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How can the maritime industry meet Sustainable Development Goals? An analysis of sustainability reports from the social entrepreneurship perspective

Xueqin Wang^{a,b}, Kum Fai Yuen^b, Yiik Diew Wong^b, Kevin X. Li^{a,*}^a Ocean College, Zhejiang University, Zhoushan, China^b School of Civil and Environmental Engineering, Nanyang Technological University, Singapore

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ABSTRACT

Sustainability Development Goals (SDGs) are a comprehensive agenda agreed upon globally that aims to stimulate actions towards economic, environmental and social sustainability. Being one of the key stakeholders, the international maritime industry plays an important role in contributing to global sustainability. By applying the concept of social entrepreneurship (SE), this study aims to examine (1) the basic and extended responsibilities (SDG 1–SDG 16) and (2) the potential collaborations within the value chain (SDG 17) concerning SDG implementation in maritime industry. To achieve these, we conduct a content analysis of sustainability reports published by container shipping liners and terminal operators from 2016 to 2019. More specifically, manual text classification is adopted to categorise the text content of sustainability reports based on 17 SDGs, and automatic text mining is employed to further identify the key roles of maritime industry related to each SDG. A unified framework is proposed, which points to varied motives and levels of comprehensiveness of the sustainability efforts by the maritime industry. This framework reveals the theoretic process of maritime industry's transitional involvement in sustainability from the SE perspective. It also creates managerial implications regarding the resource allocation strategies by maritime industry in meeting SDGs.

1. Introduction

In 2015, the United Nations (UN) released the influential document entitled ‘Transforming our world: the 2030 agenda for sustainable development’, in which 17 Sustainable Development Goals (SDGs) along with 169 targets were announced. The document aims to address a broad range of sustainable development issues such as poverty, hunger, health and well-being, and education (<https://sustainabledevelopment.un.org>). For the first time, a comprehensive agenda is agreed upon globally that could stimulate actions towards economic, environmental and social sustainability (UN, 2015). The 17 SDGs collectively serve as a shared normative framework that entails actors at all levels including governments, civil societies and private sectors (Ntona and Morgera, 2018; Recuero Virto, 2018).

The international maritime industry plays an important role in global sustainability as one of the key stakeholders (Benamara et al., 2019; Yuen et al., 2018a). By supporting world trade and facilitating global economy, maritime industry is associated with each

* Corresponding author.

E-mail addresses: xueqinwang@zju.edu.cn (X. Wang), yuen0016@e.ntu.edu.sg (K.F. Yuen), cydwong@ntu.edu.sg (Y.D. Wong), kxli@zju.edu.cn (K.X. Li).

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SDG. Firstly, maritime industry may make a primary contribution to SDG 14, a dedicated goal to conservation and sustainable use of oceans, seas and marine resources (Cormier and Elliott, 2017; Recuero Virto, 2018). However, the responsibility of maritime industry goes far beyond SDG 14 such as reducing port-related pollutions in coastal regions, which contributes to the health and well-being of coastal residents (SDG 3); ensuring decent working conditions of seafarers, which is an important component of SDG 8; and sustainable development of cities and communities (SDG 11) that depends on secure global logistics systems (see Appendix A for details). To this end, the inherent development of maritime industry is highly relevant to the implementation of the UN's 2030 agenda and the associated SDGs, by way that a sustainable maritime industry contributes directly to achieving the SDGs, whereas the SDGs act as the universal framework that effectively guides the sustainable development of the maritime industry (Benamara et al., 2019; IMO, 2017).

Given the significant importance of the maritime industry in achieving SDGs, it is surprising to note the lack of research on SDGs in maritime-related studies. Some researchers attributed the lack of study to the slow response of the International Maritime Organisation (IMO) in implementing SDGs, as no particular SDG is explicitly addressing the maritime sector (Sciberras and Silva, 2018). Consequently, the maritime industry is uncertain about its role in connection with the SDGs, and the visibility of SDGs within the industry remains generally low (Fleming et al., 2017; Sciberras and Silva, 2018). Notably, certain research efforts have been devoted to SDG 14 (Islam and Shamsuddoha, 2018; Okafor-Yarwood, 2019), yet a comprehensive assessment of *all 17 SDGs* on their collective implications on the sustainable development of the maritime industry is lacking. A comprehensive assessment is essential to avoid the 'silo' risk that undermines the internal consistency (co-benefits and trade-offs) of the SDGs (Ntona and Morgera, 2018; Singh et al., 2018). In addition, the restricted focus on certain SDGs may also suffer the risk of 'cherry-picking' by maritime firms, where SDGs with short-term benefits are unduly prioritised over the long-term goals (Stafford-Smith et al., 2017). Against this backdrop, we argue that comprehensively establishing the relevancy of the SDGs to the maritime industry is urgently needed. In particular, the following question needs to be answered: How can the maritime industry meet the 17 SDGs?

On a theoretical premise, the concept of corporate social entrepreneurship (SE) is introduced whereby the implementation of SDGs is regarded as an entrepreneurial opportunity that addresses economic, social and environmental challenges to create shared values (Littlewood and Holt, 2018; Rahdari et al., 2016). In particular, SE posits that business enterprises undergo multiple transition stages before reaching a maturity level of sustainable business model: on the one hand, business enterprises may scale up their sustainability practices from seeking minimal compliance in the core business area to shouldering extended responsibility; on the other hand, business enterprises may establish partnership with their upstream and downstream value chain members to collaborate in sustainability matters (Littlewood and Holt, 2018; Stenn, 2017). Applying the concept in maritime industry, this study intends to answer the following specific research questions (RQs):

RQ1: What are the basic or extended sustainability practices that can be adopted by the maritime industry to meet SDGs?

RQ2: What forms of collaboration with value chain partners can be adopted by the maritime industry to meet SDGs?

Methodology-wise, a content analysis is conducted which examines text-based data and provides synthesised insights that lead to the construction of reality grounded in the data (Flick, 2009; Sciberras and Silva, 2018). As companies are increasingly disclosing their sustainability performance to gain legitimacy and create goodwill in society, we make use of their sustainability or corporate social responsibility reports. These reports are the official channels for companies to communicate with their shareholders, clients, investors and the general public. More specifically, manual text classification is adopted to categorise the text content of the reports based on 17 SDGs, and automatic text mining is employed to further identify the key roles of maritime industry related to each SDG. Based on the analysis results, we provide a comprehensive assessment regarding the sustainability efforts of the maritime industry to meet the SDGs.

The contributions of this study are multi-fold. Theoretically, this study integrates the concept of SE in the implementation of SDGs within the maritime industry. Based on the comprehensiveness (basic or extended) of sustainability efforts and level of value chain collaboration, a unified framework is proposed, revealing the maritime industry's transitional involvement in sustainability from the SE perspective. Practically, our study provides a comprehensive assessment of the maritime industry's sustainability efforts towards SDGs. The research findings pinpoint the specific SDGs that are currently overlooked and thus require more collective efforts from the industry. The proposed framework also serves as a self-assessment tool for an individual maritime company regarding its current sustainable development stage and creates implications for future SDG implementation strategies. The remainder of this paper is structured as follows. Firstly, the relevant literature is reviewed, emphasising on applying the concept of SE and the current implementation status of SDGs. Next, the research methodology is elaborated which discusses the process of data collection, manual text classification and automatic text mining in detail. Illustrations and interpretations of the data analysis results are then presented, indicating differentiated responsibilities of maritime industry in relation to different SDGs. Finally, a unified framework is provided in the conclusion section followed by a discussion on research implications and contributions.

2. Literature review

As a set of goals for global sustainability, the inception of the SDGs is a remarkable achievement with a universal agreement for human development (Stafford-Smith et al., 2017). Unlike its precedent Millennium Development Goals (MDGs), SDGs actively encourage the involvement of private sectors as both an addressee and a partner in shaping the sustainable development agenda (Poddar et al., 2019; Schönherr et al., 2017). Indeed, private sectors may be a critical component in realising SDGs, while SDGs provide abundant business opportunities for the private sectors (Moratis and Melissen, 2019). In this section, we theorise SDG

implementation as an SE process where the interlink between SDGs and an entrepreneurial perspective of sustainability is established (Section 2.1). Subsequently, we review the current status of SDG implementation in the business context, leading to the identification of major research gaps in this field (Section 2.2). In particular, the maritime industry is regarded as a supporting industry for world trade, a major employer with a global reach and an energy-extensive business. Hence, it plays an incomparable role in global sustainable development and thus selected as the representative business context in our study.

