. Handling the information flow and data through GICS electronically provide an environmentally friendly solution of information handling and increase energy efficiency performance in the supply chain system. According to Watson et al. (2010), information system and technology such as GICS will focus on how information systems can be used to decrease energy consumption, and it will contribute practical solutions to advance environmental sustainability. While from the theoretical perspective of NRBV, sustainable development is dependent upon the organization's capability in pollution prevention and product stewardship. Based on the aspect of pollution prevention in NRBV, this capability can also be applied in the context of the use of GICS in reducing the environmental impact of operations. This capability creates provisions for information and communication systems that enable indirect improvement of sustainability outcomes across the extended operation of the maritime supply chain that may also translate into the enhancement of energy efficiency performance.

H2.1.a. Green Information and Communication System (GICS) positively affect energy efficiency performance (EEP)

2.6.1.3 The Relationship Between Green Information and Communication System (GICS) and Low Carbon Performance (LCP)

Monitoring, communication, and control system can be professed as an instrument for achieving the integration of sustainability practices throughout the supply chain and achieving significant performance related to the environment. In maritime supply chain context, such control system as GICS is concerned with the documents involved in a maritime operation such as booking request, booking confirmation, shipping instructions, invoice, and remittance advice (Hervás-Peralta, Poveda-Reyes, Molero, Santarremigia, & Pastor-Ferrando, 2019). To reduce the use of paper and simplify the shipping processes in achieving LCP, Lai et al. (2011) posited that GICS can automatically coordinate and integrate the sharing information of data across its customers and business partners while at the same time cutting down paperwork, reducing processing speed, and decreasing the possibility of errors by transferring data without manual intervention in maritime supply chain operational process. In this regard, GICS reduces the needs for physical transportation of delivering documentation that may lead towards improve LCP by reducing carbon emission release by regular transport system. Green Jr, Zelbst, Bhadauria, & Meacham (2012) noted that, while the establishment of environmental management systems such as GICS does not necessarily enhance substantial environmental performance, such systems unintentionally focus upon creation the documentation of policies and procedures needed related to the environmental sustainability. From the establishment of GICS documentation and procedures, GICS can be included as the mechanisms to establish real-time environmental monitoring to achieve significant LCP. Aligning with NRBV viewpoint; this study postulates that GICS can act as strategic capabilities in achieving LCP through efficient use of information technology without the need of a conventional process of paper documentation for effective maritime supply chain operation to achieve lower carbon emission.

H2.2.a. Green Information and Communication System (GICS) positively affect low carbon performance (LCP)

2.6.2 Green Value Added Logistic Service (GVALS)

Logistics comprises the entire information flows, and material flows all the way through an organizational process as well as it takes account of all the things from the movement of a product, the management of inward raw materials, product life cycle, the stock up of finished goods, the delivery to ends consumer as well after-sales services (Imran, Hamid, Binti Aziz, & Hameed, 2019). In recent years, the concept and scope of logistical dimension have vastly changed given that the appearance of the new advanced technological solution, sustainability agenda as well as strategic association and partnership in order to enhance an organization's responsiveness and added competitive advantage. The rising significance of logistical from maritime organization perspective is due to increasing awareness of organization to become global player and expand access to new markets, to enhance production efficiencies, and to increase technological competencies and solution beyond geographical barrier and market's environment (Konstantinus, Zuidgeest, Christodoulou, Raza, & Woxenius, 2019). In this sense, maritime organizations are seeking ways to improve their performance capacities and increase their competitive advantage by generating value creation strategies and services to increase their service quality. In this context, this process of value added can be associated with value creation dimension as being discussed by numerous works of literature.

The word ‘value' or ‘added-value' is frequently used in the context of customer products or goods and has different explanation and meaning according to the academic background and research context. As such, in retailing and marketing point of view, Dowell, Garrod and Turner (2019) has described perceived value as ‘the consumer's general evaluation and appraisal of the value or ‘worth' of a product or service in accordance of distinguish perceptions of what is received and what is given' and explained how ‘value symbolize a substitution of the relevant give and get components'. In this sense, Sweeney and Soutar (2001) have illustrated "value" as consist of various dimensions of emotional element, social and functional value. Further, as mentioned by Lin et al. (2005) there are several notions of value, but they have concluded that value includes numerous elements of ‘give-get' components and could be deliberately measured in terms of those components rather than being a single element which can be directly measured. Furthermore, Cockton (2004) defined the term ‘value' to explain what is valuable for end users, and shortly as a ‘unifying and combining conception for design' to increase value. In this respect, added value can also be associated with value creation analogy as "creating value" to enhance the services or products. According to Andreassen et al. (2016), in the conventional conception of value creation, the customer usually located "outside the organizations" which in other sense, value creation took place inside the organizations (within its internal activities) and outside their respective market. Thus, the concept of value-added and creation can be associated with the epitome of "value chain" that becomes the unilateral role of the organization in creating respective value (Porter, 1980).

Thus, based on the earlier definition of "value" the GVALS could be identified as the environmental element added to those logistic activities to enhance the service's value in term of logistical and maritime perspective. Hence this conception of GVALS can be understood based on Rodriguez (2001), as a logistical system or service compatible with the environment to create an environment-friendly and to increase efficient logistics flow system. From a broader perspective, GVALS can be considered as a conventional component of GSCM that intend at mixing environmental philosophy into the conventional supply chain and logistics management. For this reason, GVALS can also be associated with product design (in production phase), supplier assortment and selection as well as material sourcing, inbound and outbound shipping, manufacturing processes, waste reduction control, product wrapping and packaging, distribution to end customers, and reuse and end-of-life product returns for recycling (Fernando, Jasmi, et al., 2018).

Further, as all logistics conducts and activities influence the environment in one way or the other indirectly, activities in some areas tend to cause outsized impacts on environmental performance and the approval of GVALS in organization would convey comparatively better payback advantages in the future (Sarkis, Bai, Jabbour, Jabbour, & Sobreiro, 2016). As such, using green materials in the production or recycled parts in remanufacturing not only decrease the undesirable consequence on the environment but in the long run could also trim down the manufacturing cost respectively (Ahmed et al., 2018). Likewise, the employment of green and recycled packaging materials, simultaneously with enhanced packaging designs and techniques, could largely diminish packaging waste and cost associated using the conventional method (Crumrine et al., 2004). Nevertheless, as logistic activities mainly involved on the needs of using transportation for shipping product, GVALS also extent towards optimization of supply chain processes, and consolidation of orders, schedules as well as routes taken to reduce the delivery frequency and ultimately give value added service in term of lowering the fuel consumption (Lee, Chang, Lai, Lun, & Cheng, 2018) which may reduce the cost of shipping to customers. Ultimately the maritime organization could also implement the GVALS by extending the scope towards the employment of fuel-efficient transportations as well as alternative energy sources to decrease the greenhouse gas emission production (European Commission, 2001). In this context, to integrate the maritime green supply chain management (MGSCM) context between logistics concept and GSCM, previous learning on environmental management should be taken as primarily focused on maritime supply chain management practice (Lai & Wong, 2012), that involved closed-loop supply chain (Wong et al., 2012; Zhu et al., 2008), as well as the concept of reverse logistics (Kocabasoglu et al., 2007). Hence, as this study extends the conception of GSCM; GVALS in literature could also be extended toward the MGSCM practice.

2.6.2.1 The Relationship Between Green Value Added Logistic Service (GVALS) and Financial Performance (FP)

In recent years, there has been a growing interest within the field of innovation studies related to environmental issues and the concept of green innovation and capability (Pujari et al., 2004; Pujari, 2006; Carrillo-Hermosilla et al., 2010; Dangelico & Pujari, 2010; Del Río et al., 2010; Lin et al., 2013) that similar to GVALS. In this sense GVALS can be seen from the perspective of eco-innovations; intentional solutions that are designed to reduce the environmental impact of production, consumption and disposal activities, even if the underlying motive or intention is to reap the benefits of addressing environmental concerns (Jabbour, Neto, Gobbo, Ribeiro, & Jabbour, 2014). Eco-innovation is a relative term that refers to product innovations that differ from conventional product innovations in that they contribute to the reduction or prevention of environmental damage more than conventional products (de Jesus & Mendonça, 2018) and increase financial benefit through cost saving. On the theoretical note on NRBV, an ability to envision sustainable technologies, process flow and production can lead to an organization's competitive advantage in the market. Further elaboration of the NRBV highlighted the links between effective environmental strategies, green capabilities, and competitiveness at an organizational level (Hart, 2005; Hart & Dowell, 2011). As a part of a sustainable development strategy, GVALS can be viewed as the cultivation of distinctive, long-term focused of green capabilities that may enhance not only environmental performance but also organizational performance. Organizational performance in this sense can be a financial performance; that translates into enhancement of profitability of an organization. Extending this view, this study postulates that GVALS may positively influence the financial performance of the maritime organization.

H1.b. Green Value added Logistic Services (GVALS) positively affect financial performance

2.6.2.2 The Relationship Between Green Value Added Logistic Service (GVALS) and Energy Efficiency Performance (EEP)

According to the NRBV, which advocates the importance of organizational capability in building environmentally friendly procedures and operations to prevent pollution (Hart & Dowell, 2011), GVALS is an integral part of pollution control and product stewardship for maritime shipping organizations. In this regards, prior studies have identified the importance of eco-design and green technologies as well as process system in creating value chain, which will contribute financial improvement as well as quality benefits to organizations (Wong, Lai, Shang, Lu, & Leung, 2012). A reduction in environmental damage focusing in energy usage is also found to be an important capability for greening the value chain in the service sector such as retailing and construction industry (Lai, Cheng, & Tang, 2010). Following this logic, GVALS in the shipping context helps to control and prevent emissions and reduce energy usage via compliance with environmental and energy regulations for performance gains (Lai, Wong, Lun, & Cheng, 2013). GVALS in this sense forms an operational basis that facilitates environmental management in shipping activities. The aspects of compliance involve energy saving, shipping equipment reuse, recycling, and recovery, and targeting the operation of creating a value chain to mitigate environmental damages due to shipping activities. GVALS improves financial performance by reducing operating costs in new energy-saving shipping equipment and related green materials usage as well as achieving energy efficiency performance.

H2.1.b. Green Value added Logistic Services (GVALS) positively affect energy efficiency performance (EEP)

2.6.2.3 The Relationship Between Green Value Added Logistic Service (GVALS) and Low Carbon Performance (LCP)

In the low carbon supply chain, organizations that conduct environmental practices within themselves such as green packaging, low carbon design, and low carbon manufacturing could help produce environmentally-friendly products and reduce pollution as well as increase resource utilization rate during production processes, thus increasing environmental performance (Cai & Li, 2018). For examples, the use of green packaging and green equipment for preventing products getting damaged can have a significant impact on the amount of solid waste going to landfill and its adverse impact on the environment. Taking from this perspective, GVALS which concerned on the integration of green practices and with the use of environmentally friendly shipping equipment and facilities can achieve value-added service that enhances the LCP. For example, the container is the most crucial equipment in container shipping context. Many refrigerated containers use chlorofluorocarbon (CFC), which has been blamed for contributing to the deterioration of the protective ozone layer. To eliminate the emission of ozone-depleting substances, GVALS adoption such as abandonment the use of CFC and replaced it with more environmentally friendly types of refrigerants may lead to lower CO_2 release that translates into low carbon performance. This activity can be categorized from the NRBV viewpoint as a preventive solution (pollution prevention dimension) of environmental degradation and organization capability to gain competitive advantage.

H2.2.b. Green Value Added Logistic Service (GVALS) positively affects low carbon performance (LCP)

2.6.3 Green Supply Chain Integration Practices (GSIP)

Supply chain integration concept is one of the most significant factors in business competencies in supply chain management. It is being extensively discussed in literature review by most prolific researchers such as (Braunscheidel & Suresh, 2009; Flynn, Huo, & Zhao, 2010; Frohlich & Westbrook, 2001; Narasimhan & Kim, 2002; Swink, Narasimhan, & Wang, 2007; Vickery, Jayaram, & Droge, 2003). Over the last several decades, integration in conventional supply chain management (SCM) has been discussed widely where integration is needed for smooth coordination of business processes and strategy arrangement in the supply chain to attain customer satisfaction (Woo, Kim, Chung, & Rho, 2016a). The substance of integration concept in the supply chain can be traced back to Porter (1980, 1985), which he deposited that the theoretical groundwork for supply chain integration can be traced back to the basic value chain model. In this regard, he concluded and conceptualized the idea of linkages and relationship between customer and supplier as well as emphasizing how the optimization of this vertical relationship will develop a better supply chain integration and in return stimulate superior performance to the firms.

For that reason, "integration" itself can be acknowledged as a diversity process of supply chain activities and operation that work collectively. Whereas supply chain integration in SCM can be distinct as the extent to which an organization can collaborate with each other with its supply chain partners and jointly manage the interaction needed intra-organizationally or inter-organizationally processes efficiently to pass significance value to the end customer (Thanki & Thakkar, 2018). While Yang, Lu, Haider and Marlow (2013) deposited supply chain integration as ‘‘the degree to which an organization strategically collaborates and integrates with its supply chain partners through intra and inter-organization processes to accomplish effective and efficient flows of products, services, information, money, and decisions, with the intention of providing maximum value to its customers. Many works of literature also defined the integration of SCM in the business processes can be in term of coordination of purchasing, manufacturing, marketing, logistics, and information systems between partners to ease the flow of supply chain system (Green, Zelbst, Meacham, & Bhadauria, 2012).

As environmental sustainability becomes predominantly important, it is essential for an organization to classify and implement green supply chain integration practices (GSIP) and processes that increased competitive advantage at the SCM level which, in turn, enhanced performance for the individual supply chain partners in regard of the final customers shifting demands. Linton et al. (2007) have emphasized that the focus of green management and agenda nowadays should be shifted from the organizational level to the supply chain level for competitive advantage. Looking at GSIP perspective, many researchers pointed out that when environmental sustainability is considered, it is rather imperative for sustainability practices to be integrated into SCM among partners rather than to be integrated as an organizational solution (Vachon & Klassen, 2006, 2007; Vasileiou & Morris, 2006). GSIP implementation throughout the value chain process can enhance the value creation for the organization (Woo et al., 2016a). Moreover, Neutzling, Land, Seuring and Nascimento (2018) added that green integration process in GSCM such as environmentally friendly processes, products, and services should involve a collaboration and unification efforts by the entire component members of the supply chain to avoid sub-optimization at the partner level. Several studies have also characterized integration as a combination of interdepartmental interaction and collaboration behaviours (Chin, Tat, & Sulaiman, 2015). The distinction between the two perspectives is that interaction activities tend to be mandatory, formal, and somewhat physical, whereas collaboration is a deliberate process that cannot be mandated, programmed, or formalized (intangible) (Ellinger et al., 2000). In this sense, many researchers in GSCM classified GSIP by two distinctive organizational integration; internal integration and external integration.

From this study perspective, MGSCM should involve the integration of internal functions, as well as the integration with customers and suppliers (external integration). In the maritime industry, internal green integration could be defined as an integrative process, effected by green policy, management, and other personnel, designed to provide environmental-friendly transportation assurance regarding eco-friendly tech vessel, passed the achievement of pollutant reduction and complied with international environmental conventions to satisfy customer's requirements (Mansouri, Lee, & Aluko, 2015b). Internal integration recognizes that different functions within a firm should not act as functional silos, but instead as part of an integrated process. Accordingly, maritime companies' internal green practices and integration involve green policy (i.e. clear environmental policy statement, staff commit to and support for environmental initiative, and cross-functional cooperation for environmental preservation), green shipping (i.e. comply with ISO 14,000 series, improved engine design, waste heat recovery systems, double skin, internal oil tank, non-toxic paint, electric deck machine, ballast water handling system, clean-burning engines, and low-sulphur fuels), and green marketing (i.e. providing customers with environmental-friendly service information, spending more budget on green advertising, adopting resource and energy conservation arguments in marketing, attracting customers with green initiatives and eco-services, and updating of company website on environmental issues) working together across different functions in environmental process improvement. External integration refers to the degree to which a firm can partner with its key supply chain members (customers, partners, and suppliers) to structure their inter-organizational strategies, practices, procedures, and behaviours into collaborative, synchronized and manageable processes in order to fulfil customer requirements (Chen, Paulraj, & Lado, 2004; Stank & Keller, 2001).

In the context of MGSCM, although the widely recognized importance of conceptualizing integration as internal parts within a logistics and SCM structure, experimental work on the integration of maritime green supply chains has been minimal. In reality, Bichou and Gray (2004, p. 50) assured that "much of the literature advocating the future of ports as logistics centre […] overlooks logistics integration of the various activities performed". There are not many works of literature that emphasized the GSCM features being integrated into the maritime supply chain. Additionally, in order to address this critical issue, it is imperative to evaluate the current literature that deals with logistics and supply chain integration which may provide useful insight into the limitation of the works in this context of "integration" (Song & Panayides, 2008). Therefore, it is important to conclude that GSIP is the combination of green components in the supply chain framework. By viewing maritime supply chain from the perspective of an integrated element in the global supply chain, the value propositions "green elements" can be integrated into the maritime supply chain system so that the mergers of green practices can be synergized with collective components of shipping lines, shippers and third-party service providers (maritime stakeholders) through GSIP.

2.6.3.1 The Relationship Between Green Supply Chain Integration Practices (GSIP) and Financial Performance (FP)

SCM enhances competitive performance by tightly integrating internal organizational functions and effectively linking them with the external operations of suppliers, customers, and other channel members (Liao & Kuo, 2014). In this respect, many literatures have underlined the significance contribution of integration supply chain process, particularly with value to the positive performance outcomes (Frohlich and Westbrook, 2001; Hines et al., 1998; Johnson, 1999; Lee et al., 1997; Metters, 1997; Narasimhan & Jayaram, 1998; Stevens, 1989). In this regard, Mentzer et al. (2000) proposed that most organizations have the same integration goal which could be meant in term of increasing organizational profit or competitive advantage. Integration in this sense should involve extensive and long periods of joint activities and mutual goals. Ellinger et al. (2000) suggested that a higher level of supply chain integration may lead to greater business-partner independence and understanding. This may increase intangible competitive advantage such as financial performance in the long term. This view is aligning with the NRBV theory that includes the natural environment in the RBV viewpoint for sustainable development. According to the RBV, organizations have to acquire resources that are valuable, unique, inimitable and rare, and that have few substitutes for achieving competitive advantage (Grant, 1996). Considering the integration of green supply chain members through GSIP, which is complex and difficult for competitors to replicate, it may improve environmental performance and organizational competitiveness which translates into enhancing financial performance (Vachon & Klassen, 2008; Woo et al., 2016).

H1.c. Green Supply Chain Integration Practices (GSIP) positively affects financial performance (FP)

2.6.3.2 The Relationship Between Green Supply Chain Integration Practices (GSIP) and Energy Efficiency Performance (EEP)

According to Wuisan et al. (2012), if cargo owners have a green management policy and constantly choose freight services provided by maritime shipping companies with a high-ranking clean shipping index via green supply chain integration practice (GSIP), these maritime shipping companies will improve their fleet's green performance to gain a competitive advantage. This creates incentives for shipping companies to invest in pollution control equipment and measures to have greener ships in their fleet. GSIP activities such as a coordination of green practices and processes (e.g., green distribution and production, green resources, green manufacturing, green procurement, and monitoring) system may contribute organizational performance that includes energy efficiency. In MGSCM's viewpoint of integrative process; GSIP effected by green policy, management and other personnel, designed to provide environmental-friendly transportation assurance between partners regarding eco-friendly tech vessel, passed the achievement of pollutant reduction and complied with international environmental conventions to satisfy customer's requirements provide the necessary step in enhancing supply chain effectiveness and cost efficiency. The cost-saving nature and efficiency of GSIP and environmental performance should lead to improved economic performance, and both environmental performance and economic performance should yield improve operational efficiency (Green et al., 2012) which can be translated into EEP. However, if the implementation of GSIP is not appropriately done by the business organization, it may hamper the desired outcome of competitive advantage in term of EEP. For that reason, transaction cost researchers have for example argued that in the absence of strict monitoring in collaboration, partners or agents will always underperform (Hannes Johnson et al., 2014b).

Similarly, markets for goods or services where information is distributed asymmetrically and lack of integration, it will see the quality of goods and services deteriorated (Yang, 2018). In this sense, energy efficiency performance can be considered as the organizational outcome if the required information such as integration between partners is conducted thoroughly. From the NRBV viewpoint, GSIP can be viewed as the concrete actions of pollution prevention strategies (Wu, 2013) in maritime context. As GSIP involves tacit skill development, mutual collaboration and experiential learning among partners (Hart, 1995) which is unique to an organization, based on NRBV, this study postulates that GSIP may also influence environmental dimension of EEP in achieving long term competitiveness.

H2.1.c. Green Supply Chain Integration Practices (GSIP) positively affects energy efficiency performance (EEP))

2.6.3.3 The Relationship Between Green Supply Chain Integration Practices (GSIP) and Low Carbon Performance (LCP)

Internal and external integration is pertinent to supporting sustainability practices and operation in the supply chain (Susanty, Sari, Rinawati, & Setiawan, 2019). For this reason, the insertion of GSIP can be seen as conventional integration in SCM that may be accountable for providing the necessary knowledge on green management issues and practices to all employees (Jabbour & Jabbour, 2014) and supply chain partners. Other GSCM scholars have studied that GSIP can develop organizational performance through optimizing internal production process and collaborating intra-departments (Carballo-Penela, Mateo-Mantecón, Alvarez, & Castromán-Diz, 2018). In this regards, GSIP adoption with upstream suppliers and down-stream customers has been found useful for organizations to reap performance gains (Vachon & Klassen, 2008; Yang et al., 2009b; Zhu et al., 2010), especially in an environmental performance context. These collaborative activities of the GSIP span shared environmental goal setting, shared environmental planning, as well as working together to reduce pollution or other environmental impacts (such as LCP). In the maritime context, there is also increasing evidence that adopting GSIP can improve LCP (Lai et al., 2011). GSIP on environmental objectives (such as working with customers and suppliers on eco-design in cargo handling and shipments, involving customers and suppliers in cleaner delivery such as enforcement of programs for recycling, vehicle idling, packing waste collection, and using green packing materials) can become a strategic solution to achieve LCP. On the other note, NRBV argues that environmental management such as GSIP helps improve capabilities, thus promotes organizational and environmental performances. Extending from this view, the growing implementation of ISM code and EMS ISO 14000 standards among organizations have also become a part of GSIP dimension to pursue environmental management systems and practices intending to enhancing the LCP (Celik, 2009) and sustainable competitiveness. Furthermore, with the implementation of EEDI and SEEMP by IMO that require integration amongst maritime players, aiming to reduce CO_2 emission, this study postulates GSIP will positively affect LCP.

H2.2.c. Green Supply Chain Integration Practices (GSIP) positively affects low carbon performance (LCP)

2.6.4 Shipping Design and Compliance (SDC)

According to Lai, Wong, Lun and Cheng (2013), there are numerous numbers of shipping organizations implemented green shipping initiatives that accentuated environmental management in their supply chain operations. Furthermore, they also emphasized that one of the methods of balancing organization's productivity with the environment is through the designation of shipping practices in conformity with the energy reduction as well as resources preservation policies by IMO. In this regard, the awareness of green adoption from shipping companies is resulting from growing attention of public community (i.e., NGOs and governmental authorities) on the connection involving transportation impact towards environmental pollution of CO_2 emission. Concerning on CO_2 emissions, several researchers have established a transportation cost modelling to resolve whether to transport or manufacture domestically from Korea to provide and supply the automotive supply chains in the United States and European markets (Nieuwenhuis, Beresford, & Choi, 2012). Inevitably, the result demonstrates that the local option is better than seaborne outsourcing from the home country for lower emission production (Lai et al., 2013). Besides the shipping emission conformation concerns, fuel usage is also becoming a central challenge for the maritime shipping industry to deal with (Qi & Song, 2012).

In this section, the study revealed that in order to achieve a sustainable maritime supply chain as well as addressing environmental problems associating with shipping activities, the problems could be mitigate using proper shipping design and compliance. From the compliance perspective based on European Commission (2012) report, IMO has prepared a joint statement on emission from shipping on 1st October 2012 that briefly emphasized on global solution to mitigate environmental problem by developing a system to monitor, report, and to validate emissions production by 2013. Further, Energy Efficiency Design Index (EEDI) has also been outlined by the IMO for adoption to new and latest ships from the year 2015 onwards aiming to substantially lessen their emissions production. Nevertheless, the EEDI functioned as a technical measurement with the primary objective of encouraging the utilization of efficient energy and less polluting equipment as well as the more environmentally engines in designation and production phase. Additionally, according to Lai et al. (2013), for reducing the production of CO_2 emission and the use of fuel consumption, the IMO has also outlined the Ship Energy Efficiency Management Plan (SEEMP) as a method for shipping organization to improve in the fleet's efficiency and performance management. In this regards the ship owners and operators are obligated to consider the new technological solution and practices to be implemented in shipping fleets to improve their benchmarking under SEEMP criteria.

In the perspective of environmental-based shipping studies, prior studies are limited to the underline issues of green technologies adoption to recover the ecological efficiency of ships (Viana et al., 2009). Many researchers have also elaborated on the utilization of biofuels as an alternative solution in shipping activities (Bengtsson et al., 2012). Hence, to moderate the shipping emission, (Chang, 2012) has deliberately focused on energy efficiency enhancement in designing the fleet's engines and hulls. In this respect, the study concludes that such compliance in SDC needs to include the requirements of energy efficiency shipping equipment design, the reuse of shipping equipment, the recycling and recovery system of waste, as well as requirement to reduce environmental damages in shipping activities.

2.6.4.1 The Relationship Between Shipping Design and Compliance (SDC) and Financial Performance (FP)

NRBV advocates the importance of organizational capability in building environmentally friendly procedures and operations to prevent pollution and environmental impact (Hart, 1995). In this regards, the design of shipping operations is an integral part of pollution control for shipping firms to achieve environmental and financial performance (Lai et al., 2013). Preceding studies identify the importance of eco-design and innovation may contribute financial as well as quality benefits to business organizations (Wong et al., 2012). In this sense, SDC can be classified as eco-innovation and design because it is focusing on enhancing efficiency in shipping technology that may bring financial benefit in the long term in maritime operation. Following this logic, SDC in the shipping context helps to control and prevent emissions and effluents in compliance with environmental regulations for performance gains (Lai et al., 2013). In general, SDC may improve financial performance by reducing operational costs in new energy-saving shipping equipment and related materials.

H1.d. Shipping Design and Compliance (SDC) positively affect financial performance (FP)

2.6.4.2 The Relationship Between Shipping Design and Compliance (SDC) and Energy Efficiency Performance (EEP)

SDC is valuable for improving operations efficiency through waste elimination in the shipping operation (Lee et al., 2018), increasing cost savings through reusing of shipping equipment and reducing redundant processes through effective waste management that will reduce the energy usage and increase the energy efficiency performance. Such enhancement in SDC using green technologies enable shipping firms to streamline processes for higher operational efficiency and effectiveness. As a key practice of MGSCM practices, SDC plays an important role to ensure resources conservation, minimizing the energy usage and acts as pollution prevention in shipping operations, facilitating the development of green supply chain. Drawing from NRBV perspective, the MGSCM practice of SDC allows shipping organizations to utilize resources better and prevent pollution, contributing to environmental protection (Lai et al., 2013) and at the same time achieving better energy efficiency performance in the long run.

H2.1.d. Shipping Design and Compliance (SDC) positively affect energy efficiency performance (EEP)

2.6.4.3 The Relationship Between Shipping Design and Compliance (SDC) and Low Carbon Performance (LCP)

The capability to decrease ship emissions of carbon dioxide through design measures has been estimated at around 50% (Strong, 2018). The ship design process and development consists of constant trade-offs between diverse requirements on design parameters (Winnes, Styhre, & Fridell, 2015). In this regards, high environmental performance is often associated with extra and expensive costs and new green technologies innovation are often opted out. However, emissions of climate gases are not necessarily part of the same trade-offs between environment and cost. Saving fuel, for example, is an effective measure to reduce both operational costs and emissions of GHGs in SDC. This vast potential can be realized only if the vessels are designed for relatively low speed, and then operate according to design specifications (International Maritime Organization, 2009). SDC plays a vital role to ensure resources conservation and pollution prevention in shipping operation, facilitating the development of effective green shipping chain and along the way contributed towards LCP (Lai et al., 2013). In this regard, this practice of SDC allows shipping organization to efficiently utilize limited resources and prevent pollution, contributing to environmental protection and low carbon emission. By doing so, SDC facilitates shipping organization and maritime supply chain to comply with environmental regulations while achieving LCP and environmental protection. As NRBV point of view advocates the importance of organizational capability in building environmentally friendly procedures and pollution prevention, SDC forms an operational basis that facilitates environmental management in shipping activities that comprises of compliance involving energy saving, low emission, shipping equipment reuse, recycling, and recovery, that is targeting to mitigate environmental damages (such as CO_2 emission) (Lai, Wong, Lun, & Cheng, 2013). Drawing from this argument, this study postulates SDC may indeed have a positive influence on LCP.

H2.2.d. Shipping Design and Compliance (SDC) positively affect low carbon performance (LCP)

2.6.5 Green Financial Flow (GFF)

The correlation between financial flows and supply chain is well thought-out as an inevitable strategic solution for organizations while improving their organizational performance. To achieve sustainable operation in the maritime context, Cheng, Farahani, Lai and Sarkis (2015) have considered the financial flow process as a part of achieving an environmental solution for the maritime organization. Further, Seuring and Muller (2008) suggest for the green strategy to be successful, material management and financial flow information, and the company's cooperation along the supply chain is vital to be addressed. This shows that financial flow management is imperative for effective implementation of MGSCM. Considering MGSCM is a part of multiple and complex business framework in the maritime supply chain as well as a combination of the relationship for improved environment criteria; intricate balance between financial flow and the operational process must be monitored carefully to prevent overspending on sustainable strategies that may hamper the growth of organization in the preliminary stage of adoption. Thus, adopting GFF can be a logical solution to prevent the situation and may help the organization to manage their resources better.

To further examine the GFF concept, this study attempts to describe it in term of green accounting and green procurement perspective as it associates with financial and procurement dimension. Green accounting can be defined as a type of accounting that try to factor ecological or green costs into the financial results of operations (Huang & Fu, 2019). In the maritime supply chain context, it includes the commitment from management level, identification, and monetary measurement to measure traditional private internal costs that directly affect the green bottom line of the balance sheet. In this sense, the cost would be the direct costs, such as raw materials and labours, which are attributed to a production items or department and indirect costs, or overheads, such as rent, administration, depreciation, fuel and power (Green et al., 2000). Above all, externalities factor such as social, operational, economic and environmental costs that impact the external environment of organization operation must also be considered in the green financial flow. While it is often ignored, their insertion as internal items in the organization's accounts could mean that limited resources are efficiently allocated.

GFF as MGSCM capabilities consists of incorporating monetary savings from new green technologies consequential in lowering pollution, attaining new markets and using alternative resources of raw materials or operation processes in the maritime supply chain system. GFF is also an essential part of corporate social responsibility (CSR) and can help to assist in improved decision making and triple bottom line profitability (Constantin, Topor, Căpușneanu, & Anica-Popa, 2019). The extent of GFF in term of applicability in maritime processes can be associated with production inputs and outputs. The core activities of GFF assessment in maritime operation must include life cycle costing analysis (LCA), accounting, inventory analysis, impact analysis, and environmental auditing or green improvement analysis (Balanay & Halog, 2019; Ninlawan et al., 2010; Joseph Sarkis, 1998) to enhance operational efficiency. From green accounting and LCA viewpoint, this study concluded that GFF in MGSCM would mean that investment decisions in managing supply chain are made by comparing the green practices adoption with the overall private and social costs against the private and social benefits. In this sense, via LCA assessment, maritime organizations can decide based on environmental impacts calculation at each stage of green technologies adoption and supply chain processes, from production, transhipment of goods and final disposal of product or equipment to achieve long term operational sustainability.

Consequently, determining GFF as MGSCM construct require the inclusion of all internal and external cost categories, such as health problems for workers (social dimension), emissions and pollution of air (environmental dimension), land or water (operational dimension), as well as degradation of the natural environment and depletion of finite resources (economic and environmental dimension). Further, all this dimension of internal and external advantages must also be measured and quantified using financial (monetary) measures. Maritime companies need to evaluate the costs of avoiding or averting environmental impact against the cost of corrective activities in their supply chain operation. Using a framework of green accounting, this study concluded that GFF in MGSCM would mean that investment decisions in adopting green technologies and managing supply chain are made by comparing the overall private and social costs against the private and social benefits.

2.6.5.1 The Relationship Between Green Financial Flow (GFF) and Financial Performance (FP)

GFF involves assessing the environmental impacts and green activities over the flow entire product life cycle, from extraction and procurement of raw materials through to manufacturing, distribution, use, and disposal (Lin, Jones, & Hsieh, 2001; Ninlawan et al., 2010). GFF examines the potential environmental aspects associated with production inputs and outputs. The core activities of GFF assessment include life cycle costing, inventory analysis, impact analysis, and environmental auditing or green improvement analysis throughout the supply chain (Balanay & Halog, 2019). GFF can assist the maritime organization in the way they do business by reducing transaction costs, preventing maverick buying, making better decisions on green initiatives and getting more value in delivering services. By implementing GFF, the financial performance of the company could be improved significantly. As the NRBV is an extension of RBV towards additional capabilities necessary to manage environmental constraints and gaining competitiveness via revenue outcome, GFF can be seen as core competitive advantage and green capabilities for product stewardship and management of pollution prevention activities that may enhance financial performance.

H1.e. Green Financial Flow (GFF) positively affects financial performance (FP)

2.6.5.2 The Relationship Between Green Financial Flow (GFF) and Energy Efficiency Performance (EEP)

Measurement of the organizational performance is a new challenge for most large business organizations which attempt to adopt sustainability management in their operation proactively. In a carbon-constrained world, GFF can be an enabler to achieve this sustainability aim. The inclusion of environment-related information into financial data, such as earnings and expenses for environment-related investments or environmental liability, can be described as green financial flow to attain sustainable performance. In this sense, GFF can act as organization capability and practice to measure and report environmental impacts on its operation through the accounting and procurement process of green adoption. According to Lee (2012), green management and accounting scholars have developed environmental management accounting (EMA) or GFF which may help the business organization to achieve environmental controls and cost savings through environmental friendly operation and energy efficiencies. As current financial flow reporting follows the regulations of national laws and international standards for compliance (Burritt, Hahn, & Schaltegger, 2002), GFF aims to follow the IMO regulation to achieve sustainability through evaluation of environmental performance-related financial information in the maritime supply chain. This in return, will encourage the maritime organizations to achieve energy efficiency performance through GFF dimension in the maritime supply chain. Based on the NRBV, through product stewardship and pollution prevention management and monitoring, maritime organizations are more capable of pollution reduction and the control of accidental polluting/hazardous substance releases via GFF monitoring and activities. For this reason, GFF identifies, collects and analyses green monetary information on a division, a facility, a product line, or a system for internal purposes to achieve energy efficiency performance.

H2.1.e. Green Financial Flow (GFF) positively affects energy efficiency performance (EEP)

2.6.5.3 The Relationship Between Green Financial Flow (GFF) and Low Carbon Performance (LCP)

The NRBV proposes that green capabilities that are difficult to imitate by competitors can be developed into a competitive advantage. GFF activities that reduce the pollution at the source can be seen as a unique competitive edge and organizational capability in tackling emission problem in the maritime supply chain. In fact, the current emphasis of greenhouse gas reduction indicators through GFF activities is on improvements in process efficiency and efficient consumer product can be seen as organizational improvement and capabilities that lead towards low carbon performance (LCP) (Zhao & Liu, 2019). Accurately developed GFF document and operations may extent of the identification of effects and problems, help to create awareness and present reference points for the types and extent of emissions that must be reduced to commence on making progress toward LCP. Thus, this study postulates that GFF activities may influence LCP positively.

H2.2.e. Green Financial Flow (GFF) positively affects low carbon performance (LCP)

2.7 Conceptualization of Performance Measures

Although performance is of interest for researchers in any area of management and essential for the survival and success of organizations, the term has been surprisingly loosely defined and used in the literature. Lebas (1995) defines performance as the potential for the future successful implementation of actions in order to reach objectives and targets. According to Neely et al. (1995) performance is a function of efficiency (how well resources are utilized) and effectiveness (the extent to which goals are met). Organizational performance has been operationalized in several ways in previous studies.

Traditionally, performance has been viewed as financial performance defined from accounting perspective (Lebas 1995). However, several authors have called for a broader supply chain perspective on performance measurement and management (see studies by; Centobelli, Cerchione, & Esposito, 2018; Panayides, Borch, & Henk, 2018). For example, performance measurement metrics such as quality, time, cost and flexibility, and customer service have also been suggested as a part of performance measures (Laari, 2016). Others include performance in term of learning and reinvestment performance as major performance outcomes of the organizations (Maloni, Paul, & Gligor, 2013). Recently, organizations have begun to face increased scrutiny from various stakeholders regarding their compliance with environmental and social responsibility (Shaw et al. 2010), and performance measurement has become tangible aspect in evaluating overall organizational performance. In this study, performance is considered to consist of the following two dimensions: 1) financial performance and 2) environmental performance. Sustainability is regarded as achieving economic, social, and environmental performances simultaneously that support an organization for long-term competitiveness (Carter & Rogers, 2008). However, only two aspects of sustainability in the literature are examined for guiding the conceptual development of this study. Due to the lack of research in sustainable maritime supply chains, this study takes reference from broader areas of SCM and related GSCM research.

In this regard, the performance measurement included in this study refers to the performance of the core maritime organization in a supply chain which environmental performance and financial performance. Environmental performance is the measurable results of maritime environmental management, which is measured by the emission of wastes such as carbon materials and the consumption of natural resources such as energy-based consumption (e.g., fuel, electricity) (Hervani et al., 2005; Wagner & Schaltegger, 2004). Financial performance is used to measure the potential financial growth of the maritime organization. Therefore, it is measured by sales growth rate and profit growth rate (Youn et al., 2013; Flynn et al., 2010). In the next section, this study has emphasized in-depth these two-performance measurements based on two viewpoints (as mediator; e.g., environmental performance such as EEP and LCP and as the outcome of MGSCM practices; e.g., financial performance) respectively. It is worth to note that the hypotheses of each MGSCM linkage towards performance measurement are also deposited in the respective section.

2.7.1 Energy Efficiency Performance (EEP) as Mediating Variable

Sustainability, green concerns, and environmental impact are the chief drivers for enhancing the design and management of contemporary global supply chain networks. The intentional decisions to develop energy efficient supply chain are the critical solution to reduce carbon footprints (Tiwari, Chang, & Choudhary, 2015). In the maritime supply chain, energy efficiency and performance has always been an imperative factor to reduce ship operational costs and increase organizational profit, yet it has not always been a focus during design and operation (Lai et al., 2013). In this regard, if energy performance in term of the operational supply chain is considered, it can become a significant influence on the environmental, operational and financial performance of the organization. Over the past decades, there has been an increased pressure and concern to reduce greenhouse gas and carbon emissions, aim to mitigate the climatic change in maritime context. The importance of energy use and emissions in the maritime supply chain sector receives growing attention in a recent report on maritime transport by the United Nations and outside of peer-review conferences around the world. In this regards, the need for environmental modernization and conservation, which is concerned with the execution of innovative management practices to reduce environmental impacts while reaping operational and financial gains, has become popularized in the maritime supply chain context (Zhu et al., 2011).

According to Banks et al. (2013), the pressure resulted from a global concern has translated into several amendment of protocols and commitments by IMO through United Nations Framework Committee on Climate Change treaty (UNFCCC). These actions lead towards substantial changes in term of green adoption in the maritime industry. These significant green developments have corresponded with the worldwide financial crisis starting around 2007 that has significantly impacted on the maritime supply chain sectors and incentivized innovation, developments and implementation of energy efficient measures, both in term of design for environment and in term of operational dimension. For that reason, IMO plans to develop a system to coordinate, monitor, report, and validate emissions on the ground of fuel utilization and consumption strategy to embark on this green shipping initiative in 2013 through implementation of Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plan (SEEMP) (Lai et al., 2013). The focus of EEDI is to reduce carbon emission through technical measure by promoting green practices as well as energy efficient equipment and engine from the designation phase. Through this initiative, IMO also develops Energy Efficiency Operational Indicator (EEOI) as an intended tool for monitoring the operational transport efficiency of ships in the maritime supply chain. While SEEMP acts as a tool to reduce carbon emission and fuel consumption through better management of ship and fleet efficiency performance over time. Both policies and measures might be the determinant of why maritime organizations should align their operation through a sustainable approach via green practices adoption to increase energy efficiency performance. From this study perspective, the EEDI and SEEMP could potentially act as a mediator of energy efficiency performance (EEP) in determining the effect of the relationship between green practices (MGSCM) and financial performance.

From maritime supply chain operational practices perspective, concerns on carbon emissions and energy efficiency performance dimensions, scholars have established a transport cost model to determine whether to ship or produce locally from Korea to supply the automotive supply chains in the United States and European markets (Nieuwenhuis et al., 2012). The results show that the local option rather than seaborne sourcing from the home country is preferable for lower emission and high energy efficiency performance. Other than shipping emission, fuel consumption is also a significant challenge for the shipping industry to address to achieve high energy efficiency performance (Lai et al., 2013; Qi & Song, 2012). In current environmental-based shipping research, preceding studies are limited to environmental technologies adoption such to improve ecological and energy efficiency of ships (Viana et al., 2009). Studies have also been conducted on the use of biofuels in shipping (Bengtsson, Fridell, & Andersson, 2012), to reduce carbon emission and increase energy efficiency performance. To mitigate shipping emission, Chang (2012) advocated a focus to enhance energy efficiency performance through the designation of ships engines and hulls. While Dedes, Hudson, & Turnock (2012) investigated the potential used of a hybrid battery–diesel-electric propulsion system to reduce exhaust gas emissions and improve energy efficiency performance by reducing fuel oil consumption through consideration of a re-engineered ship propulsion system. Tzannatos & Papadimitriou (2013) studied the energy efficiency performance and carbon assessment of domestic passenger shipping in Greece through the analysis of fuel expenditure upon the overall cost of the supplied services.