2.1. Theoretical premise: An application of SE to SDG implementation

Social entrepreneurship is a prominent concept that originates from the interdisciplinary field of sustainability and entrepreneurship (Belz and Binder, 2017). Unlike the conventional view that suggests trade-offs between economic and social/environmental goals of business activities, SE studies focus on identifying opportunities for creating shared values (Rahdari et al., 2016). In this regard, SE shares great similarities with the concept of sustainable entrepreneurship, which views entrepreneurial activities as a tool to reduce environmental degradation (Cohen and Winn, 2007; Dean and McMullen, 2007). Due to the interconnection of social and environmental matters, we do not differentiate these two terms and referred them as SE in this study. Although no single definition has been agreed upon, SE is often understood as the process of exploiting the enterprise's full potential through innovative use of resources within the enterprise and across the value chain in pursuit of triple-bottom-line solutions (Belz and Binder, 2017; Rahdari et al., 2016). Taking such a view, we can apply the SE concept to a variety of organisations, large or small, non-profit or for-profit, with a social mission (Belz and Binder, 2017). To this end, the SDG implementation process can be theorised as an entrepreneurial process with innovative use of sustainability resources to create economic, social and environmental goals as specified in the 17 SDGs. Herein, by viewing SDG implementation as entrepreneurial opportunities that create shared values, SE serves as the theoretical premise of SDG implementation by business enterprises.

Furthermore, the SE concept suggests that business enterprises experience multiple dimensions of transition before entering a mature stage of sustainable business (Apostolopoulos et al., 2018; Schönherr et al., 2017). On the one hand, the business enterprises may start from practising restricted sustainability activities to ultimately shouldering extended sustainability responsibilities (Littlewood and Holt, 2018; Rahdari et al., 2016). They may start by focusing only on their core business area in seeking for minimal compliance, while gradually shifting to a broad range of sustainability efforts which create internal and external values. In this regard, the SDGs supply the SE process with a comprehensive range of specific goals for the enterprises to focus on, fulfilling restricted or extended sustainability responsibilities.

On the other hand, some researchers evaluate the maturity level of an enterprise towards sustainability by differentiating the micro- and meso-level SDGs and macro-level SDGs, suggesting that some SDGs can be achieved at the individual and organisational level whereas some SDGs require wider participation and collaboration (Rahdari et al., 2016; Yuen et al., 2018b). This view is shared by Littlewood and Holt (2018) who showed that some enterprises scale up their contribution by collaborating with their value chain members. Herein, the collaborated sustainability efforts in the SE process are a direct reflection of SDG 17 which calls for collaboration among different business sectors (and non-business sectors) towards the common sustainability goals. Given the extensive connection between the SE concept and the SDG implementation process, the SDGs serve as a reference framework that guides the SE process, whereas the SE process simultaneously contributes to the implementation of the SDGs.

2.2. Current status of SDG implementation

Despite the potential contribution of SDGs to enhance business sustainability, the awareness of SDGs within the private sector is generally low (Sciberras and Silva, 2018). Recent studies show that less than half of the companies globally have integrated SDGs into their sustainability target-setting, and even fewer have identified specific tools for their implementation (Moratis and Melissen, 2019; Poddar et al., 2019; WBCSD and DNV GL, 2018). Reviewing the extant literature, we have identified two challenges that are associated with the SDG implementation in the private sectors and likewise for the maritime industry.

Firstly, to ensure comprehensive coverage of sustainability issues, SDGs consist of diversified goals whose relevancies vary depending on the business contexts (Schönherr et al., 2017). Although companies can use SDGs as a comprehensive reference framework to broaden their scope of sustainability practices, the broad-based SDGs do not provide sufficient grounds that operationalise the general goals and targets by considering the varied relevancies to different contexts (Gupta and Vegelin, 2016; Pineda-Escobar, 2019). As pointed out by Pineda-Escobar (2019), the question on how businesses may relate with and implement SDGs requires further investigation.

Secondly, SDGs contain a coherent set of goals which are characterised by trade-offs and co-benefits, wherein the 17 goals are mutually dependent or even somewhat indivisible (Moratis and Melissen, 2019). However, at the individual organisational level, companies often do not adequately recognise the interconnections among the goals and integrate only those goals that best align with their sustainability strategies. As a result, companies may unduly prioritise goals with immediate benefits without truly weaving SDGs into their business (Moratis and Melissen, 2019). This is especially true given that companies are often more concerned on gaining legitimacy by engaging in corporate responsibility rather than genuinely embracing the big picture of sustainability (Montecchia et al., 2016; Siew, 2015; Yuen et al., 2019). Consequently, SDGs may be used merely as an instrumental tool for companies to 'cherry-pick' (Stafford-Smith et al., 2017), whereby certain goals, such as ending poverty, that require urgent participation from the private sectors are overlooked. As critically pointed out by Moratis and Melissen (2019), 'adoption of SDG framework' may eventually lead to nothing but 'rainbow-washing'.

Such is the case of the maritime industry, where the relevancy of SDGs to the maritime industry remains largely under-rated and

the focus is primarily on 'easy' goals. Extant maritime studies seem to be rather restricted, linking only SDG14 with the sustainability of maritime industry (or the broader ocean industry) (Recuero Virto, 2018; Visbeck et al., 2014). For example, Neumann et al. (2017) provided a conceptual interpretation of SDG14 advocating strong sustainability in coastal areas; Cormier and Elliott (2017) assessed the targets of SDG14 and suggested SMART-based indicators for marine management. Some studies did recognise the interconnections between SDG14 and other sustainability goals, but the primary research focus was still on SDG14 where the ocean industry was concerned (Ntona and Morgera, 2018; Singh et al., 2018). To the best of the authors' knowledge, Kronfeld-Goharani (2018) seems to be the only study that assessed the relevancy of SDGs beyond the narrow focus on SDG14, yet the emphasis was on selected sustainability goals that relate only to the core business of maritime industry.

Of note, IMO recently provides the initial conceptualisation on the potential contributions of maritime industry to each SDG (see Appendix A). However, the specified contributions are largely basic and general. The extent to which the maritime industry can truly weave all SDGs into its operations and benefit from implementing SDGs as value-laden opportunities remains unknown. Thus, a comprehensive examination of SDGs in the maritime industry is still lacking. In this respect, the SE process suggests that business enterprises need to broaden their scope of corporate responsibility to include sustainability issues about extended business areas to reach a sustainable social model (Rahdari et al., 2016). In addition, as a critical part in the global value chain, maritime industry may further collaborate with the value chain members and contribute to the broader agenda of sustainability. Therefore, this study intends to address the research gap by examining 1) basic and extended responsibilities (RQ1) and 2) potential collaborations within the value chain (RQ2) in relation to SDG implementation in maritime industry. Ultimately, this study contributes to the literature by providing an assessment framework regarding the maturity level of sustainable development of maritime industry using SDGs as a reference.

3. Research method

This study aims to extract and data mine the sustainability-related contents as disclosed by companies of the maritime industry (see Appendix B for an illustration of research method). The top container liner companies (Alphaliner, 2019) and container terminal operators (Lloyd's List, 2018) are selected as the research target because they are considered as the most influential players in the industry. Moreover, these companies are under the highest pressure to disclose their sustainability efforts to the shareholders and the public regularly (Ashrafi et al., 2019; Fleming et al., 2017; Lawer, 2019). Thus, we firstly locate their sustainability reports, or reports otherwise termed, such as *corporate social responsibility report* and *sustainable development report*. Some companies disclose their sustainability performance in an *integrated report* or designate a special section in the *annual report* for sustainability issues. Relevant contents of these reports are also included in our study. Despite the different report names and reporting forms, these are essentially voluntary disclosures on sustainability performances by respective companies which are publicly available. In addition, we restrict to reports that were published from 2016 onwards, which contain companies' sustainability efforts in response to UN SDGs (announced in 2015).

3.1. Data extraction

As shown in Table 1, a total of 56 reports are identified, the majority of which are from container liner companies (40). The total number of reports is smaller than expected because many of the targeted companies are not listed in the stock exchanges and are not obliged to publish sustainability reports. In addition, some terminals are operated by one leading group, and thus, only one sustainability report is published that also covers their subsidiaries. Nonetheless, the average length of the reports is about 50–60 pages, which contain abundant information for further analysis. In this study, 'paragraph' is used as the unit of analysis as one paragraph is likely to address one single key theme related to SDGs (Hearst, 1997; Spens and Kovács, 2006). Accordingly, relevant contents are extracted from the identified reports which are compiled into a list. A total of 6,903 paragraphs are obtained, forming a text corpus dataset for further processing.

3.2. Manual text classification

A text classification process is conducted manually to assign each paragraph with one SDG. During this process, materials published by the official website of UN SDGs are firstly referenced (<https://sustainabledevelopment.un.org>), where keywords associated with each SDG are identified and used as indicators for classification. For example, paragraphs containing keywords such as *poor*, *poverty* and *low-income* were assigned to SDG 1. Next, the assigned paragraphs are read in full, and additional keywords are again identified and used as indicators. For example, keywords such as *life difficulties* and *unable to afford* were found to be effective indicators for paragraphs related to SDG 1. With several rounds of 'snowballing', we can assign most of the paragraphs with one SDG. For the remaining paragraphs, a group of three researchers in the relevant field were invited to read the content and offer their opinions. The paragraphs are then assigned with one SDG upon agreement of the three researchers.

3.3. Automatic text mining

Paragraphs assigned to each SDG are further analysed by applying automatic text mining (ATM). The software RapidMiner is used for the association-based text mining process (Hofmann and Klinkenberg, 2013), and the tool of Vosviewer is used for visualising the analytical results (van Eck and Waltman, 2010). More specifically, after inputting the text data, a standard process was applied for

Table 1
Sample statistics.

Source	2016*	2017*	2018*	2019*	Sum
Antwerp			1		1
Bremen	1				1
Chennai (Krishnapatnam Ports)	1				1
COSCO (operator of various ports in China)		1			1
Hamburg	1				1
Hutchison Ports (Hong Kong and Yantian Ports)			1		1
Kaohsiung		1			1
Mundra (Adani Port)	1	1	1		3
Singapore		1	1		2
Vancouver		1			1
Virginia			1	1	2
Westports (Port Klang)			1		1
<i>Subtotal (Port)</i>	4	5	6	1	16
CMA CGM			1		1
China Navigation (CNCO) – Swire Shipping	1	1	1		3
COSCO Group		1	1		2
Emirates Shipping Line	1		1		2
Evergreen Line	1		1		2
Grimaldi			1		1
Hapag-Lloyd			1		1
Hyundai Merchant Marine (HMM)	1	1	1	1	4
A.P Moller – Maersk (Maersk)	1	1	1	1	4
Matson	1	1	1		3
Mediterranean Shg Co. (MSC)		1	1		2
Ocean Network Express (ONE)				1	1
Seaboard Marine			1		1
Sinotrans	1		1	1	3
SITC	1	1	1		3
Wan Hai Lines	1	1	1		3
Yang Ming Maine Transport Corp.	1	1	1	1	4
<i>Subtotal (shipping company)</i>	10	9	16	5	40
Total	14	14	22	6	56

* Year of publishing, for example, reports published in 2016 cover the companies' sustainability efforts of 2015.

creating association rules using RapidMiner, which consisted of tokenisation, case transform, removal of default stop word (English), stemming, frequency calculation (FP-growth) and association rule creation (García et al., 2011). By doing so, the keywords and key terms with high frequencies are identified (see Appendix C), and their associations are analysed based on frequency support and statistical confidence. In line with the general practice, a confidence level of 0.80 was adopted as a cut-off point. The purpose of this study is to explore all potential areas that the maritime industry may contribute to sustainability; hence, we do not filter out association rules with a low level of frequency support. The generated rules were then inputted into Vosviewer to form the final clustering results.

4. Results and discussion

By assigning each paragraph of the main contents in the sustainability reports with one primary SDG, we profile the SDG implementation status in the shipping industry with each SDG. The classification results (Fig. 1) reveal that the primary contribution of maritime industry is to SDG 8 (27%), followed by SDG 9 (12%) and SDG 11 (12%). Relatively fewer sustainability efforts are put on areas related to SDG 13 (8%), SDG 16 (7%) and SDG 12 (6%). It is worth noting that the maritime industry's contribution to SDG 14 is surprisingly small (3%) based on the percentage of paragraphs in sustainability reports. This might be due to the interconnection between SDG 14 and other goals, which shall be further elaborated in the following sections. In addition, the current implementation status seems to suggest that the remaining goals are of less relevance to the maritime industry, with less than 3% of the contents devoted to each SDG.

Furthermore, the paragraphs assigned with SDG 17 (partnerships for the goals) are further analysed to identify the specific goals that the partnership strategies are intended to achieve. As shown in the secondary pie chart, more than 50% of the contents are linked with climate change (SDG 13), industry, innovation and infrastructure (SDG 9), and decent work and economic growth (SDG 8), which are priority agendas that call for collaborated sustainability efforts from industrial partners.

The remainder of this section discusses the results of ATM in detail. We answer RQ1 by differentiating SDGs that maritime industry should take responsibility for (Section 4.1), SDGs that the industry can facilitate to achieve (Section 4.2) and SDGs that fall under the extended responsibility of the maritime industry (Section 4.3). The findings on collaborated implementation strategies (SDG 17) are discussed in Section 4.4, which provides answers to RQ2.

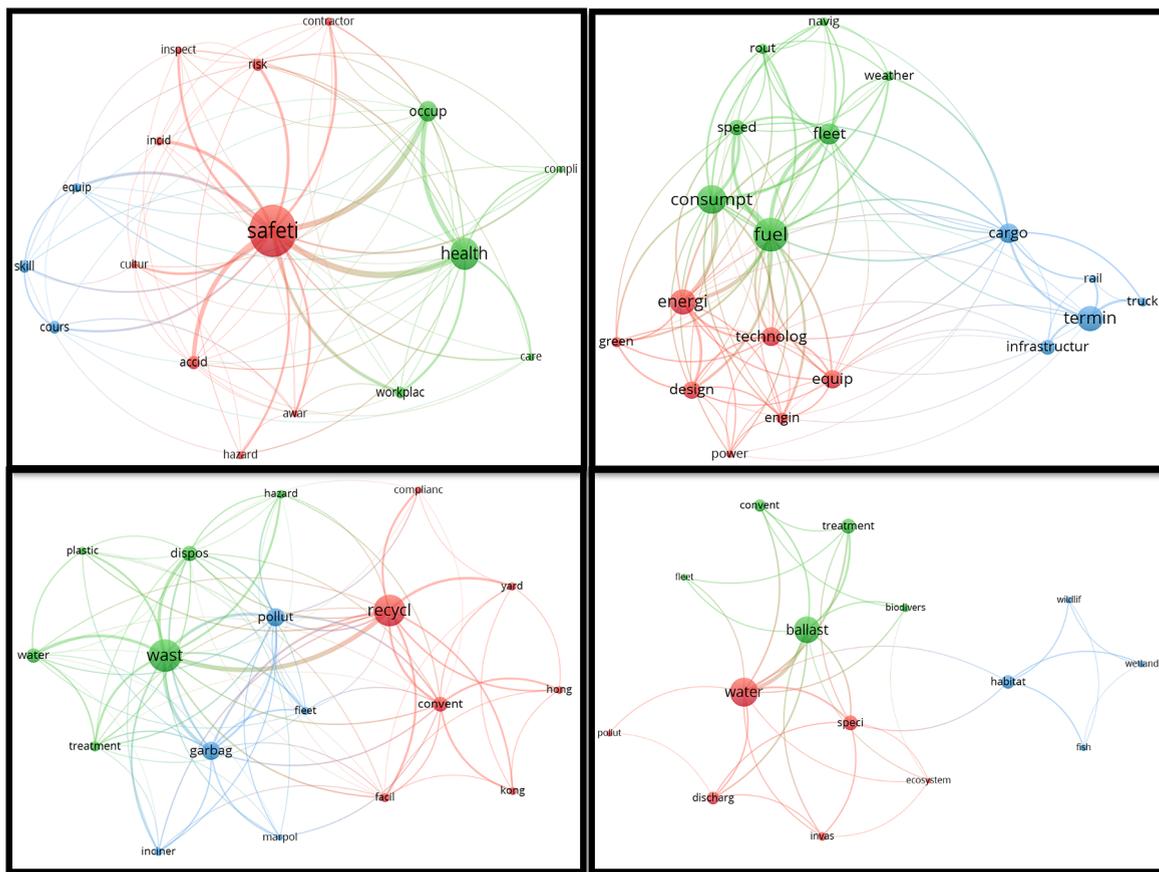


Fig. 2. SDGs that are related to the core business of maritime industry. (SDG 8-upper left, SDG 9-upper right, SDG 12-lower left & SDG 14-lower right).