There are also investigations on environmental management and green practices to achieve operational performance in term of financial and energy consumption by introducing green design, green shipping practices, green policies, green documentation and green supply chain management in maritime supply chain context (Lai et al., 2013; Lirn, Lin, & Shang, 2014; Lun, Lai, & Cheng, 2013; Lun, Lai, Wong, et al., 2013; Lun, 2011; Wuisan et al., 2012; Yang, 2012). These green capabilities mentioned in prior literature supported the theoretical link of this study which denotes that MGSCM (act as green practices dimension) could potentially serve as a positive determinant in influencing financial performance and energy efficiency performance (as a mediator). These studies reflect that environmental harms are attributable to shipping activities and the problems should be mitigated accordingly. For that reason, it is timely to investigate greening maritime supply chain that are important parts of global supply chain operations and how far these activities are friendly to the environment and the bottom-line of shipping firms through analysing MGSCM practices to achieve energy efficiency performance (EEP).

This study sought to find the hypothetical link between green initiatives (MGSCM) with financial performance through EEP linkage as a mediator. The strength of the relationship of EEP should be investigated through this question of how the EEP could affect the relationship between MGSCM and financial performance. In this context of EEP the study assumed that MGSCM capabilities (green practices adoption) could become an imperative solution to achieve both performance context which is energy efficiency performance and financial performance context through 5 dimensions (i.e. green information and communication system (GICS); green value added logistics services (GVALS); green supply chain integration practices (GSIP); shipping design and compliance (SDC) and green financial flow (GFF)) as previously discussed in prior sections. Thus, this study concluded that EEP could mediate the relationship between maritime green supply chain management (MGSCM) and financial performance through five (5) hypotheses generated as below:

H4.1: Energy efficiency performance (EEP) mediates the relationship between maritime green supply chain management (MGSCM) and financial performance (FP)

H4.1.a. There is energy efficiency performance (EEP) mediating effect on the relationship between Green Information and Communication System (GICS) and financial performance (FP)

H4.1.b. There is energy efficiency performance (EEP) on the relationship between Green Value added Logistic Services (GVALS) and financial performance (FP)

H4.1.c. There is energy efficiency performance (EEP) mediating effect on the relationship between Supply Chain Integration Practices (GSIP) and financial performance (FP)

H4.1.d. There is energy efficiency performance (EEP) mediating effect on the relationship between Shipping Design and Compliance (SDC) and financial performance (FP)

H4.1.e. There is energy efficiency (EE) mediating effect on the relationship between Green Financial Flow (GFF) and financial performance (FP)

2.7.1.1 The Relationship Between Energy Efficiency Performance (EEP) and Financial Performance (FP)

Energy efficiency performance is the most critical issues for ship operators and maritime supply chain players who are aiming through low carbon shipping and cost reductions in operation (Maritime, Concept, & Study, 2015). Even though reducing fuel and energy consumption seems to have the primary concern, environmental and sustainability considerations also thrust the shipping industry to operate more efficiently. Strict legislation on GHG emissions by IMO and increasing fuel prices twirl the focal point on energy efficiency and fuel consumption measures. These measures have the sole purpose of getting improvement in term financial performance mainly through cost reduction. In this sense, this financial and environmental reason behind energy efficiency performance resulted in several types of research to find technical and practical operational measures which increase general fuel efficiency and decrease emissions (Johnson, Johansson, Andersson, & Södahl, 2013). It has been suggested that there is a high potential to reduce emissions rate and efficiency improvement by 25% to 75% compared to existing figures (IMO, 2009). Efficient ship operation through energy efficiency performance is essential for cleaner voyages at oceans and ports around the world. This will not only facilitate ships to be greener and efficient but also maintain the whole value of the maritime supply chain through economic improvement (M S Eide, Longva, Hoffmann, Endresen, & Dalsoren, 2011).

Also, increased attention has been focused on clean vehicle technology to achieve cost reduction through two essential methods; improving the efficiency of vehicles/vessels in their day-to-day supply chain operations and switching to more efficient alternative or hybrid fuel technology sources. Even though implementation rates have been quite low for both bio-fuelled and battery-powered vehicles in the maritime supply chain, these technologies are becoming increasingly viable, and adoption rates are expected to rise in the upcoming future (Dey, LaGuardia, & Srinivasan, 2011). Until such technologies and alternative fuel sources extensively develop, numerous maritime organizations have implemented inventive solutions using less sophisticated techniques and technologies to reduce their dependency on fossil fuels and improve energy efficiency performance and financial cost. These techniques and technologies include cruise control, speed optimization through slow steaming, hull and propeller cleaning of vessels, ballast and trim optimization to save fuel consumption through less resistance in the water, GPS units, and automatic engine shut down devices (Banks et al., 2013; Johnson & Andersson, 2011; Psaraftis & Kontovas, 2013; Rizet, Browne, Cornelis, & Leonardi, 2012). For example, a recent study points out that The Kroger Co. with the assist of some eco-friendly fleet management tips (called "preventative fleet management") has been able to employ and maintain a long-term financial improvement (through cost reduction) and also decrease their energy and fuel usage at the same time (Burnson, 2008)

H3.1: There is a positive relationship between energy efficiency performance (EEP) and financial performance (FP)

2.7.2 Low Carbon Performance (LCP) as Mediating Variable

Due to the growing concern on CO_2 emission, low carbon performance (LCP) has become an imperative measure to reduce the impact of the maritime supply chain through

MGSCM adoption. Deriving from prior literature on shipping, the reduction indicator and measurement of CO_2 emissions in the maritime supply chain, this study inclined to categorized low carbon performance from CO_2 emission and another GHG emission perspective as the word 'carbon' itself in "low-carbon-performance" represent the notion of CO_2 emission. In this sense, this study defined low carbon performance (LCP) as environmental performance that aims to reduce carbon emissions and GHG gases that harmful to environment. This is aligned with definition by Lai, Lun, Wong, & Cheng (2011) that low carbon supply chain performance in maritime supply chain operations should be viewed from the natural science perspective with an emphasis on reducing the toxic and gas emissions generated from shipping activities that pollute the natural environment by adopting green practices. In recent preceding literature on CO_2 emissions reduction on maritime shipping operation, many studies draw different solution (depending on context) to achieve low carbon performance.

In the context of technical solution in maritime operation, many studies underline different method to achieve low carbon performance through; technical optimisation tool for monitoring vessel optimization using speed and fuel consumption (Armstrong, 2013), using liquefied natural gas (LNG) and methanol for shipping fuel (Bengtsson, Fridell, & Andersson, 2012), regulated slow steaming (Faber, Nelissen, Hon, Wang, & Tsimplis, 2012; Smith, 2012), hybrid battery–diesel-electric propulsion system (Dedes et al., 2012) and analysis of fuel expenditure (Tzannatos & Papadimitriou, 2013). There has also been a focus on improved ship design, for example, the development of the energy efficiency design index (EEDI) at the International Maritime Organization (IMO) that act as initiatives and policies to encourage maritime organizations to embrace green technology and practices for CO_2 emission improvement. Only recently in maritime supply chain literature, scholars have started to introduce specific green programmes and practices in accordance to supply chain context to address environmental impact and greenhouse gas emissions collectively (Gibbs et al., 2014).

Taking from the perspective of the mediating effect of LCP on the relationship between MGSCM and financial performance, MGSCM can become a viable solution to achieve better LCP. Conceptualizing from conventional GSCM perspective, many studies on green practices in maritime context have used different term in conceptualizing MGSCM such as greening and performance relativity (GPR) (Lun, Lai, Wong, et al., 2013b), green shipping practices (GSPs) (Lun et al., 2014), green management practices (GMP) (Lun, 2011), green shipping management capability (Lirn et al., 2014) and green shipping network (Lun, Lai, & Cheng, 2013). They, in particular, have introduced many dimensions of green practices (e.g., green policy, green shipping, green marketing, green integration, green design, etc) that aligned with the conventional concept of GSCM in maritime context to specifically measure improvement in environmental performance. Even though the studies do not specifically have LCP as measurement, interestingly they have included carbon emission construct/measurement as a part of environmental performance dimension in their study. Most of the studies of GSCM in maritime or outside of maritime literature mentioned have included the measurement of CO_2 emission as a part of the environmental performance indicator other than common indicators (e.g., waste, pollutant, and noise). This concludes that MGSCM could become an imperative organizational practice to achieve positive LCP.

In the perspective of LCP and financial performance, to this extends no direct low carbon literature mentioned specifically that LCP could influence the financial performance of the organization. In this sense, to conceptualize the relationship between low carbons performance (LCP) and financial performance, the theoretical linkage of this relationship requires the outlook from an environmental performance perspective in GSCM literature as the LCP can be included into environmental performance measurement. In this regard, the relationship between environmental performance and financial performance have been widely debated in the GSCM literature (Schaltegger et al., 2013) from two viewpoints (Schaltegger & Synnestvedt, 2002). The first viewpoint argues that an organization's improved environmental performance (in this case; LCP) is achieved through extra costs for the organization which leads to reduced profitability. Conversely, the second point of view follows the argument that improved environmental performance will produce cost savings and increase sales that lead to improved economic performance.

Mowen et al. (2011) supported the second viewpoint that maintains that environmental performance is a separate outcome (to financial performance) for competitive advantage arising from continuous improvement in the internal process of an organization. They argued that the core objectives of environmental performance are to minimize the use of new materials through the maximization of recycling opportunities, hazardous materials, energy requirements in production, as well as the release of residues. Further support for the second point of view is provided by Ambec and Lanoie (2008) whose model has demonstrated that environmental performance and financial performance are separate outcomes that share, through the organization's innovation strategy, the same opportunities to increase revenues (better access to specific markets, differentiated products) and reduce costs (relating to material energy, services, and capital). They have argued that an essential outcome of adopting an innovation strategy is the development of an innovation process that leads concurrently to improvements in both environmental performance and financial performance.

From the supported GSCM studies mentioned, this study inclined towards the second viewpoint that concluded that LCP could influence financial performance. This study believes that lowering emission via MGSCM practice; maritime organizations can reduce energy usage via cost saving (fuel consumption) and energy efficiency. However, this positive assumption is relatively unknown to the Malaysian maritime context. To justify the theoretical assumption, this study sought to find the hypothetical link between MGSCM with financial performance through low carbon performance (LCP) linkage as a mediator. The strength of the relationship of LCP should be investigated through this question of how the LCP could affect the relationship between MGSCM and financial performance through CO_2 emission reduction. In this context of LCP, this study assumes that MGSCM capabilities (green practices adoption) based on prior literature understanding could become an imperative solution to achieve both performance context which is low carbon performance and financial performance outcome; through 5 dimensions (i.e., green information and communication system (GICS); green value added logistics services (GVALS); green supply chain integration practices (GSIP); shipping design and compliance (SDC) and green financial flow (GFF).

H4.2: Low carbon performance (LCP) mediates the relationship between maritime green supply chain management (MGSCM) and financial performance (FP)

H4.2.a. There is low carbon performance (LCP) mediating effect on the relationship between Green Information and Communication System (GICS) and financial performance (FP)

H4.2.b. There is low carbon performance (LCP) mediating effect on the relationship between Green Value added Logistic Services (GVALS) and financial performance (FP)

H4.2.c. There is low carbon performance (LCP) mediating effect on the relationship between Supply Chain Integration Practices (GSIP) and financial performance (FP)

H4.2.d. There is low carbon performance (LCP) mediating effect on the relationship between Shipping Design and Compliance (SDC) and financial performance (FP)

H4.2.e. There is low carbon performance (LCP) mediating effect on the relationship between Green Financial Flow (GFF) and financial performance (FP)

2.7.2.1 The Relationship Between Low Carbon Performance (LCP) and Financial Performance (FP)

As being elaborated in the previous section, environmental performance such as LCP can be viewed as a performance measure that can bring internal and external benefits. From the internal perspective, high environmental performance can eventually lead to new capabilities, and competitive advantages that are embedded in organizational culture and management, and in return can enhance flexibility to adapt to external environmental changes (Mao et al., 2017). Extending from this view, competitive advantages gained from improving LCP processes can increase resource utilization rate increase efficiency and reduce the cost. Martínez-Ferrero and Frías-Aceituno (2015) have noted that promotion of environmental performance can indeed help increase organization profitability through increase reputation to attract more customers, enlarge market share, and add market value which in return lead to improve financial performance. Also, organizations that acquire favourable reputation and environmental performance can also improve the relationship with banks and investors to gain significance capital investments. The good reputation may assist in attracting excellent staffs and improving current employees' goodwill in order to improve financial performance (Przychodzen & Przychodzen, 2015). Thus, extending from this view, this study hypothesizes:

H3.2: There is a positive relationship between low carbon performance (LCP) and financial performance (FP)

2.7.3 Conceptualizing the Financial Performance as Dependent Variable

Numerous operational management literatures have reported that financial performance is typically associated with the average emphasis on a wide variety of operational competencies (Kim, Kim, & Qian, 2018; Lee, Graves, & Waddock, 2018) for comparing and evaluating the organization's behaviour over time (Li et al., 2006). In a study of the relationship between competitiveness and performance, Laari, Töyli and Ojala (2018) reported that the financial performance is affected by operational competencies via green strategy in a variety of ways. For example, when operational efficiency is improved as part of strategies to improve competitiveness, it results in better utilization of facilities, higher productivity and reduces operating costs. Again, when the competitiveness of a maritime supply chain improves, this leads to improve revenue, profit and return on investment. Therefore, as demonstrated by many studies, a wide variety of operational competencies and efficiency can be evaluated by the financial performance approach such as profit growth, the growth rate in revenue and return on investment. Table 2.18 describes the financial indicators adopted by most prior studies.

Table 2.18 Financial performance indicator

Indicator	Reference
Profit growth	Al Zaabi, Al Dhaheri and Diabat (2013); Day, Shieh and Tsai (2017); Mirhedayatian, Azadi and Farzipoor Saen (2014)
The growth rate in revenue	Al Zaabi, Al Dhaheri and Diabat (2013); Day, Shieh and Tsai (2017); Mirhedayatian, Azadi and Farzipoor Saen (2014)
Return on investment (ROI)	Alshehhi, Nobanee and Khare (2018); Ganda, (2018); Laari et al. (2018)
Return of Asset (ROA)	Bajaj, Bansod and Paul (2018); Miroshnychenko, Barontini and Testa (2017); Wang & Sarkis (2013b)
Return-On-Sales (ROS)	Fujii, Iwata, Kaneko and Managi (2013); Yang, Hong and Modi (2011)
Net profit	Avelar-Sosa, García-Alcaraz and Maldonado-Macías (2019); El Saadany, Jaber and Bonney (2011); Tippayawong, Tiwaratreewit and Sopadang (2015)
Sales Growth	Susanty, Sari, Rinawati, Purwaningsih and Sjawie (2019); Yu and Huo (2019)

Based on the above Table 2.18 financial performance indicator, financial performance could be considered as performance measured by financial indicators to assess an organization's efficiency and effectiveness. Financial performance measures define the long-term objectives of a business unit (Kaplan & Norton, 1996; Rodrigues & Rodrigues, 2018). Stock et al. (2000) have argued that in comparison to operational performance measures, financial performance measures are more likely to reflect the assessment of an organization by factors outside of the organization's boundaries. Accounting measures are the most common and readily available means of measuring organizational performance. However, it should be noted that they reflect mainly historical activity and can be limited in anticipating expectations about future performance (Richard et al. 2009).

The financial reporting-based metrics such as Return-On-Assets (ROA) (Bajaj et al., 2018), Return-On-Investment (ROI) (Jia & Wang, 2019), Return-On-Capital-Employed (ROCE) (Scott, Lundgren, & Thompson, 2018), Return-On-Sales (ROS) (Fujii et al., 2013) and Earnings before Interest and Taxes percentage (EBIT-%) (Laari et al., 2018) are also widely used to analyse financial performance. In this regard, return-based measures can be perceived as measures of managerial efficiency in the use of available resources (Babic & Plazibat, 1998). ROA reflects how effectively a firm utilizes its assets in generating profits (Wagner et al. 2012). According to Kaplan and Norton (1996), ROCE can be linked to operational performance, such as process quality and on-time delivery. Meanwhile, ROS is generally use to capture cost saving effect and capital turnover for productivity measurement (Lee, Noh, Choi, & Rha, 2017). ROI has been argued to be suitable (and perhaps the best and widely available) indicator of business performance measurement. Meanwhile, EBIT-% is included to check if profitability behaves differently compared to asset-based measures (Chen & Kitsis, 2017).

From this study perspective, most of these financial measurements such as ROCE and EBIT-% are harder to evaluate based on subjective evaluation due to difficulty to get the data and only accessible to accounting personnel in the organization. Based on this view this study inclined to use widely available and more accessible financial performance measurement such as sales growth, net profit, ROA, ROI and ROS for this study measurement items. On the other note, stock price and market share data were excluded from this study, given that most maritime supply chain companies in the chosen samples are not publicly listed. In addition to the financial reports-based measures of performance, financial performance is measured as the managerial perceptions of five financial indicators (as previously mentioned); such as sales growth, profit, ROA, ROI and ROA to capture overall performance of the company. This technique can be categorized as quasi-objective measures in which it may produce specific objective performance information by self-report techniques (Richard et al. 2009). Although any self-reported, perceptual measure might be subject to bias, similar methods have also been widely used by several other studies (e.g., Bajaj et al., 2018; Chen & Kitsis, 2017; Longoni & Cagliano, 2018; Rodrigues & Rodrigues, 2018). This study argues that subjective performance measures might be preferred for financial reporting data due to heterogeneous samples that have industry differences in capital structures and accounting conventions as well as organization differences in inventory valuation, depreciation, and salaries. Thus, financial performance measurement by self-report is the most appropriate technique to capture the competitive edge of maritime companies to achieve this study research objective.

2.8 Summary of Hypotheses

In summary, based on the full proposed framework in Figure 2.16, the outcome of financial performance was investigated through MGSCM variables and relationship between these variables is investigated through energy efficiency performance (EEP) and low carbon performance (LCP). Thus, in this study, the conceptual foundations for each of these alternative views on the relationship between MGSCM and financial performance that influence the relationship through EEP and LCP can be summarized into 27 hypotheses. Thus, to recapitulate, the following hypotheses are framed and listed as below for references:

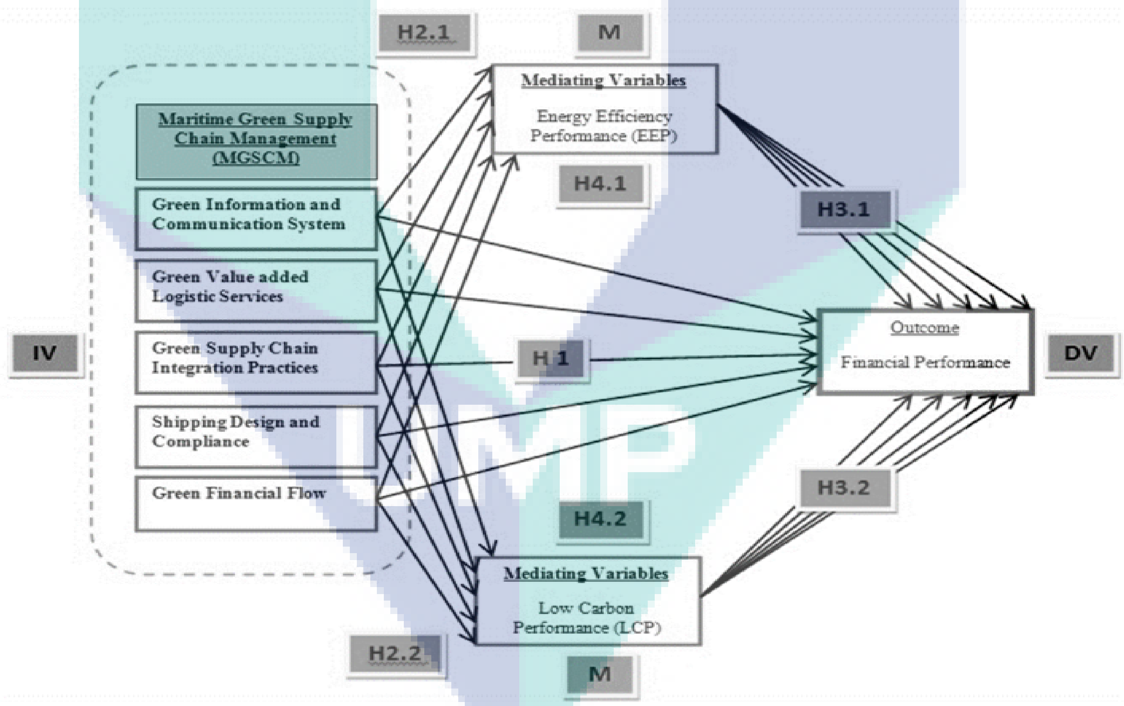

Figure 2.16 Theoretical Framework

Source: Drawn by the author

H1: There is a positive relationship between maritime green supply chain management (MGSCM) and financial performance

H1.a. Green Information and Communication System (GICS) positively affect financial performance

H1.b. Green Value added Logistic Services (GVALS) positively affect financial performance

H1.c. Green Supply Chain Integration Practices (GSIP) positively affects financial performance

H1.d. Shipping Design and Compliance (SDC) positively affect financial performance

H1.e. Green Financial Flow (GFF) positively affects financial performance

H2.1: There is a positive relationship between maritime green supply chain management (MGSCM) and Energy Efficiency Performance (EEP)

H2.1.a. Green Information and Communication System (GICS) positively affect energy efficiency performance (EEP)

H2.1.b. Green Value added Logistic Services (GVALS) positively affect energy efficiency performance (EEP))

H2.1.c. Green Supply Chain Integration Practices (GSIP) positively affects energy efficiency performance (EEP)

H2.1.d. Shipping Design and Compliance (SDC) positively affect energy efficiency performance (EEP)

H2.1.e. Green Financial Flow (GFF) positively affects energy efficiency performance (EEP)

H2.2: There is a positive relationship between maritime green supply chain management (MGSCM) and low carbon performance (LCP)

H2.2.a. Green Information and Communication System (GICS) positively affect low carbon performance (LCP)

H2.2.b. Green Value added Logistic Services (GVALS) positively affect low carbon performance (LCP)

H2.2.c. Green Supply Chain Integration Practices (GSIP) positively affects low carbon performance (LCP)

H2.2.d. Shipping Design and Compliance (SDC) positively affect low carbon performance (LCP)

H2.2.e. Green Financial Flow (GFF) positively affects low carbon performance (LCP)

H3.1: There is a positive relationship between energy efficiency performance (EEP) and financial performance

H3.2: There is a positive relationship between low carbon performance (LCP) and financial performance

H4.1: Energy efficiency performance (EEP) mediates the relationship between maritime green supply chain management (MGSCM) and financial performance

H4.1.a. There is energy efficiency performance (EEP) mediating effect on the relationship between Green Information and Communication System (GICS) and financial performance

H4.1.b. There is energy efficiency performance (EEP) mediating effect on the relationship between Green Value added Logistic Services (GVALS) and financial performance

H4.1.c. There is energy efficiency performance (EEP) mediating effect on the relationship between Supply Chain Integration Practices (GSIP) and financial performance

H4.1.d. There is energy efficiency performance (EEP) mediating effect on the relationship between Shipping Design and Compliance (SDC) and financial performance

H4.1.e. There is energy efficiency performance (EEP) mediating effect on the relationship between Green Financial Flow (GFF) and financial performance

H4.2: Low carbon performance (LCP) mediates the relationship between maritime green supply chain management (MGSCM) and financial performance

H4.2.a. There is low carbon performance (LCP) mediating effect on the relationship between Green Information and Communication System (GICS) and financial performance

H4.2.b. There is low carbon performance (LCP) mediating effect on the relationship between Green Value added Logistic Services (GVALS) and financial performance

H4.2.c. There is low carbon performance (LCP) mediating effect on the relationship between Supply Chain Integration Practices (GSIP) and financial performance

H4.2.d. There is low carbon performance (LCP) mediating effect on the relationship between Shipping Design and Compliance (SDC) and financial performance

H4.2.e. There is low carbon performance (LCP) mediating effect on the relationship between Green Financial Flow (GFF) and financial performance

2.9 Chapter Summary

The objective of this chapter is to summarize the literature on the development of maritime green supply chain management (MGSCM). Generally, global organizations are relentlessly trying to develop new and inventive ways to improve their overall organization's competitiveness in term of business performance. In this regard, the relationship involving supply chains performance and sustainability concept is the crucial step has been further assessed in this chapter. From maritime industry context, numerous maritime organizations nowadays are trying to improve their overall competitiveness throughout improvement in environmental performance to act under the growing pressure of environmental regulations by IMO, customers demand, and to lessen the environmental outcome of their products and services while at the same time increasing their economic performance.

In Malaysia context, the increasing need of a technological solution in logistic and supply chain management (SCM) resulting from rapid industrialization, globalization as well as customers demand have made maritime operation in Malaysia becoming increasingly complex and challenging. Being a central hub in South East Asia shipping trade, maritime industry in Malaysia needs to address efficiency and environmental concerns as part of competitive advantage to increase overall organizational performance. Realizing that long-term benefit of sustainability goals towards economic performance, there is a trend among maritime organizations globally to explore green initiatives by implementing green practices as their own strategic solution. Realizing the benefit of green adoption, many works of literature have emphasized the advantage of the long-term strategic solution that can be gained from adopting the sustainable practice. Prior literature review in this chapter categorized green practices as environmental and operational structure of improvement to catalyze operational planning in a supply chain system.

Further, the significance of GSCM concept introduced in this chapter has grown beyond the scope of conventional management supply chain studies (especially manufacturing sectors) and expended along the growing concern of environment and economic performance in other sectors of supply chain operation. In this context, GSCM can also be used practically in any industrial and business context within the structural management framework such as the maritime supply chain. Therefore, GSCM concept has been extended into the term maritime green supply chain management (MGSCM) that refers the integration of GSCM in maritime context. Conceptualization of MGSCM dimension in this study becomes a central theme in this chapter, and upon conducting review from prior literature, the study has proposed five dimensions of MGSCM consisting of GFF, GICS, GSIP, GVALS and SDC for measuring financial performance outcome. Extending from this conceptualization, this study has also proposed two mediating variables to be investigated (EEP and LCP) in determining the dynamic effect of these two variables on the direct relationship between MGSCM and financial performance.

Finally, the systematically investigation has also been put thoroughly to conceptualize the proposed theoretical framework with the aim to formularize the MGSCM concept to be aligned with NRBV theory as well as investigating the relationship of financial performance (outcome) with LCP and EEP as mediating variables. In pursuing this aim, the general framework has been accounted from the perspective interdisciplinary paradigm, drawing on a paradigm from environmental management, traditional SCM as well as performance studies in different sectors and backgrounds. The final section of this chapter addressed the concept of MGSCM as a foundational concept for this study as well as defining each variable’s relationship in accordance to GSCM concept from the perspective of NRBV theory to conceptualize the concluding hypothetical assumption to be tested later in the data analysis phase in chapter four.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The quality of findings depends on the scientific procedure of conducting research which involved the proper conceptualization of specific issue related to the topic. The proper procedure of data gathering techniques also contributed to the reliability and validity of the findings and implications. This is a critical part of any study to be considered by the scholars, as normally the general quality of the collected data should be aligned with the research outcomes (Gill & Johnson, 2010). Thus, this chapter discussed the methods of details and procedures to examine the extent to which the MGSCM framework acts as a measurement construct to predict the financial performance in maritime sectors. In this sense, this study used an explanatory research enquiry aims to explore this research topic. Hence, this study systematically explored literature related to a research problem and its potential scope as well as proposed a novel theoretical framework based on the underpinning theory. This chapter includes population and sampling, questionnaire design, measurement instruments, data collection, and data analysis technique that will be discussed methodologically in this chapter. This chapter aims to identify, recognize and explain the primary method used in conducting this research respectively.

3.2 Research Philosophy and Approach

"Research philosophy" can be defined as a progression of knowledge and the nature of that knowledge with regards to particular research (Saunders, Lewis, Thornhill, & Wilson, 2009). The implementation of research philosophy includes vital assumptions about how the researcher views the natural world, and those assumptions will conclude the choices of research approaches and methods. Even though it is a theoretical term used loosely, “research philosophy” is of great importance to the research strategy design and approach due to significant impact on how the research is conducted, and the foundational understanding of the research findings (Flint, Gammelgaard, Golicic, & Davis, 2012). For that reason, diverse philosophies adopted in conducting research processes will lead to various findings and views on the same issue. According to Saunders et al. (2009), no philosophy is better than another as the preeminent way to carry out research can only be based on the research reality – that is, obtaining the exact answers to the research questions. Saunders et al. (2009) also deposit that ontology and epistemology are the two most important ways of research philosophy approach, and these are frequently used in the social science context.

From another perspective, research philosophy is also grounded in the philosophical customs and conduct of discipline and initiate from its established "paradigms" (Flint et al., 2012). “Paradigm” is the term commonly used to understand research philosophy in the social sciences. The term “paradigm” refers to the progression of scientific practice on the foundation of people’s philosophies and assumptions about the natural world (Collis & Hussey, 2003). A paradigm in this sense can be scrutinized as a set of basic beliefs that associates with ultimate or primary principles (Guba, Guba, & Lincoln, 1994). While in the context of "research paradigm," it refers to how research should be constructed and conducted. A paradigm holds the elementals view of ontology, epistemology, and methodology (Guba et al., 1994). Ontology for examples is the way reality is envisioned and professed in which it addresses the enquiry of whether the objective reality exists or not (Hallebone & Priest, 2009).

While, epistemology refers to the way information and knowledge being generated, represented, understood and used in which it addresses the enquiry of what is the relationship between the researcher and what can be known (Frankel & Naslund, 2005; Guba & Lincoln, 1994; Hallebone & Priest, 2009). Ontological and epistemological conjecture guides the basis of methodological decisions, which deal with how we attain knowledge of the world (Frankel & Naslund, 2005). Crotty (1998) deposits three fundamental epistemological stances and their variations: objectivism, constructionism, and subjectivism. In the objectivist outlook, reality exists independent and free from social actors (Bryman, 2004) and objective reality can be revealed and discovered (Crotty, 1998). However, constructionism rejects this particular view, assumes that meaning or reality is not discovered but constructed by social actors (Bryman, 2004; Crotty, 1998).

While, in subjectivism meaning or reality is imposed on the object by the subject and does not interplay between the subject and the object (Crotty, 1998).

Epistemology underpins the outlook of a theoretical perspective. There are numerous theoretical perspectives exist, such as positivism, interpretivism, and realism, which are used to present a contextual element for the particular research process (Bryman, 2004; Crotty, 1998; Saunders, Lewis & Thornhill 2007). This study follows the positivist approach upholding that science can be conducted in an objective approach (Bryman, 2004). In positivism, existing theory is used to construct hypotheses that will be investigated and confirmed, in total or part, or disproved. This will pilot to the advanced progression of a theory that can be tested by future research (Saunders, Lewis & Thornhill, 2007).

Additionally, it is indispensable to deem the relationship between theory and research. There are three major research approaches that may affect the attainment of new knowledge: induction, deduction, and abduction. Inductive reasoning is a theory building development starting with detailed empirical cases or an assortment of specific observations and seeking to create generalizations about the phenomenon under examination, i.e., from facts to theory (Hyde, 2000; Spens & Kovács, 2006). Nonetheless, even in theory building, a priori assumptions, frameworks or a perceived problem provide the underpinning groundwork for the study (Flynn, Sakakibara, & Schroeder, 1990). While, deductive reasoning is a theory testing that originates with established theory, constructs a priori hypotheses and tests them empirically to see whether the theory applies to precise instances (Hyde, 2000; Kovács and Spens, 2005; Saunders, Lewis and Thornhill, 2007). Similar to induction, abductive interpretation starts with a live observation, followed by an iterative process of "theory matching" to find a novel matching framework or to extend the existing theory used before this observation and ultimately suggest a new theoretical framework (Kovács & Spens, 2005).

With regards to this study, the deductive approach is considered respectively. Saunders, Lewis and Thornhill (2007) have deposited quite a few essential characteristics of the deductive approach: (1) an investigation to describe causal relationships between variables; (2) the usage of controls to permit the hypotheses testing; (3) the development of highly structured methodology to facilitate the replication; (4) the operationalisation of concepts that enables facts to be calculated quantitatively; (5) reductionism, meaning that the underlying problems are reduced to the simplest probable elements; and (6) generalisation by selecting a adequately large sample size. Based on this reasoning, this research utilized the hypothetico-deductive approach to examine hypotheses testing. The hypothetico-deductive approach is a scientific inquiry achieved by formulating a hypothesis in the form of prediction that could conceivably be falsified or accepted by a test on observable data (Godfrey-Smith, 2003). Utilizing this approach, this study intends to gain insight perspective of the relationship and effect of MGSCM practice and financial performance as well as mediating effect of energy efficiency performance (EEP) and low carbon performance (LCP) in Malaysian maritime industry. A hypothetico-deductive approach is chosen in this research where hypotheses were generated first following by data collection to affirm or dispute the developed hypotheses based on the theoretical framework developed. There was a total of 27 hypotheses derived from the research framework to investigate the relationship among variables. All variable constructs measurement was adapted from existing literature. This study was tested using the data collected from the survey to seek the positive and significant linkage between endogenous and exogenous constructs which previously developed for the hypotheses in chapter two (2). Interestingly, the inductive approach, on the contrary, is focusing more on the flexible structure to facilitate changes as the research develop further and is less concerned with the requirement to generalize (Saunders et al. 2007).

Concerning methodology, there are two sensible approaches to perform research in social science studies namely the positivistic paradigm and phenomenological paradigm. The sole purpose of these approaches is to construct an in-depth understanding and insight of the resulting action and measures the influence of each factor to one another. According to Jankowicz (2005), some researchers inclined to identify the positivistic paradigm as quantitative and phenomenological as qualitative for the research approach. Positivists distinguish the social world from an external and exterior perspective and deem that its properties should be calculated through objective stance rather than subjective methods which are through quantitative data analysis. Positivist emphasizes realism, which refers to the objective realities that can be associated and understood with an indication of science (Lincoln & Guba, 2000).

Meanwhile, the phenomenological approach tries to glance inside into the means of people experience event and phenomenon in this world and describe its meaning subjectively through qualitative data collection approach. Positivism is regularly associated with quantitative methods (Crotty, 1998). Croom (2009) outlines the unique process of the quantitative approach: first, concepts are investigated and tested through observable, tangible and clearly defined variables. Second, by utilizing a controlled measurement, using predetermined procedures and protocols to test causality between variables. Creswell (2009) argues that surveys and experiments are proper strategies of the query for the quantitative approach. The most important practices in this approach include recognizing variables to study and examining them by the employment of questions or hypotheses, accumulating numerical information, using unbiased approaches and utilizing statistical procedures (Creswell, 2009). For that reason, based on these explanations, this research has utilized the positivistic paradigm viewpoint as it dealt with MGSCM operationalization theory and the prediction of tangible variables as well as analysing the hypotheses empirically. The quantitative method is found to be the best suit for this study because it involved the apparent progression of theory for the operationalization concept; methodology and steps identification; data collection; statistical testing to generate findings (Frankfort-Nachmias, 1996). Furthermore, quantitative research permits a large amount of data collection from a sizable population in a highly economical way which is highly appreciated in this research. By using this particular methodology, the accurate depictions of the "world" can be collected and analysed objectively to reveal the definitive or probabilistic truths or realities, as well as to evaluate, verify or falsify the constructed hypotheses (Gephart, 2004).

From the research method perspective, Yin (2003) deposits that different research methods help to answer diverse forms of research questions. Table 3.1 shows a summary of the diverse types of questions that can be answered with different research methods.

Table 3.1 Questions answered with different research methods

Strategy	The form of the research question	Require control over behavioural events?	Focuses on contemporary events?
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how many, how much	No	Yes
Archival Analysis	Who, what, where, how many, how much	No	Yes
History	How, why	No	No
Case Study	How, why	No	Yes

Source: Yin (2003)

Given the research questions listed in section 1.6, this research focuses on answering "how variables are related," "Where the relations hold" and "to what extent a given relation is present" which are concerned with identifying and understanding the phenomenon. Based on the formed research questions, this study inclined towards survey method due to the explanatory nature of this study and the relatively big sample size of its population. There are two major types of survey research which are exploratory and explanatory (Malhotra & Grover, 1998). Exploratory survey research takes place during the early stages of research investigation into a phenomenon (Forza, 2002). It intends at becoming extra familiar with the particular topic and challenges to categorize and describe the variability in different phenomena (Malhotra & Grover, 1998). Thus, it can facilitate to discover the concepts to be measured concerning the phenomenon under that particular study, how to best evaluate them and how to determine new facades of the phenomenon (Forza 2002). Explanatory survey research investigates and explains causal relationships between variables (Malhotra & Grover, 1998; Mark Saunders, Lewis, & Thornhill, 2012). It takes place when knowledge or information of the phenomenon has been articulated in a theoretical form using distinct concepts, frameworks, models, and propositions (Forza 2002).

This research is projected to form part of a larger area of study; which is descriptive and explanatory, with the bulk of questions within the questionnaire seeking to discover and identify the variables within the phenomenon, and the relationship between them, as well as to elucidate the phenomenon in detail. The use of the questionnaire survey can be further justified from the examination in Table 3.1, which shows that a study with "what," "where" and "how" questions will be more suitable to utilize survey research methodology such as this study. Furthermore, given that one of the key objectives of this study to investigate causal relationships between maritime green supply chain management (MGSCM) practices and financial performance using well-defined concepts and models, the approach used in this study is mainly explanatory.

3.3 Research Design

Research design can be associated with the overall strategy that a scholar decided to incorporate the diverse components and apparatus of the study coherently and rationally, thereby, guarantee that it will effectively deal with the research problem; it comprises the blueprint for the data collection, measurement, and analysis (Trochim, 2006). The research process frequently develops through a cyclical process which consists of revising and revisiting the novel ideas and thoughts, revising the plans, the reading list and rewriting the chapter accordingly (Eriksson & Kovalainen, 2016). In this sense, the research problem should determine the type of design that the scholar should use. Thus, the function of a research design is to make sure that the verification obtained enables the scholar to successfully address the research problem rationally and as unambiguously as possible**.** In social sciences research, acquiring information pertinent to the research problem usually necessitates specifying the type of evidence needed to test a developed theory, to evaluate a program, or to precisely describe and assess meaning related to the investigation of the phenomenon.

The length and complexity involved in describing research designs can vary considerably (Gorard, 2013; Leedy & Ormrod, 2005; Vaus & Vaus, 2001; Vogt, Gardner, & Haeffele, 2012). For example, this study can be considered a complex designs due to the investigation of the effects of more than one variable or outcome; however, according to Saunders (2011), a well-developed design will ultimately achieve the following:

1. The precise identification and justification of a selected research problem, mainly concerning any suitable alternative designs that could have been used,
2. Review and synthesize prior literature that associated with the research problem,
3. Explicitly specify clear hypotheses development [i.e., research questions] central to the problem,
4. Effectively explain the data which will be essential for ample and adequate testing of the hypotheses and describe how such data will be acquired, and
5. Explain the methods of analysis to be applied to the data in determining whether the hypotheses are true or false.

In this study the research design includes the selection of participants and inducting them to the research processes, introducing the participants to the questionnaires, undertaking the questionnaires and analyzing feedback on the questionnaires for validity and facilitating data collection in a survey-based form. Research design involves planning, preparation, and execution of a research project. The design process covers all the issues from theoretical reading, methodology, empirical data gathering, analysis, and the writing process.

The positivistic paradigm methodology stressed diverse methods and procedures to accomplish the research design such as a case study, longitudinal study, cross-sectional study or a survey study (Hussey, 1997). Researchers in this respect are free to employ any of those research designs in accordance to their research objectives and research questions respectively. As a rule, the method of data collection resolutely depends on the research questions, width, depth and the period of the research conducted. In most cases, other universal factors to consider in method selection can be in term of purpose and objective of the research, the sample of respondent concerned and the researcher's financial consideration.

A cross-sectional study is usually used to explore and collect data on pertinent variables at once (one time) from a multiplicity of the population involved in the research. The data is typically collected at the same time or within a short time phase. Based on Hussey & Hussey (1997), the cross-sectional study involved a single investigation of a sample of elements chosen for the targeted population to have a snapshot of an ongoing situation. This technique if appropriately done may unveil how the variables are represented in a cross-section of the intended population of the studies at the time. Additionally, in the view of the financial standpoint, this method is notably cheaper to conduct as well as faster (time) to use and ethically safe. However this study method has the disadvantages in term of the validity because it is hard to establish a connection between variables as the indication of relationships are susceptible towards bias and ambiguous result between the cause studied (Hussey & Hussey, 1997).

For that reason, the most suitable research design to conduct this study is not a cross-sectional research design but a survey-based research design because it is easy to develop, flexible, cost-effective, less time to develop, broad range data collection and easy to administer respectively. Furthermore, as this study is explanatory, survey-based research design is found to be most relevance. This study requires a large sample size to administer and to gather the data. Thus, the survey research design is a very effective and most efficient tool for data collection method due to more extensive and hardest-to-reach respondent can be easily attained regardless.

In order to conduct this explanatory study, the method used is a structural equation model (SEM) to develop and test the new MGSM framework by considering some statistical assumptions. This justification is supported by Rigdon (1998) that indicates SEM could be used to answer and investigate entirely new theories and concepts respectively. Since this research emphasized more on the correlation between tangible variables, thus based on Babin, Hair, and Boles (2008) the used of SEM's can be considered substantial as it is capable of measuring the dimension of latent variables, while at the same time testing the relationships and correlation between latent variables significantly. Albeit the groundwork purpose of this method much more associated with a covariance-based approach (CB-SEM), many researchers could have opted for the alternative, by selecting the variance-based partial least squares technique (PLS-SEM) in their studies (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). In this respect, the research used PLS-SEM method formerly developed by Wold (1974, 1980, 1982) PLS is an SEM technique derived from the iterative method that takes the full benefit of the explained variance of endogenous (Fornell & Bookstein, 1982). Hair, Ringle, and Sarstedt (2011) suggested that PLS-SEM method could be functioning identically likes a multiple regression analysis and particularly useful for explanatory research purpose such as this study.

As this study involved with the new groundwork of theoretical assumption, according to Hair et al. (2014) the PLS is reasonably suitable to analyse the concurrently data-rich and theory-skeletal data. They also convoluted extensively concerning in the process of analysing the data; the model extracts fresh knowledge from the data and thereby putting flesh on the theoretical bones respectively. Due to this assumption, a great extent of the increased practice of PLS-SEM can be attributed to the fact that this method can handle problematic modelling issues that routinely arise in the social sciences such as unusual data characteristics (e.g., non-normal data) and highly complex models (Hair et al., 2014). Given the PLS-SEM potentiality, this study aimed to discuss the data interpretation and analysis using PLS-SEM method to analyse the MGSCM theoretical framework and outcomes model as well as the mediating effect of its framework.

3.3.1 Unit of Analysis

Unit of analysis can be defined as the level of aggregation of data collected through the data analysis process (Sekaran & Bougie, 2011). In that sense, the unit of analysis used in this study is based on the organizational level where the primary respondents are from a managerial position in the maritime industry in Malaysia. The study targeted a managing director, general manager, supply chain manager, head of the department, environmental health and safety (ESH) manager and other general executive or assistant manager involved directly or indirectly in maritime supply chain system as they are well familiar and conversant of their business operations to precisely represent their relevant organization.

3.3.2 Population

According to Sekaran and Bougie (2011) population refers to the whole group of an event, people, or merely a topic of importance that the researchers are intended to investigate. The population of this study is chosen from the managerial position within the internal organization spectrum. This includes operation manager, logistics manager, general manager as well as managing directors in the Maritime Logistic Service Provider (MLSP) industry in Malaysia that are listed in Marine Department of Malaysia (MARDEP), Malaysia External Trade Development Corporation (MATRADE 2018) and Federation of Malaysian Manufacturers (FMM 2018) respectively. In this regard, derived from the list retrieved from MATRADE website, 3542 maritime supply chain companies have been identified and categorized into nine different fields of sectors such as:

1. Cargo handling and services
2. Land transport services (freight and passengers)
3. Maintenance services for the support vehicle
4. Rental service of transport vehicles
5. Storage and warehousing services
6. Supporting services for water transport
7. Water transport services (freight and passenger)
8. Container services
9. Postal and courier services

It is worth to note that, numerous companies were registered in more than two fields. For example, an active cargo handling company could also be a service supplier for storage and warehousing service. For that reason, to conduct the survey, the questionnaires were categorized and distributed to each company singularly according to their relevance field respectively.

3.3.3 Sample Size

Sample size can be defined as the steps of choosing the amount/number of observations or replicates to incorporate in a statistical sample. The sample size is a crucial aspect of any empirical or quantitative study in which the objective is to formulate inferences about a population from a sample taken. Generalizations about populations from the data collected using any probability sample techniques are based on statistical probability. The larger the sample's size, the lesser the probable error in generalizing to the population. Probability sampling is finding the middle ground between the accuracy of the findings and the amount of time and money to be invested in collecting, checking and analysing the obtained data. The sample size within this study is governed by:

i. The confidence level needed for the data –the level of certainty the data collected will represent the characteristics of the whole population being investigated;
ii. The margin of error that the study can tolerate –the accurateness for any estimates made from the samples;
iii. The types of analyses being adopted –the number of categories to subdivide the data, as many statistical techniques have a minimum threshold of data cases;
iv. The size of the entire population from which the sample is drawn.

Given these influences, the final sample size is a matter of judgement as well as of calculation. In order to make specific unreliable results do not occur, the data analysed must be normally distributed. The larger the total size of a sample, the more likely its distribution will be to the normal distribution and thus the more robust it will be (Saunders et al., 2009). Providing they are not biased, samples of larger absolute size are more likely to be representative of the population than smaller samples and the mean (average) calculated for the sample is more likely to equal the mean for that population. Researchers adopt a 95% level of certainty. If the sample were selected 100 times, at least 95 of these samples would be confident to represent the characteristics of the entire population. The confidence level implies the precision of the estimations of the population as the percentage within an assured range or margin of error. In general Table 3.2 represents a rough guide to the various minimum sample sizes needed from different sizes of the population given a 95% confidence level for different margins of error.

According to Saunders et al. (2009), most business and management research is content to calculate approximately the population's characteristics at 95% certainty to within plus or minus 3% to 5% of its actual values. This means that if 45% of the sample is in a specific category, then it will be 95% certain that estimation for the entirety of population within the same category will be at 45% plus or minus the margin of error – somewhere between 42 and 48% for a 3% margin of error. Table 3.2 implies that the smaller the absolute size of the sample, the smaller the relative proportion of the total population sampled, and the higher the margin of error. Within this contextual presentation, the impact of the absolute sample size on the margin of error lessens for larger sample sizes. It is worth to note, a 100% response rate is improbable, and the sample will need to be larger to make enough responses for the margin of error the study requires. As this study has the size of the population of 3542, it has a closer to 5000 (according to the Table 3.2) which implies the study needs roughly around 357 sample size at 5% margin errors.

Table 3.2 Sample sizes for different sizes of the population at a 95% confidence level

	Margin of error			
Population	**5%**	**3%**	**2%**	**1%**
50	44	48	49	50
100	79	91	96	99
150	108	132	141	148
200	132	168	185	196
250	151	203	226	244
300	168	234	267	291
400	196	291	343	384
500	217	340	414	475
750	254	440	571	696
1 000	278	516	706	906
2 000	322	696	1091	1655
5 000	357	879	1622	3288
10 000	370	964	1936	4899
100 000	383	1056	2345	8762
1 000 000	384	1066	2395	9513
10 000 000	384	1067	2400	9595

Source: Saunders et al. (2009)

Statistical software such G-Power analysis can also be used to find the number of
Statistical software such G-Power analysis can also be used to find the number of samples required to obtain specific statistical power (Faul, Erdfelder, Lang, & Buchner, 2007; Hair, Hult, Ringle, & Sarstedt, 2017). For example, using F-test and linear multiple regression analysis with predictor input of 7 in G-Power, the resulting sample size of 70 is enough to yield the power of 0.95. Nevertheless, Cohen (1992) deposits that power of 0.80 is generally acceptable to be used for general study and should not be lower than 0.80 to prevent Type II error of statistical test. Type II error is an error of keeping false null hypothesis (false negative finding) while Type I error occurs when a true null hypothesis (false positive finding) is incorrectly rejected. While Bryant and Yarnold (1995) suggest, 100 is the minimum sample size for statistical validation.

Additionally, there are many guiding principle and rule of thumb in selecting the sample size. For examples, (Roscoe, 1975) has proposed the thought of optimum sample size between 30 and 500 are adequate for most researches. He also highlighted that researcher might use of sample about 10% of the parent population. In this case, if 3542 is a total population for this study, the required sample size needed is 354. Bryant and

Yarnold (1995) have proposed that the number of variables should consider being at least larger of 5 times the numbers of variables being examined. In this study, the variables examined are 8, and thus, the required sample size is 40. However, this number cannot be used as sample size measurement due to the minimum sample size for any statistical analysis needed for validation using this method is 100 (Bryant & Yarnold, 1995).

While, according to Cohen, Manion, and Morrison (2007), the lowest amount of sample size required for a scientific research should be the number of questions in the questionnaire for model variables (constructs in the framework) multiplied by a minimum number of at least 5 respondents (Cohen et al., 2007). In this case, 43 questionnaires multiply by 5 would result in 215 of sample size. On the contrary, the sample size should be an item-to-response ratio from 1:4 to 1:10 for each set scales to be examined (Hinkin, 2009). There were 43 items to be measured in this study; thus, the sample size from 172 to 430 respondents would be enough for this study analysis. Based on abovementioned justification, this study inclined to adopt minimum sample size requirement of at least 100 (Bryant & Yarnold, 1995) and the best sample size should be close to 430 observations (Hinkin, 2009). Nevertheless, after collecting the data from the respondents, this study has achieved 160 responses which satisfied the minimum sample size required as suggested by Bryant and Yarnold (1995) for optimum data validation and reliability.

3.3.4 Sampling Method

In general, the sampling process can be classified as a fundamental selection of a population. In this study, the assortment of proper sampling is an imperative component of the positivistic study. The selection of the sample is essential and needed by the researcher to deem each member of the population has a good possibility of being selected. The sampling process can be divided into two types of sampling techniques: probability or representative sampling and non-probability or judgmental sampling (Saunders et al., 2009). With probability samples, the possibility, or probability, of each sample being particularly selected from the population is known and is typically equal for all samples. Using this technique, it is feasible to answer research questions and to accomplish objectives that require the study to calculate approximately and statistically the characteristics of the entire population from the sample. Probability sampling is frequently associated with survey-based study and experimental research strategies (Saunders et al., 2009). Non-probability samples, on the contrary, the probability of each sample being selected from the total population is not known, and it is not possible to answer research questions or to deal with objectives that require the study to make statistical inferences about the characteristics of the population. In this regard, the researcher still can generalize from non-probability samples about the population, but usually not on statistical grounds. Figure 3.1 shows the sampling techniques in general and the variations of the technique based on probability or non-probability samples.

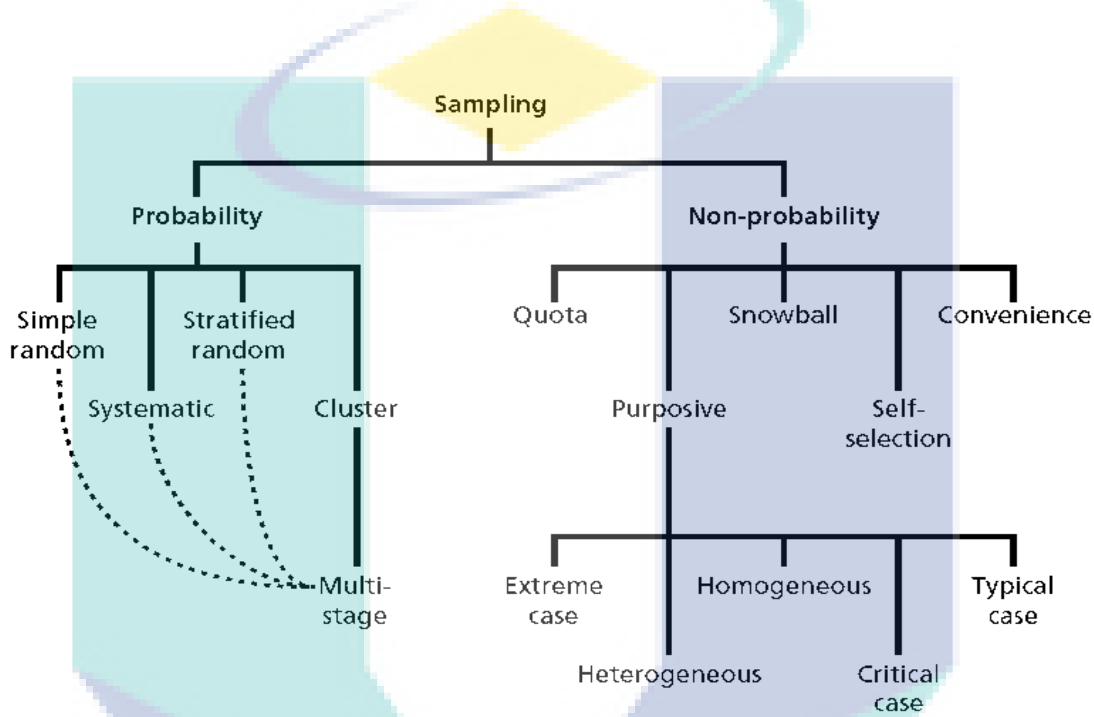

Figure 3.1 Sampling technique variations

Based on Saunders et al. (2009)

To meet the research objective, disproportionate stratified random sampling is used heterogeneously to contain more than one element in this research. Disproportionate stratified random sampling can be defined as a modification of random sampling in which the population is divided into two or more appropriate and significant strata based on one or some attributes relative to stratified samples of unequal sizes (Schofield, 1996). This sampling technique segregates the population into subgroups or strata but utilizes a sampling fraction that is not similar for all strata; some strata are oversampled relative to others. This technique is also known as stratification. Stratification is a technique of separating members of the population into subgroups of a homogeneous/similar item prior to sampling (Fernando & Wah, 2017). In this regard, the strata should and ought to be similarly exclusive: by means of each aspect in the population must be categorized to only one strata. Dividing the population into a series of pertinent strata means that the sample is more probable and likely to be representative, as it can ensure that each of the strata is represented equally within the sample. Hence, each unit in the population could be identified, and each unit has a known, non-zero probability of being in the sample. This is mainly used when the population has sub-groups (strata) that are of interest of the exacting study. The key reasons why disproportionate stratified random sampling is used due to:

1. The study wants to emphasize a subgroup within the population. This technique is practical in this study because it ensures the presence of the key subgroup within the sample.
2. The study employs disproportionate stratified random sampling when it wants to scrutinize existing relationships between two or more subgroups (in this case the whole subgroups of maritime supply chain) due to not sure whether the subgroups that this study wants to observe are represented equally or proportionately within the sample.
3. The study can characteristically sample even the smallest and most inaccessible subgroups in the population due to the very high strata population ratio. This allows the study to sample the rare extremes of the population.
4. Higher statistical precision compared to simple random sampling. This is because the variability within the subgroups is lower compared to the variations when dealing with the entire population (Fernando & Wah, 2017).
5. It has high statistical accuracy and precision; it also means that it entails a relatively small sample size which can save a lot of time, money and effort.

Each company in the maritime supply chain is chosen based on these 9 sub-groups from MATRADE and FMM (2018). The strata in the context of this study, defined as the group of people from each maritime company from diverse backgrounds of the field who are responsible for the performance or have knowledge related to the strategic decisions of the company like the mid-level manager. The listing of sub-group was classified as 9 strata which are cargo handling and services, land transport services (freight and passengers), maintenance services for support vehicle, rental service of transport vehicles, storage and warehousing services, supporting services for water transport, water transport services (freight and passenger), container services as well as postal and courier services. The respondents were then selected from the population to be listed in strata in accordance with their respective strata based on their unique line of operation/specialization. A total of 700 companies were identified as mutually exclusive in the strata for distribution. After that, the surveys were distributed to all respondents in each strata via emails to achieve a higher response rate. To steer clear of possible bias from this sampling technique, surveys were completed through email with follow-up calls using the company's details provided in MATRADE and FMM (2018). The targeted sample companies were recognized from the list, which focused on the 9 major sectors as mentioned before. The demographic sample thus covered the entire population of the maritime supply chain in Malaysia as every sub-group was chosen based on 9 major types of operation in the maritime supply chain that represented the entire maritime sectors in Malaysia.

3.4 Measurement of Variables and Constructs

In this section, this study has discussed the procedure needed in the construction of the items used in the process of developing the questionnaire. Based on Luam and Lin (2004), the items used for constructs should be adopted from prior research in order to ensure the content validity of the scale used. Thus, in order to develop a reliable and valid questionnaire, a nominal scale was used in section A to determine the demographic variable. In this regard, from a statistical approach, it is the lowest measurement level that this study could use. Nominal scale, as its name suggested can be a "label"; it is the data placement into categories, without any order or arrangement and can be easily distinguished. Next, For Section B, Section C, and Section D, the questionnaire used the interval scale of measurement to collect data. Whereas in section E, a nominal scale was again being utilized like Section A. In this regards, Section A and Section E were individually questioning on the necessary information of company profile and respondent profile background. Section B measured the independent variable (IV) which is MGSCM and it contains five (5) constructs with 27 items respectively. Meanwhile, Section C assessed the mediating variables of two (2) constructs which is energy efficiency performance (EEP) and low carbon performance (LCP) with 11 items in total. Finally, Section D measured the dependent variable (DV) which is financial performance (FP) of the company which includes one (1) construct through 5 items. All constructs and items were adapted from renowned preceding published literature from SCM and GSCM domain. It is also worth to note that some questionnaires were adopted from different authors due to some of the green concepts are relatively new and need to be investigated from different dimensions/angles in various maritime/green studies highlighting the same concept to capture this study objective and purposes accurately.

For section B, C and D, the instruments of each variable are measured using five (5) points of the Likert scale as below:

1 - Strongly disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly agree

Likert scales are ordinal by nature, which serve to rank responses for each question items. In this study, the measurement scales of the variables were based on five (5) points of Likert-type scales (Likert, 1932). The reason why this study used five (5) points of Likert-type scales is due to:

1. Comparability of results as the questionnaire was adopted from previous studies that utilized the five (5) points of Likert-type scales (Preston & Colman, 2000).
2. Its ability to increase the response rate and response quality along with reducing respondents' "frustration level" (Babakus & Mangold, 1992).
3. Higher reliabilities for five-point scales (Preston & Colman, 2000).
4. Preceding research found that a five-point scale is readily understandable to respondents and allows them to convey their accurate view (Marton-Williams, 1986).
5. The literature suggests that the five (5) points of Likert-type scales emerge to be less confusing to the respondents (Babakus & Mangold, 1992).

Questionnaire surveys were dispersed to the management personnel of the firms with the primary objective of targeting the top management team of the companies. The method of collecting data was through an online questionnaire submitted by email. This study was conducted online due to the advantage of online survey reflected through low-cost implementation; time-saving and can reach to the broader population in the industry. However, it is worthwhile to note that specific drawback may impact the reliability of data as it has limited sampling and respondent availability due to internet coverage, the probability to be ignored by respondent as well as misinterpretation of the questionnaire by potential respondents. The data collected would then be quantified, and assessed variables in testing the hypotheses developed earlier in the previous chapter.

Consequently, examining the relationship among all the variables, Structural Equation Modelling (SEM) method with Partial Least Square (PLS) Algorithm and Bootstrapping in SmartPLS software version 3.0 were used to evaluate the data gathered from the questionnaire. The primary objective of using the algorithm is to employ a broad range of both explanatory and exploratory multivariate method, from regression to path modelling respectively (Vinzi & Russolillo, 2013). In this sense through a proper procedure called bootstrapping in SmartPLS, T-statistics for significance testing for both the inner and outer model could be identified.

3.4.1 Measurement of Independent Variables

Independent variable (IV) refers to the variable that manipulates or influence the dependent variable (DV). Therefore, the independent variable (IV) will bring significant impact to the dependent variable (DV). Thus, in this study, the variables have been investigated to discover the impact whether maritime green supply chain management (IV) (MGSCM) practices will influence the outcome of sustainable business performance (DV) in the maritime sector. As a result, there were five (5) constructs beneath the independent variable which include the 26 items respectively. The items were mainly adapted from Stephan Vachon & Klassen (2008); Badell, Romero, & Puigjaner (2005); Comelli, Féniès, & Tchernev (2008); Flynn, Huo, & Zhao (2010); Lai, Wong, Lun, & Cheng (2013); Lee, Tae Kim, & Choi (2012); Lun, Lai, & Cheng (2013); Prajogo & Olhager (2012); Wu, Yeniyurt, Kim, & Cavusgil (2006); Zhu, Sarkis, & Geng (2005); Zhu, Sarkis, & Lai, (2008) and Zhu, Sarkis, & Lai (2013) research. The items are exhibited in Table 3.3, to table 3.7.

Table 3.3 Items for GVALS (Independent Variable)

Variables	Items	Sources
Green Value Added Logistic Services	GVALS 1: Our company try to avoid using material/equipment that is harmful to the environment after considering the changes in price	Adapted from Lee, Tae Kim, & Choi (2012)
	GVALS 2: Our company's suppliers are required to have an implemented green management system (e.g. ISO 14000, SEEMP, EEDI, EEOI certification)	Adapted from Lee, Tae Kim, & Choi (2012)
	GVALS 3: Our company improve the design of shipping equipment/processes to meet environmental standards/certifications	Adopted from Lun, Lai, & Cheng (2013)
	GVALS 4: Our company utilizing green design of products/equipment for reduced consumption of material/energy	Adopted from Zhu, Sarkis, & Geng (2005)

Table 3.3 Continued

Variables	Items	Sources
	GVALS 5: Our company has optimized operational processes to reduce waste/emission/energy usage (e.g. green material handling, green purchasing, green logistic, etc.)	Adapted from Zhu, Sarkis, & Lai (2013) and Lee, Tae Kim, & Choi (2012)

Table 3.4 Items for GICS (Independent Variable)

Variables	Items	Sources
Green Information and Communication Systems	GICS 1: Our company use electronic transfer (purchase order, invoices and funds) to reduce the use of paper transaction/documentation	Adapted from Prajogo & Olhager (2012).
	GICS 2: Our company share information on energy efficiency best practices with our key partners to ensure that we have the same knowledge	Adapted from Prajogo & Olhager (2012).
	GICS 3: Our company use the advanced information system to track /expedite shipments	Adopted from Flynn, Huo, & Zhao (2010)
	GICS 4: Our company has real-time searching of the level of inventory and equipment	Adopted from Flynn, Huo, & Zhao (2010)
	GICS 5: Our company has real-time searching of logistic related operating data	Adopted from Flynn, Huo, & Zhao (2010)

Table 3.5 Items for GSIP (Independent Variable)

Variables	Items	Sources
Green Supply Chain Integration Practices	GSIP 1: Our company collaborates actively with our partners in developing sustainable strategies	Adopted from Wu, Yeniyurt, Kim, & Cavusgil (2006)
	GSIP 2: Our company collaborates actively with our partners in demand forecasting to eliminate waste	Adopted from Prajogo, & Olhager (2012)
	GSIP 3: Our company integrates our partners in a participative decision-making process that promotes environmental innovation	Adopted from Prajogo, & Olhager (2012)
	GSIP 4: Our company logistic activities are well integrated with our key partners' logistic activities	Adopted from Prajogo, & Olhager (2012)
	GSIP 5: Our company work closely with our suppliers in order to minimize service/production impact on the environment	Adopted from Stephan Vachon & Klassen (2008)
	GSIP 6: Our suppliers are selected with environmental criteria consideration	Adopted from Stephan Vachon & Klassen (2008)

Table 3.6 Items for SDC (Independent Variable)

Variables	Items	Sources
Shipping Design and Compliance	SDC 1: Our company try hard to comply for energy saving shipping equipment design	Adopted from Lai et al. (2013)
	SDC 2: Our company try hard to comply with shipping equipment reuse	Adopted from Lai et al. (2013)
	SDC 3: Our company try hard to comply to reduce environmental damages	Adopted from Lai et al. (2013)
	SDC 4: Our company try hard to comply with the recycling of waste	Adopted from Lun et al. (2013)
	SDC 5: Our company try hard to comply with the recovery of waste	Adopted from Lun et al. (2013)

Table 3.7 Items for GFF (Independent Variable)

Variables	Items	Sources
Green Financial Flow	GFF 1: We give a budget priority to each planning of physical and financial flow to support green supply chain activities	Adapted from Comelli, Féniès, & Tchernev (2008)
	GFF 2: We apply activity-based costing (ABC) to determine direct and indirect energy/material consumptions with net sales evaluation from green activities	Adapted from Comelli, Féniès, & Tchernev (2008)
	GFF 3: We monitor payment delay for each green activity transaction in our financial flow	Adapted from Comelli, Féniès, & Tchernev (2008))
	GFF 4: We considering depreciation of each of our green equipment used for day-to-day business operations	Adapted from Comelli, Féniès, & Tchernev (2008)
	GFF 5: We use separate evaluation of cash position which generated from green activities and conventional transactions at the end of a period of the year	Adapted from Badell, Romero, & Puigjaner (2005); Comelli, Féniès, & Tchernev (2008)

3.4.2 Measurement of Mediating Variables

The mediating variable can be defined as the variable that causes mediation in the independent variable (IV) and the dependent variables (DV). It explains the relationship strength between the dependent variable and the independent variable. According to Baron and Kenny (1986), a specified variable may be said to function as a mediator to the extent that it accounts and measure for the relation connecting the predictor (IV) and the criterion (DV). The mediating variables explain how external physical events take on internal psychological significance. The universal test for mediation is to examine the relationship between the independent variable (IV) and the dependent variables (DV), the relation between the independent variable (IV) and the mediating variables, and the relation between the mediator and dependent variables (DV). The process of complete mediation is defined as the complete intervention caused by the mediator variable. The dimension of mediating variable in this study is energy efficiency performance (EEP) and low carbon performance (LCP) which mediates the relationship between the determinant of maritime green supply chain management (MGSCM) and financial performance (FP). Eleven (11) items were adapted from the studies from researchers such as Boettcher & Mueller (2015); Chen (2011); Chiou, Kai, Lettice, & Ho (2011); Fernando & Hor (2017); Oh, Pang, & Chua (2010); Zhu et al. (2008) research. The items are displayed in Table 3.8 to 3.9 respectively.

Table 3.8 Items for EEP (Mediating Variable)

Variables	Items	Sources
Energy Efficiency Performance	EEP 1: Our company has decreased the cost of energy consumption.	Adapted (Fernando & Hor, 2017; Zhu et al., 2008)
	EEP 2: Our company has achieved a reduction in energy use/consumption (per unit of output).	Adopted (Boettcher & Mueller, 2015; Chen, 2011)
	EEP 3: Our company has consumed fewer resources, such as energy, water, electricity, gas and petrol	Adopted (Chiou et al., 2011)
	EEP 4: Our company has reduced energy wastage through equipment selection	Adapted (Fernando & Hor, 2017)
	EEP 5: Our company apply energy efficiency strategies in lowering energy consumption in an organization	Adapted from Oh, Pang, & Chua (2010)
	EEP 6: Our company has reduced overall energy consumption significantly throughout the organization	Adapted (Fernando & Hor, 2017)

Table 3.9 Items for LCP (Mediating Variable)

Variables	Items	Sources
Low Carbon Performance	LCP 1: Our company has achieved a reduction of carbon emissions (per unit of output).	Adapted (Boettcher & Mueller, 2015)
	LCP 2: Our company has managed to reduce carbon emissions in its operation	Adapted (Fernando & Hor, 2017)
	LCP 3: Our company has achieved reduction use of carbon-intensive materials (per unit of output).	Adapted (Boettcher & Mueller, 2015)
	LCP 4: Our company has reduced fees/fines/taxes paid for carbon emissions discharge	Adapted (Fernando & Hor, 2017)
	LCP 5: Our company has limited carbon and other emissions	Adapted (Chen, 2011)
	LCP 6: Our company has reduced overall carbon emissions	Adapted (Fernando & Hor, 2017)

3.4.3 Measurement of Dependent Variables

The essential factor of this study is the outcomes or the dependent variable (DV). It is the primary objective of this study to illustrate or predict whether the variable is affected by several other factors. Hence, the dependent variable (DV) for this study is the financial performance in the maritime industry adopted from SCM and GSCM literature. Five (5) items were adapted from the studies from researchers such as Zhu, Sarkis, & Lai (2008) and Lai, Wong, Veus Lun, & Cheng (2013) research. The items are displayed in Table 3.10 respectively.

Table 3.10 Items for Financial Performance (Dependent Variable)

Variables	Items	Sources
Financial Performance	ECP 1: Our company has improved in terms of profitability	Adopted from Lai, Wong, Lun, & Cheng (2013)
	ECP 2: Our company has improved the sales growth in revenue	Adopted from Lai, Wong, Lun, & Cheng (2013)
	ECP 3: Our company has improved the growth in return on sales (ROS)	Adopted from Lai, Wong, Lun, & Cheng (2013)
	ECP 4: Our company has improved the growth return on investment (ROI)	Adopted from Cao and Zhang (2011)
	ECP 5: Our company has improved the growth in return of asset (ROA)	Adapted from Busch and Hoffmann (2011)
	ECP 6: Our company has improved the overall net profit of the company	Adapted from Cao and Zhang (2011)

3.4.4 Measurement of Demographic Variables

In this study, there are two types of demographic variables that should be considered; which are the company profile and the respondent's profile. In this manner, demographic variables may include the company's environmental certification, business sector, type of company, duration of involvement in MGSCM, the port location of supplying service, the location of the company, number of the employee as well as ownership of the company. The information of this demographic data could be used to determine if significant organization demographic differentiation presented between the organizations involved or could potentially act as control variables.

3.5 Pilot Test

Before distributing the real questionnaire for data collection, this study has conducted a pre-test and pilot test beforehand. The summary of pilot test finding is presented in the next sub-section which include the method and sample used, descriptive analysis, reliability analysis as well as person correlation analysis to determine the initial result of the relationship between MGSCM and financial performance.

3.5.1 Method of Pilot Testing

A pilot test and pre-test were conducted to understand the preliminary projection of the research design aiming to evaluate the feasibility, time, cost, adverse events, and improve upon the study design and research instruments prior to conducting of an actual study. Before distributing the questionnaires for the pilot test, face validity (pre-test) was conducted to validate the questionnaires from experts and academician in the maritime field. After the feedback received, questions that were too ambiguous or too lengthy were amended to avoid potential vague and misinterpretation. Meanwhile, for pilot test analysis, based on Hill (1998) and Isaac and Michael (1982), they suggested 10 to 30 participants for pilots in survey research. However, Doody and Doody (2015), suggested 10% of the project sample size may also deem suitable. While, Boyd, Westfall, and Stasch (1977) proposed 20 respondents to allow proper statistical testing procedures. Hence, to get the optimum result, this study's pilot test used a total of twenty (20) set of questionnaires and were tested among the respondents or experts in the maritime industry and academicians in the area of maritime operations, logistics and supply chain management. Ten (10) sets of online questionnaire (complete questionnaire) were distributed among ten respondents working with the maritime companies while another ten (10) sets of questionnaire were distributed to the academicians with maritime industry background and experiences from Netherlands Maritime Institute of Technology and University Kuala Lumpur Malaysian Institute of Marine Engineering Technology. The reliability of measurement was tested based on the Cronbach alpha coefficient to ensure the reliability and quality of the instrument. Others analyses such as company profile, descriptive analysis, and Pearson correlation were also conducted to achieve this study's objective of the pilot testing. Meanwhile, the mediation analysis was not conducted due to low sample size that may impact the accuracy of the pilot test result due to the smaller sample size can have a significant outlier. All the analyses and data in the pilot test were computed using the SPSS Version 23. It is worth to note that the sample from the pilot study was not used for an actual data analysis in Chapter 4.

3.5.2 Result and Discussion of Pilot Test

3.5.2.1 The Sample

Table 3.11 demonstrates the overall widespread of 20 demographic profile of respondents collected which are from 9 diverse sectors such as cargo handling (35%), supporting service for water transport (35%), container service (30%), storage and warehousing service (20%), maintenance service for support vehicle (25%), land transport service (25%), water transport service (22.2%), rental service for support vehicle (10%), as well as postal and courier service (8.3%). It is worth to note that each company had more than a single operation in its business process reflected through multiple choice of answers in the survey questionnaires. Regardless of the sectors that the company function in, most of the respondent responded were primarily involved in cargo handling (35%), supporting service for water transport (35%) and container service (30%) due to the fact that primary maritime supply chain usually involved with these three (3) major services in particular. It can be concluded that maritime supply chain main operating activities would be the shipping of goods, dealing with the external operation of cargo and container handling with maintenance service as main supplementary services.

Next section summarizes the type of company business involved in the maritime industry. The results explained that the highest frequency and percentage of 35 % of companies involved in cargo handling as well as a shipping agent in Malaysia ports supply chain, following with shipping linear and forwarding agent with 40.3% and 31.9% respectively. The remaining types of the companies primarily scattered around in various operations such as ship repair (23.6%), depot operator (20.8%), warehousing (19.4%), Haulage Company (18.1%), ship chandler (16.7%) and stevedore (5.6%). The initial results concluded that most of the companies have more than one type of operations in their respective company business operation.

Moving on to green certification, the analysis showed that 68.4% of participating respondents of the maritime supply chain in Malaysia were certified with ISM, which is an international standard for safe management and operation of ships and pollution prevention since it was amended in the year 2000. Followed second by EMS ISO 14001

(63.2%) as the most adopted environmental management certification, the third place was MARPOL 73/78 as the most adopted pollution prevention of ships. The results show that most companies were adopting green certification in their daily operations. In addition, 45% of the companies had served in a maritime supply chain for 6-10 years which was still relatively new. Further details of the profile of ports supplied, location and number of employees are presented in Table 3.11 below

Table 3.11 Company profile

Demographic	Categories	Overall N=20	
		Frequency	Percent (%)
Green certification (multiple)	Environment Management System (EMS) ISO 14001	12	63.2
	Energy Management System Certification (EnMS) ISO 50001	3	15.8
	Ship Energy Efficiency Management Plan (SEEMP)	3	15.8
	Energy Efficiency Design Index (EEDI)	2	10.5
	Ship Energy Efficiency Operational indicator (SEEOI)	2	10.5
	International Safety Management (ISM)	13	68.4
	International Convention for the Prevention of Pollution from Ships (MARPOL 73/78 Annexes)	6	31.6
	More than 200 employees	4	20
Years served	less than 1 year	2	10
	1-5 years	4	20
	6-10 years	9	45
	11-15 years	3	15
	16 years and above	2	10
Employees	5 to 30 employees	3	15
	30 to 75 employees	8	40
	75 to 200 employees	5	25
	More than 200 employees	4	20
Sectors (multiple)	Cargo handling and services	7	35
	Land transport services (freight and passengers)	3	15
	Maintenance service for support vehicle	6	30
	Rental services of transport vehicles	2	10
	Storage and warehousing services	4	20
	Supporting service for water transport (port and waterway operation services)	7	35
	Water transport services (freight and passengers)	3	15
	Container services	6	30
	Postal and courier services	2	10

Table 3.11 Continued

Demographic	Categories	Overall N=20	
		Frequency	Percent (%)
Type (multiple)	Shipping linear	7	35
	Shipping agent	7	35
	Forwarding agent	4	20
	Depot operator	1	5
	Haulage company	3	15
	Warehousing	7	35
	Stevedore	2	10
	Ship Chandler	6	30
	Cargo/container handler	7	35
	Ship repair	5	25
Location	Terengganu	2	10
	Johor	4	20
	Pahang	2	10
	Kuala Lumpur	4	20
	Penang	4	20
	Sarawak	2	10
	Selangor	2	10
Port supplied (multiple)	Bintulu Port Sdn. Bhd.	6	30
	Johor Port Bhd	8	40
	Kelang Multi Terminal Sdn. Bhd.	4	20
	Kuantan Port Consortium Sdn. Bhd.	6	30
	Lembaga Pelabuhan Kelang	9	45
	Lembaga Pelabuhan Kuching	5	25
	Lembaga Pelabuhan Miri	3	15
	Lembaga Pelabuhan Sabah	2	10
	Northport (Malaysia) Bhd.	5	25
	Pelabuhan Tanjung Pelapas Sdn. Bhd	8	40
	Penang Port Sdn. Bhd.	9	45

Table 3.12 shows that most respondents pointed out that shipping/warehousing were critical areas of implementation of green practices (45%) followed by distribution/logistic (30%). Nevertheless, when the participating respondents were asked about how many years that MGSCM had been adopted in their company, the highest frequency (35%) was indicated 1 to 5 years, which means that they were still new to MGSCM practices in their supply chain operations. The result was supported by the level of adoption of most companies which was currently in the start-up stage of MGSCM (35%). Meanwhile, the most apparent factor that motivated MGSCM implementation in the operations was regulations and requirements compliance (70%) followed by the need to minimize adverse impacts to the environment (45%) and as cost-saving measures (45%).

Table 3.12 MGSCM profile of the company

Demographic	Categories	Overall N=20	
		Frequency	Percent (%)
Years adopted MGSCM	less than 1 year	6	30
	1-5 years	7	35
	6-10 years	5	25
	11-15 years	1	5
	16 years and above	1	5
MGSCM most apparent	Service development	2	10
	Shipping/warehousing	9	45
	Distribution / Logistics	6	30
	Information/communication technology	3	15
Level of adoption	Seed	6	30
	Start-up	7	35
	Expansion	4	20
	Monitoring and control	3	15
Motivation (multiple)	To comply with regulations and requirements	14	70
	To minimize environmental negative impacts	9	45
	To be more competitive in the market	8	40
	To increase the efficiency in all processes/operations	6	30
	To minimize the cost (cost-saving measures)	10	50
	To fulfill the buyers/clients request	7	35
	To be an environmentally responsible company	9	45

3.5.2.2 Descriptive Analysis

In Table 3.13, the mean of independent variables consisting of GICS, GVALS, GSIP, SDC, and GFF, shown that most companies have MGSCM practices integrated into their operations (the mean minimum number is 1, and the maximum number for mean is 5). As observed, the mean for all variables was above 3, and this indicated that all companies in the maritime supply chain are indirectly involved in MGSCM and somehow influence financial performance. The highest mean of MGSCM is achieved by GICS (3.8800) which signifies the most adoption while the lowest mean was GSIP (3.2917) which signifies the least implementation of MGSCM. For financial performance dimension, the agreement level is relatively high (3.8333) which signify that MGSCM indirectly influenced the financial performance based on the level of agreement amongst respondents. Finally, for the mediator construct of LCP and EEP, the mean is also quite high with a value of 3.9750 and 3.5900 that translate into high agreement level on the impact of LCP and EEP.

The results of a reliability test and an item-total correlation analysis also showed that the derived results are reliable. The reliability coefficient alpha values of the five MGSCM, LCP, EEP and FP constructs are high, in the range of 0.949 – 0.959 which was exceeding 0.700 (Hair et al., 2006), suggesting consistency and reliability of dimension tested. All item-total correlation coefficients are also high, ranging from 0.505 to 0.918 for all MGSCM and performance dimensions well above 0.500 thresholds which suggest the consistency and highly inter-correlated item in the same construct (Shang, Lu, & Li, 2010) without the need for item elimination

Table 3.13 Descriptive Statistics

Variables	Items	Mean	Std. Deviation	Cronbach Alpha	Item-Total Correlation
GICS	5	3.8800	0.92997	0.959	0.555-0.816
GVALS	5	3.6833	0.72729	0.954	0.505-0.655
GSIP	6	3.2917	0.91267	0.955	0.552-0.777
SDC	5	3.5700	0.98467	0.954	0.604-0.805
GFF	5	3.5800	0.86548	0.951	0.520-0.851
LCP	5	3.9750	0.85886	0.953	0.745-0.855
EEP	6	3.5900	0.98296	0.955	0.662-0.839
FP	6	3.8333	0.78174	0.949	0.670-0.918

3.5.2.3 Correlation Analysis and Summary of Finding

A Pearson correlation analysis was computed to assess the fundamental relationship between MGSCM practices and financial performance outcome. For the test of significance, the two-tailed test was selected due to this study do not have an assumption of whether it is a positive or negative correlation between MGSCM practices and financial performance. The result shows that there was a positive correlation between MGSCM practices and financial performance. For example, GICS dimension indicates the significant correlation $r = 0.779$, $n = 20$, $p = 0.000$ at $p < 0.01$ level. Table 3.14 summarizes all the results of this analysis. Overall, there was a strong, positive correlation between MGSCM practices (GICS, GVALS, GSCIP, SDC, and GFF) and financial performance. These initial results show that the adoption of MGSCM practices were indeed correlated with the positive outcome of the financial performance.

Table 3.14 Results of correlations

MGSCM Dimensions		Financial Performance (FP)
GICS	Pearson Correlation	0.779**
	Sig. (2-tailed)	0.000
	N	20
GVALS	Pearson Correlation	0.813**
	Sig. (2-tailed)	0.000
	N	20

Table 3.14 Continued

	MGSCM Dimensions	Financial Performance (FP)
GSCIP	Pearson Correlation	0.752**
	Sig. (2-tailed)	0.000
	N	20
SDC	Pearson Correlation	0.857**
	Sig. (2-tailed)	0.000
	N	20
GFF	Pearson Correlation	0.835**
	Sig. (2-tailed)	0.000
	N	20

**. Correlation is significant at the 0.01 level (2-tailed).

3.5.3 Conclusion of Pilot Test Result

The initial results of the pilot test indicated clearly that MGSCM practices do exert a positive impact on maritime supply chain financial efficiency that can either translated in terms of profit or revenue. This claim is supported by the pilot test result (Pearson correlation analysis) from the perception of academics and maritime expert's point of view. The result from the descriptive analysis (MGSCM profile of the company) also showed that the motivation of adopting green practices reside within the firm motivation to comply with regulation and to minimize the operational cost to increase financial performance. Even though the initial result suggests the adoption of MGSCM is still in its infancy, the result is still inconclusive due to small sample size. However, the result of the broader sample population that represents the whole industry can be taken in the actual data collection.

3.6 Data Collection

There are numerous methods that can be used to collect data for survey research. Among the methods that usually used are a personal distributed survey, email survey, and web-based survey. The option of selecting each method is solely depended on the principle idea of the study, research purpose, time limit, available resources, population size as well as the type of sample considered.

3.6.1 Data Collection Method

Typically, managing the survey through the internet could enhance administration time, and radically cut down the cost (Sheehan & Sheehan, 1999; Yun & Trumbo, 2006). In this regards, Kaplowitz, Hadlock and Levine (2004) recommended that using internet-based survey would provide a significant advantage to the researcher as its ability to attain high response rate provided that the population could access to the internet easily. As Malaysia is a developing country with a relatively advanced internet network, almost all companies are available with the internet connection and thus motivate this study to be conducted online, through sending private emails to targeted respondents. Higher response rate can be expected and shorter response time also can be achieved via this method. Additionally, individual distribution of the questionnaire was conducted on related companies that are functioning within a maritime port complex.