Table 2
Key quotes related to SDG 8.

Key theme	Quote from sustainability report	Source
SDG 8-safety	<i>In 2017, we conducted 1179 safety inspections to track owned vessels 832 times with navigational risks ...</i>	COSCO Shipping (2018)
SDG 8-health	<i>All our employees will be treated fairly in a safe and healthy working environment ... (by) ensur(ing) complianc with ... internationally recognised labour standards.</i>	Maersk (2019)
SDG 8-training	<i>The Seaman Dept ... organise training courses that improve their familiarity in professional areas such as navigation safety ... to continue enhancing the competency of foreign deck officers.</i>	Evergreen (2018)

operating systems to further advance the operational efficiency (Fig. 2 (upper right)).

For the maritime industry’s contribution to infrastructure building (blue), it is found that both *container terminals* and container maritime companies are investing extensively in *transportation infrastructure* in searching for more efficient and greener solutions. This includes renewing *trucking fleet*, strengthening *road and rail connections*, modernising *cargo operational facilities*, etc. Furthermore, *green ship design* has also been found to be a recurrent theme in sustainability reports (red cluster). The modern container ships have been designed to be increasingly more *energy-efficient* and environmentally friendly. Closely associated with the red cluster is the green cluster. This cluster concerns the use of innovative operation systems that process real-time *navigational data* to optimise the *shipping routes* for the fleet. For sustainability efforts related to all three clusters, latest energy-saving technologies are applied in designing ultra-efficient fleets or terminals that lead to economic saving for the companies and ensure legal compliance of emission standards (see Table 3 for key quotes related to SDG 9).

4.1.3. SDG 12: Waste management and responsible ship recycling in support of responsible consumption and production

A significant amount of wastes is generated from shipping activities on-board and shore-based activity from terminals and supporting offices. Proper waste management is an essential aspect that maritime industry should take responsibility for and thus contribute to the goal of responsible consumption and production (SDG 12) (Löhr et al., 2017). Furthermore, from a life cycle

Table 3
Key quotes related to SDG 9.

Key theme	Quote from sustainability report	Source
SDG 9-green ship design	<i>These mega-ships will be propelled by ultra-efficient G-type engines and will include the latest energy-saving technologies in line with the IMO's Energy Efficiency Design Index (EEDI) standards.</i>	MSC (2018)
SDG 9-innovative operation system	<i>MSC has also extensively invested in a state-of-the-art automatic data acquisition and monitoring system to better evaluate the optimisation of energy consumption of its fleet.</i>	MSC (2017)
SDG 9-infrastructure building	<i>Our task is to develop the infrastructure in the port region so that the port experiences healthy growth in both national and international contexts and is able to compete at a high level.</i>	Hamburg Port (2016)

perspective, the end-of-life ship recycling activity is also a critical component of SDG 12 (Rahman et al., 2016). The traditional ship recycling activity is often held to be a major safety hazard to the yard workers and an environmental threat to the coastal ecosystem (Abdullah et al., 2013; Choi et al., 2016; Du et al., 2018). In this regard, sustainable and responsible ship recycling practices form another important aspect that should be integrated into the sustainability strategy of maritime industry.

Indeed, these two aspects are well reflected in the sustainability reports under examination (Fig. 2 (lower left)). As shown in the green and blue clusters, maritime companies have stressed the importance of the proper management for both non-hazardous wastes, such as *waste paper*, *waste plastic* and *garbage*, and *hazardous wastes* such as *oily water*. Under the **MARPOL Convention** (International Convention for the Prevention of Pollution from Ships), maritime companies have formulated a Waste Management Plan detailing the standard procedures for waste receiving, storage, *treatment*, *disposal*, etc. In addition, although *incineration* on board is not specifically prohibited by MARPOL convention, some companies forbid such a practice that may lead to air pollution. Furthermore, concerning the ship recycling practices (see red cluster), maritime companies are seeking *compliance* with the **Hong Kong Convention** by using ship recycling facilities that are ratified by the convention. However, it is worth noting that the convention has not yet come into force despite a strong devotion by some responsible companies, and about 90% of ships were still dismantled in sub-standard facilities (Maersk, 2019) (see Table 4 for relevant quotes related to SDG 12).

4.1.4. SDG 14: Responsible ballast water management in support of life below water

As discussed in the earlier section, SDG 14 has been the primary focus of the extant literature concerning marine ecology (Neumann et al., 2017; Ntona and Morgera, 2018). However, when the perspective of maritime industry is adopted, the situation seems to turn out differently. Our finding suggests that only about 3% of the content (by paragraph) in sustainability reports is primarily associated with SDG 14. This is probably due to the difference between the concepts of marine and maritime, where marine concerns substances or lives *of seas*, whereas maritime refers to things *associated with seas*. In addition, other goals such as SDG 12 (e.g. waste management) also play an important role in protecting life below water, which also explains the relatively less focus on SDG 14 by the maritime industry.

The clustering result suggests a predominant focus on protecting biodiversity in relation to SDG 14 (Fig. 2 (lower right)). More specifically, some companies acknowledge the consequences of *alien species invasion* associated with illegal ballast water discharge, which may cause serious damage to the whole ecosystem (red cluster). The green cluster illustrates the sustainability efforts of the maritime industry devoted to biodiversity in compliance with the **Ballast Water Management Convention**. With the recent entry into force of the convention, maritime companies are required to equip their ships with standard *ballast water treatment system* to avoid discharge of harmful organisms and pathogens. This represents a strong commitment to protecting marine lives by the maritime industry. Additionally, the container terminals also demonstrate efforts towards protecting the *coastal ecosystem* as shown in the blue cluster. Particular efforts are made in restoring *tidal wetlands* which are a *natural habitat* for diverse *wildlife and fish* (see Table 5 for relevant quotes related to SDG 14).

4.2. Maritime industry as a facilitator in achieving sustainability

Apart from SDGs that are aligned well with the core business, the maritime industry can move one step further to facilitate achieving other sustainability goals. Unlike sustainable behaviours that are out of economic and legal considerations, the maritime industry can commit to create social benefits when an overlap occurs between their business activities and some SDGs to a certain

Table 4
Key quotes related to SDG 12.

Key theme	Quote from sustainability report	Source
SDG 12-waste management (on-board and ashore)	<ul style="list-style-type: none"> Hyundai Glovis safely treats wastes generated in operation of its logistics or Logistics Centers by developing 'Convention Guidelines for Waste Treatment'. Incinerating plastic waste causes emissions of dioxins and toxic gases, and therefore Yang Ming strictly forbids our crew to incinerate plastic waste on board. 	HMM (2016); Yang Ming (2017)
SDG 12-responsible ship recycling	<i>We pre-audited four Ship Recycling Facilities (SRF) in India ... This enabled us to be assured that the selected SRF are operating in/ beyond basic compliance with the Hong Kong International Convention ...</i>	CNCO (2016)

Table 5
Key quotes related to SDG 14.