Thus, a questionnaire is needed for quantitative data collection and attached through the mail survey method. The questionnaire is a self-administered by the researcher, and it is conducted through an online survey service provider endowed by Google Form. This method is chosen due to its convenience and also because the population is scattered all over Malaysia. It can also be used to cover broader geographical regions throughout Malaysia including Sabah and Sarawak region. By using Google Form service, the prepared questionnaires are sent to the respondents through email along with a cover letter that includes an online survey link generated by Google Form respectively

The cover letter will elucidate the purpose of the study, and offer guarantees to the respondents with full anonymity and confidentiality along with a deadline of the respondent's submission. Every section of the questions in the questionnaire is set accordingly and can only be proceeded to the next questions if the required section has been fully answered by respondents to evade missing data problem. A period of 2 weeks upon receiving the questionnaire is given to all respondents, and it is expected that the questionnaire will be submitted online once it is completed. Follow-up calls and emails as a reminder were administrated one week after the initial mailing of the questionnaire to the respondents to ensure a higher response rate of the data collection. However, responses with missing data have been removed from the analysis accordingly. In this study, the data were collected together via structured questionnaires based on the variables that were studied. The online form could be viewed by clicking on this link:

https://docs.google.com/forms/d/e/1FAIpQLSehmZopBXdpzJUW-dLdUL4ieJS95huo-thntg80Z1vLXfugOQ/viewform?usp=sf_link

3.6.2 First Question Selection

The decision of fixing the initial first question in a questionnaire is essential according to Dillman (2000) as it will verify how respondents would react and treat towards the question. Unsurprisingly, respondents would take a quick look at the first few questions and would only carry on answering if they could narrate to the question asked. In this regard, the first question selected for the questionnaire was about the general adoption of green practices in the company that is quite direct to answer and easy to comprehend. Naturally, the respondents would be stimulated to continue answering should they consider that the questions are uncomplicated for them to go through.

3.6.3 Raising Response Rate

Gaining a reasonable response rate has always been a challenge for researchers. Thus, in order to mitigate this problem, various researchers have commenced diverse approaches to manage and administer the survey with a variety of survey design to develop a better response rate. Numbers of methods could be done to increase the response rate that includes, audience targeting, email personalization, simplify questions, sending annual reminder email as well as offering rewarding incentives to respondents. Consequently, according to Dillman (2000) and Porter (2004) they also have suggested that lessening the length of the survey and providing appreciation as well as gratitude are among the techniques used to boost respondents' participation respectively.

3.6.3.1 Survey Length

The questionnaire has a length of 82 questions grouped in 5 sections. Subsequently, a five-point Likert scale was used to certify statistical variability in every single one of the questions following the suggestion for developing this survey instruments. In this respect, the respondents were then requested to examine and point out their agreement or disagreement on their level of implementation in each of the statement provided.

3.6.3.2 Introductory and Cover Letter

The study was required to draft out the introductory letter and attached with each email to be sent to selected personnel of the company involved in the maritime supply chain. This letter includes the principal intention of this study, the assurance of confidentiality of the information that would be collected and the importance of their participation in this study. An endorsement letter or cover letter from UMP on their consent for attaining data required through involved participation in the maritime sector was also attached with the email in that order.

3.6.3.3 Survey Distribution

Questions involving this study were created in Google drive, and the link was forwarded to the respective companies in the maritime port's supplier list through email. For easier responding process, the respondents were required to tick on the answers that best represent their company, and when they are completed, the respondent would finally click on the "SUBMIT" button to end the process of data collection.

3.7 Statistical Data Analysis

IBM SPSS statistics software was the primary tool for accomplishing this descriptive analysis. The data collected through questionnaires was entered and as well as labelled in the statistical software. In order to test the validity of the constructs, the goodness of data, as well as the hypothesis, computerized smart PLS (Partial Least square) software, has been used to analyse the data. All the information acquired from the survey instrument has been coded accordingly with SPSS software. Next, the outcome of the output (the data analysis) resolute the consistent patterns and has been summarized in the relevant details throughout the survey. Employing the numerous of statistical techniques used, the derivative of critical characteristics of the acquired sample, such as descriptive statistics, the goodness of data, correlation, reliability and the correlation of the relationships between the independent and dependent variable has been tested correspondingly.

As this study utilized a SmartPLS 3.2.7 program, Hulland (1999) deposited that the program could perform a partial least square analysis that gives an insight perspective of the theory tested and measure simultaneously. In this matter, Partial least squares structural equation modelling (PLS-SEM) is used to discover the relationship involving each the variables, and it is somehow identical to multiple regression analysis (Hair, Anderson, Babin, & Black, 2010). PLS method permits more flexibility and efficiency in modelling and is capable of presenting with concrete results in the case of multicollinearity and small samples (Abdi, 2003; Hulland, 2002). Consequently, the principal objective of PLS-SEM is to take full advantage of the experienced variance in the dependent construct but also to assess the data quality from dimension model characteristics (Hair et al., 2010). In this regard, this study was conducted using PLS because:

1. Permitting the analysis of systems of independent and dependent variables simultaneously (Cassel, Hackl, & Westlund, 2000).
2. A better method with respect to multicollinearity assessment (Cassel et al., 2000).
3. Due to the violation of the normality distribution of theory and assumption (Cassel et al., 2000; Haenlein & Kaplan, 2005).
4. Relatively small sample sizes (Haenlein & Kaplan, 2005)
5. Appropriate for complicated modelling including models with hierarchical constructs, mediating and moderating effect that gets the most out of the explained variance of all dependent variables (Wetzels, Odekerken-Schröder, & van Oppen, 2009).
6. Proper for perspective analysis in the position of little theoretical information that leads towards proper theory building rather than theory verification (Birkinshaw & Morrison, 1995; Caniëls et al., 2013; Jöreskog & Sörbom, 1982).

3.7.1 Descriptive Statistics

The first important move in statistical data analysis is to produce descriptive statistics significantly. The reason of descriptive statistics is to give details of the information of respondents embedded in the data collected previously (Chinna et al., 2013). These respondents are representative of the whole population that the researcher is investigating. Hence, through descriptive analysis, information regarding the profile of the companies and profile of respondents who fill the questionnaire can be used to identify with the background of the study. Descriptive statistics correspond to this valuable information in the most complete and uncomplicated form through frequencies, percentages, means of the distribution and measures of variability or dispersion like standard deviation of the analysed item. The means can help show the tendency of the MGSCM practices undertaken by maritime companies and the standard deviation indicates how much difference between those MGSCM practices exist among maritime companies from the same industrial sector.

3.7.2 Goodness of Measures

Validity and reliability are the two most important criteria used for testing the goodness of measures. The survey instruments should be able to capture information to achieve research objectives. Additionally, reliability is also imperative to be considered because the validity of data must also be reliable and consistent with the findings in prior studies in the literature.

3.7.2.1 Validity

Validity is used to determine how fit instrument developed measures the particular concept is intentional to measure at the first place (Sekaran & Bougie, 2011). The validity of a measure includes content validity and constructs validity encompassing convergent and discriminant validity. Content validity is generally concerned with appropriateness and relevance establishing the correspondence between theoretical constructs and measurement items (Mentzer and Flint, 1997). Therefore, content validity exists when the domain of the characteristics is appropriately reflected by the scale items (Churchill, 1992). For example, if a research instrument involves a typical characteristic of the subject investigated in research, it is considered as having relevant content validity. On the contrary, domains different from the domain of the variables investigated indicate a lack of content validity (Cooper and Schindler, 2011). However, there is no rigorous way to statistically test content validity (Dunn et al., 1994), in which content validity is mostly depending on a subjective judgment of the researcher (Garver and Mentzer, 1999; Churchill, 1992).

Nevertheless, literature provides that content validity can be certified from a comprehensive literature review (Bryman and Bell, 2011) and interviews with practitioners and academics (Li et al., 2006). This study tested the content validity of the research instrument through a comprehensive analysis of the relevant literature and input from an expert in the field. On the other note, this study examined and evaluated three further categories of validity, specifically construct validity, convergent validity, and discriminant validity in the next subsection.

3.7.2.1.1 Construct Validity

In this study, construct validity is tested to scrutinize how well the results acquired from the application of the measure suit the intended theories around which the test is designed (Sekaran & Bougie, 2011). In this regard, it shows the function of how well the dimension aspect of conception has been portrayed (Sekaran & Bougie, 2011) and the assessment of the correspondence of variables to integrate into a summated scale and its conceptual classification (Hair et al., 2010). To achieve a construct validity, this study ensured the underlying item of the constructs were derived from an extensive review of relevant literature and followed by an evaluation from academicians and industry practitioners.

3.7.2.1.2 Convergent Validity

The convergent validity is the level amount of which multiple methods of a construct is correlated (Hair et al., 2010). It examined the degree to which multiple items have similar concepts that are in agreement. Hair et al. (2014) recommended using factor loading, composite reliability (CR) and average variance extracted (AVE) to measure convergent validity. The loading factor and cross loading are measured to recognize any problem and difficulty with any particular items. As recommended by Hair et al. (2014), the cut off is 0.5 for AVE and 0.7 for CR. For this reason, this study used CR, AVE and loading factor to determine convergent validity

3.7.2.1.3 Discriminant Validity

Discriminant validity assesses the degrees to which items differentiate among constructs or investigating distinctive concepts. It observed the relationship between the measures of potentially overlying constructs. In statistical analysis, Hair et al. (2014) and Henseler, Ringle and Sarstedt (2015) proposed that to measure discriminant validity statistical tests should be performed:

1. Fornell-Larcker criterion
2. Cross-loadings
3. The heterotrait-monotrait ratio of correlations (HTMT)

4. Confirmatory factor analysis

The item should load more strongly on their own construct in the model, and the average variance shared involving each construct should be larger than the variance shared between the constructs and other constructs (Compeau, Higgins, & Huff, 1999). According to Hair et al. (2010), the general rule of thumb points out that the AVE of each latent construct should higher than the constructs' highest squared in connection with any other latent constructs as per Fornell-Larcker criterion, and an indicator loading should be higher than all its cross loading. While HTMT should be lower 0.9 (Henseler et al., 2015) and if the researcher is performing confirmatory factor analysis, the rule of thumb to follow is all items of that loadings should be stronger on their construct than on all other constructs in the model (Hulland, 2002). Due to the recent literature has recommended HTMT (Hair et al., 2017) utilization, this study used HTMT as a method of choice in determining discriminant validity.

3.7.2.2 Reliability Analysis

Reliability is to determine how constantly a measuring instrument measures whatever concept it is investigating (Sekaran & Bougie, 2010). It can be measured by a few empirical methods such as test-retest, split-half, Cronbach's Alpha, and a composite reliability approach (McDaniel and Gates, 2011; Mentzer and Flint, 1997; Fornell and Larcker, 1981). Among them, the test-retest and split-half approach involve the severe problem arising from the researcher or respondents such as a false memory to the first answers and high dependence on how the researcher splits the items. Therefore, Cronbach's α is widely employed as a reliability test in social science research where a high Cronbach's α can be interpreted as implying the high internal consistency of the responses (Pallant, 2007). However, some limitations exist in Cronbach's α approach.

For instance, a measuring scale is inflated when the construct has a few items to measure and all the items measured have equal reliability (Gerbing and Anderson, 1988). Regarding these limitations, the confirmatory factor analysis (CFA) approach offers more rigorous tests for reliability measurement by offering the composite reliability (CR) of each construct and average variance extracted (AVE) (Hair et al., 2010; Garver and Mentzer, 1999; Fornell and Larcker, 1981). Hence, CR and AVE were used in this study to test the reliability and consistency of the constructs. CR is the reliability of a summated scale whereas AVE is the variances in the indicator clarified by the universal factor.

According to Fornell and Larcker (1981), composite reliability of 0.70 or higher is well thought-out satisfactory while AVE must be greater than 0.5 to be reliable. In this study's measurement, CR and AVE were calculated using this formula:

$$\text{Composite reliability} = \frac{\text{Square of total standardize loadings}}{\text{Total of standardized loading squared} + \text{Total of error variance}}$$

$$\text{Average variance extracted} = \frac{\text{Total of standardized loading squared}}{\text{Total of standardized loading squared} + \text{Total of error variance}}$$

3.7.3 Hypothesis Testing

In the hypothesis testing period, a structural model was built via the SmartPLS software. The path coefficients are formed using the bootstrapping procedure which is fundamentally a re-sample using the existing observation as the foundation. The bootstrapping result in a bigger sample is declared to model the unknown population. A large number of sub-samples (i.e., bootstrap samples) in bootstrapping are drained from the original sample with replacement. The path with t-value above 1.96 is presumed significantly diverse at a significance level of 5% (α = 0.05; two-tail test). Many researchers can accept 5% and accomplish it in reasonable size samples, as well as have sensible power to notice effect-sizes that are of interest. A level of 5% is selected by the standard of previous studies (Stigler, 2008). The justification of p-value given at 5% of confidence in the determination of considerable significant level is to get stronger evidence to acknowledge the hypothesis developed when the study deals with the perception of respondents in social science studies.

3.7.4 Assessing Common Method Bias

Given that the data collected from a distinctive respondent from each firm, this study tested for universal method bias using full collinearity test. Variance inflation factor (VIF) can be used to determine the collinearity assumption. As recommended by Kock (2015) VIF value must be lower than 3.3 thresholds to deem that the model is free from common method bias.

3.8 Ethical Consideration

There are four stakeholders in general business management research: (1) the researcher, (2) the customers/consumers, (3) the respondents, and (4) the general public/society (Baran, 2016). In this sense, all of these stakeholders are interconnected, and occasionally, they have diverse interests concerning the research activity. Ethical issues frequently become a social and ethical dilemma between these involved stakeholders (Golder, Ahmed, Norman, & Booth, 2017). Addressing the possible ethical issues related to this study, a few considerations have been adopted when conducting this study to protect all of the stakeholder's interest from negative ethical issues. Firstly, the study was designed to guarantee that there were no potential ethical risks related to the methods of collecting, analysing, and presenting the data in this study. Examples of some of these potential ethical issues include voluntary participation and informed consent. These ethical principles are followed to ensure that the respondents are choosing to partake in the survey of their own free will and that they have been fully informed regarding the procedures of the study and any associated potential risks. Secondly, formal invitation (cover note) letters were sent to all participating respondents to obtain permission for collecting data. The cover note letter informed the potential respondents of the study objectives and the benefits of the study for the industry. The letter also emphasized on agreement related to respondent's confidentiality and participation, which is strictly for academic purpose. The potential respondents who needed more information before participating in the research were given the option to contact the researcher via email and telephone number. Finally, the maritime companies' names and the respondent's name were kept confidential in the thesis. Similarly, no sensitive respondent personal information was identified in the questionnaire.

3.9 Chapter Summary

This chapter discussed the methodology applied in this research. The chapter has justified the need to employ a positivist paradigm in gathering responses to the research questions with the aim of testing the hypothesis from quantitative point of view. The research design and approach were also reviewed, specifically relating to the reasoning of using self-administered and survey-based questionnaire for data collection. Next, the reason of using the PLS-SEM over CB-SEM for data analysis method was also presented for justification. Subsequently the development of the scale using 5 Likert-scale and the questionnaire design as a tool for collecting data were discussed. Following this discussion was a comprehensive review of the sampling technique and a discussion about the procedure of conducting the survey. The statistical data analyses used to test the hypotheses were also explained and justified. Lastly, ethical issues related to collecting, analysing, and reporting the outcome of this study were clarified. The next chapter would further elaborate on the data analysis and results.

CHAPTER 4

DATA ANALYSIS

4.1 Introduction

This chapter presents the data analysis conducted and the empirical results of the study. The chapter primarily consists of the analyses conducted using initial data analysis, descriptive data analysis and model assessment. At the end of this chapter, a brief conclusion is provided to conclude the analysis of all the hypotheses measurement accomplished throughout the data analysis phase.

4.2 Initial Data Analysis

Initial data analysis is critical to be assessed to ensure the quality of measurement and data collected before taking the actual phase of data analysis (Huebner, Vach, & Le Cessie, 2016). In this study, the initial data analysis involved the measurement of the quality of data through data cleaning and data screening (see Figure 4.1). To prevent false-positive results, a systematic approach and documentation/reporting have been taken to preserve the information for later statistical analysis and model measurement. Figure 4.1 shows the framework (steps/stages) for initial data analysis used in this study while in the next two sections each of these stages were explained accordingly.

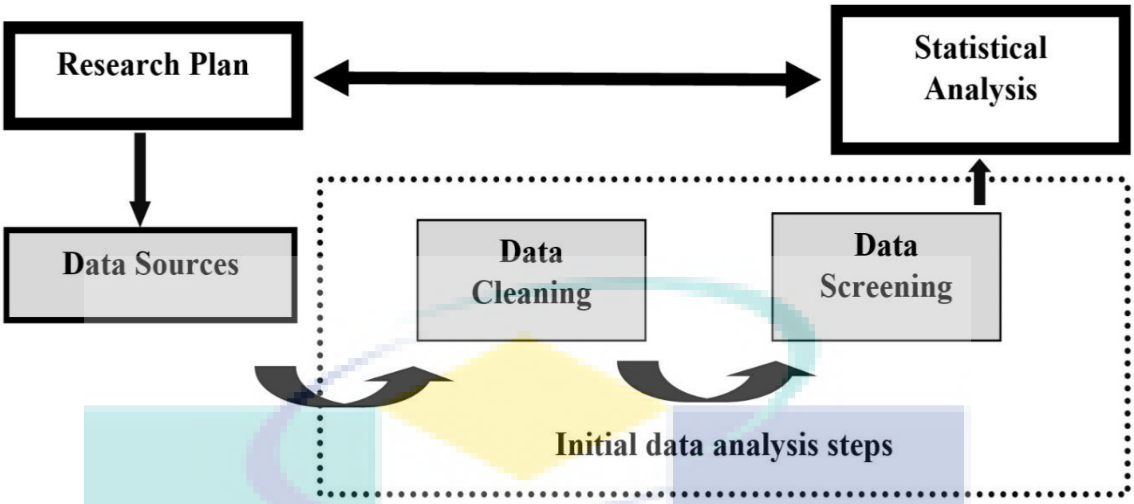

Figure 4.1 Initial data analysis framework

Source: Drawn by author

4.2.1 Data cleaning

After completed the data collection phase, this study used a data cleaning technique to spot data errors and inconsistencies. The first step of data cleaning stage in this study involved reviewing the raw data collected through questionnaires that were recorded in the Google Document Spreadsheet format. At this stage, the raw data were reviewed thoroughly to spot whether they were complete, valid, consistence and acceptable. Duplicated records and missing data were eliminated to ensure the correctness of the result. The second step in data cleaning processes involved process editing stage consisting of checking the data collection for omission and legibility. Finally, the final step involved the relocation of raw data from the spreadsheet, into IBM SPSS data sheet. Frequency analysis was executed at this stage on each of the measurement items to identify the out of range and missing values. The values were thoroughly revisited and corrected when the author find them necessary to be omitted.

4.2.2 Data Screening

Data screening is essential to determine the data are free from outliers and missing data, correctly entered and to validate that the distribution of data is normal. In the case of missing data, Cohen, Cohen, West and Aiken (1983) denote that missing data up to 10% (due to respondents failed to answer one or more items in the survey) may not cause a severe problem of data interpretation. However, the treatment of the missing data can be remedied through Expected Maximization (EM) technique or more simplistic approach using mean substitution and list-wise deletion (Graham, Hofer, Donaldson, MacKinnon, & Schafer, 1997). This study used mean substitution technique for missing data treatment as it produced a more consistent set of results internally without affecting too much data interpretation on the next stage of the data analysis result.

Validation to the normality is also crucial in data screening before choosing any statistical method to analyse the data because that is the first requirement in order to be evaluated through structural equation modelling (SEM) (Hair Jr, Sarstedt, Hopkins, & Kuppelwieser, 2014). Based on this argument, it is imperative for this study to examine the data files through normality test before proceeding for the chosen method of statistical measurement (see Table 4.1).

Table 4.1 Kolmogorov–Smirnov and Shaphiro-Wilk test of normality for eight variables

Variables	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
FP	0.171	160	0.000	0.904	160	0.000
GICS	0.102	160	0.000	0.917	160	0.000
GVALS	0.135	160	0.000	0.930	160	0.000
GSCIP	0.112	160	0.000	0.937	160	0.000
SDC	0.201	160	0.000	0.867	160	0.000
GFF	0.131	160	0.000	0.952	160	0.000
EEP	0.181	160	0.000	0.866	160	0.000
LCP	0.160	160	0.000	0.924	160	0.000

Table 4.1 shows the result of Kolmogorov–Smirnov and Shaphiro-Wilk test of normality for eight variables. As a rule of thumb, both tests are significance if p>0.05 indicating a normal distribution of data. However, the results indicated that insufficient evidence existed to support the data were normally distributed since all the variables did not follow a normal distribution (p<0.05). According to Hair Jr et al. (2014), for non-normally distributed data, non-parametric analysis such as PLS-SEM is more suitable to be used since it is more robust against non-normally distributed data with relatively small sample size such as this study. While this supportive evidence supported the justification of the method chosen, other criteria such as high level of model complexity (this study has seven (7) predictors) and the explanatory nature of this study have also contributed to the validation of PLS-SEM utilization. Thus, based on the result, this study has adopted

the non-parametric approach of PLS-SEM statistical analysis using SmartPLS software for model measurement and hypotheses testing.

4.3 Descriptive Analysis

For descriptive analysis, the analysis was conducted using IBM SPSS Statistics version 23 respectively. The software has been purposely chosen due to widely adopted usage by most researchers in social sciences predominantly for frequency data analysis to determine respondents' characteristics.

4.3.1 Response Rate

In this study, in order to achieve an adequate response rate, a total of 700 questionnaires were distributed through email to all the companies involved in the Malaysian maritime supply chain. All respondents were listed as MATRADE members representing a broad array of companies that includes sea freights, shipping ports, warehousing services, cargo handling services, container services and other supporting logistics companies functioning in the maritime supply chain. For each company, only one set of questionnaire has to be filled accordingly. After submission of questionnaires, follow up calls and a soft remainder in the form of email notifications were made to the relevant personnel consecutively to increase response rate. Table 4.2 shows the summary of response gained in this study.

Table 4.2 Summary of Response Rate

	Frequency	Percentage (%)
No response questionnaire	540	77.14
Total questionnaire returned	160	22.86
Total questionnaire distributed	700	100.00

A total of 160 maritime companies (22.86%) have completed the questionnaires out of 700 companies. As mentioned in chapter 3 (methodology) the minimum sample size needed for this study must be at least 100 respondents to be statistically reliable. Thus, achieving 160 respondents can be considered adequate for this study's need for sample size. However, the 160 response rate was relatively low compared to similar studies conducted in the literature. This is due for several reasons. The first reason for the high percentage (77.14%) of no response rate might be likely due to managerial level people of the selected companies are generally busy or have no time to answer the question. Secondly, some companies were hesitant to take part in the survey due to the company's policy to not disclose any of their operations concerning their privacy policy. Nevertheless, even though the response rate was low, the quality of data received from returned questionnaires was quite decent with a relatively low rate of the incomplete answer. This situation might be due to the survey design; in which the respondents were required to answer each section first (in the google form webpage) before they could proceed to another section.

Meanwhile, the non-response rate of questionnaires was statistically analysed using Mann-Whitney U test to test the potential occurrence of non-response bias in this study. For non-normally distributed data such as this study, Mann-Whitney U test was suitable to be used to prove whether there are no significance differences between two groups (early response and late response or non-response). The results of testing using the Mann-Whitney U tests are presented in Table 4.3.

Table 4.3 Mann-Whitney U Test of Early and Late Respondents

	Variables				
	GICS	**GVALS**	**GSIP**	**SDC**	**GFF**
Mann-Whitney U	2284	2236	2155	1969.5	2269
Wilcoxon W	9787	2977	2896	2672.5	3010
Z	-0.137	-0.33	-0.656	-1.044	-0.198
Asymp. Sig. (2-tailed)	0.891	0.741	0.512	0.297	0.843

This study has divided samples into two groups namely; 1) “Early” for respondents that reply to the survey within one week after the survey commenced and 2) “Late” group for respondents that reply after a week until the cut off time of data collection phase. Based on the indicated timestamp in Google Form, there were 38 early respondents and 122 for late respondents identified. After identifying descriptive information about the early and late group respondents, investigation on differences in answer between groups need to be undertaken. Based on the Asymptotic two-tailed significance value, it shows that the value is greater than 0.05 which means the assumption is rejected. The assumption for non-response bias is that there is a significant difference between early and late (or non-response) respondents answers. This finding indicates that the perception between early and late respondents on GICS, GVALS, GSIP, SDC and GFF dimensions were not significantly different. Therefore, it can be concluded that non-response bias is not a concern for this study since late response has been taken as proxy or representative for unresponsive respondents.

4.3.2 Sample Characteristic

Table 4.4 reveals the complete widespread of 160 demographic profile of sample companies from 9 diverse sectors that include cargo handling (41.9%), container service (39.4%), storage and warehousing (33.1%), maintenance service for support vehicle (29.4%), supporting service (28.1%), land transport service (18.1%), postal and courier service (14.4%) rental service for support vehicle (13.8%), as well as water transport service (13.1%). It is worth to note that some questions in the questionnaires were multiple choice answer and labelled as ‘multiple' to be answered by respondents (see at section; ‘sectors,' ‘types' and ‘ports'). This is because most maritime companies have more than a single operation/function in their business processes. Regardless of the sectors that the companies responded, most of them were primarily involved in cargo handling, container services and warehousing services. This clear indicator directed to the conclusion that the main operating activities of the maritime supply chain were handling, shipping/distribution and storing of merchandises from import/export activities.

Next section reviews the type of business maritime companies involved in. The results indicated that the highest percentage of 37.5% of companies were involved in shipping linear, followed by with warehousing and cargo/container handling with 35.0% and 33.8% respectively. The remaining types of the companies were dispersed around in various operations such as shipping agent (31.9%), ship repair (30.0%), forwarding agent (26.3%), depot operator (22.5%), ship chandler (22.5%), haulage service (15.0%) and stevedore (10.0%). The results highlighted that most of the companies were involved as the shipping companies in the maritime supply chain.

Next section in Table 4.4 shows the years of the company involved in the maritime supply chain. Most companies involved in the maritime supply chain for 11 to 15 years (30.6%) whereas 28.7% of companies served for 6 to 10 years and 22.5% involved 16 years and above. The remaining companies with 14.4% involved 1 to 5 years and a small portion of companies remaining involved below 1 year with 3.8% correspondingly. The numbers show that numerous of the maritime companies were involved in the maritime business for quite sometimes. This is reflected through the high maturity level of serving years of most companies at the range 11 to 15 years in the maritime supply chain.

Next, Table 4.4 illustrates the location of the port where the companies provide their services. Penang Port has the highest frequency with (45.0%) followed by Lembaga Pelabuhan Kelang (43.8%), Johor port (40.0%) and Pelabuhan Tanjung Pelepas (38.1%) respectively. The other remaining port distributed through Bintulu Port (31.9%), Kuantan Port (30.0%), Lembaga Pelabuhan Kuching (28.1%), Northport (25.0%), Kelang Multi Terminal (20.0%), Lembaga Pelabuhan Miri (15.0%) and Lembaga Pelabuhan Sabah (10.0%). The result shows that most of the ports that companies provide their services located at a more developed city/states and near the industrial area (e.g., Penang, Kelang and Johor area).

Most of the companies located mainly in Penang contributing around 25% of the population. This is due to the fact that they were near Penang Port and close to its surrounding industrial area which caters most of the port operations. The data tally with prior ‘ports' indicator that the highest frequency located in Penang Port. The same indicators also reflected in Johor and Selangor as they contributed around 21.9% and 15.6% of total responses which rated as second and the third highest frequency. The remaining locations were scattered relatively evenly among them with Sabah and Terengganu contributed around 6.9%, Labuan and Sarawak equally at 5.6%, Kuala Lumpur at 4.4%, Pahang at 4.4% and Perak at 1.9% respectively.

Meanwhile, the companies were not evenly characterized in terms of organizations size with the majority of companies (38.1%) have 30-50 employees, 26.3% of companies have more than 70 employees, 25.0% of companies have 51-70 employees and 10.6% of companies have below than 30 employees. The results showed that most maritime companies were medium size and large size enterprise. This is due to its globalize nature of maritime industry operation often dealing with transnational shipments which require a higher number of employees to function.

Table 4.4 Company Profiles

Demographic	Categories	Overall	
		Frequency	Percent (%)
Sectors (multiple)	Cargo handling	67	41.9
	Land transport service	29	18.1
	Maintenance service	47	29.4
	Rental Service	22	13.8
	Storage/Warehousing	53	33.1
	Supporting service	63	39.4
	Water transport	21	13.1
	Container service	45	28.1
	Postal/ Courier Service	23	14.4
Types (multiple)	Shipping linear	60	37.5
	Shipping agent	51	31.9
	Forwarding agent	42	26.3
	Depot operator	36	22.5
	Haulage company	24	15.0
	Warehousing	56	35.0
	Stevedore	16	10.0
	Ship Chandler	36	22.5
	Cargo/Container	54	33.8
	Ship repair	48	30.0
Years Served	Less than 1 year	6	3.8
	1-5 years	23	14.4
	6-10 years	46	28.7
	11-15 years	49	30.6
	16 years and above	36	22.5
Ports (multiple)	Bintulu Port	51	31.9
	Johor Port	64	40.0
	Kelang Multi Terminal	32	20.0
	Kuantan Port	48	30.0
	Lembaga Pelabuhan Kelang	70	43.8
	Lembaga PelabuhanKuching	45	28.1
	Lembaga Pelabuhan Miri	24	15.0
	Lembaga Pelabuhan Sabah	16	10.0
	Northport	40	25.0
	Pelabuhan Tanjung Pelepas	61	38.1
	Penang Port	72	45.0

Table 4.4 Continued

Demographic	Categories	Overall	
		Frequency	Percent (%)
Location	Cyberjaya	0	0
	Johor	35	21.9
	Kedah	0	0
	Kelantan	0	0
	Kuala Lumpur	7	4.4
	Labuan	9	5.6
	Malacca	3	1.9
	Negeri Sembilan	0	0
	Pahang	7	4.4
	Penang	40	25.0
	Perak	3	1.9
	Perlis	0	0
	Putrajaya	0	0
	Sabah	11	6.9
	Sarawak	9	5.6
	Selangor	25	15.6
	Terengganu	11	6.9
Employees	Less than 30	17	10.6
	30-50	61	38.1
	51-70	40	25.0
	More than 70	42	26.3

Table 4.5 presents MGSCM profile of the companies. From 160 companies sampled, the years of green adoption was at 6 to 10 years (38.7%) which was a sign that most of the maritime companies were relatively new to green practices in their daily operation. While 31.3.3% of the companies corresponded that they have adopted green practices for at least 1 to 5 years. Conversely, 17.5% of the companies settled at below than 11 to 15 year, while 7.5% of companies adopted green practices below than 1 year. The remaining of 5.0% sorted at 16 years and above of green practices adoption. From this analysis, it can be concluded that MGSCM practices are quite new and still in its infancy phase. It is possible from the duration of adoption that the implementation of MGSCM is going towards maturity in the maritime industry.

Additional information on MGSCM adoption established that the area that exhibits MGSCM most apparent was in the distribution/logistic area of their operation (40.0%). Whereas, information technology indicated 27.5% followed by procurement and sourcing at 12.5%, product development at 11.9% and manufacturing at 8.1%. The results were not surprising given the fact that most maritime companies were involved in logistics and distribution in handling goods transhipment. Further, the requirement of recent IMO's regulations on green practices also, in fact, focusing more on the area of distribution and shipping to reduce carbon emission and energy usage.

Meanwhile, most of the maritime companies were generally in the start-up stage of MGSCM (29.4%) followed by expansion (25.0%), seed (23.8%) and monitoring phase (21.9%). The result confirmed the fact that most of the maritime companies were still in its beginning phase of MGSCM implementation and at the stage of exploring the green practices that suited their company's operation.

Finally, the motivation to adopt MGSCM in the maritime operation was to comply with regulation and requirement at 71.3% followed by to minimize the cost of company at 49.0%, to be environmentally responsible company at 42.0%, to increase efficiency at 41.4%, to minimize negative impact at 38.2%, to be more competitive at 36.3% and to full fill client request at 27.4%. This information indicated that regulatory compliance was the primary determinant for maritime companies to adopt green practices in their company's operation. This is also might be due to recent straightening regulation on emission and energy efficiency regulation imposed by the Malaysian government and IMO on Malaysian maritime companies.

Table 4.5 MGSCM Profile of Companies

Demographic	Categories	Overall	
		Frequency	Percent (%)
Years Adopted	Less than 1 year	12	7.5
	1-5 years	50	31.3
	6-10 years	62	38.7
	11-15 years	28	17.5
	16 years and above	8	5.0
Important Area of MGSCM	Product Development	19	11.9
	Procurement/ sourcing	20	12.5
	Manufacturing	13	8.1
	Distribution/Logistic	64	40.0
	Information Technology	44	27.5
Stage of GSCM	Seed	38	23.8
	Startup	47	29.4
	Expansion	40	25.0
	Monitoring and controlling	35	21.9

Table 4.5 Continued

Demographic	Categories	Overall	
		Frequency	Percent (%)
Motivation to Adopt MGSCM (multiple)	To comply with regulations and requirements	112	71.3
	To minimize negative impacts caused by the operation to the environment	60	38.2
	To be more competitive in the market	57	36.3
	To increase the efficiency in all processes/operations	65	41.4
	To minimize the cost (cost-saving measures)	77	49.0
	To fulfill the buyers/clients request	43	27.4
	To be an environmentally responsible company	66	42.0

4.3.3 Green Certification

Table 4.6 shows the company profile on green certification. Most of the companies' respondents were having certification of the International Safety Management (ISM) Code at 25.1%. The ISM code stands for the International Management Code for the Safe Operation of Ships and for Pollution Prevention which is mandatory for all shipping and vessel companies to operate on the sea since 1998. The result also shows that the wide adoption of ISM among the maritime companies in Malaysia is due to the regulatory requirement by the Malaysian government. Meanwhile, the remaining companies' respondents were certified with Environmental Management System Certification (EMS) ISO 14001 at 24.1%, International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) at 22.8%, Ship Energy Efficiency Management Plan (SEEMP) at 8.8%, Energy Efficiency Operational Indicator (EEOI) at 6.8% as well as Energy Efficiency Design Index (EEDI) at 6.2%. It is worth to note that some of these certifications are quite new in regulatory rectification in Malaysia (e.g., SEEMP, EEOI, EEDI and EnMS ISO 15001) and may reflect low or no implementation among them (as shown by EnMS ISO 15001 result). However, the indicators also showed that most of the maritime companies were indeed practicing MGSCM direct or indirectly in their operation as shown by a high implementation of ISM, MARPOL 73/78 and EMS ISO 14001 certification.

Table 4.6 Company Profile: ISO Certification

Demographic (multiple)	Frequency	Percent (%)
EMS ISO 14001	74	24.1
EnMS ISO 50001	0	0
SEEMP	27	8.8
EEDI	19	6.2
EEOI	21	6.8
ISM	77	25.1
MARPOL 73/78	70	22.8

4.3.4 Green Training, Program and Incentives

Table 4.7 shows the overall results on company profile regarding green training, program, and incentives. From 160 companies responded, 117 companies (73.1%) of the companies have participated with green certification training with more than half of them were company certification at 61.3%, while the remaining 11.9% were certified through individual certification. This positive indicator showed that most companies were aware of the importance of 'green practices' in their organization as only a slight amount of the companies (at 26.9%) did not participate in any green certification training. For the next section, the respondents were also asked about their company participation regarding green program organized by the government. Most of the companies (52.5%) indicated that they were involved in green program organized by Malaysian government (the remaining 47.5% picked 'No') with most of them participated in Ship Emission Management System (SEMS) at 33.1% and equally at 30.1% participated in Green Technology Finance Scheme, 19.9% participated in Green Building Index (GBI) and the remaining 16.9% involved in Green Port Initiatives. Next, when asked about incentive received, more than half (62.5%) of the companies stated they received the incentive given by government in term of tax exemption (66.2%), deduction on capital expenditure on green equipment (53.2%), monetary and tax allowance for green investment and R&D (31.2%), infrastructure allowance (29.9%) as well as exemption on stamp duty for high tech equipment (11.7%).

Meanwhile, 37.5% of the companies did not receive any incentive due to not fulfilling the ‘green’ requirement set by the government or might also be due to the companies not applying for the incentive. For the next few sections, the study asked a similar question regarding whether the company has a dedicated monitoring/auditing system to monitor:

1. *Green practices* - most of the companies did not have a dedicated monitoring system at 63.7% while only 36.3% of the companies had a dedicated monitoring/auditing system on overall green practices
2. *Energy efficiency* - most of the companies did not have a dedicated monitoring system (79.4%) while only 20.6% of the companies had a dedicated monitoring/auditing system on energy efficiency
3. *Carbon emission* - most of the companies did not have a dedicated monitoring system (64.4%) while only 35.6% of the companies had a dedicated monitoring/auditing system on energy efficiency

The study also asked a few comparable questions to the respondents regarding whether the company has dedicated staff or department to monitor:

1. *Green practices* - most of the companies did not have dedicated staff or department on green practices at 79.4% while only 20.6% of the companies had dedicated staff or department on overall green practices
2. *Energy efficiency* - most of the companies did not have dedicated staff or department on energy efficiency at 75.6% while only 24.4% of the companies had dedicated staff or department on energy efficiency.
3. *Carbon emission* - most of the companies did not have dedicated staff or department on carbon emission at 68.1% while only 31.9% of the companies had dedicated staff or department on energy efficiency.

From the abovementioned results, it can be summarized that most companies did not have dedicated monitoring/auditing or staff/department to monitor overall green practices, energy efficiency, and carbon emission. The reasons might be due to most of the maritime companies relied entirely on outside auditing and monitoring bodies for a regulatory reason (due to transparency purpose), low green awareness and for costing purposes as higher investment/capital needed to hire dedicated/skilled people on green expertise.

Table 4.7 Company Profile: Green Training, Program and Incentives

Demographic	Categories	Overall	
		Frequency	Percent (%)
Green Training Certification	Yes	117	73.1
	No	43	26.9
Type of Training Certification	Company certification	98	61.3
	Individual certification	19	11.9
Green Program Participation	Yes	84	52.5
	No	76	47.5
Type of green Program (multiple)	Green Technology Finance Scheme	41	30.1
	Green Building Index (GBI)	27	19.9
	Ship Emission Management System (SEMS)	45	33.1
	Green Port Initiatives	23	16.9
	Other	0	0
Incentive Received	Yes	100	62.5
	No	60	37.5
Type of Incentive (multiple)	Tax exemption/deduction	51	66.2
	Infrastructure allowance	23	29.9
	Deduction on capital expenditure on green equipment	41	53.2
	Exemption on stamp duty for high tech equipment	9	11.7
	Monetary incentive and tax allowance for green investment and R&D	24	31.2
Dedicated Monitoring/ Auditing (Green Practices)	Yes	58	36.3
	No	102	63.7
Dedicated Staff/Department (Green Practices)	Yes	33	20.6
	No	127	79.4
Dedicated Monitoring/ Auditing (Energy Efficiency)	Yes	33	20.6
	No	127	79.4
Dedicated Staff/Department (Energy Efficiency)	Yes	39	24.4
	No	121	75.6
Dedicated Monitoring/ Auditing (Carbon Emission)	Yes	57	35.6
	No	103	64.4
Dedicated Staff/Department (Carbon Emission)	Yes	51	31.9
	No	109	68.1

4.3.4 Respondent Profiles

Table 4.8 shows the classification of 160 respondent profiles according to their, gender, age, ethnicity, education, position, numbers of working experience, the department involved as well as ownership of the company. Majority of respondents were male with 65.0% followed by female respondents with 35.0%. This is predominantly so due to maritime sectors which usually associated with heavy industry mainly hired male workers as their employees. Meanwhile, the highest frequency of was at 26 to 35 years old (49.4%) followed by age 36 to 50 (43.1%), 51 to 65 (12%) and under 25 at 0%. The results confirmed this study unit of analysis expectation that most of the respondents at middle and top management level were aged above 26 years old due to longer duration of working experience needed to be at higher positions. The results are also confirmed by the frequency of position in the maritime company with the highest frequency was Manager/R&D Director at 30.6% followed by Senior Manager/Head of Department at 27.5%, Environmental Health and Safety (EHS) Manager at 21.3%, General Manager/Managing Director at 10.0% and Director/CEO at 8.8%. The analysis also showed that the majority of the respondents were Malay (54.4%), followed by Chinese and Indian with both contributed at 26.9% and 13.1% respectively. The remaining ethnicity of 5.6 % belonged to the “others” category. For the educational level, the majority of respondents were Bachelor’s Degree holder (45.8%) followed by Postgraduate (32.6%) and Certificate/Diploma (21.5%). However, the result recorded 0% Secondary School as their highest educational level. In total, most of the respondents worked in the industry for less than 10 years (41.3%), followed by 11-15 years (28.7%), 16 to 20 years (17.5%) and more than 20 years (12.5%). Meanwhile, the majority of the respondent’s department were at Logistic/Distribution (25%), Maritime Administration (21.9%), Maritime Operation (16.9%), Ship Management (16.3%), Freight Forwarding (8.1%), Warehousing (6.3%), Supply chain (3.8%) and Procurement (1.9%). Finally, the ownership of the companies mostly belongs to the local company with 43.1% followed by foreign-local company (24.3%) and foreign-owned company (21.9%).

Table 4.8 Summary of Respondent Profiles

Demographic	Categories	Overall	
		Frequency	Percent (%)
Gender	Male	104	65.0
	Female	56	35.0
Age	Under 25	0	0
	26-35	79	49.4
	36-50	69	43.1
	51-65	12	7.5
Ethnicity	Malay	87	54.4
	Chinese	43	26.9
	Indian	21	13.1
	Others	9	5.6
Education	Secondary School	0	0
	Certificate/Diploma	31	21.5
	Bachelor's Degree	66	45.8
	Postgraduate	47	32.6
Position	Director/Chief Executive Officer (CEO)	14	8.8
	General Manager/Managing Director	16	10.0
	Senior Manager/Head of Department	44	27.5
	Manager/R&D Director	49	30.6
	Environmental Health and Safety (EHS) Manager	34	21.3
	Others	3	1.9
Years Working	Less than 10 years	66	41.3
	11-15 years	46	28.7
	16-20 years	28	17.5
	More than 20 years	20	12.5
Department	Maritime operation	27	16.9
	Maritime Administration	35	21.9
	Ship Management	26	16.3
	Freight Forwarding	13	8.1
	Supply chain	6	3.8
	Logistic/Distribution	40	25.0
	Warehousing	10	6.3
	Procurement	3	1.9
	Maritime Crewing	0	0
	Sales/Trading	0	0
	Others	0	0
Ownership	Local company	69	43.1
	Foreign-local company	56	24.3
	Foreign-owned company	35	21.9

4.3.5 The Extent of MGSCM Adoption

SPSS tabulation was conducted to identify the mean of each MGSCM construct in order to assess the extent of MGSCM adoption as percept by the companies in the maritime supply chain. As displayed in Table 4.9, the mean of GICS, GVALS, GSIP, SDC and GFF showed that most companies adopted MGSCM practices in their organization. The minimum number of means is 1, and the maximum number is 5 as reflected in the 5-point Likert scale. The value of mean can be interpreted as the level of agreement among maritime supply chain companies with more than median value of each construct can be considered high in implementation. It is worth to note that this study used median score as a baseline for determining central tendency of the data set to determine level of agreement. From the observation, the mean for all variables were above their median value, and this indicated that most companies were indeed adopting MGSCM practice in their organization based on a high level of agreement. For performance dimensions, all three performance measurements indicated a comparatively higher level of agreement with EEP (4.4667), LCP (4.4075) and financial performance (4.4000) which signified the indirect influence of MGSCM on EEP, LCP and financial performance dimension based on the high level of agreement amongst respondents. Finally, the low standard deviation <1 (below than 1) for all MGSCM and performance dimensions suggested a more similar experiences among maritime companies on MGSCM practice and its effect on performance dimension.

Table 4.9 Summary of MGSCM mean, median and standard deviation

	GICS	GVALS	GSIP	SDC	GFF	FP	LCP	EEP
Mean	3.9288	3.8958	3.6885	4.0076	3.6550	4.4000	4.4075	4.4667
Median	3.7800	3.8000	3.6667	3.8900	3.5000	4.3333	4.2000	4.3500
Std. Deviation	0.79157	0.76405	0.96300	0.88980	0.77377	0.59087	0.60600	0.59075

4.4 Common method bias

Common method bias can be defined as resulting variance that is measured by measurement technique/method rather than assuming variance explained by the study's construct (Podsakoff et al., 2003; Carol et al., 2010). Common method bias can become a problem if a single latent factor describes the majority of the explained variance. In this regard, common method bias occurred when the respondents create false internal correlations due to their propensity to provide consistent answers to survey questions that are otherwise not related. Due to the possibility of common method bias occurring in the study, the study performed a full collinearity assessment as shown in Table 4.10. As proposed by Kock and Lynn (2012), a full collinearity test can be used to assess common method bias. Through this procedure, which is fully automated by the PLS algorithm in SmartPLS software, variance inflation factors (VIFs) are generated for all latent variables in a model. The central assumption of the test is that a variance inflation factor must be lower than 3.3 thresholds to deem that the model is free form common method bias (Hair Jr, Sarstedt, Ringle, & Gudergan, 2017; Kock, 2015). Meanwhile, the occurrence of a VIF greater than 3.3 is considered as an indication of pathological collinearity and may be contaminated by common method bias. The results indicated all VIF values below 3.3 at the range of 1.128 (lowest) to 2.832 (highest) for each hypothesized effect of exogenous (GICS, GVALS, GSIP, SDC and GFF) to endogenous (LCP, EEP and FP) variables which rejected the assumption of collinearity and common method bias.

Table 4.10 Summary of VIF value for Common Method Bias Test

	EEP	**FP**	**LCP**
EEP		2.832	
GFF	1.923	2.154	1.923
GICS	1.345	1.917	1.345
GSIP	1.128	1.163	1.128
GVALS	2.678	2.797	2.678
LCP		2.553	
SDC	2.394	2.983	2.394

4.5 Model Evaluation: Measurement Model Results

Primarily, testing the goodness of measure is the most critical aspect of model evaluation where significant attention was put to assess the validity and reliability of the construct's measurement. Convergent and discriminant validity were included in this section as a part of the assessment on the accurateness of the measures. Before attaining the extent of measurement results, the entire structural links connecting each construct was drawn accordingly in SmartPLS software to develop a research model as exhibited in Figure 4.2.

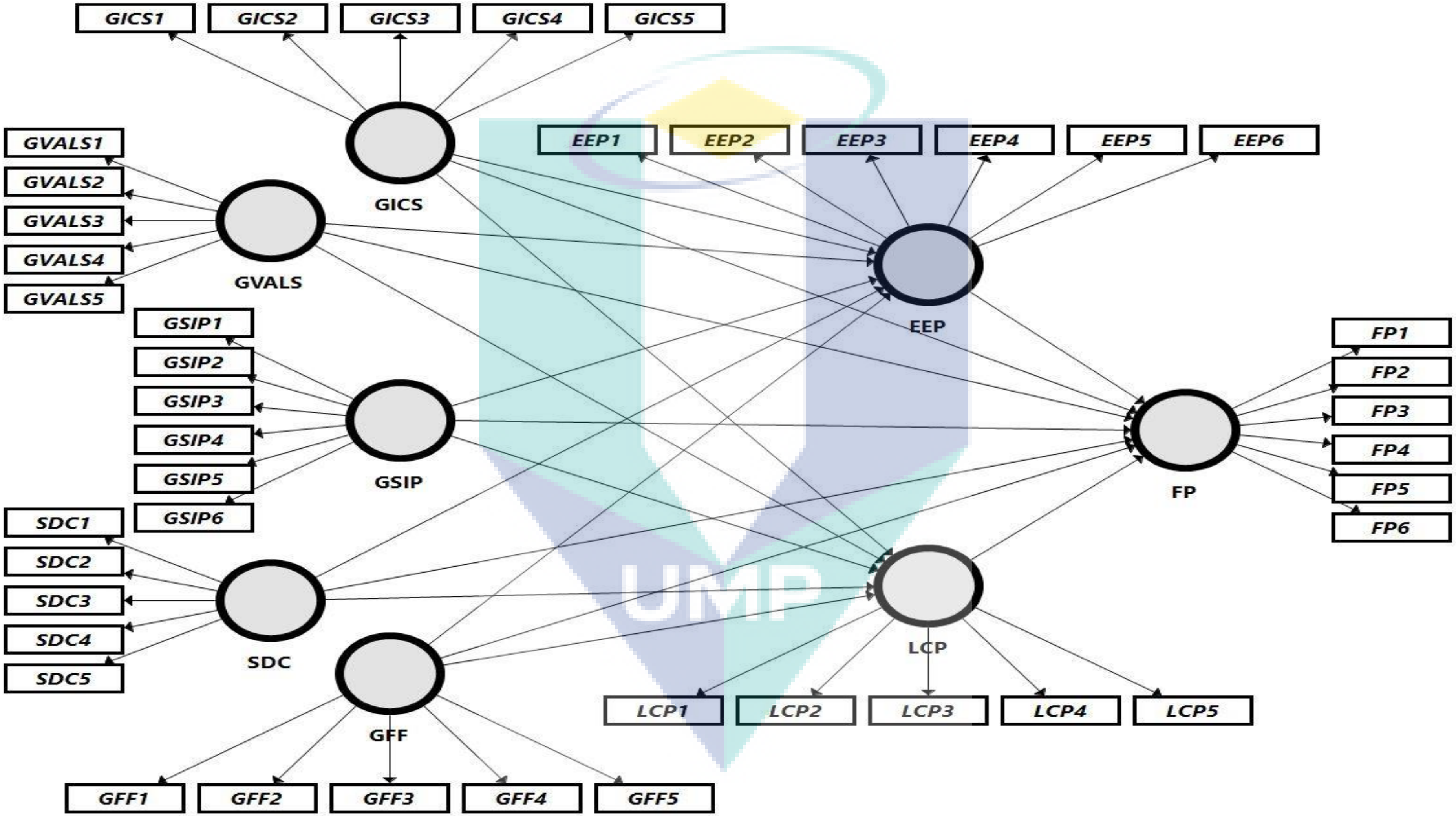

Figure 4.2 Research Model

4.5.1 Validity

To attain a reliable result, the validity of measurement is imperative to be achieved in the PLS-SEM analysis. The resulting result from PLS SEM's loading and cross loading, construct validity, convergent validity and discriminant validity can determine the overall validity of the model's measurement in this study.

4.5.1.1 Construct Validity

In this study, construct validity was a part of a significant component to be validated in the model's measurement through PLS SEM's loading and cross loading. The purpose of this analysis was to assess any issue related to the particular items leading to latent variables (construct). As this study has reflective indicators, reliability of an individual item is assessed by analysing its loading on the intended construct. A satisfactory value needed for each of the loadings should be at least 0.5 to be significant (Byrne, 2016; Hair Jr et al., 2014) and acceptable. On the other note, an item that has a loading of 0.5 or higher for two or more factors were considered as an item that has significant cross-loadings. Figure 4.3 exhibits the model of loading while in Table 4.11, the model of loading and cross loading was displayed with all the measurement items used in an exacting construct, whether the items loaded highly on that construct or loaded at the lower value on the other construct. Overall results show that all the loadings and cross-loadings were above the threshold value of 0.5 that justify the construct validity in this study was satisfactorily met.

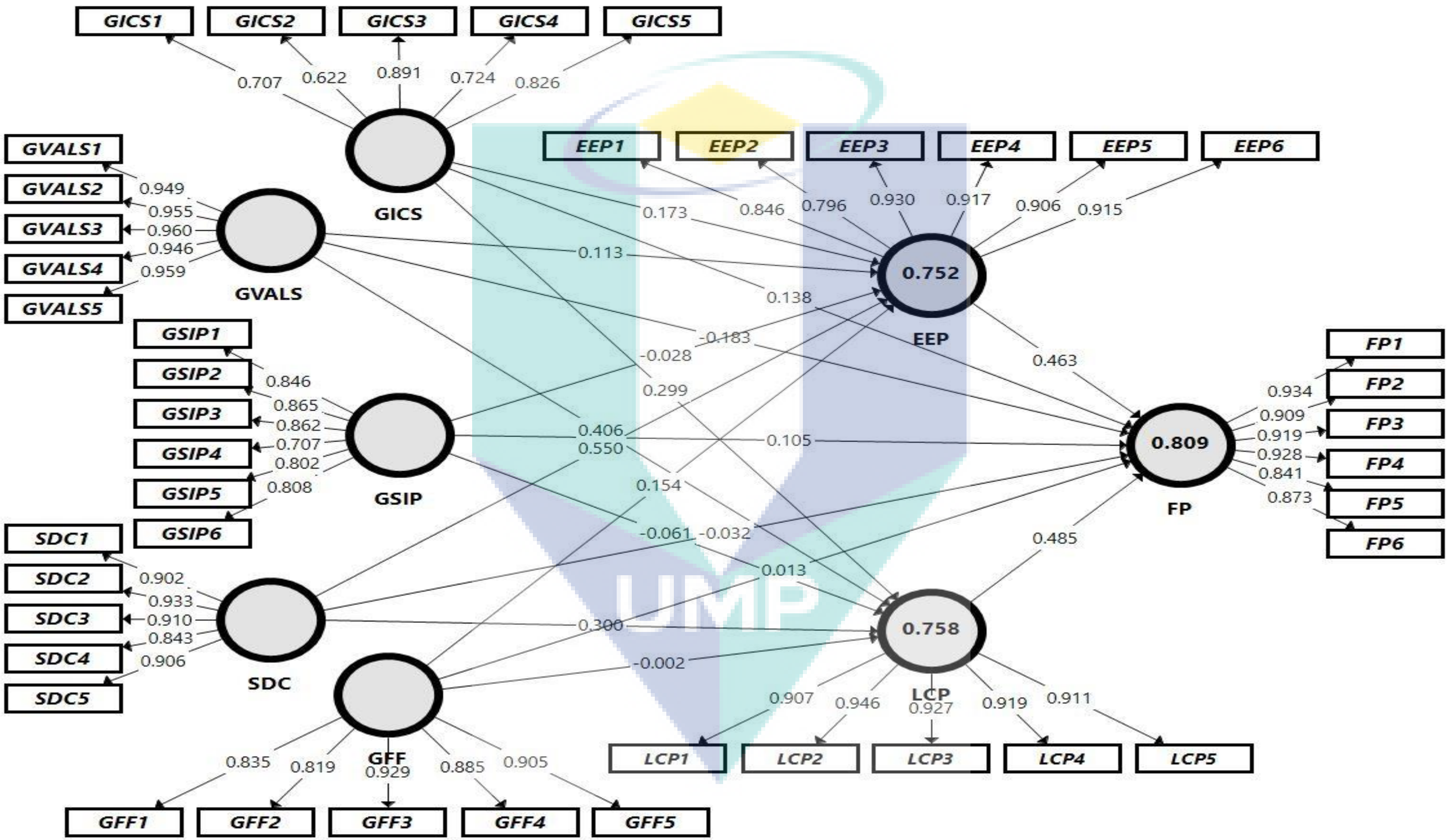

Figure 4.3 Model of Loadings

Table 4.11 Loading and Cross Loading

	EEP	FP	GFF	GICS	GSIP	GVALS	LCP	SDC
EEP1	**0.846**	0.726	0.6	0.537	0.413	0.705	0.709	0.723
EEP2	**0.796**	0.821	0.532	0.639	0.433	0.62	0.739	0.668
EEP3	**0.930**	0.748	0.617	0.62	0.44	0.722	0.72	0.768
EEP4	**0.917**	0.714	0.563	0.574	0.46	0.676	0.688	0.773
EEP5	**0.906**	0.762	0.626	0.624	0.45	0.698	0.766	0.757
EEP6	**0.915**	0.712	0.573	0.603	0.488	0.701	0.691	0.756
FP1	0.767	**0.934**	0.596	0.72	0.409	0.63	0.788	0.648
FP2	0.733	**0.909**	0.514	0.628	0.492	0.628	0.752	0.627
FP3	0.755	**0.919**	0.545	0.637	0.477	0.633	0.763	0.639
FP4	0.765	**0.928**	0.556	0.719	0.495	0.644	0.789	0.683
FP5	0.826	**0.841**	0.529	0.648	0.492	0.683	0.751	0.787
FP6	0.704	**0.873**	0.449	0.523	0.421	0.598	0.729	0.652
GFF1	0.73	0.613	**0.835**	0.514	0.565	0.739	0.637	0.741
GFF2	0.481	0.432	**0.819**	0.366	0.103	0.422	0.457	0.413
GFF3	0.574	0.537	**0.929**	0.581	0.416	0.612	0.547	0.544
GFF4	0.539	0.507	**0.885**	0.557	0.319	0.531	0.46	0.505
GFF5	0.505	0.453	**0.905**	0.471	0.252	0.509	0.482	0.46
GICS1	0.244	0.372	0.372	**0.707**	0.025	0.178	0.269	0.142
GICS2	0.192	0.329	0.297	**0.622**	-0.02	0.141	0.275	0.121
GICS3	0.745	0.719	0.54	**0.891**	0.536	0.744	0.772	0.754
GICS4	0.245	0.421	0.372	**0.724**	0.119	0.215	0.338	0.171
GICS5	0.713	0.663	0.505	**0.826**	0.548	0.7	0.733	0.726
GSIP1	0.328	0.329	0.214	0.289	**0.846**	0.463	0.325	0.456
GSIP2	0.411	0.371	0.292	0.349	**0.865**	0.546	0.407	0.498
GSIP3	0.384	0.36	0.271	0.327	**0.862**	0.533	0.344	0.499
GSIP4	0.426	0.587	0.304	0.479	**0.707**	0.37	0.47	0.407
GSIP5	0.415	0.39	0.406	0.329	**0.802**	0.509	0.384	0.502
GSIP6	0.463	0.407	0.436	0.337	**0.808**	0.545	0.436	0.53
GVALS1	0.741	0.702	0.632	0.623	0.592	**0.949**	0.792	0.815
GVALS2	0.742	0.667	0.628	0.612	0.608	**0.955**	0.782	0.81
GVALS3	0.758	0.672	0.644	0.629	0.549	**0.960**	0.781	0.813
GVALS4	0.733	0.662	0.605	0.611	0.55	**0.946**	0.771	0.803
GVALS5	0.728	0.669	0.641	0.619	0.591	**0.959**	0.768	0.806
LCP1	0.68	0.823	0.526	0.654	0.468	0.712	**0.907**	0.652
LCP2	0.77	0.746	0.566	0.665	0.498	0.815	**0.946**	0.812
LCP3	0.793	0.758	0.552	0.720	0.49	0.787	**0.927**	0.769
LCP4	0.82	0.775	0.634	0.718	0.429	0.781	**0.919**	0.796
LCP5	0.665	0.81	0.486	0.59	0.394	0.657	**0.911**	0.645
SDC1	0.731	0.67	0.595	0.62	0.66	0.834	0.716	**0.902**
SDC2	0.785	0.696	0.571	0.584	0.565	0.783	0.731	**0.933**
SDC3	0.745	0.667	0.553	0.575	0.485	0.753	0.763	**0.910**
SDC4	0.762	0.72	0.55	0.672	0.506	0.742	0.705	**0.843**
SDC5	0.736	0.605	0.549	0.441	0.446	0.697	0.679	**0.906**

4.5.1.2 Convergent Validity

Factor loadings (FL), composite reliability (CR), and average variance extracted (AVE) can be used to determine convergence validity (Hair, Anderson, Babin, & Black, 2010). Convergent validity can be defined as the degree to which a measure correlates positively with alternative measures of the same construct. To determine convergent validity in this study, the validity measurement to which the construct's indicators that indicate the latent variable (the outer loading) should exceed the above recommendation value of 0.5 (Byrne, 2016). As shown in Table 4.12 the loading value for all the items were higher than the recommended value of 0.5 to assess convergent validity.

Meanwhile, for CR can also be used to determine convergent validity. As this study is explanatory, CR value equal to or more than 0.7 is adequate for confirmatory purposes (Henseler, Ringle, & Sarstedt, 2012). As shown in Table 4.12 the values of CR were at the range of 0.871 to 0.981 that proved the convergent validity.

AVE is used to measure the level of convergent validity in this study by mean of the level of a construct. A minimum threshold of 0.5 value or higher is required that indicate the construct will be explained by 50% or more by the indicators variance (Hair Jr et al., 2014). The current model adopted in this study has 43 items altogether in which AVE of the model was viewed to be within the range of 0.577 to 0.910. The results of AVE values were indeed exceeded the recommendation value of 0.5 to determine the variance confined by the indicators relative to measurement error that proved the convergent validity in this study.

Table 4.12 Result of Measurement Model

Constructs	Items	Loadings	Cronbach's Alpha	Composite Reliability	AVE
EEP	EEP1	0.846	0.945	0.956	0.786
	EEP2	0.796			
	EEP3	0.930			
	EEP4	0.917			
	EEP5	0.906			
	EEP6	0.915			
FP	FP1	0.934	0.954	0.963	0.813
	FP2	0.909			
	FP3	0.919			
	FP4	0.928			
	FP5	0.841			
	FP6	0.873			

Table 4.12 Continued

Constructs	Items	Loadings	Cronbach's Alpha	Composite Reliability	AVE
GFF	GFF1	0.835	0.924	0.942	0.766
	GFF2	0.819			
	GFF3	0.929			
	GFF4	0.885			
	GFF5	0.905			
GICS	GICS1	0.707	0.846	0.871	0.577
	GICS2	0.622			
	GICS3	0.891			
	GICS4	0.724			
	GICS5	0.826			
GSIP	GSIP1	0.846	0.900	0.923	0.667
	GSIP2	0.865			
	GSIP3	0.862			
	GSIP4	0.707			
	GSIP5	0.802			
	GSIP6	0.808			
GVALS	GVALS1	0.949	0.975	0.981	0.910
	GVALS2	0.955			
	GVALS3	0.960			
	GVALS4	0.946			
	GVALS5	0.959			
LCP	LCP1	0.907	0.956	0.966	0.850
	LCP2	0.946			
	LCP3	0.927			
	LCP4	0.919			
	LCP5	0.911			
SDC	SDC1	0.902	0.940	0.955	0.809
	SDC2	0.933			
	SDC3	0.910			
	SDC4	0.843			
	SDC5	0.906			

4.5.1.3 Discriminant Validity

Discriminant validity examines whether the measurement items that are not supposed to be related are actually unrelated. To determine discriminant validity, the correlation between correspondence measures of the potentially related or overlapping construct was assessed in this study. In this regard, measurement items evaluated should load more strongly on their individual constructs in the entire measurement model (Hair Jr et al., 2016). Hence, to assess discriminant validity, the heterotrait-monotrait ratio of correlations (HTMT) criterion was used in this study. The HTMT value must be lower than 0.90, for discriminant validity to be established between two reflective constructs. Thus, as shown in Table 4.13, the values for all construct are of lower values than 0.90 that signified sufficient and satisfactory discriminant validity.

Table 4.13 Result of HTMT

	EEP	FP	GFF	GICS	GSIP	GVALS	LCP	SDC
EEP								
FP	0.888							
GFF	0.692	0.617						
GICS	0.609	0.707	0.607					
GSIP	0.538	0.538	0.412	0.401				
GVALS	0.809	0.732	0.677	0.554	0.646			
LCP	0.852	0.888	0.626	0.674	0.519	0.843		
SDC	0.888	0.787	0.653	0.551	0.641	0.885	0.840	

4.5.2 Reliability Analysis

To estimate the consistency of all items listed under the measurement construct, this study reported Cronbach's alpha coefficient, CR, and AVE for reliability analysis. According to Hair et al. (2010), Cronbach's alpha values must be exceeding 0.70 to be deemed reliable. All Cronbach's alpha values from the result in previous Table 4.12 were more significant than 0.70 which fulfilled the reliability analysis in this study. However, Garson (2014) notes that Cronbach's alpha may overestimate or underestimate scale reliability due to its sensitivity to underestimate the internal consistency reliability based on the number of the item. For this reason, this study also used CR for reliability analysis as widely adopted by numerous researchers in social science study due to its higher estimation of true reliability. As reported in the previous section, CR values were also in a good range of 0.871 to 0.981 (above 0.70 values), which considered as reliable. Finally, the AVE results also were reliable as the values were all above 0.5 as previously mentioned in the prior section. In conclusion, drawing from acceptable values of Cronbach's alpha coefficient, CR and AVE, this study's reliable analysis can be concluded as consistence and reliable.

4.5.3 Hypotheses Testing

In this study, path analysis was used for hypotheses measurement and structural model testing. Firstly, a structural model was developed to confirm and test the research constructs validity and reliability as mentioned in the previous section. The hypotheses were developed based on the connected relationship among latent variables/constructs comprising of seven (7) main hypotheses and 27 sub-hypotheses in this study. Then, the path analysis on the structural model was analysed (using PLS Algorithm) and validated by testing the path coefficients, loadings and R^2 as shown in Figure 4.3. For hypotheses measurement of the structural model, bootstrapping procedure with a resample of 5,000 was generated to assess the corresponding t-values, p-value, f^2 and R^2 for hypotheses validation. Figure 4.4 exhibits the results of path analysis (using a bootstrapping procedure) of the direct and indirect relationship of the structural model as well as the generated path coefficient and t-values for the inner and outer model. From the calculated t-values and *p*-values, a test was conducted to analyse whether the hypotheses were significant or not.

Meanwhile, to test the prediction relevance of the structural model, blindfolding test was also conducted in SmartPLS software. The test is applicable only to reflective modelled endogenous factors (such as this study), in which Q^2 greater than 0 means that the PLS-SEM model is predictive of the given endogenous variable under scrutiny (Garson, 2014). In this test, Q^2 values of EEP (0.545), FP (0.602) and LCP (0.595) (see Table 4.13) were well above zero indicated that the model of this study was well reconstructed and satisfied the model's predictive relevance. For R^2, also called the coefficient of determination was also tested to measure the overall effect size for the structural model in regression analysis. As suggested by Hair, Hult, Ringle and Sarstedt (2014), R^2 values of 0.75, 0.50, or 0.25 for endogenous latent variables can, as a rough rule of thumb, be respectively described as substantial, moderate or weak. In Table 4.14 the R^2 of FP was 0.809 which translates to all the five constructs of MGSCM were explaining the 80.9% of the variance in FP. While R^2 value for endogenous constructs for mediating variables of EEP and LCP were 0.752 and 0.758 suggesting 75.2% of the variance of EEP and 75.8% were explained by five MGSCM constructs. No R^2 was shown for GICS, GVALS, GSIP, GFF and SDC as these were exogenous latent factors. The overall value of R^2 in this study can be considered substantial for FP, EEP and LCP in term of effect size.

Table 4.14 Smart PLS Output for Overview

	Cronbach 's Alpha	Composite Reliability	AVE	R^2	Q^2
EEP	0.945	0.956	0.786	0.752	0.545
FP	0.954	0.963	0.813	0.809	0.602
GFF	0.924	0.942	0.766	-	-
GICS	0.846	0.871	0.577	-	-
GSIP	0.900	0.923	0.667	-	-
GVALS	0.975	0.981	0.910	-	-
LCP	0.956	0.966	0.850	0.758	0.595
SDC	0.940	0.955	0.809	-	-

Finally, for hypotheses testing, parameter estimates and path coefficient values were used to produce the approximate population covariance matrix for the structural model (Tabachnick & Fidell, 2001). A non-parametric approach using a bootstrapping procedure was conducted to determine the paths produced by calculating a standard error of the individual model parameter. The assessment of the model parameters' significances depends on the standard errors from bootstrapping, which may be magnified if the data is markedly skewed (Tan & Ramayah, 2018). For mediation analysis, SmartPLS software supports to model and analyse mediators based on PLS-SEM algorithm results and the bootstrap procedure which include the direct, the total indirect effect, the specific indirect effects, and the total effect. These finding outcomes, which are available in the comprehensive SmartPLS results reports, permit conducting and identifying a mediator analysis outcome. It is worth to note that the SmartPLS results allow analysing for both single and multiple mediation models (such as this study) for data reporting. For the purpose of reporting mediating hypotheses, this study only used the specific indirect effect measure for mediation analysis (see the SmartPLS3 output in section Appendix D). The used of a two-tail test was appropriate in this study to observe the research hypotheses with mediation variables to reduce potential bias. From the calculated t-values and p-value, the hypotheses can be determined whether they were significant or not. In this regard, if the t-value is larger than 1.96 for a regression weight, the parameter would be significant at 95% while the t-value of 2.58 would generate 99% of significant (Hair, Ringle, & Sarstedt, 2011). The summary of hypotheses results were presented in the subsequent section based on the conceptualization of hypotheses assumption in the prior chapter (Chapter 2).

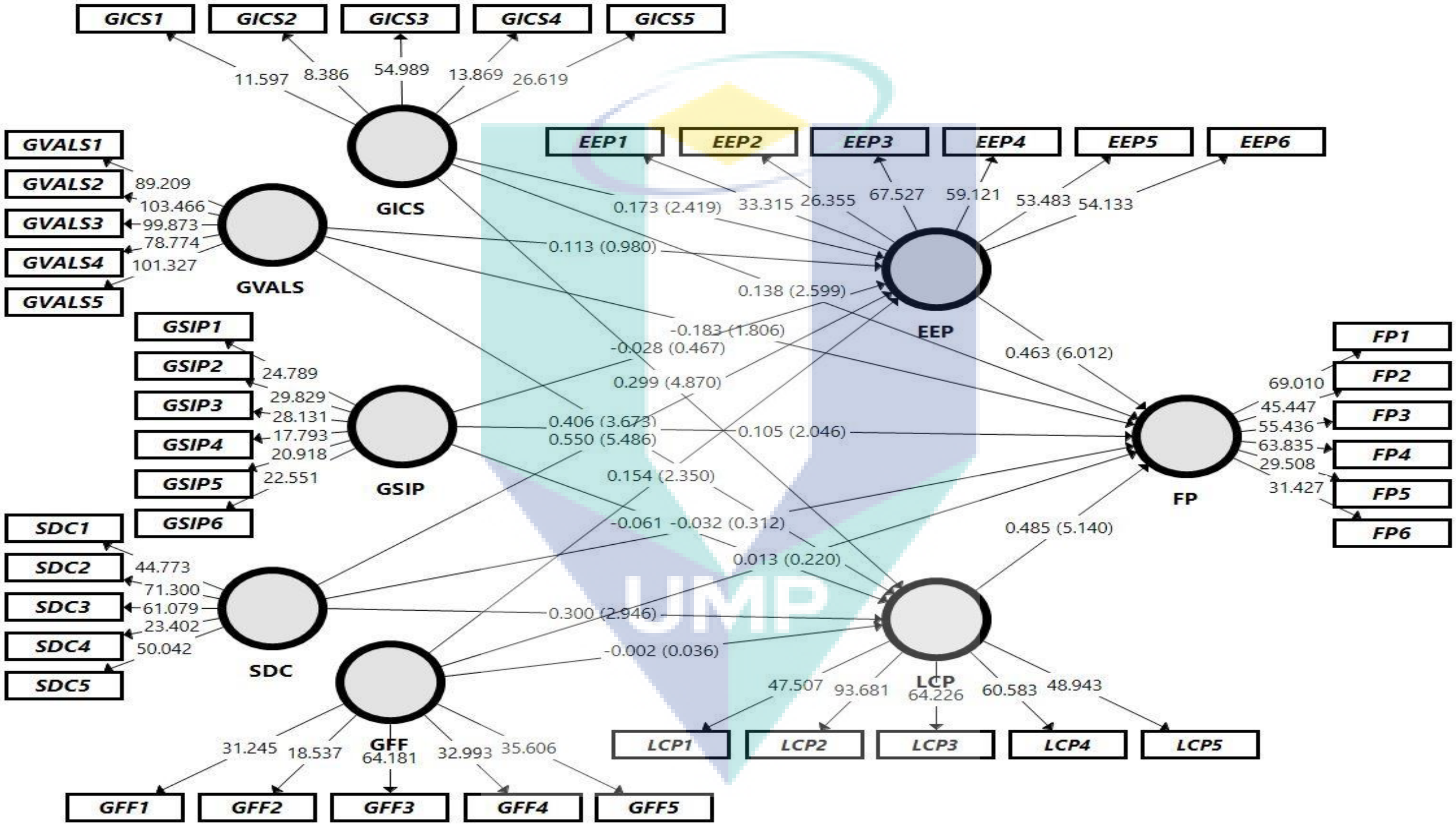

Figure 4.4 Bootstrapping results of the structural model (path coefficient and t-value)

4.5.3.1 H1: There is a positive relationship between maritime green supply chain management (MGSCM) and financial performance

Hypothesis H1 predicted that MGSCM has a positive relationship with financial performance. However, this major hypothesis H1 can only be accepted or rejected after assessing the result of five (5) sub-hypotheses containing MGSCM practices relationship with financial performance. It is worth to note that the relationship between MGSCM and financial performance can be considered the direct effect of the relationship between MGSCM and mediation (EEP and LCP) and mediation towards financial performance (indirect effect). From the results measured, the affect size (f^2) values of the MGSCM practices on financial performance were valued at 0.000 (GFF), 0.001 (SDC), 0.035 (GSIP & GVALS) and 0.043 (GICS). Based on Cohen (1988) affect size of 0.02, 0.15 and 0.35, can be considered to be small, medium and large. From this view, the affect size of all MGSCM constructs can be considered small towards the relationship with financial performance. Even though the affect size was small, Tan and Ramayah (2018) noted that even the slightest strength of f^2 can be considered substantial, and has an impact of the independent variables on the dependent variable.

Moving on to hypotheses testing, hypothesis H1a (GICS -> FP) ($\beta = 0.138$, $t = 2.599$, $p < 0.05$, $f^2 = 0.043$) and H1c (GSIP -> FP) ($\beta = 0.105$, $t = 2.046$, $p < 0.05$, $f^2 = 0.035$) were positively affect financial performance explaining 80.9% (R^2) of the variance in financial performance. From the accepted level of t-value ($t>1.96$) and p-value ($p< 0.05$) of H1a and H1c, it can be concluded that both hypotheses were accepted significantly. For H1b (GVALS -> FP) ($\beta = -0.183$, $t = 1.806$, $p>0.05$, $f^2 = 0.035$) and H1d (SDC -> FP) ($\beta = -0.032$, $t = 0.312$, $p>0.05$, $f^2 = 0.035$) were negatively related (due to negative standardize beta coefficient) with financial performance explaining 80.9% (R^2) of the variance in financial performance. From the accepted level of t-value ($t<1.96$) and p-value ($p> 0.05$) of H1b and H1d, it can be concluded that both hypotheses were statistically not significant and not supported. Meanwhile, hypothesis H1e (GFF -> FP) was also not supported due to statistically not significant at ($\beta = 0.013$, $t = 0.220$, $p>0.05$, $f^2 = 0.000$) even though there was positive relation (due to positive standardize beta coefficient). From the results in Table 4.15 it can be concluded that only two sub hypotheses were supported (H1a and H1c), thus the major hypothesis H1 was partially supported.

Table 4.15 Summary result of hypothesis H1 (direct effect)

	Relationship	Std. Beta	Std. Error	t-value	*p*-value	f^2	R^2	Q^2	Supported
H1	**There is a positive relationship between MGSCM and FP**								**Partially supported**
H1a	GICS -> FP	0.138	0.053	2.599	0.009	0.043	0.809	0.602	Yes
H1b	GVALS -> FP	-0.183	0.101	1.806	0.071	0.035	0.809	0.602	No
H1c	GSIP -> FP	0.105	0.051	2.046	0.041	0.035	0.809	0.602	Yes
H1d	SDC -> FP	-0.032	0.103	0.312	0.755	0.001	0.809	0.602	No
H1e	GFF -> FP	0.013	0.058	0.220	0.826	0.000	0.809	0.602	No

Note: Accepted level is t>1.96

4.5.3.2 H2.1: There is a positive relationship between maritime green supply chain management (MGSCM) and energy efficiency performance (EEP)

Hypothesis H2.1 has postulated that MGSCM has a positive relationship with financial EEP. The major hypothesis H2.1 can only be accepted or rejected after assessing the result of five (5) sub-hypotheses containing MGSCM practices relationship with EEP (indirect effect). From the results In Table 4.16, the affect size (f^2) values of the MGSCM practices on EEP were valued at 0.002 (GSIP), 0.012 (GVALS), 0.049 (GFF), 0.063 (GICS) and 0.308 (SDC). The results concluded that the affect for GSIP, GVALS, GFF, GICS were small, while SDC was medium towards the relationship with EEP.

For hypotheses testing, hypothesis H2.1a (GICS -> EEP) ($\beta = 0.173$, $t = 2.419$, $p < 0.05$, $f^2 = 0.063$), H2.1d (SDC -> EEP) ($\beta = 0.550$, $t = 5.486$, $p < 0.05$, $f^2 = 0.308$), and H2.1e (GFF -> EEP) ($\beta = 0.154$, $t = 2.350$, $p < 0.05$, $f^2 = 0.049$), were positively affect the EEP with 75.2% (R^2) of the variance explaining the EEP. From the accepted level of t-value ($t>1.96$) and p-value ($p< 0.05$) of H2.1a, H2.1d, and H2.1e, it can be concluded that these three (3) hypotheses were accepted and statistically significant. For H2.1b (GVALS -> EEP) ($\beta = 0.113$, $t = 0.980$, $p>0.05$, $f^2 = 0.012$) the hypothesis was statistically not significant and thus, not supported. Meanwhile, H2.1c (GSIP -> EEP) ($\beta = -0.028$, $t = 0.467$, $p>0.05$, $f^2 = 0.002$) were negatively related (due to negative standardize beta coefficient) with EEP explaining 75.2% (R^2) of the variance in EEP. From the accepted level of t-value ($t<1.96$) and p-value ($p> 0.05$) of H2.1b and H2.1c, it can be concluded that both hypotheses were not supported due statistically not significant. From the summarized results in Table 4.16 it can be concluded that only three (3) sub hypotheses were supported (H2.1a, H2.1d and H2.1e), thus the major hypothesis H2.1 was partially supported.

Table 4.16 Summary result of hypothesis H2.1 (indirect effect)

	Relationship	Std. Beta	Std. Error	t-value	*p*-value	f^2	R^2	Q^2	Supported
H2.1	**There is a positive relationship between MGSCM and EEP**								**Partially supported**
H2.1a	GICS -> EEP	0.173	0.072	2.419	0.016	0.063	0.752	0.545	Yes
H2.1b	GVALS -> EEP	0.113	0.115	0.980	0.327	0.012	0.752	0.545	No
H2.1c	GSIP -> EEP	-0.028	0.059	0.467	0.641	0.002	0.752	0.545	No
H2.1d	SDC -> EEP	0.550	0.100	5.486	0.000	0.308	0.752	0.545	Yes
H2.1e	GFF -> EEP	0.154	0.065	2.350	0.019	0.049	0.752	0.545	Yes

Note: Accepted level is t>1.96

4.5.3.3 H2.2: There is a positive relationship between maritime green supply chain management (MGSCM) and low carbon performance (LCP)

Hypothesis H2.2 has postulated that MGSCM has a positive relationship with LCP. The major hypothesis H2.2 can only be accepted or rejected after assessing the result of five (5) sub-hypotheses containing MGSCM practices relationship with LCP (indirect effect). From the results in Table 4.17, the affect size (f^2) value of the MGSCM practices on LCP were valued at 0.000 (GFF), 0.009 (GSIP), 0.094 (SDC), 0.159 (GVALS) and 0.191 (GICS). The results concluded that the affect for all MGSCM constructs was small towards the relationship with EEP.

For hypotheses testing, hypothesis H2.2a (GICS -> LCP) ($\beta = 0.299$, $t = 4.870$, $p < 0.05$, $f^2 = 0.191$), H2.2b (GVALS -> LCP) ($\beta = 0.406$, $t = 3.673$, $p < 0.05$, $f^2 = 0.159$), and H2.2d (SDC -> LCP) ($\beta = 0.300$, $t = 2.946$, $p < 0.05$, $f^2 = 0.094$), were positively affect the LCP with 75.8% (R^2) of the variance explaining the LCP. From the accepted level of t-value ($t>1.96$) and p-value ($p < 0.05$) of H2.2a, H2.2b, and H2.2d, it can be concluded that these three (3) hypotheses were accepted and statistically significant. For hypothesis H2.2c (GSIP -> LCP) ($\beta = -0.061$, $t = 1.123$, $p>0.05$, $f^2 = 0.009$) and H2.2e (GFF -> LCP) ($\beta = -0.002$, $t = 0.036$, $p>0.05$, $f^2 = 0.000$) the hypothesis was statistically not significant and thus, not supported. They were negatively related (due to negative standardize beta coefficient) with LCP explaining 75.8% (R^2) of the variance in LCP. From the accepted level of t-value ($t<1.96$) and p-value ($p> 0.05$) of H2.2c and H2.2e, it can be concluded that both hypotheses were not supported due statistically not significant. From the summarized results in Table 4.17 it can be concluded that only three (3) sub hypotheses were supported (H2.2a, H2.2b and H2.2d), thus the major hypothesis H2.2 was partially supported.

Table 4.17 Summary result of hypothesis H2.2 (indirect effect)

	Relationship	Std. Beta	Std. Error	t-value	*p*-value	f^2	R^2	Q^2	Supported
H2.2	**There is a positive relationship between MGSCM and LCP**								**Partially supported**
H2.2a	GICS -> LCP	0.299	0.061	4.870	0.000	0.191	0.758	0.595	Yes
H2.2b	GVALS -> LCP	0.406	0.111	3.673	0.000	0.159	0.758	0.595	Yes
H2.2c	GSIP -> LCP	-0.061	0.054	1.123	0.262	0.009	0.758	0.595	No
H2.2d	SDC -> LCP	0.300	0.102	2.946	0.003	0.094	0.758	0.595	Yes
H2.2e	GFF -> LCP	-0.002	0.061	0.036	0.972	0.000	0.758	0.595	No

Note: Accepted level is t>1.96

4.5.3.4 H3.1: There is a positive relationship between energy efficiency performance (EEP) and financial performance

Hypothesis H3.1 has postulated that EEP has a positive relationship with financial performance (indirect effect). Table 4.18 shows that the affect size (f^2) value of the EEP on financial performance was 0.253 which signified the medium affect size of the relationship. For the hypothesis testing, hypothesis H3.1 (EEP -> FP) (β = 0.463, t = 6.012, p< 0.05, f^2 = 0.253) was positively affect the financial performance with 80.9% (R^2) of the variance explaining the financial performance. From the accepted level of t-value (t>1.96), p-value (p< 0.05) and medium affect size of f^2 of H3.1, it can be concluded that the hypothesis was accepted and statistically significant.

Table 4.18 Summary result of hypothesis H3.1

	Relationship	Std. Beta	Std. Error	t-value	*p*-value	f^2	R^2	Q^2	Supported
H3.1	**There is a positive relationship between EEP and FP**								**supported**
H3.1	EEP -> FP	0.463	0.077	6.012	0.000	0.253	0.809	0.602	Yes

Note: Accepted level is t >1.96

4.5.3.5 H3.2: There is a positive relationship between low carbon performance (LCP) and financial performance

Hypothesis H3.2 postulated that LCP has a positive relationship with financial performance (indirect effect). Table 4.19 shows that the affect size (f^2) value of the LCP on financial performance was 0.271 which signified the medium affect size of the relationship. For the hypothesis testing, hypothesis H3.2 (LCP -> FP) ($\beta = 0.485$, $t = 5.140$, $p < 0.05$, $f^2 = 0.271$) was positively affect the financial performance with 80.9% (R^2) of the variance explaining the financial performance. From the accepted level of t-value ($t > 1.96$), p-value ($p < 0.05$) and medium-size affect of f^2 of H3.2, it can be concluded that the hypothesis was accepted and statistically significant.

Table 4.19 Summary result of hypothesis H3.2

	Relationship	Std. Beta	Std. Error	t-value	*p*-value	f^2	R^2	Q^2	Supported
H3.2	**There is a positive relationship between LCP and FP**								**supported**
H3.2	LCP -> FP	0.485	0.094	5.14	0.000	0.271	0.809	0.602	Yes

Note: Accepted level is t >1.96

4.5.3.6 H4.1: Energy efficiency performance (EEP) mediates the relationship between maritime green supply chain management (MGSCM) and financial performance

Hypothesis H4.1 postulated that the EEP mediates the relationship between MGSCM and financial performance. Based on this observation the five (5) sub-hypotheses were tested to determine the effect of EEP whether it has mediation or no mediation on the MGSCM-financial performance relationship. From Table 4.20, only three (3) hypotheses were accepted and have a mediation effect of EEP. They were H4.1a (GICS -> EEP -> FP) ($\beta = 0.080$, $t = 2.251$, $p < 0.05$), H4.1d (SDC -> EEP -> FP) ($\beta = 0.255$, $t = 3.930$, $p < 0.05$) and H4.1e (GFF -> EEP -> FP) ($\beta = 0.071$, $t = 2.113$, $p < 0.05$) which indicated that EEP mediates the relationship between MGSCM (GICS,SDC, and GFF) and financial performance with 80.9% (R^2) of the variance explaining the financial performance. From the accepted level of t-value ($t > 1.96$) and p-value ($p < 0.05$) it can be concluded that H4.1a, H4.1d, and H4.1e were supported significantly.