Key theme	Quote from sustainability report	Source
SDG 14-biodiversity (ballast water management)	<ul style="list-style-type: none"> • <i>The purpose of the Convention is to minimise ... transmigration ... of harmful aquatic micro-organisms and pathogens... a phenomenon that damages ... biodiversity</i> • <i>Our fleet management team will work with ship owners to select the appropriate ballast water treatment system ... to protect biodiversity ...</i> 	Grimaldi (2018); ONE (2019)
SDG 14-biodiversity (coastline restoration)	<i>We began construction on the New Brighton Park Shoreline Habitat Restoration Project. This project is an opportunity to restore coastal wetland habitat to provide productive habitat for juvenile fish and wildlife...</i>	Vancouver Port (2017)

extent. From the SE perspective, sustainability efforts at this level may correspond to an equivalent view of corporate citizenship where companies participate in a broad range of entrepreneurial activities in search for both economic and social returns (Rahdari et al., 2016). In a sense, companies are facilitating in achieving sustainable goals while fulfilling their entrepreneurial motives. Based on the ATM result, our study identifies four SDGs that the maritime industry can facilitate to achieve, namely SDGs 2, 7, 13 and 16 (Fig. 3).

SDG 2 calls attention on the issue of global food security. Although maritime industry is not directly involved in the food production stage, a considerable proportion of **food loss** occurs during the journey from **producer to market**, citing inadequate infrastructure and technology for storing and transporting goods as the key restrictions. Although ensuring food security is by no means the priority of maritime industry, it can partner with the chain members to **develop solutions** for more efficient global **food chains**. Thus, the issue of food loss is rightly positioned in the nexus of maritime industry's economic and social agendas.

SDGs 7 and 13 represent two synergistic goals that the maritime industry can participate to achieve. As shown in Fig. 3 (upper right and lower left), companies respond to both goals by switching to **clean energies** (mainly for shore-based offices and terminals) such as **electricity** and **natural gas**. They are also committed to developing **energy-saving technologies** that decrease the **energy consumption** level. Consequently, companies can alleviate the industry's reliance on fossil fuel and reduce their **carbon footprint** simultaneously, which ultimately leads to economic benefits for the companies.

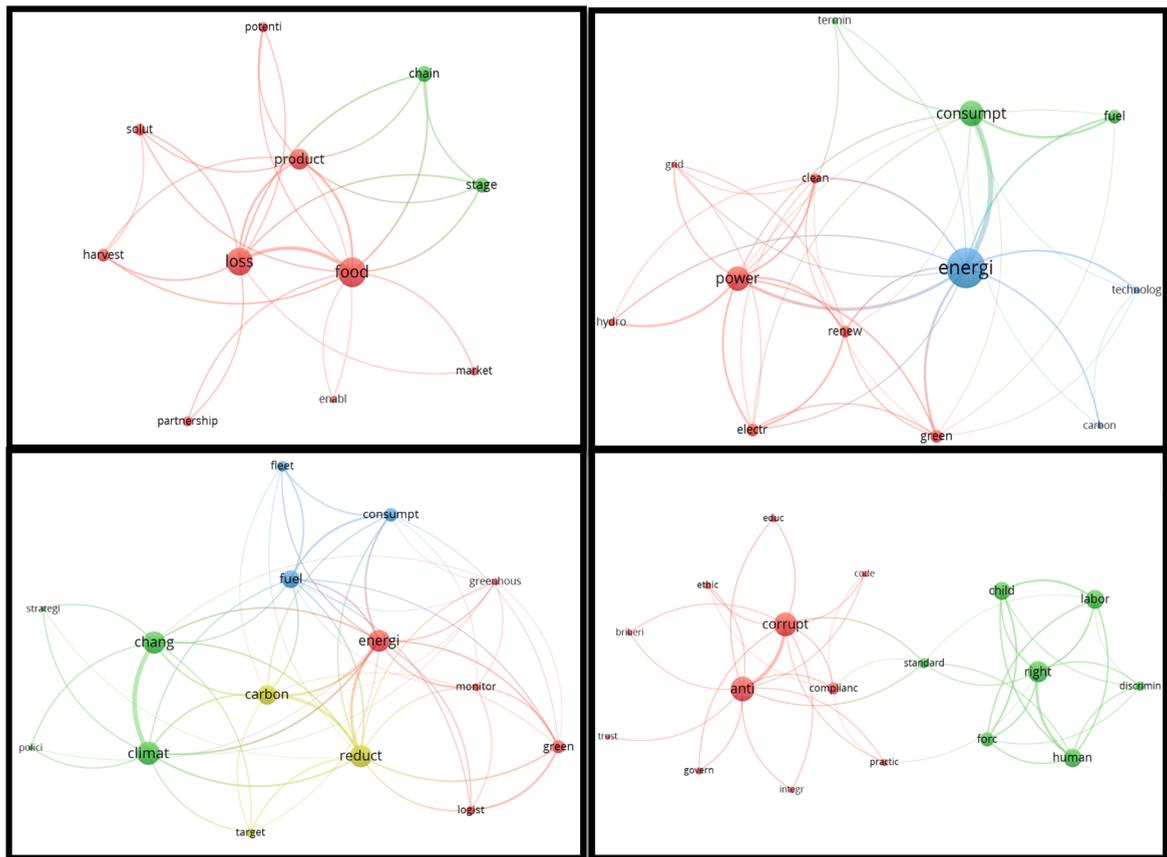


Fig. 3. SDGs that maritime industry facilitates to achieve. (SDG2-upper left, SDG7-upper right, SDG13- lower left & SDG16-lower right).

Table 6
Key quotes related to SDGs 2, 7, 13 and 16.

Key theme	Quote from sustainability report	Source
SDG 2-global food chain	<i>Our commitment to help halve food loss by 2030 is a new area in our sustainability strategy established in 2017. We are currently shaping our activities and growing our insights and understanding of the issue.</i>	Maersk (2019)
SDG 7-clean energy	<i>Over the last two years, we have purchased a total of 2.7 million kWh of green power, making valid contributions towards a cleaner future.</i>	Wan Hai Lines (2018)
SDG 13-control greenhouse gas emission	<i>Increasing the proportion of green electricity ... feeding the electricity into the grid and a solar heating system ... have enabled us to reduce our CO2 emissions steadily.</i>	Bremen Port (2016)
SDG 16 anti-corruption and human right	<ul style="list-style-type: none"> • <i>Operations assessed for risks related to corruption... communication and training about anti-corruption policies and procedures...</i> • <i>We have created human rights clauses in agreements with our external stakeholders. Contractors ... have to address human rights ... as part of the agreement, violations of which incur penalties.</i> 	Singapore Port (2018) Krishnapatnam Port (2016)

Finally, the ATM results of SDG 16 reveal two relatively under-noticed issues by academic researchers: **anti-corruption** and **human rights**. The problem associated with **bribery** or 'facilitation costs' at ports is widely acknowledged in the maritime industry (Sequeira and Djankov, 2014). In response, the industry is found to have formed a partnership-based Maritime Anti-Corruption Network intending to combat corruption and end facilitation payment in ports. Meanwhile, companies are trying to foster **ethical conduct** and honest culture at all levels through conversations, campaigns and **education**. Regarding human rights, companies express strong devotions to human rights which include the prohibition of **child labour**, compulsory labour, **sexual harassment and discrimination**. Thus, by addressing the issues of corruption and human rights, the maritime industry facilitates in building a more transparent business model and a more inclusive workforce which contribute to achieving SDG 16 (see Table 6 for related quotes).

4.3. Extended responsibility of maritime industry towards sustainability

Some SDGs are not ideally aligned nor even overlapped with the core business of maritime industry. However, as employers and major value creators, the industry can still contribute to these SDGs by extending their responsibilities towards sustainability. By doing so, the industry further evolves along the SE process and becomes one step closer to a mature sustainability model (Rahdari et al., 2016). This stage is similar to an extended view of corporate citizenship, and companies' sustainable behaviours are mostly explained by social and philanthropic motives. In this study, eight SDGs are identified as belonging to this category (Fig. 4).