On the contrary, two (2) of the hypotheses were not significant and had no mediation effect of EEP. They were H4.1b (GVALS -> EEP -> FP) (β = 0.052, t = 0.950, p> 0.05), H4.1c (GSIP -> EEP -> FP) (β = -0.013, t = 0.457, p> 0.05), indicated that EEP did not mediates the relationship between MGSCM (GVALS and GSIP) and financial performance with 80.9% (R^2) of the variance explaining the financial performance. The hypotheses (H4.1b and H4.1c) were statistically not significant and thus, not supported. Further, H4.1c were negatively related due to negative standardize beta coefficient. From the accepted level of t-value (t<1.96) and p-value (p> 0.05) of H4.1b and H4.1c, it can be concluded that both hypotheses were not supported due statistically not significant. From the summarized results in Table 4.20 it can be concluded that only three (3) sub-hypotheses were supported (H4.1a, H4.1d, and H4.1e); thus, the major hypothesis H4.1 was partially supported. However, EEP can be still considered as mediating the relationship between MGSCM and financial performance due to three (3) supported sub-hypotheses.

Table 4.20 Summary result of hypothesis H4.1 (mediation effect)

	Relationship	Std. Beta	Std. Error	t-value	*p*-value	f^2	R^2	Q^2	Mediation
H4.1	**EEP mediates the relationship between MGSCM and FP**								**Yes**
H4.1a	GICS -> EEP -> FP	0.080	0.036	2.251	0.024	-	0.809	0.602	Yes
H4.1b	GVALS -> EEP -> FP	0.052	0.055	0.950	0.342	-	0.809	0.602	No
H4.1c	GSIP -> EEP -> FP	-0.013	0.028	0.457	0.648	-	0.809	0.602	No
H4.1d	SDC -> EEP -> FP	0.255	0.065	3.930	0.000	-	0.809	0.602	Yes
H4.1e	GFF -> EEP -> FP	0.071	0.034	2.113	0.035	-	0.809	0.602	Yes

Note: Accepted level is t>1.96

4.5.3.7 H4.2: Low carbon performance (LCP) mediates the relationship between maritime green supply chain management (MGSCM) and financial performance

Hypothesis H4.2 postulated that the LCP mediates the relationship between MGSCM and financial performance. Based on this observation the five (5) sub-hypotheses were tested to determine the effect of LCP whether it has mediation or no mediation on the MGSCM-financial performance relationship. From Table 4.21, only three (3) hypotheses were accepted and have a mediation effect of LCP. They were H4.2a

(GICS -> LCP -> FP) (β = 0.145, t = 3.649, p< 0.05), H4.2b (GVALS -> LCP -> FP) (β = 0.197, t = 3.180, p< 0.05) and H4.2d (SDC -> LCP -> FP) (β = 0.145, t = 2.252, p< 0.05) which indicated that LCP mediates the relationship between MGSCM (GICS, GVALS and SDC) and financial performance with 80.9% (R^2) of the variance explaining the financial performance. From the accepted level of t-value (t>1.96) and p-value (p< 0.05) it can be concluded that H4.2a, H4.2b, and H4.2d were supported significantly.

Meanwhile, two (2) of the hypotheses were not significant and had no mediation effect of LCP. They were H4.2c (GSIP -> EEP -> FP) (β = -0.029, t = 1.074, p> 0.05), H4.1c (GFF -> EEP -> FP) (β = -0.001, t = 0.034, p> 0.05), indicated that LCP did not mediate the relationship between MGSCM (GSIP and GFF) and financial performance with 80.9% (R^2) of the variance explaining the financial performance. The hypotheses (H4.2c and H4.2e) were statistically not significant and thus, not supported. Further, H4.2c and H4.2e were negatively related due to negative standardize beta coefficient. From the accepted level of t-value (t<1.96) and p-value (p> 0.05) of H4.2c and H4.2e, it can be concluded that both hypotheses were not supported due statistically not significant. From the summarized results in Table 4.21, it can be concluded that only three (3) sub-hypotheses were supported (H4.2a, H4.2b, and H4.2d); thus, the major hypothesis H4.2 was partially supported. However, LCP can be still considered as mediating the relationship between MGSCM and financial performance due to three (3) supported sub-hypotheses.

Table 4.21 Summary result of hypothesis H4.2 (mediation effect)

	Relationship	Std. Beta	Std. Error	t-value	*p*-value	f^2	R^2	Q^2	Mediation
H4.2	**LCP mediates the relationship between MGSCM and FP**								**Yes**
H4.2a	GICS -> LCP -> FP	0.145	0.040	3.649	0.000	-	0.809	0.602	Yes
H4.2b	GVALS -> LCP -> FP	0.197	0.062	3.180	0.001	-	0.809	0.602	Yes
H4.2c	GSIP -> LCP -> FP	-0.029	0.027	1.074	0.283	-	0.809	0.602	No
H4.2d	SDC -> LCP -> FP	0.145	0.065	2.252	0.024	-	0.809	0.602	Yes
H4.2e	GFF -> LCP-> FP	-0.001	0.031	0.034	0.973	-	0.809	0.602	No

Note: Accepted level is t>1.96

4.6 Chapter Summary

This chapter analysed and evaluated the results from the data collected from survey respondents in the Malaysian maritime sectors. A Statistical Package of Social Science (SPSS) version 23 and Partial Least Squares (Smart PLS 3.2.8) were used as statistical analysis techniques to analyse the data. SPSS was employed to examine the descriptive data Smart PLS software was used to validate the construct and goodness of measures for reliability analysis. Additionally, Smart PLS was used to test the hypotheses and model measurement. From the results achieved, this study has established valid, accurate and reliable measures of data for the conclusion in Chapter 5. The results from the bootstrapping procedure have established 16 accepted hypotheses from 27 hypotheses altogether.

In summary, from a demographic perspective, this study found that most companies in this sector were involved in shipping operation with major operation located near the port system. While from MGSCM perspective, the adoption level can be considered infancy (reflected from years of adoption) with the implementation of green practices going towards the maturity resulted from the wider adoption of green certifications. Finally, from the hypothesis results, the findings showed that most of the MGSCM practices affected financial performance when mediating variables exist between the relationship. Thus, this finding confirmed the assumption of the mediation effect of EEP and LCP towards the outcome of financial performance respectively. For a more elaborate explanation of the findings, the next chapter provides the complete discussion with supporting evidence from literature as well as the overall conclusion for this study.

CHAPTER 5

CONCLUSION

5.1 Introduction

This final chapter concluded and discussed the findings derived from the preceding chapter four. It includes the research results, a discussion of findings based on previous studies, the implication and limitation of this study as well as conclusion remarks for future research direction. In general, the chapter provided the overall summation that concluded the whole study.

5.2 Recapitulation of the Research Objectives and Hypothesis Findings

To recap, the research objectives of this study consist of 8 unique objectives to be solved. They were:

1. To examine the extent of MGSCM practices adoption in Malaysian maritime supply chain
2. To investigate the effect of maritime green supply chain management (MGSCM) on financial performance in the maritime supply chain industry in Malaysia
3. To examine the effect of maritime green supply chain management (MGSCM) to the energy efficiency performance (EEP) in the maritime supply chain industry in Malaysia
4. To examine the effect of maritime green supply chain management (MGSCM) to the low carbon performance (LCP) in the maritime supply chain industry in Malaysia
5. To investigate the effect of energy efficiency performance (EEP) on financial performance in the maritime supply chain industry in Malaysia

6. To investigate the effect of low carbon performance (LCP) on financial performance in the maritime supply chain industry in Malaysia
7. To examine whether energy efficiency performance (EEP) mediate the relationship between maritime green supply chain management (MGSCM) and financial performance
8. To examine whether low carbon performance (LCP) mediate the relationship between maritime green supply chain management (MGSCM) and financial performance

From these objectives, this study has developed the conceptual framework on MGSCM based on literature review and empirically tested for proving the relationships and hypotheses assumption. The general findings (see Table 5.1 for results overview) indicated that the independent variables (MGSCM dimensions) have indirectly influenced the positive outcome of the financial performance. There was also a mediation effect of EEP and LCP on the relationship between MGSCM and financial performance. The Table 5.1 also shows the overall results gained with 16 hypotheses accepted (highlighted in the table) from overall 27 hypotheses tested. In summary, the results gained from the quantitative analysis (using SPSS and PLS-SEM) based on the data gathered from 160 respondents have been quantified thoroughly to provide insight understanding of MGSCM practices in Malaysian maritime supply chain industry. The evaluation of each research objective and conclusion for future research is provided in the next discussion section based on the results overview in Table 5.1.

Table 5.1 Summary results of hypotheses

Hypothesis	Relationship	Results
H1	**There is a positive relationship between MGSCM and FP**	**Partially supported**
H1a	GICS -> FP	Yes
H1b	GVALS -> FP	No
H1c	GSIP -> FP	Yes
H1d	SDC -> FP	No
H1e	GFF -> FP	No
H2.1	**There is a positive relationship between MGSCM and EEP**	**Partially supported**
H2.1a	GICS -> EEP	Yes
H2.1b	GVALS -> EEP	No
H2.1c	GSIP -> EEP	No
H2.1d	SDC -> EEP	Yes
H2.1e	GFF -> EEP	Yes

Table 5.1 Continued

Hypothesis	Relationship	Results
H2.2	**There is a positive relationship between MGSCM and LCP**	**Partially supported**
H2.2a	GICS -> LCP	Yes
H2.2b	GVALS -> LCP	Yes
H2.2c	GSIP -> LCP	No
H2.2d	SDC -> LCP	Yes
H2.2e	GFF -> LCP	No
H3.1	**There is a positive relationship between EEP and FP**	**Fully supported**
H3.1	EEP -> FP	Yes
H3.2	**There is a positive relationship between LCP and FP**	**Fully supported**
H3.2	LCP -> FP	Yes
H4.1	**EEP mediates the relationship between MGSCM and FP**	**Mediated**
H4.1a	GICS -> EEP -> FP	Yes
H4.1b	GVALS -> EEP -> FP	No Mediation
H4.1c	GSIP -> EEP -> FP	No Mediation
H4.1d	SDC -> EEP -> FP	Yes
H4.1e	GFF -> EEP -> FP	Yes
H4.2	**LCP mediates the relationship between MGSCM and FP**	**Mediated**
H4.2a	GICS -> LCP -> FP	Yes
H4.2b	GVALS -> LCP -> FP	Yes
H4.2c	GSIP -> LCP -> FP	No Mediation
H4.2d	SDC -> LCP -> FP	Yes
H4.2e	GFF -> LCP-> FP	No Mediation

5.3 Findings and Discussion

This section includes the discussion of findings prescribed in the data analysis in the previous chapter. The perspective of discussion involved from a theoretical viewpoint and empirical evidence as a basis for a conclusion. The discussion also includes the results of this study investigation which examined the extent of MGSCM practices in influencing the outcome for financial performance and the mediating effect of EEP and LCP. From the findings exhibited in Chapter 4, 16 hypotheses were accepted out of 27 proposed hypotheses for further discussion and conclusion. In the subsequent section, this study concluded the finding based on eight (8) research objectives based on the results of hypotheses.

5.3.1 RO 1: To examine the extent of MGSCM practices adoption in Malaysian maritime supply chain

Based on the result in Chapter 4 the MGSCM concept can be extended into the maritime supply chain. The result showed that MGSCM has an indirect effect on EEP, LCP and financial performance based on a relatively high level of agreement. This initial postulation has concluded the positive postulation of this study that to such extent, most maritime companies were indeed implementing MGSCM in their operation. Furthermore, as the relative value of standard deviation is below than 1, this study concluded that most maritime companies experienced similar adoption of MGSCM and impact on performance. Thus, based on this view, this study firmly believed the results can be generalized in maritime industry. On the other note, even though most companies denoted that the adoption of MGSCM is still in its infancy phase based on the stage of adoption (most companies were at the start-up phase; based on level of adoption in descriptive analysis), several number companies were also at expansion stage where most companies' years of MGSCM adoption was at 6 to 10 years. Looking from another perspective, the applicability of green conception in this industry echoed back since the 1980s by the introduction of the mandatory adoption of the International Convention for the Prevention of Pollution from Ships (MARPOL). Although MGSCM connotation is quite a new concept in the Malaysian maritime industry, it might be possible that the industry players have been implemented MGSCM concept all along without knowing extensively as shown by the relatively wide adoption of green regulations (ISO 14001, ISM, SEEMP, EEDI, EEOI) and conventions (MARPOL 73/78) set up by International Maritime Organization (IMO) reflected from descriptive analysis in Section 4.3.3. Supporting this evidence, from the result of descriptive analysis on green training, program, and incentives (see section 4.3.4), most companies were also participated in the green program as well as receiving the incentive for green practice adoption. These shreds of evidence show that the extent of MGSCM adoption among maritime supply chain players are also in the path towards maturity as reflected from wider adoption of green certificates (e.g., ISO 14001, ISM and MARPOL 73/78) and government supports in term of incentive and green program.

5.3.2 RO 2: To investigate the effect of maritime green supply chain management (MGSCM) on its financial performance in the maritime supply chain industry in Malaysia

Examining the first research objective, the proposed hypotheses H1 which postulated that MGSCM practices (GICS, GVALS, GSIP, SDC and GFF) have a positive effect on financial performance were tested accordingly. Based on the partially supported hypotheses findings, only hypotheses H1a and H1c indicated GICS and GSIP have positively influenced financial performance, while hypotheses H1b (GVALS), H1d

(SDC) and H1e (GFF) were not supported in regard of MGSCM- financial performance relationship.

The study suggested that GICS improved financial performance (H1a). Through the integrative process of information sharing, operational efficiency in the maritime supply chain can be increased significantly. In the maritime industry, frequent and effective communication system helps resolve ex-ante contract disputes rapidly and allow the fast alignment of buyer-seller expectations and joint decision which help in increasing supply chain efficiency. In this regard, the improvement gained from GICS adoption support the effective key processes of order fulfilment between suppliers, sourcing of resources, procurement and supply chain operation may improve financial performance through enhance supply chain efficiency. Consistent with the finding by Mohan, Wong and Soh (2018), when efficiency increased, the benefits to supply chain operation (such as reduced energy consumption, overall cost reduction and increase revenue growth) also increase which translated into improving financial performance outcome. Further, streamlining the GICS adoption in the maritime supply chain may increase financial performance through decrease dependency of paper documentation which reduces the overall cost of documentation materials for entire supply chain processes.

For the next supporting hypothesis H1c, GSIP improved financial performance. From the maritime supply chain perspective, when coordination and cooperation between supply chain players achieved, green supply chain processes and operation can become more effective and efficient. For example, the integration and coordination of purchasing, manufacturing, marketing, logistics, and information among supply chain players may increase responsiveness that in turn increase the quality of services and efficiency. Increase quality of services may drive customer demand in which it would enhance long term organizational profit. The finding is corroborated with the results by Woo, Kim, Chung, and Rho (2015) in which GSIP fulfil the customer demand through sharing strategies and information capabilities that reduced environmental impact and disposal cost in which it would improve long term financial performance.

Meanwhile, the results showed that GVALS (H1b) and SDC (H1d) did not improve financial performance. The low impact of GVALS and SDC on financial performance can be deduced that GVALS and SDC are very costly to be implemented due to low cost-effectiveness. For GVALS, high investments and fewer return-on-investments and extra expenditure in implementing GVALS may hamper short term profit as the initial capital needed to implement green processes is high. For SDC, as shipping industries in maritime supply chain involved handling costly equipment and heavy machinery (water vessels, cargo ships, containers, heavy land transports, etc.), a slight change in the specification in ship design require huge investment capital to implement new green technology. Supported by Govindan, Azevedo, Carvalho and Cruz-machado (2014), due to high capital and investment reason, most companies may choose to neglect to adopt green practices as it may take a longer return on investment that may impact financial performance. For this reason, both green practices of GVALS and SDC showed no positive effect on financial performance.

Finally, the relationship between GFF (H1e) and financial performance was not supported. Even though there is limited evidence in literature supporting this finding, this study postulates that the reason for no improvement toward financial performance is due to the nature of GFF practice itself in which it involves in internal financial flow and accounting only but not an actual or 'physical' green practice (such as GICS, GVALS, SDC and GSIP). Supported by Fernando, Jasmi and Shaharudin (2019), the intangible aspect of GFF only involved with internal management processes of green accounting, financial flow and investment resulting in difficulty to measure physical effectiveness of GFF as an operational measure to achieve a profitable operation. Instead, GFF only acts as a mechanism for financial reporting/statement for the companies to only make a sound decision regarding green adoption and does not necessarily give a substantial impact on the financial performance outcome.

5.3.3 RO 3: To examine the effect of maritime green supply chain management (MGSCM) to the energy efficiency performance (EEP) in the maritime supply chain industry in Malaysia

For the second research objective, the proposed hypotheses H2.1 which postulated that MGSCM practices (GICS, GVALS, GSIP, SDC and GFF) have a positive effect on EEP were tested accordingly. Based on the partially supported hypotheses findings, only hypotheses H2.1a, H2.1d and H2.1e indicated GICS, SDC and GFF have positively influenced EEP, while hypotheses H2.1b (GVALS) and H2.1c (GSIP) were not supported in regard of MGSCM- EEP relationship.

The finding revealed that GICS improved EEP (H2.1a). As supported by Nishant, Teo and Goh (2013), can bring benefit through reduced energy consumption at the organizational level. From maritime supply chain perspective, maritime companies who adopt GICS can reduce energy consumption through efficient handling of information, ordering procedure, order discrepancy handling, order quality, order condition, order accuracy, order release quantities and timeliness handling of logistic information that increase accuracy for just-in-time (JIT) operation without delayed transhipment. The result of these intricate processes reduced the usage of the hand-in transaction, paper documentation and unnecessary delivery trip of documentation that eliminate the needs for physical transportation. With the online management of data through GICS, energy efficiency performance can be improved significantly as supported by this study result.

Next, this study found that SDC improved EEP (H2.1d). The results showed that SDC is beneficial for the energy efficiency performance of maritime companies. As SDC encompasses the compliance dimension of energy efficient equipment and construction as ruled in environmental certification (such as SEEMP and EEDI), the adoption leads towards energy efficiency performance gains. Supported by Lai, Wong, Lun and Cheng (2013), SDC practices such as energy efficient of shipping equipment design, shipping equipment reuse, recycling of waste, recovery of waste, and reduction of environmental damages can lessen the impact to the environment through reduction on energy usage. Such compliance may give prolong efficiency in term of energy usage that translates into improved EEP.

This study also suggested that GFF (H2.1e) improved EEP. From this study perspective, as GFF concerns with the monetary flow of allocating green investment management and accounting processes, the evaluation of green investment and technology leads to economic analysis for cost optimization. In this sense, before maritime companies adopt any new green practice, they first look at the ability of the green practice whether it can give a significant advantage in term of energy saving that can give them reduce liability cost that meets the requirement of mandatory green certification endorsed by IMO. The projected cost of optimization of reducing energy usage can only be then, determine through GFF practice for allocating appropriate green investment for yearly operational saving. Supported by Baldi, Gabrielii, and Andersson (2012), that for green adoption practice, estimation of the yearly savings and advantage must be first determined for the calculation of the payback time of different actions and measures towards higher energy efficiency outcome. Based on this view, the indirect effect of this processes leads towards the assumption that the maritime companies in supply chain believe GFF can lead toward better financial management flow of green adoption that focus into energy improvement.

Meanwhile, the results showed that GVALS (H2.1b) did not improve EEP. From this finding, this study assumes that the GVALS impact on EEP is minuscule as most of the GVALS primary processes involved pollution prevention to the environment such as waste reduction, green material handling, and recycling activities in which it does not involve the energy efficiency dimension. This finding is consistent with Jabbour, Neto, Gobbo, Ribeiro, and Jabbour (2014) that denote that the primary intention of GVALS is designed to lessen the environmental effect of production, consumption and disposal activities, even if the initial intention is achieving competitiveness through addressing environmental concerns. From this view, this study believes that from the result shown, GVALS only impact the environmental dimension (such as reduce waste, pollution or emission) but not on reducing energy efficiency dimension.

Finally, the relationship between GSIP (H2.1c) and EEP was not supported. As GSIP involves integrating green practices into internal organizational functions through collaboration and coordination with the suppliers, customers, and other channel members, it does not involve in 'actual' or 'physical' green practice to reduce energy usage. GSIP in a broader view, only creating synergy between partner to enhance the managerial flow of green practice through cooperation between supply chain players. The negative result might also be due to the complex dimension of maritime supply chain players which involves multiple layers of stakeholders resulting in an asymmetrical distribution that hamper the green practices outcome that impact the whole supply chain processes to achieve energy reduction. As deposited by Vachon and Klassen (2008), when information is asymmetrically distributed, it may lead to lack of integration that impacts the whole supply chain to achieve any desired outcome of environmental performance (in this case, it refers to the EEP dimension).

5.3.4 RO 4: To examine the effect of maritime green supply chain management (MGSCM) to the low carbon performance (LCP) in the maritime supply chain industry in Malaysia

For the third research objective, the proposed hypotheses H2.2 which postulated that MGSCM practices (GICS, GVALS, GSIP, SDC, and GFF) have a positive effect on LCP were tested respectively. Based on the partially supported hypotheses findings, only hypotheses H2.2a, H2.2b, and H2.2d indicated GICS, GVALS and SDC have positively influenced LCP, while hypotheses H2.2c (GSIP) and H2.2e (GFF) were not supported in regard of MGSCM- EEP relationship.

The result of hypothesis H2.2a revealed that GICS improved LCP. As mentioned in the previous section, GICS diminish the need for the hand-in transaction, physical paper documentation and physical transportation. Due to these advantage in term of the diminishing need for physical transportation, it reduces the emission of transportation used to cater the supply chain management process. In a broader perspective in maritime context, GICS may also enhance the maritime operation efficiency via streamlining the information flow that reduced engine idling, wasted working hours of waiting time, fewer trips (lower asset utilization), unnecessary return trips, reduce vehicular emission and reduce maintenance repairs. This enhancement of maritime supply chain processes through GICS can be translated into a more efficient operation that reduces carbon footprint and emission. Consistent with the finding by Uddin and Rahman (2012), green IT such as GICS can help organizations to mitigate the direct contribution of CO^2 emissions through an efficient flow of information and data processes.

For hypothesis H2.2b, the result showed that GVALS improved the LCP outcome. From this study viewpoint, GVALS reduce the LCP in maritime supply chain context through the adoption of environmentally friendly operation such as enhancing shipping equipment and activities that include reuse, recycling, and material recovery to comply with environmental compliance. These green supply chain processes improve LCP as denoting by Lirn, Lin and Shang (2014) through the use of sustainable design products and equipment and efficient use of resources during production processes that translate into improving environmental performance that extend the benefit to emission reduction as well.

Next, the hypothesis H2.2d showed that SDC improved LCP. As elaborated in the previous section, SDC emphasizes prevention focus on wastage and adoption of green equipment to lower the emission as a part of compliance to IMO's regulations. These reduction activities through efficient usage of green technologies and equipment may lessen the environmental damages due to shipping operations that translate into improved LCP in the long term. This finding consistent with a study by Lai, Lun, Wong, and Cheng (2011) that denotes design of shipping activities and equipment for reduced consumption of materials and energy can reduce carbon emission and energy usage.

Meanwhile, hypotheses H2.2c suggested that GSIP did not improve LCP. As mentioned in the previous section, GSIP practice does not involve in ‘physical' green practices or processes and focus more on internal and external integration of maritime supply chain players to improve the flow of information and managerial decision of green practices. From the result, the lack of integration among supply chain players may also become a significant reason why the GSIP does not improve LCP. One plausible explanation of this situation is the complicated nature of this industry which involve in a multilayer of stakeholders as also elaborated in the prior section. For this reason, it is hard to achieve any environmental performance such as LCP through GSIP. The result is supported by Fernando, Jasmi, and Shaharudin (2019) in which the study denotes that due to the multifaceted nature of this sector, it is challenging to develop and implement GSIP measures that meet all the collective requirements of stakeholders especially in term of environmental performance.

Finally, the result also showed that the hypothesis H2.2e in which GFF has a positive impact on LCP was not supported. This study postulates that the negative influence of GFF on LCP is due to its nature of financial flows and processes is infrequently associated with significant impact on intangible dimension such as environmental impacts. Instead, it is frequently associated with tangible dimension encompasses managing the costing aspect of the green product, fuel costs for efficient consumption, delivery costs, green investment costs, and resources, therefore failed to produce any significant improvement environmental performance especially in term of emission reduction. Consistent with the finding by Fernando et al. (2019), they noted that GFF only plays an internal role of financial flow management of greening the maritime operation and not influenced external dimension especially in term of environmental performance.

5.3.5 RO 5: To investigate the effect of energy efficiency performance (EEP) on financial performance in the maritime supply chain industry in Malaysia

For the fourth research objective, the proposed hypotheses H3.1 which postulated that EEP has a positive effect on financial performance was supported respectively. From maritime supply chain view, this effect is possible due to recent regulation requirement such as ship energy efficiency management plans (SEEMP), environmental management system (EMS ISO 140001) and energy efficiency design index (EEDI) being mandatory by most maritime companies. These operational measures established a comprehensive mechanism to improve the energy efficiency of a ship against the daily operation of supply chain operation in a cost-effective manner. Due to this adoption, energy-efficient transportation and operation can be attained, and long-term gain in term of financial performance and competitiveness can be achieved. The finding is supported by Fan, Pan, Liu, and Zhou (2017), in which the study found that when companies achieve a similar economic output with less energy, it shows improved financial performance.

5.3.6 RO 6: To investigate the effect of low carbon performance (LCP) on financial performance in the maritime supply chain industry in Malaysia

For the fifth research objective, the proposed hypotheses H3.2 which postulated that LCP has a positive effect on financial performance was supported respectively. As mentioned in the previous section (RO 4), the mandatory effect of green regulation imposed by IMO required many maritime companies to comply. These green regulations assess not only the energy efficiency of maritime shipping operation but also the emission of the ships in the disposal (Lai et al., 2013). Increase energy efficiency not only reduced the cost of operation, but also decrease the emission through efficient use of fossil fuel. This inevitable reduction of emission eventually leads towards cost reduction that translates into increased financial performance. Moreover, with the adoption of these green certification, the benefits of cost reduction may also due to lower cost of operation from tax exemption and monetary incentive provided by the government.

5.3.7 RO 7: To examine whether energy efficiency performance (EEP) mediates the relationship between maritime green supply chain management (MGSCM) and financial performance

This study suggested that the indirect effect of MGSCM on financial performance could be mediated by EEP when MGSCM practices such as GICS, GVALS, GSIP, SDC, and GFF are implemented as an integral strategy to increase financial performance. From the findings, only three hypotheses supported the effect of EEP as the mediator between GICS (H4.1a), SDC (H4.1d) and GFF (H4.1e) with financial performance. To explain the EEP as a mediator, EEP must be viewed from technology and human involvement viewpoint. In this sense, energy efficiency outcome such as EEP is achieved through the measures employed during ship design and supply chain operation, of which some are technology-related, and others are good operational practices from human intervention consisting of supply chain players. In this regard, both processes require human intervention concerning selecting the best and precise measure of MGSCM practice and implementing it. Any inefficient selection or implementation will naturally lead to less efficient ship design or operation, which in turn will impact the ability to gain profitable operation.

From this view, as supported by the result of hypotheses in RO2, the technology-related dimension of GICS and SDC which involve the integration of information technology (GICS) and greening the shipping design and equipment for compliance (SDC) can increase energy efficiency which translate into less utilization of resources in physical transportation and maritime operation. When the less usage of resources such as fuel consumption or electricity usage is reduced, the optimization of maritime supply chain processes could be increased and thus cost saving benefit can be achieved that leads toward a higher profitable outcome. Meanwhile, the adopting green and energy efficient technology without human intervention in term of managerial practice is impractical (Kitada & Ölçer, 2015) provided that without a proper system of costing analysis to make a sound decision may hamper long term benefits of increased financial performance. For this reason, GFF acts as a proper management tool in which sound decision is made through proper costing analysis and financial flow processes of adopting energy efficient technology and processes in which long term benefit of financial performance could be realized. Based on this explanation, this study confirmed that energy efficiency performance mediates the relationship between 3 dimensions of MGSCM (GICS, SDC, and GVALS) and financial performance.

Meanwhile, this study suggested EEP did not mediate the relationship between GVALS (H4.1b) and GSIP (H4.1c) with financial performance. As mentioned in the hypotheses result in RO2, EEP does not mediate GVALS- financial performance relationship due to GVALS main activities aimed at pollution prevention to the environment such as waste reduction, green material handling, and recycling activities in which it does not involve direct impact on energy efficiency dimension. As there is no reduction in energy consumption or impact on energy efficiency, cost reduction is not affected by GVALS and thus resulting in a low impact on financial performance. Based on this view, EEP does not mediate the impact of GVALS on financial performance. For GSIP, the EEP did not mediate the relationship with financial performance due to difficulty in integrating green measures in the maritime supply chain in which it hampers the two possible outcomes of improving EEP or gain in financial performance. The previous study by Kitada and Ölçer (2015) denotes that stakeholder's attitudes and organizational behaviour towards the implementation of energy efficiency measures can result in difficulty for cohesive integration practice which may hamper energy efficient practice that leads to lower income for maritime companies. The complicated nature of the maritime industry also can become a major drawback to achieve energy efficient operation due to difficulty in monitoring the green operation of each member of the supply chain player. For this reason, energy efficiency performance is hard to be achieved and thus resulting in no mediation of EEP on GSIP-financial performance relationship.

5.3.8 RO 8: To examine whether low carbon performance (LCP) mediates the relationship between maritime green supply chain management (MGSCM) and financial performance

This study also revealed that the indirect effect of MGSCM on financial performance could be mediated by LCP when MGSCM practices such as GICS, GVALS, GSIP, SDC, and GFF are implemented as an integral strategy to increase financial performance. However, from the results, only three hypotheses were supporting the effect of LCP as a mediator between GICS (H4.2a), GVALS (H4.2b) and SDC (H4.2d) with financial performance. The result of LCP as a mediator for GICS-financial performance relationship is expected as it has a positive indirect effect with LCP as elaborated in RO3. In this sense, as GICS reduce the need for the physical transaction, physical documentation, and physical transportation, it reduces the emission of transportation and related operation that usually used to cater the supply chain operation. The efficient flow of information through GICS adoption enhances the operational efficiency and financial performance through reduce delivery time, enhance the quality services to the customers as well as reduce the liability cost associated with the hefty fine imposed by the regulatory body. As denoted by Zhu, Sarkis and Lai (2012), this enhancement of maritime supply chain processes through GICS can be translated into not only efficient operation that reduces the emission but also improved financial performance in the long term.

For hypothesis H4.2b and H4.2d, the result showed that LCP mediated the relationship between GVALS and SDC with financial performance. As noted in RO3 GVALS reduce the emission through adoption of environmentally friendly operation (such as utilization of green material and handling, reduce waste, implementation of the environmental management system and etc) while SDC involved in a prevention system focusing on wastage reduction and adoption of green shipping equipment to lower down the emission to comply with environmental compliance. Both practices lead to the reduction of liability cost associated with the hefty fine imposed by the regulatory body that translates into improved financial performance. As denoted by Hitchcock (2012), concerning the procurement, manufacturing and logistics processes in supplier countries, the maritime companies could be required to certify that a green practice system had been employed in order to trade with destined countries (especially involving developed country where green certification is mandatory). From this view, when the LCP is achieved, maritime companies can also improve their service quality in term of more efficient transportation as well as improve operational capability to make the trade with multinational companies that already adopted the green equipment as mandatory by IMO. This streamlining function of operational capability may increase financial performance through increasing demand from customers and the ability to make a trade with countries that require certified green adoption practice.

Based on the results of hypotheses H4.2c and H4.2e, LCP did not mediate the relationship between GSIP and GFF with financial performance. As stated in RO3, there is no effect of GSIP on LCP as integration practice is hard to achieve due to the complex nature of this industry. Due to this reason, the collective measurement of green practices that meet every player needs of emission requirement is difficult to be achieved. Moreover, with less implementation and the state of integration at its infancy, the LCP measures becoming harder to be accomplished. As denoted by Yuan, Ng, and Sou (2016), the indirect result of this situation leads to information asymmetry and uncertainty that hamper the efficiency of supply chain operation and decision making among supply chain players. This additional drawback, uncertainty and inefficient process of information flow will eventually affect the service quality and ability to meet customer demand that translates into lower financial performance.

Meanwhile, LCP did not mediate the GFF and financial performance relationship due to GFF primary focus is on financial flows and processes in which it does not impact the emission as postulated in RO3. As GFF associated with managing the costing aspect of green operation, green investment costs, and resources, therefore it failed to produce any significant improvement in term of emission reduction. As LCP is considered as the external outcome, only physical/external activities of green practice can achieve the external outcome (Hitchcock, 2012). In this sense, GFF act as internal management capability of managing financial flow in which emission reduction is not a direct effect of these internal activities. Even though there is no literature to support this hypothesis of why LCP does no mediate the GFF-financial performance relationship, from RO1 result, this study confirms that GFF relationship with financial performance also not supported as GFF only acts as a mechanism for financial reporting/statement to make sound decision regarding green adoption and does not impact the external outcome of financial performance nor any emission reduction activities.

5.5 Implications of the Study

The finding of this study has several implications from the theoretical, practical and social perspective.

5.5.1 Theoretical Implications

This study contributes towards the body of existing literature in MGSCM, and maritime supply chain. With the dominant GSCM study footholds relating to the exploration of GSCM in other sectors of industries (e.g., manufacturing, automotive, construction, SME, etc), this study attempts to provide a broad picture of how green development such as MGSCM evolved in the maritime sector. Although there are several studies about GSCM and its performance exist in literature, there is still lack of concrete understanding and evidence concerning the direct and indirect effects of GSCM on financial performance (Feng et al., 2018b). A few empirical, evidence-based studies (mostly in manufacturing sectors) suggest some GSCM practices could have positive, negative or insignificant relationships with financial performance. This inconclusive evidence leads to the motivation of this study to investigate green practice (MGSCM) impact on financial performance as well as contributing evidence towards a limited body of maritime literature.

While some scholars have previously pointed out the possibility of mediation effects (Feng et al., 2018; King & Lenox, 2001; Zhu, Sarkis, & Lai, 2012; Zhu, Feng, & Choi, 2016), this study has explored this possibility through EEP and LCP as a pivotal mediator to this relationship linkage. The finding contributes to the existing literature by confirming the postulation of these two variables (EEP and LCP) as a critical mediator that impact the MGSCM-financial performance relationship. Moreover, this study provides some of the first evidence that not all MGSCM practices lead to improved financial performance; however, if EEP and LCP are implemented as an integral strategy, MGSCM could indirectly affect financial performance through both energy efficiency performance and low carbon performance.

Despite being governed by global conventions and regulations related to environmental protection in the maritime sector, there is still lacks clear guidelines on how maritime supply chain can assist in decreasing its carbon footprint and involvement to global warming (Khalid et al., 2010). There is an absence of green awareness consisting of comprehensive knowledge regarding processes, procedures, and measures among the maritime industry players to lessen the environmental impact in their daily operation. This study has embarked a journey to address this gap in the literature by providing a general overview and insight perspective on existing MGSCM practices in maritime supply chain context.

The study provides the foundation for extending the NRBV theory to develop a new model of green practice adoption that comprises a new perspective and understanding from a maritime perspective. This study has revealed that NRBV theory has significant importance in influencing the adoption of MGSCM practice as product stewardship aim at improving competitive advantage via increase financial gain. Gaining competitive advantage through MGSCM and enhanced environmental performance (EEP and LCP) have influenced their actions and perceptions on MGSCM practices in their operation. The finding showed that each element of MGSCM variables has direct or indirectly influenced the energy efficiency, low carbon and financial outcome in a maritime supply chain system. As denoted by NRBV theory, EEP and LCP as pollution prevention system have a significant impact in this study especially in propelling financial improvement from MGSCM adoption. Hence, the extent of NRBV theory in this study offers a plausible source for explaining the effects of each element of variables in this study to support the hypotheses assumption.

Finally, as this study is the first empirical study investigating green concept in Malaysia maritime supply chain on carbon reduction and energy efficiency, consequently, it would create an outcome which would provide an opportunity to other researchers to study further especially in other areas of MGSCM practice. Additionally, as this study is among the earliest maritime green study in Malaysia, the study provides the theoretical insight and general overview of green adoption from developing country context. Further, this study also leads the way toward the pioneering effort of quantitative research, especially in the explanatory study context, to determine the applicability of MGSCM concept from Malaysia maritime supply chain perspective.

5.5.2 Practical Implications

This study has several practical implications that are discussed below.

As an effective stakeholder, governmental bodies have been playing a critical role in encouraging maritime companies to implement MGSCM practices. Considering this factor, regulatory stakeholders especially should note the importance of green practices concerning their both economic and environmental contribution to organization and society, and try to transform regulatory pressures (the green regulations and maritime conventions) into effective assistance and proactive encouragements to maritime stakeholders/companies to motivate wider adoption of MGSCM. The core benefits of MGSCM adoption not only appear on the competitive advantage of business (such as financial performance improvement) but also can be extended into significant impact on environmental well-being in term of EEP and LCP.

Even though some of the MGSCM dimensions are relatively new in Malaysian maritime context, it could start as a preliminary exertion of green initiative among the industrial players and top management to fulfil industry's requirement. MGSCM can become a viable corporate strategy that would enable increase competitive advantage and sustainable operation in the long run.

The findings of this study aim to contribute towards recognizing green factors that influence sustainability in the maritime sector as well as enhancing the maritime supply chain through MGSCM practices. Identifying these factors by industry players would facilitate maritime industry's competitive strategic planning for better decision making and management improvement in the future.

Based on this study, an MGSCM framework can be suggested by which the maritime company can improve EEP, LCP, and financial performance. The framework attempts to make the MGSCM effort run through the whole supply chain operation of the maritime companies for long term benefit of competitive advantage. Although the model has limited universality as it was proposed for the maritime industry, it still can be served as a reference for others industry as well. Other industry can develop a more comprehensive framework to suit their green development strategy based on MGSCM concept as well as combined with their technical characteristics.

Increasing green awareness is vital for successful implementation of MGSCM practices. As shown in the descriptive analysis result, most companies did not have a dedicated monitoring department or personnel overseeing green practices in their organization due to low awareness of its importance (one of the reasons). However, to address this problem, training and green education for both management and employees, investing more into pollution preventive solutions, and integrating environmental strategies into the whole supply chain process can be recommended as effective internal strategies to improve awareness amongst employees and industry players.

To achieve potential competitive advantages through MGSCM, it is vital for maritime companies to implement various environmental management practices that focus not only on internal green operations but also an environmental collaboration with upstream suppliers and downstream customers. Industry players should commit to a program of extensive collaboration across functional internal and external departments, suppliers and customers to implement MGSCM practices, instead of adopting MGSCM symbolically or simply implement one or two MGSCM practices. Understanding this complementarity effects between different internal and external MGSCM practices that generate improved environmental and financial performance through a cost-efficient operation. These insights give industry players a new way to understand the implementation of MGSCM practices and their pathways to achieving a significant financial outcome.

Industry players should not expect MGSCM to directly influence financial performance. The findings caution that MGSCM affects financial performance indirectly through both EEP and LCP which means when justifying a business decision for adopting MGSCM practices, the focus should be on identifying the set of integral MGSCM practices that could improve EEP and LCP, instead of solely using financial gain as the criterion for making strategic decisions. Too much expectation and focus on financial performance could lead to a failure concentrating on creating resources and operational efficiency.

Finally, the results derived from respondents' perceptions of MGSCM imply that GSIP and GFF were the lowest in term of the agreement or implementation level. This is due to industry players lack of adequate knowledge and basis for taking important economically efficient decisions due to multiple phases of complex organizational level. For example, various players can be involved in providing a shipping service, with separated geographically and managerially differences that potentially create many problems related to misinformation, and communication problems related to the adoption of GSIP and GFF. Practically, maritime companies can improve these two areas of dimension by increasing collaboration and cooperation among supply chain partners to increase GSIP via integration practice (through training and green awareness) while regularly evaluate their financial flow to improve GFF performance via close inspection of monetary investment and decision-making process. Therefore, effective communications and well-managed cooperation throughout the organizations should make significant contributions towards helping maritime companies to achieve these objectives. This improvement in return may encourage their business partners to participate in green programs for the collective enhancement of the whole maritime supply chain processes.

5.5.3 Social and Environmental Implications

From the findings, maritime companies that implement certain MGSCM practices can decrease a significant impact on the environment through the efficient use of energy and decrease carbon emission. Meanwhile, looking from a societal viewpoint, proper integration of MGSCM among industry players could lessen hazardous emission, toxic waste, marine pollution as well as environmental impact which could lead towards improved social aspect of its employees and its surrounding community. From another facet of the social dimension, the adoption of MGSCM would give not only positive environmental implication but also towards more cost-efficient operation which may improve client satisfaction and trust. For example, the benefit of adopting MGSCM may reduce shipping discrepancy, optimum used of green material, enhance productivity, prevention of unforeseen pollution and cleaner production practices that translated into improved quality of services and customers satisfaction in a long run which beneficial to company's strategic planning of gaining competitive advantage. Thus, if MGSCM is properly done among the maritime supply chain players, environmental impacts could not only be reduced significantly but also could enhance industrial collaboration and technological advancement which will benefit to the society a whole. The ultimate impact of this situation would enhance company reputation and logistical services through energy efficient operation, decrease the wastage production, reduce emissions and consequently improve the environmental well-being for community benefit. Finally, as the nature of this industry is linked to each other, knowledge and awareness regarding of

MGSCM advantages would spread among the industry players, stakeholders as well as policymakers that would in turn giving society the benefit of environmental and social well-being respectively.