The findings suggest that maritime companies can be involved in a wide range of voluntary activities that benefit the local community and society at large. For example, companies can establish **philanthropic foundations** to help the poor families with **medical, educational and employment needs** (SDGs 1, 3 and 4). They can also make **donations** to the local community to help **disadvantaged people** or provide scholarship for students from low-income families (SDGs 4 and 11). Furthermore, as an employer, companies can offer **internship opportunities** to local university students (SDGs 4 and 11). They can also enforce strict **labour standards** to promote **equal employment opportunities** regardless of gender, religion, race and cultural background (SDGs 5 and 10). Table 7 provides a summary of key quotes from the sustainability reports that address each of the eight SDGs. It is found that although these SDGs are only remotely related to the maritime industry, companies are voluntarily extending their responsibilities and engaging in diverse sustainable behaviours with varying degrees of involvement.

4.4. Partnerships for sustainability

SDG 17 calls for global partnerships and cooperation for successful implementation of the goals. As a critical component in the global supply chain, the maritime industry is also actively collaborating with chain members to achieve sustainability goals. With reference to Fig. 5, the text analysis result shows that the industry has established partnerships for economic, environmental and social purposes. For partnerships on economic considerations, the leading companies are found to pursue shared growth and mutual benefits with their **suppliers and customers**, to enhance the overall **competitiveness of the supply chain** in the market (yellow and orange clusters). They also support the **Fair Trading** Voluntary Compliance Program which promotes fair practices and avoid unhealthy competitions within the industry (blue cluster). For partnering efforts on environmental protection, the primary focus is on the **prevention of pollution** from ships by ensuring compliance with various international **conventions, codes and guidelines** (red cluster). In particular, the companies are working with internationally recognised organisations such as IMO and ISO (International Organisation for Standardisation) for standard-setting and promoting best practices. In addition, by collaborating with the energy sector, sustainability efforts are also committed on investing in **clean energies** and other energy-saving technologies that further enhance the energy-efficiency and reduce the **environmental impact** of maritime industry (green cluster). Finally, the companies partner with various social organisations and charity groups to promote **labour standards** (brown cluster), **decent working conditions** (purple cluster) and **social welfare** (sky-blue cluster).

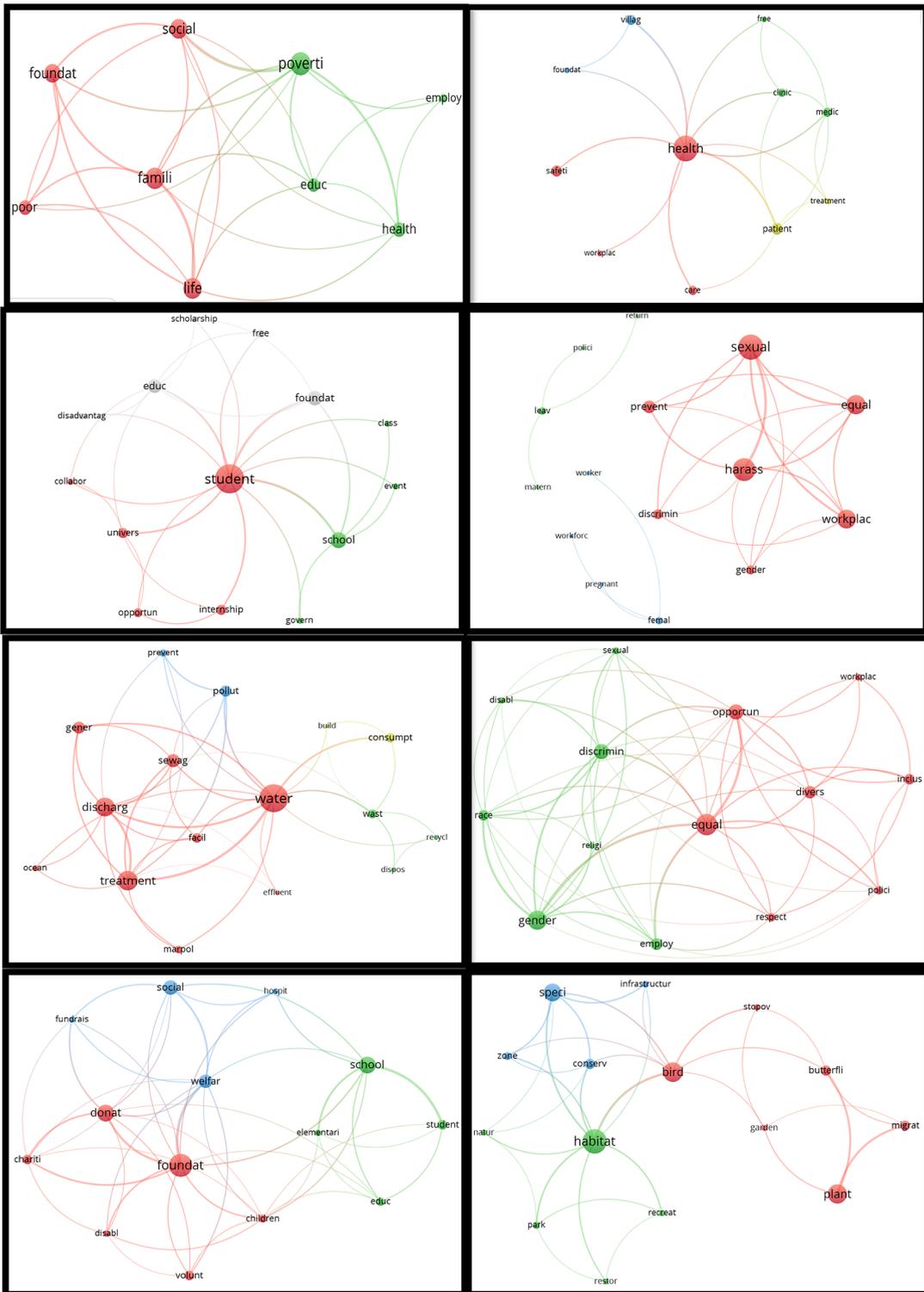


Fig. 4. SDGs that are related to extended responsibility of maritime industry. SDG1-1st row left, SDG3-1st row right, SDG4-2nd row left, SDG 5-2nd row right, SDG6-3rd row left, SDG10-3rd row right, SDG 11-4th row left & SDG15-4th row right.

Table 7
Key quotes related to SDGs 1, 2, 4, 5, 6, 10, 11 and 15.

Key theme	Quote from sustainability report	Source
SDG 1 – end poverty	<i>The organisation works with children and their families to challenge poverty ... Each year, Seaboard Marine employees elect to sponsor a child, providing them with clothes, food</i>	Seaboard Marine (2018)
SDG 3 – good health and well-being	<i>We offer health and wellness incentives that reward colleagues and their spouses financially for things including getting annual physical exams, taking an online wellness evaluation ...</i>	Virginia Port (2018)
SDG 4 – quality education	<i>SPO also sponsors the annual Swire Pacific Offshore Bursary at Nanyang Technological University in perpetuity. This SGD 250,000 bursary supports two students with disabilities ...</i>	Swire (2017)
SDG 5 – gender equality	<i>While the proportion of men has fallen slightly in favour of a limited rise in the number of women employed in industry ... there are still a lot more men than women working in the port of Antwerp ...</i>	Antwerp Port (2018)
SDG 6 – clean water and sanitation	<i>Dry Wash Project completed its second year ... reaching a turnover of about 55%. This enabled them to provide 31,659,615 L of water...</i>	Emirates (2016)
SDG 10 – reduce inequality	<i>We aspire to create an inclusive culture ... we will be in a prime position to attract people from the widest talent pool, specifically increasing the gender and nationality diversity at our senior levels.</i>	Maersk (2019)
SDG 11 – sustainable cities and communities	<i>The Group will ... adopt a more active way to acquire a deeper understanding of community needs, ensure the process of business operation takes into account community interests ...</i>	Sinotrans (2016)
SDG 15 – life on land	<i>In this way ... Antwerp Port Authority and the Left Bank Development Corporation seeks to achieve correct conservation of the protected bird species and habitats</i>	Antwerp Port (2018)

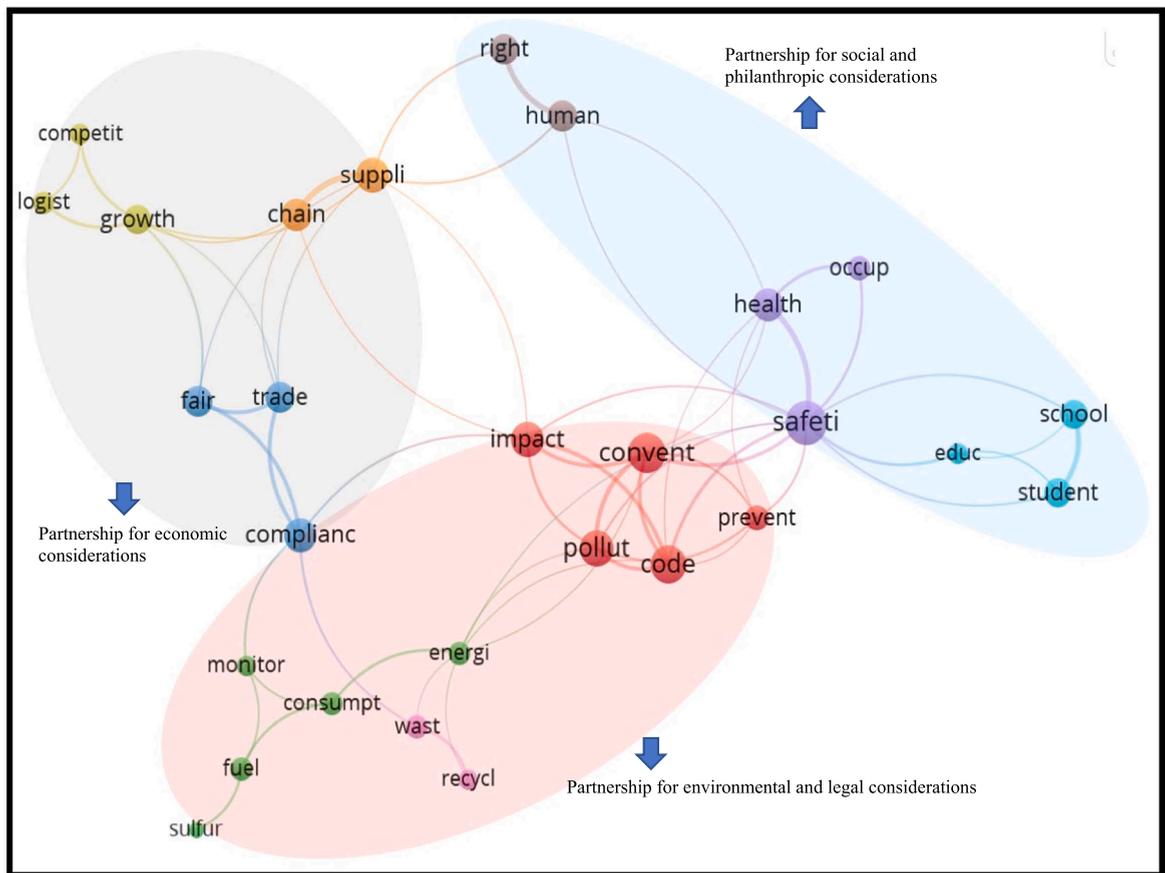


Fig. 5. Clustering analysis of SDG 17 (keywords ‘partner’ and ‘partnership’ are removed for analysis due to high occurrence).

5. Conclusion

By applying the text mining technique, this study conceptualises the relevancy of the 17 SDGs in the context of the maritime industry. The differentiated roles played by the industry concerning sustainability goals are presented, leading to a transitional process of social or sustainable entrepreneurship.

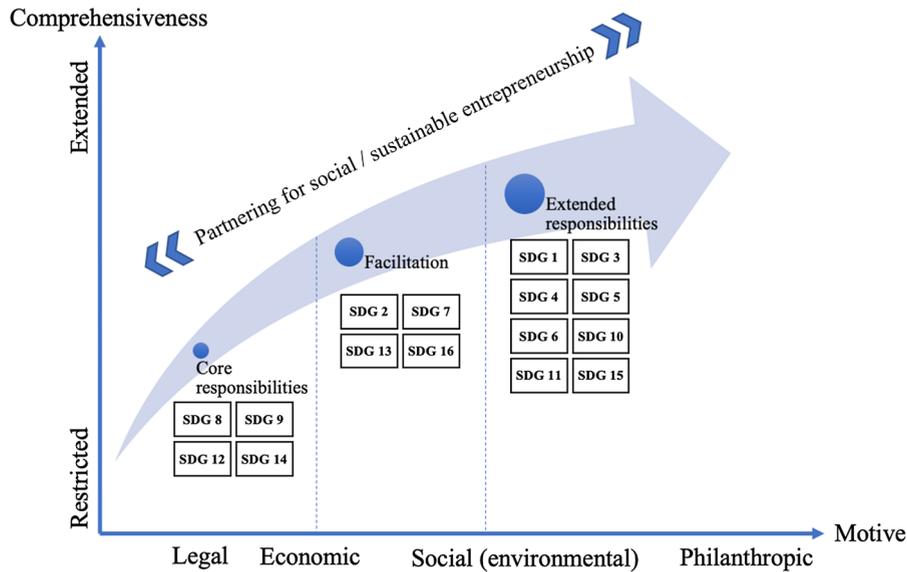


Fig. 6. A unified framework.

5.1. A unified framework and practical implications

Based on the motives and comprehensiveness of sustainability efforts, a unified framework is proposed in Fig. 6, which serves as an assessment framework of the SDG implementation status in the maritime industry. More specifically, it is found that the core responsibilities of the maritime industry lie in the goals concerning provision of safe and healthy working environment (SDG 8), development of green technologies and transport infrastructure (SDG 9), responsible waste management and ship recycling (SDG 12), and proper ballast water management and coastal ecosystem protection (SDG 14). Maritime companies can go one step further to facilitate the achievement of SDGs 2, 7, 13 and 16 by developing secure global food chains, investing in energy efficiency, and promoting anti-corruption practices and human rights. Finally, the industry can fully embrace all SDGs by extending its responsibilities beyond the business agenda. In this regard, companies' sustainability efforts can be put in a wide range of activities that address the needs of their employees, the local communities, and the less fortunate groups in the society, ensuring no one is left behind in pursuing sustainability. Along the process, maritime companies can partner with chain members and leading organisations in seeking for shared values that lead to economic, environmental and social benefits (SDG 17). By doing this, the industry can evolve from behaving out of legal and economic motives to truly weaving social and philanthropic goals into the entrepreneurial endeavours.

This study strongly advocates the relevancy and criticality of SDGs in developing a sustainable maritime industry. By providing detailed illustrations and a unified framework, we pinpoint various priorities, partnership strategies and future directions that the industry may consider for sustainability planning. Thus, we contribute to promote the visibility of the global sustainability initiative within the maritime industry and provide guidance on its implementation, which in turn elevates the sustainability profile of the maritime industry.

5.2. Theoretical contributions

This study makes several theoretical contributions. Firstly, our study integrates the insights of SE into the sustainable development process in the maritime industry. Therefore, we contribute to the maritime literature with an entrepreneurial perspective of SDG implementation. Such a perspective not only points to a series of opportunities for shared value creation but also provides a roadmap of SDG implementation that may guide the sustainable transition of the maritime industry.

Secondly, we synthesise the maritime industry's contributions to all SDGs, which extends the previous literature that restricted to the industry's involvement in SDG 14 or a few SDGs (Kronfeld-Goharani, 2018; Neumann et al., 2017; Ntona and Morgera, 2018). In addition, this study presents a transitional view of sustainability goals by differentiating core responsibilities, facilitator roles and extended responsibilities of the maritime industry. While the prior research focuses heavily on the internal connections among the SDGs (i.e. co-benefits and trade-offs) (Moratis and Melissen, 2019; Singh et al., 2018), we suggest that more attention should be paid to the external context of the industry's sustainable development stage (i.e. the maturity stage of sustainability along the transitional process). Therefore, this study not only broadens the scope of SDGs research by comprehensively establishing the relevancy of 17 SDGs to the maritime industry but also supplies a new transitional perspective of maritime sustainability research as anchored on the SDGs scheme.