5.6 Limitations and Future Research

This study has a few limitations that can be addressed for future research. First of all, the literature on MGSCM or GSCM, in general, is continuously being published and added to, for this reason, this study generalizes the finding and MGSCM concept based on prior literature. Thus, there could be a literature which may have been published in related to this study since the research was completed.

The second limitation is, while the study has focused on developing and testing the MGSCM variables for maritime supply chains (what to measure), it has not explored the 'how to measure' dimension which is admittedly a significant barrier to the implementation of MGSCM. Future research may address this limitation by identifying how to measure each of the MGSCM practice in a different sector in the complex maritime supply chain industry.

Thirdly, this study recommended the application of five MGSCM variables that maritime organizations can use. However, this by no means represents an exhaustive list of green dimension/concept that can be investigated in the maritime supply chain in the future. For example, there is limited research evidence and literature review for GFF at this current stage of this thesis writing. It is necessary to understand the GFF dimension further where the researcher mostly ignores this domain. Hence, future study should include GFF as a critical measurement for expending deeper understanding on GFF for future reference.

The fourth limitation is concerning the relatively small sample size and unequally to all sectors within a local dimension which limits to such extent the result cannot be comprehensively generalized. For that reason, future research may extend this study towards a larger sample size that may include other countries or region, for wide-ranging generalizability of the findings as well as identifying the potential country effect.

Fifthly, the questions listed in the questionnaire used in this study were closed-ended that other MGSCM practices and performances experienced by maritime companies may have been unnoticed or overlooked. In this regard, additional future studies should consider this limitation where open-ended questions may be asked for further identification of MGSCM practices and performances.

Finally, the limitation of this study is dampened on the likability of respondents to capture incorrect perceptions and understanding of MGSCM concept due to the new and unheard of MGSCM term in Malaysia. This limitation is due to the lack of literature in regards to MGSCM practice and evidence in Malaysian maritime context. Addressing this limitation require future study to widen the MGSCM investigation to policy maker and related stakeholders (such as governmental bodies) to truly capture their understanding on MGSCM concept so that they can encourage and instill precise knowledge of MGSCM among bottom line industry players.

5.7 Conclusion

This study advances the existing knowledge of GSCM/MGSCM in maritime literature. The study has conceptualized the MGSCM variables that are pertinent and relevant to their adoption in the maritime context, and their potential impact of performance for empirical measurement. Prior GSCM research was analysed to provide an extension groundwork for developing MGSCM framework in this study for comprehensive understanding. In this sense, this study also conceptualized the underpinning theory of NRBV that explain the relationship of MGSCM variables on the tendency of maritime companies to adopt MGSCM, which in turn improves their competitive advantage in term of financial performance. On that note, difference construct of MGSCM may postulate a different impact on financial performance as depicted from this research finding.

This study also makes significant contributions to maritime literature in term of testing a conceptual MGSCM model examining the mediating role of EEP and LCP performance in the relationship between MGSCM and financial performance. The ambiguous suppositions of preceding studies motivate for further investigation of the relationships between MGSCM and performance outcomes. These study findings of the mediating role of EEP and LCP help to elucidate the mixed empirical findings concerning the general effect of green adoption on financial performance found in the literature. The study shows that the argument that MGSCM directly creates financial performance is unfounded because EEP and LCP might eventually influence operational efficiency and profitability in term of increasing market share, overall cost reduction and reduce environmental liability. Concurrently, a company's financial performance ultimately depends upon various factors in addition to resource efficiency as portrayed by many previous studies. The findings provide the industry players with profound understanding and overall picture of how to achieve financial performance through MGSCM adoption.

In this study, there are also relationships that exist either directly or indirectly between MGSCM practice and financial performance; thus, the straight results are not constantly clear. The data interpretation from this empirical study was perceptual, and this factor conveys into the issue whether these perceptions can be used to generalize the overall maritime sector pertaining to the actual reality. Even within the maritime industry, environmental performance (such as EEP and LCP) measurements were still ambiguous and not clearly recorded and, in this case, associating the financial measures to specific MGSCM practices as the motivation of adopting MGSCM is quite inconclusive to infer. For example, the complexity of this industry extent towards GFF as MGSCM capabilities require the inclusion of each internal and external cost category for better decision making. This includes the cost of technology adopted, energy usage pattern, emissions, and pollution control system, efficient use resources as well as other factor need to be included for comprehensive measurement of performances impact in term of financial or environmental impact (EEP and LCP).

From another perspective, the mediation linkage of this MGSCM-financial performance relationship through EEP and LCP also confirmed the study's hypotheses proposed in Chapter 2. However, similar to the finding of the direct effect of MGSCM-financial performance relationship, only certain MGSCM practices show the positive impact on financial performance when EEP and LCP exist between this linkage. As this study provides the general overview of explaining the outcome, the issues and factors pertaining on why the outcome produced in that way could be further investigated in future research on the much more comprehensive scale such as longitudinal studies for more concrete evidence and identifying long-term patterns. This is because each MGSCM dimensions could be industry specific and different industry might be using different technology and method in adopting MGSCM practices.

Meanwhile, for most of MGSCM practices, many of the practices required a key effort which is incorporating effective coordination and awareness level pertaining to green knowledge to each level of maritime supply chain players to not only lowering the environmental impact (through increase EEP and LCP), but also to increase operational efficiency in maritime supply chain system. Without these efforts, it is hard for the maritime sector to achieve comprehensive benefits in term of MGSCM adoption in the first place. Consequently, maritime companies need to assess the costs of avoiding or averting environmental impact against the cost of corrective activities to achieve the full benefit of MGSCM practices. This is particularly relevant to the financial performance of MGSCM itself, as a high initial investment in green technology and operations often requires an extended repayment period.

Finally, it is critical for the maritime sector to give the highest priority to preserving the environment through practicing MGSCM. To realize this vision, investment recovery by improving current policies and establishing comprehensive infrastructures and incentives that help motivate the industry players is something that should be highlighted by Malaysian national policymakers. This study is one of the few initial efforts to investigate MGSCM practices in Malaysia that help the policy maker to better serve the maritime stakeholders through understanding the extent of green adoption in Malaysian maritime supply chain. The insight perspective gained from this investigation and its findings is still relatively exploratory. However, it can become a practical solution for the industry players to achieve the potential advantage of achieving long term competitive advantage. In conclusion, this study has confirmed performing MGSCM in the maritime supply chain would consequently benefit the maritime industry by increasing the competitive advantage in term of increase financial gain and at the same time aid the supply chain processes to achieve efficient operation and cost efficiency through EEP and LCP.

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APPENDIX A

COVER LETTER AND QUESTIONNAIRES

Doctorate Study for Sustainable Adoption in Maritime Industry

Dear Sir / Madam,

My name is **Muhamad Fairuz Bin Ahmad Jasmi**, a final year Ph.D. candidates in **Faculty of Industrial Management (FIM), Universiti Malaysia Pahang (UMP).** I am conducting a study with the above-mentioned title under the supervision of Dr. Yudi Fernando as a requirement for my doctorate degree. Your company is selected as one of the respondents in this survey. Your valuable input is highly appreciated to represent your company.

For your kind information, the purpose of this survey is to study **the impact of green practices on financial performance in Malaysia's maritime sector.**

It is believed that your company is practicing green supply chain in your business operation, thus, the synthesized information would provide insight on how green supply chain adoption can affect your firm performance. Consequently, the information provided would instill better understanding on the impacts of green practices in the maritime industry in Malaysia.

Your honest opinion is requested. We can assure you that whatever information gathered will be treated with the utmost confidentiality and used strictly only for academic purpose.

This survey consists of **five (5) sections** to be answered according to the given instructions. It will take you about **5- 10 minutes** to complete this survey form.

I greatly appreciate the help of your organization and yourself in furthering this research endeavor. If you have any inquiries, please do not hesitate to contact me at **017-4675571** or email to **fairuzjasmi89@gmail.com**. Thank you very much for your kind cooperation.

Yours sincerely,

Muhamad Fairuz Jasmi
PHD candidates,
Logistic & supply chain
research cluster,
Universiti Malaysia Pahang (UMP)

Dr Yudi Fernando
Deputy Dean/ Supervisor,
Logistic & supply chain
research cluster,
Universiti Malaysia Pahang (UMP)

SECTION A: COMPANY PROFILE

This section consists of general questions, which are important for us to know about background of your company. Please select the box that most closely matches your company background.

1. Have your company adopted green practices in the logistic supply chain or in your company's daily operation?

- [ ] Yes (If yes, please resume to the next question)
- [ ] No (If your answer is no for Q1 and Q2, you can leave the survey)

2. Have your company adopted maritime supply chain in your company operation?

- [ ] Yes (If yes, please resume to the next question)
- [ ] No (If your answer is no for Q1 and Q2, you can leave the survey)

3. How long has your company involved in maritime supply chain?

- [ ] < 1 year
- [ ] 1-5 years
- [ ] 6-10 years
- [ ] 11-15 years
- [ ] 16 years and above

4. Is your company certified with any of these environmental certifications?

You may tick more than one

- [ ] Environment Management System (EMS) ISO 14001
- [ ] Energy Management System Certification (EnMS) ISO 50001
- [ ] Ship Energy Efficiency Management Plan (SEEMP)
- [ ] Energy Efficiency Design Index (EEDI)
- [ ] Ship Energy Efficiency Operational indicator (SEEOI)
- [ ] International Safety Management (ISM)
- [ ] International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)
- [ ] Others (please specify): ____________________

5. How many years have your company adopted green practices?

Green practice is the integration of environmental concerns into supply chain operation. It aims to reduce the maritime operation impact to the environment.

- [ ] < 1 year
- [ ] 1-5 years
- [ ] 6-10 years
- [ ] 11-15 years
- [ ] 16 years and above

6. What motivates your company to adopt green practices or green policies?

You may tick more than one category.

- ☐ To comply with regulations and requirements
- ☐ To minimise negative impacts caused by operation to the environment
- ☐ To be more competitive in the market
- ☐ To increase the efficiency in all processes/operations
- ☐ To minimize the cost (cost saving measures)
- ☐ To fulfil the buyers/clients request
- ☐ To be environmentally responsible company

7. Which business sector are you operating in?

You may tick more than one

- ☐ Cargo handling and services
- ☐ Land transport services (freight and passengers)
- ☐ Maintenance service for support vehicle
- ☐ Rental services of transport vehicles
- ☐ Storage and warehousing services
- ☐ Supporting service for water transport (port and waterway operation services)
- ☐ Water transport services (freight and passengers)
- ☐ Container services
- ☐ Postal and courier services
- ☐ Other (please specify): ____

8. What type of company you involved in maritime supply chain?

You may tick more than one

- ☐ Shipping linear
- ☐ Shipping agent
- ☐ Forwarding agent
- ☐ Depot operator
- ☐ Haulage company
- ☐ Warehousing
- ☐ Stevedore
- ☐ Ship Chandler
- ☐ Cargo/container handler
- ☐ Ship repair
- ☐ Others (please specify): ____

9. Which ports do you supply your services or products to?

You may tick more than one

- [ ] Bintulu Port Sdn. Bhd.
- [ ] Johor Port Bhd
- [ ] Kelang Multi Terminal Sdn. Bhd.
- [ ] Kuantan Port Consortium Sdn. Bhd.
- [ ] Lembaga Pelabuhan Kelang
- [ ] Lembaga Pelabuhan Kuching
- [ ] Lembaga Pelabuhan Miri
- [ ] Lembaga Pelabuhan Sabah
- [ ] Northport (Malaysia) Bhd.
- [ ] Pelabuhan Tanjung Pelapas Sdn. Bhd
- [ ] Penang Port Sdn. Bhd.
- [ ] Others (please specify): ______________________________

10. Where is the location of your company?

- [ ] Kuala Lumpur
- [ ] Kelang
- [ ] Penang
- [ ] Sabah
- [ ] Sarawak
- [ ] Johor Bahru
- [ ] Other (please specify): ______________________________

11. What is the approximate number of employees in the company?

- [ ] < 5 employees
- [ ] 5 to 30 employees
- [ ] 30 to 75 employees
- [ ] 75 to 200 employees
- [ ] More than 200 employees

12. In your company, which area do you think green practices are most apparent?

You may tick more than one category.

- [ ] Service development
- [ ] Procurement / Sourcing
- [ ] Shipping/warehousing
- [ ] Distribution / Logistics
- [ ] Information/communication technology
- [ ] Other (please specify): ______________________________

13. Which stage of green practices best describes your company?

☐ **Seed** (Main activities include research, assessment and planning of green practices- it is not yet in practice.)

☐ **Start-up** (Main activities include practicing green practices and educating its importance to employees of the organisation.)

☐ **Expansion** (The green practices have been practised internally and the whole process and its importance are well understood by all employees. The focus of expansion stage is to expand the green practice to all suppliers and customers in order to gain full benefit of its practices.)

☐ **Monitoring and controlling** (As the whole chain adopt green practices, the company is ensuring that the green implementation runs continuously in the operation and all practices adhere to organisation's outline of green practices.)

14. Do your company receive any incentive/ support from Malaysian government for adopting green practices?

☐ Yes (If yes, please resume to the next question)
☐ No (If no, skip the next question and continue to question 16)

15. What is the type of incentive received from Malaysian government for adopting green practices?

You may tick more than one category.

☐ Tax exemption/deduction
☐ Infrastructure allowance
☐ Deduction on capital expenditure for green equipments
☐ Exemption on stamp duty for high tech equipment
☐ Monetary incentive and tax allowance for green investment and R&D
☐ Other (please specify): ________________________________

16. Do your company participate in the organizational training for green certification?

☐ Yes (If yes, please resume to the next question)
☐ No (If no, skip the next question and continue to question 18)

17. What is the type of green certification training?

☐ Company certification
☐ Individual certification

18. Do your company participate in any Malaysian governmental green program?

☐ Yes (If yes, please resume to the next question)
☐ No (If no, skip the next question and continue to question 20)

19. What is the type of Malaysian governmental green program your company involved?

You may tick more than one category.

☐ Green Technology Finance Scheme
☐ Green Building Index (GBI)
☐ Market-based Instruments (MBI)
☐ Ship Emission Management System (SEMS)
☐ Green Port Initiatives
☐ Other (please specify): ______________________________

20. Do your company have dedicated monitoring/auditing system to monitor overall green practice?

☐ Yes
☐ No

21. Do your company have dedicated staff/department to monitor overall green practices?

☐ Yes
☐ No

22. Do your company have dedicated environmental monitoring/auditing system to monitor energy efficiency production?

☐ Yes
☐ No

23. Do your company have dedicated environmental monitoring/auditing system to monitor carbon emission production?

☐ Yes
☐ No

24. Do your company have dedicated environmental staff/department to monitor the energy efficiency production?

☐ Yes
☐ No

25. Do your company have dedicated environmental staff/department to monitor the carbon emission production?

☐ Yes
☐ No

SECTION B: ASSESSMENT OF IMPLEMENTATION OF GREEN PRACTICES IN YOUR COMPANY

In this section we assess the extent of implementation of green practices in your company. Please **circle/tick** at the most appropriate answer that best represents the extent to which you agree with statements given below.

(1) Green Information and Communication Systems

Green information and communication systems defined as the systematic application of sustainability in various processes of IT and communication management in order to reduce related emissions and to improve energy efficiency.

	Green Information and Communication Systems	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Our company use electronic transfer (purchase order, invoices and funds) to reduce the use of paper transaction/documentation	1	2	3	4	5
2	Our company share information of energy efficiency best practices with our key partners to ensure that we have the same knowledge	1	2	3	4	5
3	Our company use the advanced information system to track /expedite shipments	1	2	3	4	5
4	Our company has real time searching of the level of inventory and equipment	1	2	3	4	5
5	Our company has real time searching of logistic related operating data	1	2	3	4	5

(2) Green Value Added Logistic Services

Green value added logistic service defined as the systematic application of sustainability in various processes value added logistic in the n supply chain to reduce emission and to improve energy efficiency

	Green Value Added Logistic Services	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Our company try to avoid using material/equipment that is harmful to the environment after considering the changes in price	1	2	3	4	5
2	Our company's suppliers are required to have an implemented green management system (e.g. ISO 14000, SEEMP, EEDI, EEOI certification)	1	2	3	4	5
3	Our company improve the design of shipping equipment/processes to meet environmental standards/certifications	1	2	3	4	5
4	Our company utilizing green design of products/equipment for reduced consumption of material/energy	1	2	3	4	5
5	Our company has optimized operational processes to reduce waste/emission/energy usage (e.g. green material handling, green purchasing, green logistic , eco-design and etc.)	1	2	3	4	5

(3) Green Supply Chain Integration Practices

Green supply chain integration practices defined as the systematic approach of integrating sustainability in various processes with supply chain partner in order to reduce emission to the environment and gain energy efficiency.

	Green Supply Chain Integration Practices	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Our company collaborates actively with our partners in developing sustainable strategies	1	2	3	4	5
2	Our company collaborates actively with our partners in demand forecasting to eliminate waste	1	2	3	4	5
3	Our company integrates our partners in a participative decision- making process that promotes environmental innovation	1	2	3	4	5
4	Our company logistic activities are well integrated with our key partners' logistic activities	1	2	3	4	5
5	Our company work closely with our suppliers in order to minimize service / production impact to the environment	1	2	3	4	5
6	Our suppliers are selected with environmental criteria consideration	1	2	3	4	5

(4) <u>Shipping Design and Compliance</u>

Shipping design and compliance defined as the systematic approach of sustainability in various processes of shipping design as well as conformity with sustainable compliance in order to reduce impact to environment and gain energy efficiency.

	Shipping Design and Compliance	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Our company try hard to comply for energy saving shipping equipment design	1	2	3	4	5
2	Our company try hard to comply for shipping equipment reuse	1	2	3	4	5
3	Our company try hard to comply to reduce environmental damages	1	2	3	4	5
4	Our company try hard to comply with recycling of waste	1	2	3	4	5
5	Our company try hard to comply with recovery of waste	1	2	3	4	5

(5) <u>Green Financial Flow</u>

Green financial flow defined as the systematic approach of sustainability in various processes of financial management, procurement and investment in order to reduce impact to environment and improve sustainability in a long term.

	Green Financial Flow	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	We give a budget priority to each planning of physical and financial flow to support green supply chain activities	1	2	3	4	5
2	We applying activity-based costing (ABC) to determine direct and indirect energy/material consumptions with net sales evaluation from green activities	1	2	3	4	5
3	We monitor payment delay for each green activity transaction in our financial flow	1	2	3	4	5
4	We considering depreciations of each of our green equipment used for day-to-day business operations	1	2	3	4	5
5	We use separate evaluation of cash position which generated from green activities and conventional transactions in the end of a period of the year	1	2	3	4	5

SECTION C: ASSESSMENT OF ENERGY EFFICIENCY PERFORMANCE & LOW CARBON PERFORMANCE IN YOUR COMPANY

In last three years, due to the implementation of **green practices** there have been specific benefits achieved in each of the following categories.
Please indicate your level of agreement on your company's business performance based on the statements given below.

	Energy Efficiency Performance	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Our company has decreased the cost for energy consumption.	1	2	3	4	5
2	Our company has consumed less resources (e.g. such as energy, water, electricity, gas and petrol/diesel)	1	2	3	4	5
3	Our company has lowered the consumption of energy (e.g. water, electricity, gas and petrol) during production/use/disposal	1	2	3	4	5
4	Our company has achieved reduction of energy use/consumption (per unit of output).	1	2	3	4	5
5	Our company apply energy efficiency strategies in lowering energy consumption in organization	1	2	3	4	5
6	Our company has reduced overall energy consumption significantly throughout the organization	1	2	3	4	5

	Low Carbon Performance	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Our company has achieved reduction of carbon emissions (per unit of output).	1	2	3	4	5
2	Our company has managed to reduce carbon emissions in its operation	1	2	3	4	5
3	Our company has achieved reduction use of carbon-intensive materials (per unit of output).	1	2	3	4	5
4	Our company has reduced fees/fines/taxes paid for carbon emissions discharge	1	2	3	4	5
5	Our company has limited carbon and other emissions	1	2	3	4	5
6	Our company has reduced overall carbon emissions	1	2	3	4	5

SECTION D: ASSESSMENT OF FINANCIAL PERFORMANCE IN YOUR COMPANY

In last three years, due to the implementation of green practices there have been specific benefits achieved in each of the following categories.
Please indicate your level of agreement on your company's business performance based on the statements given below.

	Financial Performance	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Our company has improved profitability	1	2	3	4	5
2	Our company has improved the sales growth	1	2	3	4	5
3	Our company has improved the growth in return on sales (ROS)	1	2	3	4	5
4	Our company has improved the growth return on investment (ROI)	1	2	3	4	5
5	Our company has improved the growth in return of asset (ROA)	1	2	3	4	5
6	Our company has improved overall net profit of the company	1	2	3	4	5

SECTION E: RESPONDENT PROFILE

This section consists of general questions, which are important for us to know about the profile of respondent. Please select the box that most closely matches your profile background.

1. Gender

☐ Male
☐ Female

2. Age (years)

☐ Under 25
☐ 25-35
☐ 36-50
☐ 51-65
☐ Over 65

3. Ethnicity

☐ Malay
☐ Chinese
☐ Indian
☐ Other (please specify):

4. Highest education level

- [ ] Secondary School
- [ ] Certificate/Diploma
- [ ] Bachelor's Degree
- [ ] Postgraduate
- [ ] Other (please specify):

5. What is your job position?

- [ ] Director/Chief Executive Officer (CEO)
- [ ] General Manager/Managing Director
- [ ] Senior Manager/Head of Department
- [ ] Manager/R&D Director
- [ ] Environmental Health and Safety (EHS) Manager
- [ ] Others (please specify):

6. What is your department you are involving in?

- [ ] Maritime operation
- [ ] Maritime Administration
- [ ] Ship Management
- [ ] Freight Forwarding
- [ ] Supply chain
- [ ] Logistic/Distribution
- [ ] Warehousing
- [ ] Procurement
- [ ] Maritime Crewing
- [ ] Sales/Trading
- [ ] Others (please specify):

7. How long have you been in your company?

- [ ] Less than 10 years
- [ ] 11-15 years
- [ ] 16-20 years
- [ ] More than 20 years

8. What is the ownership type of the company?

- [ ] Local company
- [ ] Foreign-local company
- [ ] Foreign-owned company (please specify):

APPENDIX B

SPSS OUTPUT FOR PILOT STUDY

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
GICS 1	157.75	1138.724	.555	.	.977
GICS 2	158.25	1117.250	.691	.	.977
GICS 3	158.05	1114.576	.676	.	.976
GICS 4	157.85	1108.766	.707	.	.976
GICS 5	157.70	1099.379	.816	.	.976
GVALS 1	158.30	1112.747	.655	.	.976
GVALS 2	157.95	1142.155	.568	.	.977
GVALS 3	158.50	1115.000	.552	.	.977
GVALS 4	158.05	1131.418	.522	.	.977
GVALS 5	158.05	1113.629	.635	.	.976
GVALS 6	157.85	1126.134	.505	.	.977
GSCIP 1	158.05	1125.629	.612	.	.976
GSCIP 2	158.75	1108.724	.552	.	.977
GSCIP 3	158.60	1107.200	.724	.	.976
GSCIP 4	158.55	1114.471	.677	.	.976
GSCIP 5	158.25	1108.197	.777	.	.976
GSCIP 6	158.85	1116.976	.579	.	.977
SDC 1	158.05	1099.945	.708	.	.976
SDC 2	158.30	1106.116	.805	.	.976
SDC 3	158.10	1108.516	.786	.	.976
SDC 4	158.15	1119.082	.604	.	.976
SDC 5	158.55	1106.997	.719	.	.976
GFF 1	157.85	1124.766	.641	.	.976
GFF 2	158.25	1102.408	.790	.	.976
GFF 3	158.00	1111.474	.850	.	.976
GFF 4	158.80	1120.905	.520	.	.977
GFF 5	158.20	1106.589	.737	.	.976
FP 1	157.75	1118.618	.851	.	.976
FP 2	158.10	1129.568	.670	.	.976
FP 3	158.00	1109.684	.878	.	.976
FP 4	158.05	1109.734	.918	.	.976
FP 5	158.20	1116.800	.890	.	.976
FP 6	157.70	1110.221	.854	.	.976
EEP 1	157.90	1126.095	.690	.	.976
EEP 2	157.85	1128.871	.662	.	.976
EEP 3	157.80	1116.695	.795	.	.976
EEP 4	157.90	1105.463	.800	.	.976
EEP 5	158.00	1108.105	.741	.	.976
EEP 6	157.50	1113.737	.839	.	.976
LCP 1	158.20	1106.379	.771	.	.976
LCP 2	158.35	1112.871	.833	.	.976
LCP 3	158.20	1100.168	.855	.	.976
LCP 4	158.25	1106.197	.805	.	.976
LCP 5	158.05	1109.524	.745	.	.976

Item Statistics

	Mean	Std. Deviation	N
GICS_mean	3.8800	.92997	20
GVALS_MEAN	3.6833	.72729	20
GSIP_MEAN	3.2917	.91267	20
SDC_MEAN	3.5700	.98467	20
GFF_MEAN	3.5800	.86548	20
EEP_MEAN	3.9750	.85886	20
LCP_MEAN	3.5900	.98296	20
FP_Mean	3.8333	.78174	20

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
GICS_mean	25.5233	30.297	.765	.722	.959
GVALS_MEAN	25.7200	31.509	.853	.817	.954
GSIP_MEAN	26.1117	29.978	.819	.788	.955
SDC_MEAN	25.8333	29.050	.846	.799	.954
GFF_MEAN	25.8233	29.787	.896	.890	.951
EEP_MEAN	25.4283	30.500	.818	.883	.955
LCP_MEAN	25.8133	28.894	.865	.925	.953
FP_Mean	25.5700	30.239	.948	.966	.949

How long has your company involved in maritime supply chain?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. less than 1 year	2	10.0	10.0	10.0
	ii. 1-5 years	4	20.0	20.0	30.0
	iii. 6-10 years	9	45.0	45.0	75.0
	iv. 11-15 years	3	15.0	15.0	90.0
	v. 16 years and above	2	10.0	10.0	100.0
	Total	20	100.0	100.0	

What is the approximate number of employees in the company?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ii. 5 to 30 employees	3	15.0	15.0	15.0
	iii. 30 to 75 employees	8	40.0	40.0	55.0
	iv. 75 to 200 employees	5	25.0	25.0	80.0
	v. More than 200 employees	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

How long has your company involved in maritime supply chain?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. less than 1 year	6	30.0	30.0	30.0
	ii. 1-5 years	7	35.0	35.0	65.0
	iii. 6-10 years	5	25.0	25.0	90.0
	iv. 11-15 years	1	5.0	5.0	95.0
	v. 16 years and above	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

In your company, which area do you think green practices are most apparent?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Service development	2	10.0	10.0	10.0
	iii. Shipping/warehousing	9	45.0	45.0	55.0
	iv. Distribution / Logistics	6	30.0	30.0	85.0
	v. Information/communication technology	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

Which stage of green practices best describes your company?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Seed	6	30.0	30.0	30.0
	Startup	7	35.0	35.0	65.0
	Expansion	4	20.0	20.0	85.0
	Monitoring and control	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

$Multiple Frequencies

		Responses		Percent of Cases
		N	Percent	
Certification[a]	Environment Management System (EMS) ISO 14001	12	29.3%	63.2%
	Energy Management System Certification (EnMS) ISO 50001	3	7.3%	15.8%
	Ship Energy Efficiency Management Plan (SEEMP)	3	7.3%	15.8%
	Energy Efficiency Design Index (EEDI)	2	4.9%	10.5%
	Ship Energy Efficiency Operational indicator (SEEOI)	2	4.9%	10.5%
	International Safety Management (ISM)	13	31.7%	68.4%
	International Convention for the Prevention of Pollution from Ships (MARPOL 73/78 Annexes)	6	14.6%	31.6%
Total		41	100.0%	215.8%

a. Dichotomy group tabulated at value 1.

$multiple Frequencies

		Responses		Percent of Cases
		N	Percent	
Sector[a]	Cargo handling and services	7	17.5%	35.0%
	Land transport services (freight and passengers)	3	7.5%	15.0%
	Maintenance service for support vehicle	6	15.0%	30.0%
	Rental services of transport vehicles	2	5.0%	10.0%
	Storage and warehousing services	4	10.0%	20.0%
	Supporting service for water transport (port and waterway operation services)	7	17.5%	35.0%
	Water transport services (freight and passengers)	3	7.5%	15.0%
	Container services	6	15.0%	30.0%
	Postal and courier services	2	5.0%	10.0%
Total		40	100.0%	200.0%

a. Dichotomy group tabulated at value 1.

$Multiple Frequencies

		Responses		Percent of Cases
		N	Percent	
Type of company[a]	Linear	7	14.3%	35.0%
	Agent	7	14.3%	35.0%
	Forwarding	4	8.2%	20.0%
	Depot	1	2.0%	5.0%
	Haulage	3	6.1%	15.0%
	Warehousing	7	14.3%	35.0%
	Stevedore	2	4.1%	10.0%
	Ship	6	12.2%	30.0%
	Cargo	7	14.3%	35.0%
	Repair	5	10.2%	25.0%
Total		49	100.0%	245.0%

a. Dichotomy group tabulated at value 1.

$motivation Frequencies

		Responses		Percent of Cases
		N	Percent	
$motivation[a]	To comply with regulations and requirements	14	22.2%	70.0%
	To minimise negative impacts caused by operation to the environment	9	14.3%	45.0%
	To be more competitive in the market	8	12.7%	40.0%
	To increase the efficiency in all processes/operations	6	9.5%	30.0%
	To minimize the cost (cost saving measures)	10	15.9%	50.0%
	To fulfil the buyers/clients request	7	11.1%	35.0%
	To be environmentally responsible company	9	14.3%	45.0%
Total		63	100.0%	315.0%

a. Dichotomy group tabulated at value 1.

$port Frequencies

		Responses		Percent of Cases
		N	Percent	
$port[a]	Bintulu Port Sdn. Bhd.	6	9.2%	30.0%
	Johor Port Bhd	8	12.3%	40.0%
	Kelang Multi Terminal Sdn. Bhd.	4	6.2%	20.0%
	Kuantan Port Consortium Sdn. Bhd.	6	9.2%	30.0%
	Lembaga Pelabuhan Kelang	9	13.8%	45.0%
	Lembaga Pelabuhan Kuching	5	7.7%	25.0%
	Lembaga Pelabuhan Miri	3	4.6%	15.0%
	Lembaga Pelabuhan Sabah	2	3.1%	10.0%
	Northport (Malaysia) Bhd.	5	7.7%	25.0%
	Pelabuhan Tanjung Pelapas Sdn. Bhd	8	12.3%	40.0%
	Penang Port Sdn. Bhd.	9	13.8%	45.0%
Total		65	100.0%	325.0%

a. Dichotomy group tabulated at value 1.

$Type_company Frequencies

		Responses		Percent of Cases
		N	Percent	
$Type_company[a]	Linear	7	14.3%	35.0%
	Agent	7	14.3%	35.0%
	Forwarding	4	8.2%	20.0%
	Depot	1	2.0%	5.0%
	Haulage	3	6.1%	15.0%
	Warehousing	7	14.3%	35.0%
	Stevedore	2	4.1%	10.0%
	Ship	6	12.2%	30.0%
	Cargo	7	14.3%	35.0%
	Repair	5	10.2%	25.0%
Total		49	100.0%	245.0%

a. Dichotomy group tabulated at value 1.

Pearson Correlation

MGSCM Dimensions		Financial Performance (FP)
GICS	Pearson Correlation Sig. (2-tailed) N	0.779** 0.000 20
GVALS	Pearson Correlation Sig. (2-tailed) N	0.813** 0.000 20
GSCIP	Pearson Correlation Sig. (2-tailed) N	0.752** 0.000 20
SDC	Pearson Correlation Sig. (2-tailed) N	0.857** 0.000 20
GFF	Pearson Correlation Sig. (2-tailed) N	0.835** 0.000 20

**. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX C

SPSS OUTPUT FOR DESCRIPTIVE ANALYSIS

Normality Test

Variables	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
FP	0.171	160	0.000	0.904	160	0.000
GICS	0.102	160	0.000	0.917	160	0.000
GVALS	0.135	160	0.000	0.930	160	0.000
GSCIP	0.112	160	0.000	0.937	160	0.000
SDC	0.201	160	0.000	0.867	160	0.000
GFF	0.131	160	0.000	0.952	160	0.000
EEP	0.181	160	0.000	0.866	160	0.000
LCP	0.160	160	0.000	0.924	160	0.000

MGSCM Mean

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
GICS_mean	160	100.0%	0	0.0%	160	100.0%
GVALS_mean	160	100.0%	0	0.0%	160	100.0%
GSCIP_mean	160	100.0%	0	0.0%	160	100.0%
SDC_mean	157	98.1%	3	1.9%	160	100.0%
GFF_mean	160	100.0%	0	0.0%	160	100.0%
FP_mean	160	100.0%	0	0.0%	160	100.0%
LCP_mean	160	100.0%	0	0.0%	160	100.0%
EEP_mean	160	100.0%	0	0.0%	160	100.0%

	GICS_ mean	GVALS_ mean	GSCIP_ mean	SDC_ mean	GFF_ mean	FP_ mean	LCP_ mean	EEP_ mean
Mean	3.9288	3.8958	3.6885	4.0076	3.6550	4.4000	4.4075	4.4667
Std. Deviation	.79157	.76405	.96300	.88980	.77377	.59087	.60600	.59075

Descriptive Analysis

$Sectors_multiple Frequencies

		Responses		Percent of Cases
		N	Percent	
$Sectors_multiple[a]	Cargo handling and services	67	21.9%	41.9%
	Land transport services (freight and passengers)	29	9.5%	18.1%
	Maintenance service for support vehicle	47	15.4%	29.4%
	Rental services of transport vehicles	22	7.2%	13.8%
	Storage and warehousing services	53	17.3%	33.1%
	Supporting service for water transport (port and waterway operation services)	63	20.6%	39.4%
	Water transport services (freight and passengers)	21	6.8%	13.1%
	Container services	45	14.8%	28.1%
	Postal and courier services	23	7.5%	14.4%
Total		305	100.0%	190.6%

a. Dichotomy group tabulated at value 1.

$Company type multiple Frequencies

		Responses		Percent of Cases
		N	Percent	
$Companytype_multiple[a]	Linear	60	15.3%	37.5%
	Agent	51	13.1%	31.9%
	Forwarding	42	10.7%	26.3%
	Depot	36	9.2%	22.5%
	Haulage	24	6.2%	15.0%
	Warehousing	56	14.4%	35.0%
	Stevedore	16	4.1%	10.1%
	Ship	36	9.2%	22.5%
	Cargo_type	54	13.8%	33.8%
	Repair	48	12.3%	30.0%
Total		390	100.0%	243.8%

a. Dichotomy group tabulated at value 1.

How long has your company involved in maritime supply chain?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. less than 1 year	6	3.8	3.8	3.8
	ii. 1-5 years	23	14.4	14.4	18.1
	iii. 6-10 years	46	28.7	28.7	46.9
	iv. 11-15 years	49	30.6	30.6	77.5
	v. 16 years and above	36	22.5	22.5	100.0
	Total	160	100.0	100.0	

$Port_multiple Frequencies

		Responses		Percent of Cases
		N	Percent	
$Port_multiple[a]	Bintulu Port Sdn. Bhd.	51	9.8%	31.9%
	Johor Port Bhd	64	12.2%	40.0%
	Kelang Multi Terminal Sdn. Bhd.	32	6.1%	20.0%
	Kuantan Port Consortium Sdn. Bhd.	48	9.2%	30.0%
	Lembaga Pelabuhan Kelang	70	13.4%	43.8%
	Lembaga Pelabuhan Kuching	45	8.6%	28.1%
	Lembaga Pelabuhan Miri	24	4.6%	15.0%
	Lembaga Pelabuhan Sabah	16	3.1%	10.0%
	Northport (Malaysia) Bhd.	40	7.6%	25.0%
	Pelabuhan Tanjung Pelapas Sdn. Bhd	61	11.7%	38.1%
	Penang Port Sdn. Bhd.	72	13.8%	45.0%
Total		523	100.0%	326.9%

a. Dichotomy group tabulated at value 1.

How many years have your company adopted green practices

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. less than 1 year	12	7.5	7.5	7.5
	ii. 1-5 years	50	31.3	31.3	38.8
	iii. 6-10 years	62	38.7	38.7	77.5
	iv. 11-15 years	28	17.5	17.5	95.0
	v. 16 years and above	8	5.0	5.0	100.0
	Total	160	100.0	100.0	

What is the approximate number of employees in the company?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ii. 5 to 30 employees	17	10.6	10.6	10.6
	iii. 30 to 50 employees	61	38.1	38.1	48.7
	iv. 51 to 70 employees	40	25.0	25.0	73.7
	v. More than 70 employees	42	26.3	26.3	100.0
	Total	160	100.0	100.0	

Which stage of green practices best describes your company?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Seed	38	23.8	23.8	23.8
	ii. Startup	47	29.4	29.4	53.2
	iii. Expansion	40	25.0	25.0	78.1
	iv. Monitoring and controlling	35	21.9	21.9	100.0
	Total	160	100.0	100.0	

$Motivation_multiple Frequencies

		Responses		Percent of Cases
		N	Percent	
$Motivation_multiple[a]	To comply with regulations and requirements	112	23.3%	71.3%
	To minimise negative impacts caused by operation to the environment	60	12.5%	38.2%
	To be more competitive in the market	57	11.8%	36.3%
	To increase the efficiency in all processes/operations	65	13.5%	41.4%
	To minimize the cost (cost saving measures)	77	16.0%	49.0%
	To fulfil the buyers/clients request	43	8.9%	27.4%
	To be environmentally responsible company	66	13.7%	42.0%
Total		480	100.0%	312.5%

a. Dichotomy group tabulated at value 1.

$certification_multiple Frequencies

		Responses N	Responses Percent	Percent of Cases
$certification_multiple[a]	Environment Management System (EMS) ISO 14001	74	24.1%	48.4%
	Energy Management System Certification (EnMS) ISO 50001	0	0	0%
	Ship Energy Efficiency Management Plan (SEEMP)	27	8.8%	17.6%
	Energy Efficiency Design Index (EEDI)	19	6.2%	12.4%
	Ship Energy Efficiency Operational indicator (SEEOI)	21	6.8%	13.7%
	International Safety Management (ISM)	77	25.1%	68.0%
	International Convention for the Prevention of Pollution from Ships (MARPOL 73/78 Annexes)	70	22.8%	45.8%
Total		288	100.0%	218.3%

a. Dichotomy group tabulated at value 1.

Does your company participate in the organizational training for green certification?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	iii. Yes (If yes, continue to next question)	117	73.1	73.1	73.1
	iv. No (If no, skip the next question and continue to question 18)	43	26.9	26.9	100.0
	Total	160	100.0	100.0	

What is the type of green certification training?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	43	26.8	26.8	26.8
	i. Company certification	98	61.3	61.3	88.1
	ii. Individual certification	19	11.9	11.9	100.0
	Total	160	100.0	100.0	

Does your company have dedicated monitoring/auditing system to monitor overall green practices?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Yes	58	36.3	36.3	36.3
	ii. No	102	63.7	63.7	100.0
	Total	160	100.0	100.0	

Does your company have dedicated staff/department to monitor overall green practices?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Yes	33	20.6	20.6	20.6
	ii. No	127	79.4	79.4	100.0
	Total	160	100.0	100.0	

Does your company have dedicated environmental monitoring/auditing system to monitor energy efficiency production?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Yes	33	20.6	20.6	20.6
	ii. No	127	79.4	79.4	100.0
	Total	160	100.0	100.0	

Does your company have dedicated environmental staff/department to monitor the energy efficiency production?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Yes	39	24.4	24.4	24.4
	ii. No	121	75.6	75.6	100.0
	Total	160	100.0	100.0	

Does your company have dedicated environmental staff/department to monitor the carbon emission production?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Yes	57	35.6	35.6	35.6
	ii. No	103	64.4	64.4	100.0
	Total	160	100.0	100.0	

$GreenProg_multiple Frequencies

		Responses		Percent of Cases
		N	Percent	
$GreenProg_multiple[a]	Gtechnologyscheme	41	31.1%	37.6%
	Greenbuilding	27	20.5%	24.8%
	Shipemissionmanagement	45	33.1%	37.6%
	Greenport	23	17.4%	21.1%
Total		133	100.0%	121.1%

a. Dichotomy group tabulated at value 1.

Does your company receive any incentive/ support from Malaysian government for adopting green practices?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Yes (If yes, continue to next question)	100	62.5	62.5	62.5
	ii. No (If no, skip the next question and continue to question 16)	60	37.5	37.5	100.0
	Total	160	100.0	100.0	

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Male	104	65.0	65.0	65.0
	ii. Female	56	35.0	35.0	100.0
	Total	160	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ii. 25-35	79	49.4	49.4	49.4
	iii. 36-50	69	43.1	43.1	92.5
	iv. 51-65	12	7.5	7.5	100.0
	Total	160	100.0	100.0	

Duration in company

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Less than 10 years	66	41.3	41.3	41.3
	ii. 11-15 years	46	28.7	28.7	70.0
	iii. 16-20 years	28	17.5	17.5	87.5
	iv. More than 20 years	20	12.5	12.5	100.0
	Total	160	100.0	100.0	

Ethnicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Malay	87	54.4	54.4	54.4
	ii. Chinese	43	26.9	26.9	81.3
	iii. Indian	21	13.1	13.1	94.4
	melanau	9	5.6	5.6	100.0
	Total	160	100.0	100.0	

What is your job position?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Director/Chief Executive Officer (CEO)	14	8.8	8.8	8.8
	ii. General Manager/Managing Director	16	10.0	10.0	18.8
	iii. Senior Manager/Assistant Manager/Head of Department	44	27.5	27.5	46.3
	iv. Manager/R&D Director	49	30.6	30.6	76.9
	Project Executive	3	1.9	1.9	78.8
	v. Environmental Health and Safety (EHS) Manager	34	21.3	21.3	100.0
	Total	160	100.0	100.0	

Ownership type

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	i. Local company	69	43.1	43.1	43.1
	ii. Foreign-local company	56	35.0	35.0	78.1
	iii. Foreign-owned company	35	21.9	21.9	100.0
	Total	160	100.0	100.0	

Department

		Frequency	Percent	Valid Percent	Cumulative Percent
	i. Maritime operation	27	16.9	16.9	16.9
	ii. Maritime Administration	35	21.9	21.9	38.8
	iii. Ship Management	26	16.3	16.3	55.1
	iv. Freight Fowarding	13	8.1	8.1	63.2
	v. Supply chain	6	3.7	3.7	66.9
	vi. Logistic/Distribution	40	25.0	25.0	91.9
	vii. Warehousing	10	6.3	6.3	98.1
	viii. Procurement	3	1.9	1.9	100.0
	Total	160	100.0	100.0	

Man-Whitney U Test Statistics[a]

	GICS	GVALS	GSIP	SDC	GFF
Mann-Whitney U	2284.000	2236.000	2155.000	1969.500	2269.000
Wilcoxon W	9787.000	2977.000	2896.000	2672.500	3010.000
Z	-.137	-.330	-.656	-1.044	-.198
Asymp. Sig. (2-tailed)	.891	.741	.512	.297	.843

a. Grouping Variable: Bias

APPENDIX D

SMARTPLS3 OUTPUT

Construct reliability and validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
EEP	0.945	0.945	0.956	0.786
FP	0.954	0.955	0.963	0.813
GFF	0.924	0.936	0.942	0.766
GICS	0.846	0.926	0.871	0.577
GSIP	0.9	0.902	0.923	0.667
GVALS	0.975	0.975	0.981	0.91
LCP	0.956	0.958	0.966	0.85
SDC	0.94	0.941	0.955	0.809

Discriminant Validity (HTMT)

	EEP	FP	GFF	GICS	GSIP	GVALS	LCP	SDC
EEP								
FP	0.888							
GFF	0.692	0.617						
GICS	0.609	0.707	0.607					
GSIP	0.538	0.538	0.412	0.401				
GVALS	0.809	0.732	0.677	0.554	0.646			
LCP	0.852	0.888	0.626	0.674	0.519	0.843		
SDC	0.888	0.787	0.653	0.551	0.641	0.885	0.84	

R Square

	R Square	R Square Adjusted
EEP	0.752	0.744
FP	0.809	0.801
LCP	0.758	0.75

f Square

	EEP	FP	GFF	GICS	GSIP	GVALS	LCP	SDC
EEP		0.253						
FP								
GFF	0.049	0					0	
GICS	0.063	0.043					0.191	
GSIP	0.002	0.035					0.009	
GVALS	0.012	0.035					0.159	
LCP		0.271						
SDC	0.308	0.001					0.094	

Bootstrapping (path coefficient)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
EEP -> FP	0.463	0.463	0.077	6.012	0
GFF -> EEP	0.154	0.151	0.065	2.35	0.019
GFF -> FP	0.013	0.011	0.058	0.22	0.826
GFF -> LCP	-0.002	0.001	0.061	0.036	0.972
GICS -> EEP	0.173	0.173	0.072	2.419	0.016
GICS -> FP	0.138	0.137	0.053	2.599	0.009
GICS -> LCP	0.299	0.299	0.061	4.87	0
GSIP -> EEP	-0.028	-0.024	0.059	0.467	0.641
GSIP -> FP	0.105	0.108	0.051	2.046	0.041
GSIP -> LCP	-0.061	-0.054	0.054	1.123	0.262
GVALS -> EEP	0.113	0.11	0.115	0.98	0.327
GVALS -> FP	-0.183	-0.183	0.101	1.806	0.071
GVALS -> LCP	0.406	0.396	0.111	3.673	0
LCP -> FP	0.485	0.498	0.094	5.14	0
SDC -> EEP	0.55	0.554	0.1	5.486	0
SDC -> FP	-0.032	-0.046	0.103	0.312	0.755
SDC -> LCP	0.3	0.305	0.102	2.946	0.003

Bootstrapping (specific indirect effect)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
GFF -> EEP -> FP	0.071	0.071	0.034	2.113	0.035
GICS -> EEP -> FP	0.08	0.08	0.036	2.251	0.024
GSIP -> EEP -> FP	-0.013	-0.012	0.028	0.457	0.648
GVALS -> EEP -> FP	0.052	0.052	0.055	0.95	0.342
SDC -> EEP -> FP	0.255	0.256	0.065	3.93	0
GFF -> LCP -> FP	-0.001	0.002	0.031	0.034	0.973
GICS -> LCP -> FP	0.145	0.148	0.04	3.649	0
GSIP -> LCP -> FP	-0.029	-0.027	0.027	1.074	0.283
GVALS -> LCP -> FP	0.197	0.195	0.062	3.18	0.001
SDC -> LCP -> FP	0.145	0.153	0.065	2.252	0.024

Blindfolding (Q Square)

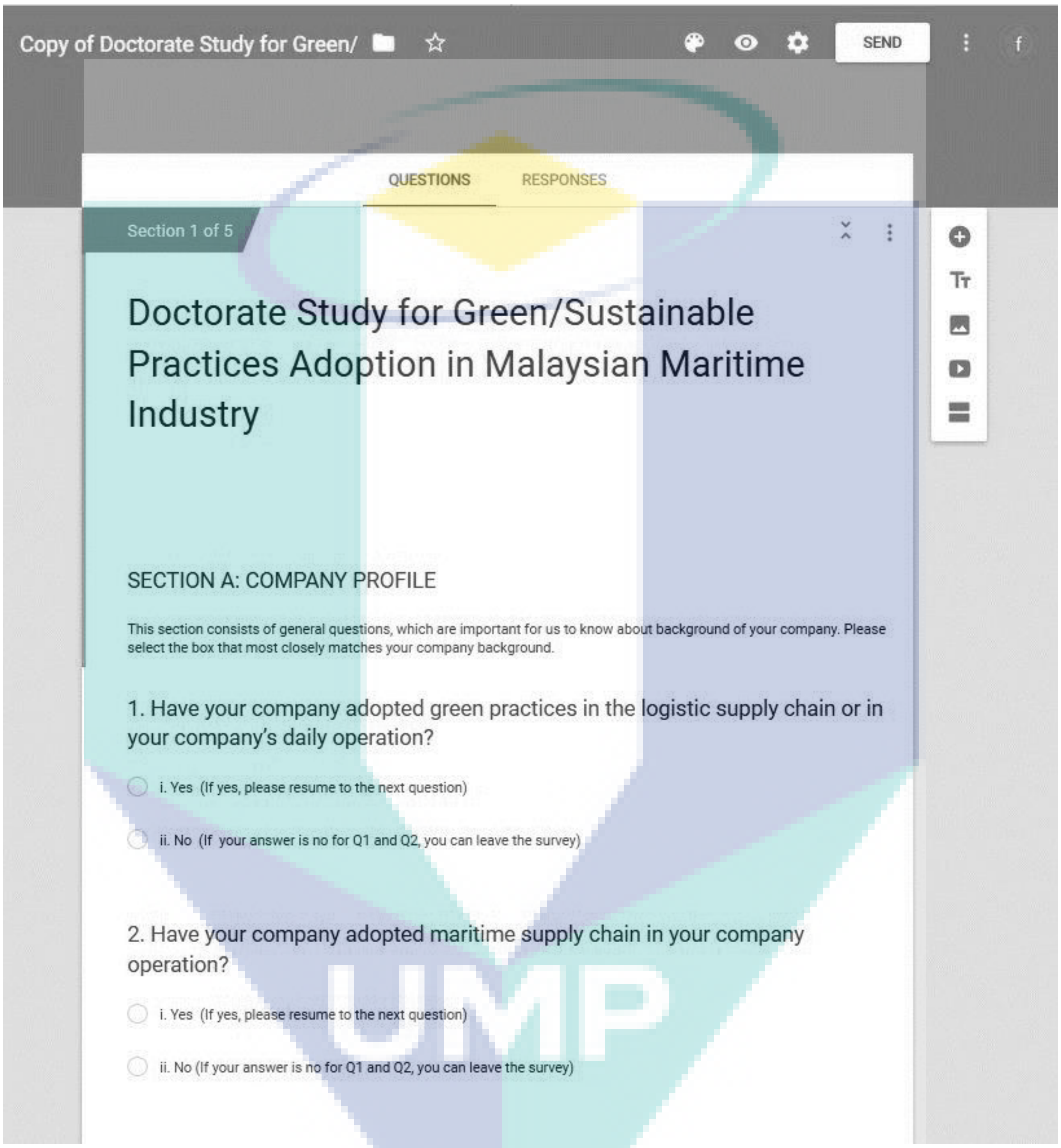
	SSO	SSE	Q^2 (=1-SSE/SSO)
EEP	960	436.522	0.545
FP	960	382.513	0.602
GFF	800	800	
GICS	800	800	
GSIP	960	960	
GVALS	800	800	
LCP	800	323.701	0.595
SDC	800	800	

Inner VIF values

	EEP	FP	GFF	GICS	GSIP	GVALS	LCP	SDC
EEP		2.832						
FP								
GFF	1.923	2.154					1.923	
GICS	1.345	1.917					1.345	
GSIP	1.128	1.163					1.128	
GVALS	2.678	2.797					2.678	
LCP		2.553						
SDC	2.394	2.983					2.394	

APPENDIX E

GOOGLE ONLINE SURVEY (SNAPSHOT)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QUESTIONS RESPONSES

Section 1 of 5

Doctorate Study for Green/Sustainable Practices Adoption in Malaysian Maritime Industry

SECTION A: COMPANY PROFILE

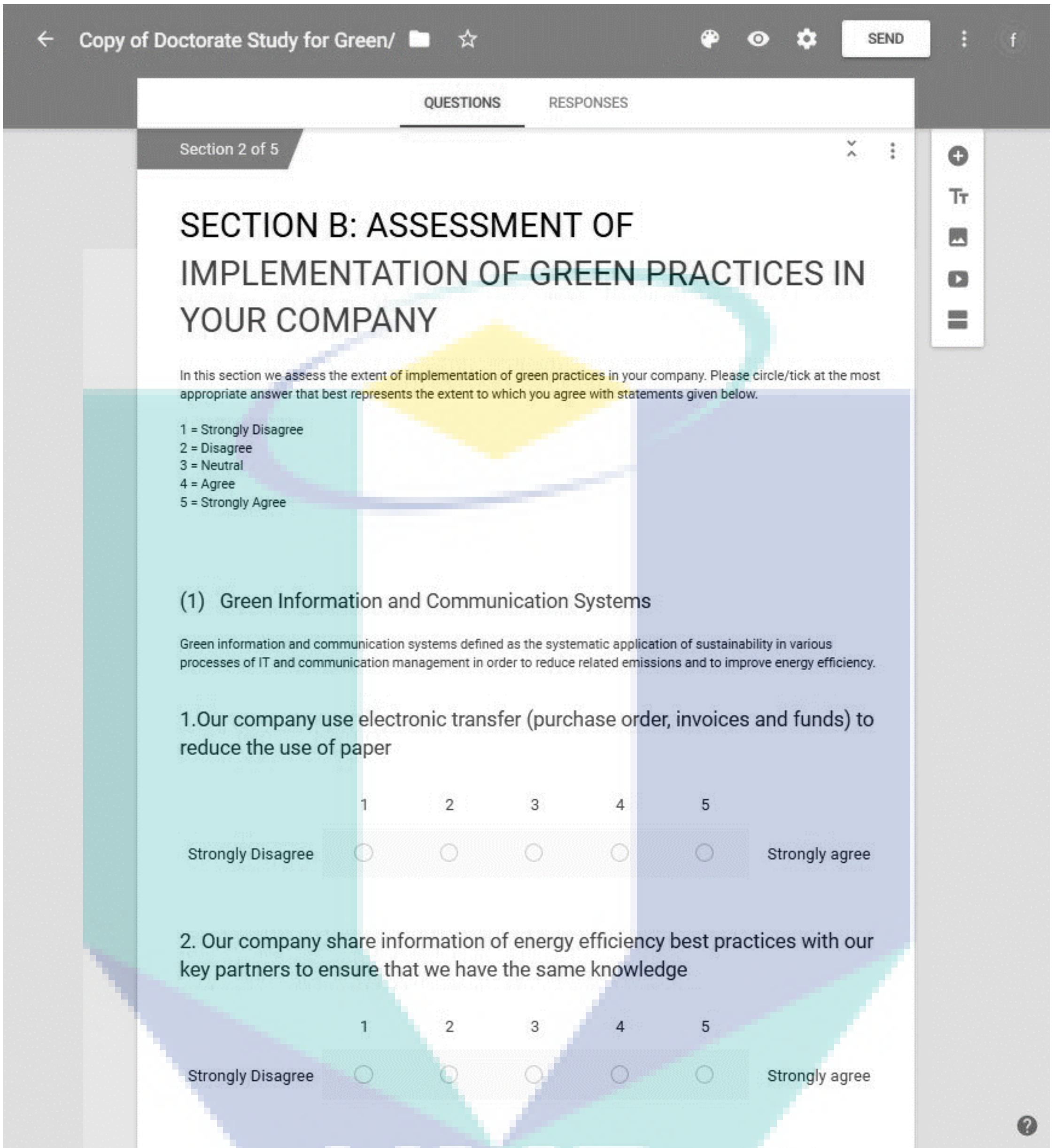
This section consists of general questions, which are important for us to know about background of your company. Please select the box that most closely matches your company background.

1. Have your company adopted green practices in the logistic supply chain or in your company's daily operation?

- i. Yes (If yes, please resume to the next question)
- ii. No (If your answer is no for Q1 and Q2, you can leave the survey)

2. Have your company adopted maritime supply chain in your company operation?

- i. Yes (If yes, please resume to the next question)
- ii. No (If your answer is no for Q1 and Q2, you can leave the survey)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QUESTIONS RESPONSES

Section 2 of 5

SECTION B: ASSESSMENT OF IMPLEMENTATION OF GREEN PRACTICES IN YOUR COMPANY

In this section we assess the extent of implementation of green practices in your company. Please circle/tick at the most appropriate answer that best represents the extent to which you agree with statements given below.

1 = Strongly Disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree

(1) Green Information and Communication Systems

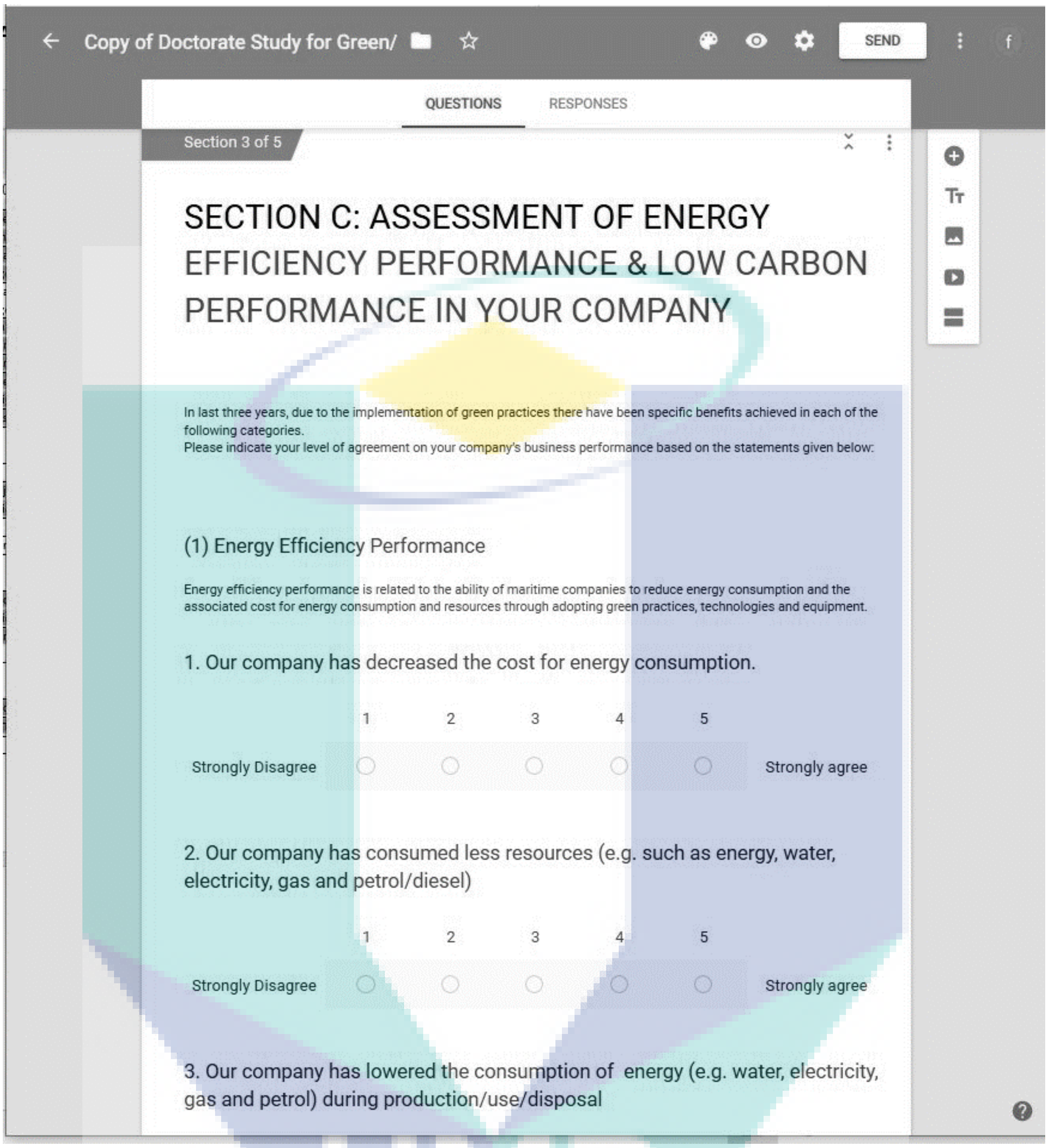
Green information and communication systems defined as the systematic application of sustainability in various processes of IT and communication management in order to reduce related emissions and to improve energy efficiency.

1.Our company use electronic transfer (purchase order, invoices and funds) to reduce the use of paper

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly agree

2. Our company share information of energy efficiency best practices with our key partners to ensure that we have the same knowledge

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly agree



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QUESTIONS RESPONSES

Section 3 of 5

SECTION C: ASSESSMENT OF ENERGY EFFICIENCY PERFORMANCE & LOW CARBON PERFORMANCE IN YOUR COMPANY

In last three years, due to the implementation of green practices there have been specific benefits achieved in each of the following categories.
Please indicate your level of agreement on your company's business performance based on the statements given below:

(1) Energy Efficiency Performance

Energy efficiency performance is related to the ability of maritime companies to reduce energy consumption and the associated cost for energy consumption and resources through adopting green practices, technologies and equipment.

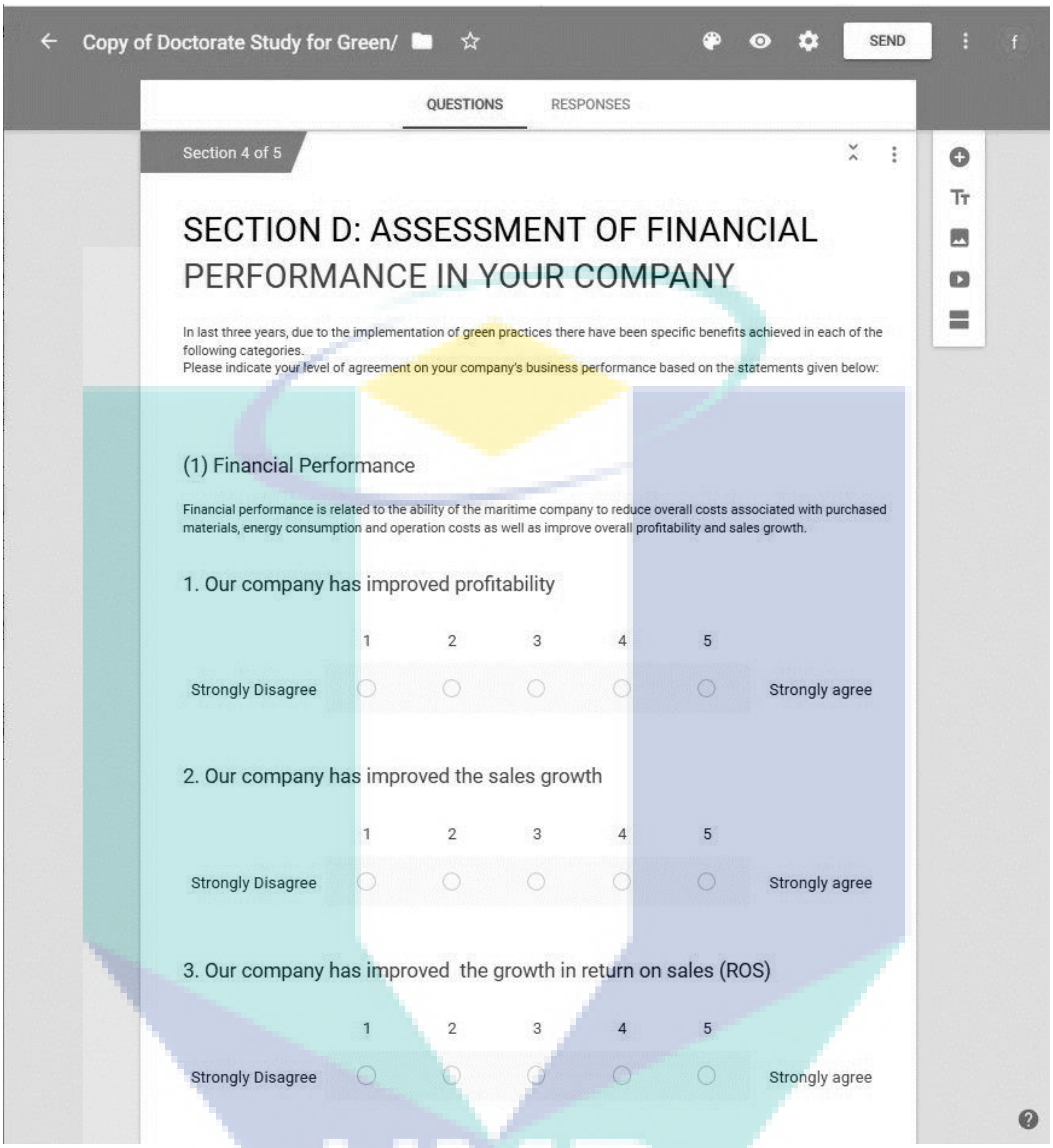
1. Our company has decreased the cost for energy consumption.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly agree

2. Our company has consumed less resources (e.g. such as energy, water, electricity, gas and petrol/diesel)

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly agree

3. Our company has lowered the consumption of energy (e.g. water, electricity, gas and petrol) during production/use/disposal



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QUESTIONS RESPONSES

Section 4 of 5

SECTION D: ASSESSMENT OF FINANCIAL PERFORMANCE IN YOUR COMPANY

In last three years, due to the implementation of green practices there have been specific benefits achieved in each of the following categories.
Please indicate your level of agreement on your company's business performance based on the statements given below:

(1) Financial Performance

Financial performance is related to the ability of the maritime company to reduce overall costs associated with purchased materials, energy consumption and operation costs as well as improve overall profitability and sales growth.

1. Our company has improved profitability

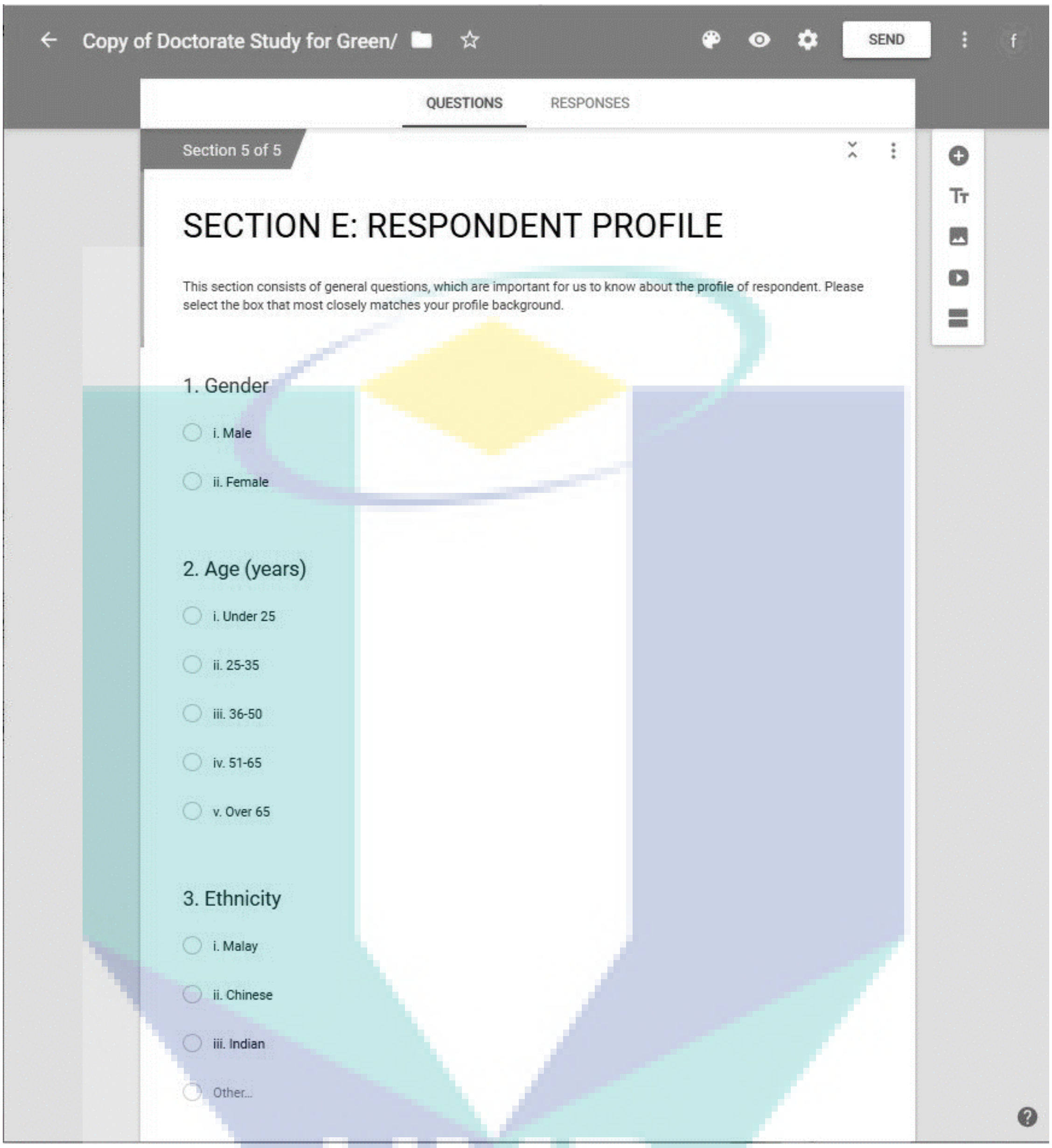
	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly agree

2. Our company has improved the sales growth

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly agree

3. Our company has improved the growth in return on sales (ROS)

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly agree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QUESTIONS RESPONSES

Section 5 of 5

SECTION E: RESPONDENT PROFILE

This section consists of general questions, which are important for us to know about the profile of respondent. Please select the box that most closely matches your profile background.

1. Gender

- i. Male
- ii. Female

2. Age (years)

- i. Under 25
- ii. 25-35
- iii. 36-50
- iv. 51-65
- v. Over 65

3. Ethnicity

- i. Malay
- ii. Chinese
- iii. Indian
- Other...

APPENDIX F

PUBLICATIONS

Fernando, Y., Jasmi, M. F. A., & Shaharudin, M. S. (2019). Maritime green supply chain management: its light and shadow on the bottom-line dimensions of Sustainable business performance. International Journal of Shipping and Transport Logistics, 11(1), 60-93

Jasmi, F., & Fernando, Y. (2018). Notions of Maritime Green Supply Chain (pp. 5465 Management. In Encyclopaedia of Information Science and Technology, Fourth Edition 5475). IGI Global.

Jasmi, M. F. A., & Fernando, Y. (2018). Drivers of maritime green supply chain management. Sustainable cities and society, 43, 366-383

Jasmi, M. F. A., & Fernando, Y., Ismail, I. (2019). Adoption level of maritime green supply chain management: preliminary findings from a pilot study. International Journal of Logistics Systems and Management. (Forthcoming)

Shaharudin, M. S., Fernando, Y., Jabbour, C. J. C., Sroufe, R., & Jasmi, M. F. (2019). Past, Present, and Future Low Carbon Supply Chain Management: A Content Review Using Social Network Analysis. Journal of Cleaner Production, 218, 629–643.

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Past, present, and future low carbon supply chain management: A content review using social network analysis

Muhammad Shabir Shaharudin [a], Yudi Fernando [a, b], Charbel Jose Chiappetta Jabbour [c], Robert Sroufe [d, *], Muhamad Fairuz Ahmad Jasmi [a]

[a] Faculty of Industrial Management, Universiti Malaysia Pahang, 26300, Pahang, Malaysia
[b] Management Department, BINUS Online Learning, Bina Nusantara University, 11530, Indonesia
[c] Montpellier Business School, International Center of Research and Education, Montpellier, France
[d] Duquesne University, 820 Rockwell Hall, 600 Forbes Avenue, Pittsburgh, PA, USA

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ABSTRACT

The aim of this study is to identify the past, present, and future research trends for low carbon supply chain (LCSC) management. The literature on low carbon supply chain management has expanded, however, a systematic review of lessons learned and future research opportunities is necessary. We do this using a review of the literature and social network analysis. The data for this study consists of English articles published by multiple databases found through the Web of Science and Scopus. We reviewed, collected, and sorted articles from 124,793 publications and then identified 2199 as being relevant to the scope of work for this study. Next, we utilized a social network analysis of the data. The results uncovered six main domains of LCSC: sustainability, climate change, green supply chain management, supply chain management, innovation, sustainable development, and environmental management. Contributions of this study include the development of these domains along with several important themes. The insights uncovered by our analysis primarily focus on LCSC modelling, low carbon energy, and carbon emission measurements. Numerous sustainability management practices are associated with low carbon energy use and actions to avoid increasing the rate of climate change. Paradoxically, we find limited evidence in the literature on how the LCSC practices can achieve integrated levels of performance that should also include carbon performance indicators.

1. Introduction

Business trends over the last two centuries and continued population growth has triggered the clearing of lands for agriculture, development, manufacturing facilities, and supply chain infrastructure. Because of this continued expansion, global environmental problems have become challenging operations issues (Fernando et al., 2018a). Why are global environmental problems important to operations? Because manufacturing firms and their supply chains are considered to be the most significant contributors to carbon emissions. For example, deforestation exists because of uncontrolled output of agriculture products (Huisingh et al., 2015), the overuse of burning coal for fuel (Aguirre-Villegas and Benson, 2017), and the supply chain activities of global firms (Camanzi et al., 2017). As we now know that over 90 percent of emissions can be found in the supply chains of firms (Mao et al., 2016a), the overuse of fossil fuel for energy to support transportation and production has more recently enabled the adoption of Low Carbon Supply Chain (LCSC) practices throughout firms' supply chain activities and networks.

For the purpose of this study, LCSC can be defined as a strategic, environmentally-aligned initiative that aims to achieve operational excellence and cost reductions by focusing on energy efficiency and reducing carbon emissions. We find this is operationalized throughout four important domains of supply chain activities, including: procurement, production process, product, and logistics. To help ensure successful LCSC, firms must communicate, share, collaborate, and integrate their business process with supply chain networks to respond to market demand while making fast, accurate

* Corresponding author.
E-mail addresses: shabir.shaharudin@gmail.com (M.S. Shaharudin), yudhitjoa@gmail.com, yudifernando@binus.ac.id (Y. Fernando), cjcjabbour@gmail.com (C.J. Chiappetta Jabbour), sroufer@duq.edu (R. Sroufe), fairuzjasmi89@gmail.com (M.F.A. Jasmi).

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Drivers of maritime green supply chain management

Muhamad Fairuz Ahmad Jasmi[a], Yudi Fernando[a,b,*]

[a] Faculty of Industrial Management, Universiti Malaysia Pahang, 26300, Pahang, Malaysia
[b] Management Department, BINUS Online Learning, Bina Nusantara University, 11530, Indonesia

A R T I C L E I N F O

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Information and communication system
Supply chain integration
Value added logistic service
Shipping design

A B S T R A C T

The aim of this paper is to investigate the relationship between drivers of green maritime supply chain management and dimensions of maritime green supply chain management (MGSCM) practices. The theoretical model was developed from institutional theory to explore the drivers of MGSCM based on the Malaysian maritime sector. The online survey was used to collect the data. The sample was unit businesses that are involved in the green maritime supply chain. From 144 usable questionnaires, the findings found that green initiative, regulation and securities had partially significant relationships with the five dimensions of MGSCM. This study contributes to maritime transport literature by filling a gap with respect to survey-based research evidence of a theoretical model of MGSCM.

1. Introduction

Pressure from customers, society, local and global regulatory agencies is moving the maritime industry one step ahead to green up its business activities. The industry has begun practising sustainability strategies and using green technology to meet emissions standards and reduce the impacts of marine pollution and climate change. Maritime industry has contributed to the successful implementation of sustainable cities and fulfils modern needs of people in urban areas. The challenge of urban sustainability deals with ecology and technology aspects (Bibri & Krogstie, 2017). Maritime industry used shipping transport systems and land vehicles to support business operations. Almost all vehicles are powered by internal combustion engines which lead to unsustainable practices (Muneer, Celik, & Caliskan, 2011). Concern for green practices to achieve sustainability goals became stakeholders interest in the maritime sector. Green strategy refers to a set of strategy that are based on ecologically responsible business activities designed to reduce costs of operation and protect the current and future interests of stakeholders. From a maritime perspective, green can be refer to environmentally friendly commercial and non-commercial seafaring activities including reducing emissions and marine pollution that are designed to decrease negative impacts to the environment.

Aware of the environmental issues, the maritime sector has embraced sustainability efforts in business operations (Lai, Lun, Wong, & Cheng, 2011; Lirn, Lin, & Shang, 2014). Despite the fact that maritime transportation relatively has "greener image" compared to other transportation sectors because it emits less CO_2 per ton-mile than other transportation, maritime transportation has been predicted to be a major contributor to climate change in the future (Lister, Poulsen, & Ponte, 2015). Research on sustainability aspect in the maritime sector will assist practitioners to comply with international regulations, environmental benefits and financial profits (Yiğit & Acarkan, 2018). Society and regulatory agencies are main stakeholders that will benefit from high degree environmental implementation. Both society and regulatory agencies are constantly monitoring the dynamic pressure of green efforts throughout the supply chain network including production, logistics, distribution, and operations (Caniëls, Gehrsitz, & Semeijn, 2013; Awaysheh & Klassen, 2010). Maritime authorities play a critical role in protecting society from the harmful effects of the maritime operations (Acciaro, 2015). As one step in doing so, the maritime industry has adopted green strategies to improve resource efficiency and competitiveness in the industry. Regulations, social needs and market changes are among other reasons that lie beyond the strategies of individual organizations for implementing green initiatives (Caniëls et al., 2016).

Additionally, the International Maritime Organization (IMO) has amended its regulations on emissions, ballast water discharge, and ship design. These amendments add further pressure on the maritime sectors to leverage their sustainability agenda (Alvik, Eide, Endresen, Hoffmann, & Longva, 2009; Lirn, Jim Wu, & Chen, 2013). The sustainability agenda should be a main interest of all supply chain networks. Recently, supply chain management has gained popularity because of the intensified global competition and value-seeking initiatives

* Corresponding author at: Faculty of Industrial Management, Universiti Malaysia Pahang, 26300, Pahang, Malaysia.
E-mail addresses: fairuzjasmi89@gmail.com (M.F.A. Jasmi), yudi@ump.edu.my, yudi.fernando@binus.ac.id (Y. Fernando).

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Maritime green supply chain management: its light and shadow on the bottom line dimensions of sustainable business performance

Yudi Fernando*

Logistics and Supply Chain Management Research Cluster,
Faculty of Industrial Management,
Universiti Malaysia Pahang,
26300, Malaysia
Email: yudi@ump.edu.my
and
Management Department,
BINUS Online Learning,
Bina Nusantara University,
11530, Indonesia
Email: yudi.fernando@binus.ac.id
*Corresponding author

Muhamad Fairuz Ahmad Jasmi and Muhammad Shabir Shaharudin

Logistics and Supply Chain Management Research Cluster,
Faculty of Industrial Management,
Universiti Malaysia Pahang,
26300, Malaysia
Email: fairuzjasmi89@gmail.com
Email: shabir.shaharudin@gmail.com

Abstract: The objective of this paper is to investigate the effects of maritime green supply chain management (MGSCM) on sustainable business performance. This paper addresses the complex dimensions of 'sustainability' to be integrated into maritime supply chain activities with the existing green supply chain concept linking the concept with the extended bottom line dimensions of sustainable business operations. To achieve the objective, an online survey was administrated to various maritime supply chain companies in Malaysia. The findings confirmed that MGSCM practices indirectly facilitate sustainable economic, environmental, operational and social performance for these businesses. This paper presents practical suggestions for maritime practitioners that highlight the need to materialise green practices adoption in the maritime supply chain in the future.

Keywords: maritime sector; sustainability; green information; supply chain integration; green supply chain management; shipping design.

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Adoption level of maritime green supply chain management: preliminary findings from a pilot study

Muhamad Fairuz Ahmad Jasmi,
Yudi Fernando* and Ishak Ismail

Faculty of Industrial Management,
Universiti Malaysia Pahang,
26300, Malaysia
Email: fairuzjasmi89@gmail.com
Email: yudi@ump.edu.my
Email: ishakismail@ump.edu.my
*Corresponding author

Abstract: It is essential to investigate the awareness of maritime industry concerning environmental practices that could cause damage and pollution to coastal and marine ecosystems. The perception of maritime firms in Malaysia was examined with a view to understanding the adoption level of maritime green supply chain management and its correlation with financial outcomes. Three statistical tests were utilised. The first adopted assessment was the internal consistency test which measured the scale reliability. Afterwards, the different variations among group means level of adoption (seed, start-up, expansion, monitoring and control) in the sample was examined using one-way ANOVA analysis. The results showed that the aggregate value of MGSCM practices has positive correlation with maritime supply chain financial efficiency. This paper, apart from establishing that small sample size is sufficient for a pilot study. It is necessary to conduct a pilot study prior the actual data collection.

Keywords: maritime, green supply chain management; GSCM; green adoption; financial performance; pilot study.

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Biographical notes: Muhamad Fairuz Ahmad Jasmi is a PhD candidate and has research interests in area of maritime green supply chain management and energy efficiency in the Logistics and Supply Chain Management Research Cluster at the Faculty of Industrial Management, Universiti Malaysia Pahang. He has awarded MyBrain Scholarship (MyPhD) from Malaysian Government in 2016–2018. He received his MBA in Sustainable Development from the Graduate School of Business Universiti Sains Malaysia.

Yudi Fernando is a Deputy Dean Research and Postgraduate Studies at the Faculty of Industrial Management, Universiti Malaysia Pahang. He has been working in the electronics industry for several years. His current research interests are green operations management, service management, logistics, and sustainable issues in supply chain management. He is the Research Committee Chair and a founding member of the Academy of Business and Management (ABM). He is also a member of the Society of Logisticians,

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Notions of Maritime Green Supply Chain Management

Fairuz Jasmi
Universiti Sains Malaysia, Malaysia

Yudi Fernando
Universiti Malaysia Pahang, Malaysia

INTRODUCTION

Intercontinental trade relies heavily on maritime transportations to carry various cargoes for catalyzing global import-export trade. Roughly about 80% of international trade by volume and over 70% by value is carried by maritime operations globally (Cheng, Farahani, Lai, & Sarkis, 2015). As a vital component of life-line trade for various manufacturing companies all over the world, maritime supply chain have established new opportunities and unforeseeable challenges. The challenges faced by maritime supply chain dampened in the increased rate of climate change and global warming during the precedent decade (Lai, Lun, Wong, & Cheng, 2011). In this respect, carbon dioxide (CO^2) and other greenhouse gases (GHGs) are emitted through the burning of fossil fuels from maritime transportation are responsible for a host of global environmental concerns. Playing the critical role as a major transportation and intermediary to assist trade flows in the global supply chain (Wong, Lai, & Cheng, 2009; Yang, Marlow, & Lu, 2009), many issues have been raised in operational context of maritime supply chain especially on environmental issues. As such, environmental protection has been extensively discussed by stakeholders, businesses, authorities as well as political leaders globally (e.g., Boykoff & Yulsman, 2013; Boykoff, 2009; Revkin, 2009; Rosenthal, 2009). In scholarly field, there has also been a surge in researches committed to address the related issues of environmental issues (e.g., Lee & Kim, 2011; Ostrom, 2008; Wong, Lai, Shang, Lu, & Leung, 2012). The tightened environmental regulations imposed by International Maritime Organization (IMO) to the maritime sectors also contribute to this rising green trend (Sulaiman, Akmar, & Michel, 2013). As a result of this 'green' pressure, numerous maritime organizations have gradually begun to react to environmental concerns by embracing green supply chain management (GSCM) and other sustainability concept in their supply chain operations (Lai et al., 2011).

To the author's limited knowledge, relatively a small amount of studies have discussed GSCM dimension in the context of the maritime supply chain as well as sustainable notion of maritime green supply chain management (MGSCM). Preceding studies have stressed on tangible aspect of maritime operation such as sewage pollution, air pollution, and greenhouse gas (GHG) emissions (Cariou, 2011; Corbett, Wang, & Winebrake, 2009; Giziakis & Christodoulou, 2012; Hoffmann, Eide, & Endresen, 2012; Lirn, Lin, & Shang, 2014) but no intangible aspect in term of organizational management perspective of internal or external organizational capabilities can be found. If there is, it is literally a new domain in maritime supply chain and it is sensible to fill the gap in the literature by examining the GSCM dimensions that can be conceptualize towards defining the notion of MGSCM. Accordingly, the purpose of this paper is not to investigate empirically the dimension of MGSCM but to identify key GSM capability factors and examine the accountability of the

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