Finally, it is worth pointing out that the extant sustainability literature (maritime-related or in general) is often considered segmented, focusing on the different aspects of economic (Darousos et al., 2019), environmental (Di Vaio et al., 2018; Rahim et al.,

2016) and social dimensions (Fasoulis and Kurt, 2019; Yuen and Lim, 2016). In this regard, SDGs which are essentially an all-encompassing sustainability scheme becomes an effective framework that may unify the scattered focuses of sustainability literature. Herein, along with a few pilot attempts (Benamara et al., 2019; Kronfeld-Goharani, 2018), our study represents one of the few works that adopts the SDG scheme to comprehensively examine sustainability issues in the maritime industry. We encourage future researchers to extend our study to the wider service contexts.

Methodology-wise, this study proposes a text processing technique that combines a snowballing-based classification process (manual) with an association-based clustering analysis (automatic). The proposed method is proven to be effective in mining a massive amount of text data and visualising complex patterns hidden within. While this study is conducted under the context of the maritime industry, the method can be well adapted to other contexts, which represents our contribution to methodology.

5.3. Limitations

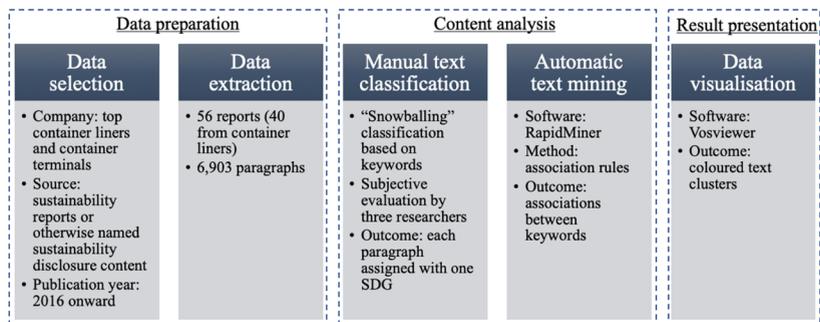
Finally, the findings of our study have to be interpreted considering its limitations. Firstly, the majority amount of text data is from top container liner companies. Although they are the main players of maritime industry, they represent only a single voice from the industry. However, many maritime companies are family-based businesses; hence, not much information is available publicly, let alone their sustainable contributions. Therefore, the predominant focus on liner companies (and to a less extent, on container terminal operators) is a potential limitation of this study. Thus, we encourage future research to identify other appropriate research contexts in the maritime industry where abundant information can be extracted and rich insights can be generated. Secondly, SDG 10 of 'reduce inequality within and among countries' may be subject to different interpretations. In line with most maritime companies, it is interpreted as a prohibition of discrimination against race, religion and culture, which is considered an extended responsibility of the maritime industry. However, the industry may play an essential role in enhancing logistics efficiency and increasing accessibility of less developed countries, which contributes to reducing inequality at the national level. Nonetheless, this aspect is seldom mentioned in the sustainability report. Future studies may further investigate SDG 10 from this direction.

Appendix A. Role of maritime industry in UN's Sustainable Development Goals (SDGs)

No.	SDG	Role of maritime industry in achieving SDGs
1	No poverty	Ensure shipping is safe, secure and clean-creating prosperity and sustainable growth in a green and blue economy
2	Zero hunger	Ensure efficient and economical supply chains for global food distribution; Safeguard a major source of nutrition by tackling illegal, unreported and unregulated fishing
3	Good health and well-being	Contribute to the reduction of shipping-related pollution in oceans, ports and coastal regions
4	Quality education	Safety, security and environmental protection at sea depend on seafarer education and training.
5	Gender quality	Support gender equality and empowers women in the maritime section through a global programme and targeted activities
6	Clean water and sanitation	Minimise dumping and waste disposal at sea, which is a key component of the overall waste-management cycle
7	Affordable and clean energy	Promote funding, research and development of clean energy technology for the maritime sector
8	Decent work and economic growth	Seafaring is an important source of work, especially in developing countries. Issues surrounding seafarers' health and welfare are a central theme of shipping industry.
9	Industry, innovation and infrastructure	More efficient shipping, working in partnership with the port sector, will be a major driver towards global stability and sustainable development for the good of all people
10	Reduced inequalities	Enhance capacity in countries which lack the technical knowledge and resources to operate a safe and efficient shipping industry
11	Sustainable cities and communities	Sustainable cities and communities rely on a secure supply chain. Shipping industry helps to enhance maritime safety and security which protects the global logistics infrastructure
12	Responsible consumption and production	Reduce waste generation, both operational waste from ships and dumping of wastes at sea
13	Climate action	Control emissions from the shipping sector and solutions to minimise shipping's contribution to air pollution and its impact on climate change
14	Life below water	Shipping industry is responsible for global measures to improve the safety and security of international shipping and to prevent pollution from ships
15	Life on land	Shipping industry is responsible for security in ports and is part of global efforts to halt illegal wildlife trafficking
16	Peace, justice and strong institutions	Shipping industry promotes effective institutions to ensure the safe, secure and environmentally protective flow of maritime commerce
17	Partnerships for the goals	IMO currently has partnership arrangements with more than 60 IGOs and more than 70 NGOs, including major global environmental organisations and bodies

Source: Adapted from IMO and the sustainable development goals (<http://www.imo.org/en/MediaCentre/HotTopics/Pages/SustainableDevelopmentGoals.aspx>)

Appendix B. Illustration of research method



Appendix C. Keywords or key terms of each SDG based on frequency count

SGD1	Support	SDG2	Support	SDG3	Support	SDG4	Support
Poverti(y)	0.40	Food + loss	0.50	Health	0.44	Student	0.33
Famili(es)	0.32	Food + product(ion)	0.31	Safeti(y)	0.28	Educ(ation)	0.29
Foundat(ion)	0.24	Food + market	0.31	Emerg	0.16	School	0.20
Life	0.24	Enabl(e) + food	0.25	Medic	0.15	Foundat(ion)	0.16
Poor	0.24	Food + partnership	0.25	Procedur(e)	0.15	Opportun(ity)	0.16
SGD5	Support	SDG6	Support	SDG7	Support	SDG8	Support
Women	0.46	Water + consumpt(ion)	0.21	Fuel	0.30	Safeti(y)	0.26
Femal(e)	0.39	Water + treat(ment)	0.19	Energi + co-	0.26	Health	0.13
Equal	0.33	Water + discharg(e)	0.18	Power	0.24	Cours(e)	0.09
Leav(e)	0.20	Water + pollut(ion)	0.16	Electr(icity)	0.19	Risk	0.08
Harass(ment)	0.19	Wast(e) + water	0.16	Green	0.16	Skill	0.07
SGD9	Support	SDG10	Support	SDG11	Support	SDG12	Support
Fuel + consumpt(ion)	0.06	Equal(ity)	0.36	Foundat	0.18	Wast(e) + recycl(ing)	0.18
Fuel + speed	0.03	Gender	0.36	School	0.15	Wast(e) + dispos(al)	0.11
Termin(al) + infrastructur(e)	0.03	Divers(ity)	0.34	Donat(ion)	0.14	Wast(e) + water	0.08
Technolog(y) + energi	0.03	Discrimin(ation)	0.22	Educ(ation)	0.13	Wast(e) + pollut(ion)	0.07
Suppli(y) + chain	0.03	employ(ment) + opportun(ity)	0.21	Volunt(ary)	0.10	Recycl(ing) + convent(ion)	0.06
SGD13	Support	SDG14	Support	SDG15	Support	SDG16	Support
Climat(e) + chang(e)	0.14	ballast + water + treatment	0.08	Habitat	0.37	Anti + corrupt(ion)	0.15
Carbon + reduct(ion)	0.08	natur(al) + habitat	0.07	Speci(es)	0.29	Human + right	0.11
Energi(y) + consump(ion)	0.08	water + biodivers(ity)	0.06	Bird	0.25	Labour + right	0.05
Reduct(ion) + target	0.06	ballst + water + convent(ion)	0.06	Plant	0.22	Child + labour	0.05
Fuel + fleet	0.06	water + pollut(ion)	0.06	Natur(e)	0.20	Forc(e) + child	0.05

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