Discerning sustainability approaches in shipping

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Abstract

Sustainability should be the ultimate goal of human beings. Over the years, sustainability in shipping has attracted growing attention through the ways of green or sustainable shipping, just like sustainable development and green development being the prominent approaches to sustainability. However, the concepts of green or sustainable shipping, as well as that for green or sustainable development, remain vague. This paper, thus, distinguishes these four seemingly similar but essentially different concepts with respect to their theoretical bases, objectives, and implications through a structured literature review. Many have discussed the concept of sustainable development, while only a few explored that for green development, sustainable shipping, and green shipping. The main difference between sustainable and green development is whether it is anthropocentric: the former emphasizes satisfying the needs of the present and future generations, while the latter is non-anthropocentrism or eco-centrism, focuses on conserving nature health. We argue that green shipping should follow the concept of green development. It is a better approach to reach sustainability than sustainable shipping which follows sustainable development. Lastly, a definition of green shipping is proposed for decision makers' consideration towards sustainability.

Keywords: Sustainability; Sustainable development; Green Development;

Sustainable shipping; Green shipping

1 Introduction

Sustainability should be viewed as a long-term and ultimate goal of human beings (McGrath 2010; United Nations Environment Programme 2011; Adams 2009). However, the reality is not optimistic. According to the international surveys, among 7.5 billion people, most seem to care more about their own, and sometimes,other people's welfare, often defined in terms of living standards.

Having recognized the adverse impacts of the past development on the global ecosystem and the limit on the future economic growth due to the environmental carrying capacity (Jun 1967; Meadows et al. 1972), the Brundtland report advocated the adoption of sustainable development, to balance development with the environment, for long-term sustainability (WECD 1987). It is followed by numerous commitments, strategies, and measures, such as the Rio Declaration 1992 and Agenda 21 (Adam 2009). The Sustainable Development Goals (SDGs), launched by United Nations in 2015, presents an action plan for thriving the planet and society by 2030 (United Nation Conference on Environment and Development 2015), and the 24th Conference of the Parties to the United Nations Framework Convention on Climate Change provided some corresponding efficient solutions for preserving the environment profitably (Solar Impulse Foundation 2018). However, after three decades, we still see global changes, including climate change which threatens the living conditions for human beings (United States Global Change Research Program 2018), and threats of mass extinction of biodiversity and biological annihilation (Piccolo 2017; Ceballos et al. 2017). The withdrawal of the United States from the Paris Agreement further challenges the delivery of the SDGs (Robinson 2017), as does its failure to sign the Convention for Biological Diversity.

As the enabler of global trade, international shipping undoubtedly draws attention to sustainability due to its contribution to global greenhouse gas emissions (Smith et al. 2015) and the air pollution in port areas (Wan et al. 2016). The International Maritime Organization (IMO) is committed to environmental, social and economic sustainability in international shipping (International Chamber of Shipping 2013). Taking the international shipping Greenhouse Gas (GHG) emissions as an example, according to the IMO GHG studies, international shipping CO_2 emissions were estimated to be about 1.8% of global total emissions in 1996 (Skjølsvik 2000), but it reached 2.9% of global total emissions with 921

million tonnes in 2008 (Smith et al. 2015). Until 2012, the international shipping CO_2 emissions still accounted for 2.2% of global total emissions with 796 million tonnes (Smith et al. 2015). The international shipping CO_2 emissions was targeted by IMO to reduce "at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008" (IMO 2018), but the third IMO GHG Study 2014 predicted the CO_2 emissions will grow 50% to 250% by 2050 (Smith et al. 2015). Although the IMO's strategic plan for the period 2018 to 2023 includes the strategic directions of seven SDGs (IMO 2017), and the Initial IMO Strategy on Reduction of GHG Emissions from Ships was adopted in 2018 (IMO 2018), it deserves consideration whether the international shipping GHG emissions reduction target in 2030 and 2050 can be achieved, because barriers, such as the satisfaction of the needs of developing countries (IMO 2018) and the limited IMO power (Sciberras 2018), do exist.

Observing the continued threat of climate changes and the slow reduction of emission from international shipping after having advocated sustainable development for more than 30 years, it is a high time to question whether this approach is effective to achieve sustainability (Shaker 2015; Blewitt 2015). If not, should we consider the other alternatives, such as green development (Stockholm Environment Institute 2002; Adams 2009)? To answer this question, it is essential to clarify and compare the conceptual differences between these two terms. Using the same logic, to achieve sustainability in shipping, achieve the emission reduction objectives in 2030 and 2050, and improve environmental management, a clarification of sustainable shipping and green shipping is also critical. It will not only change peoples' attitudes toward environmental measures in shipping (Psaraftis 2016; Wu et al. 2018) but also direct the researchers to provide effective recommendations and policymakers to set up appropriate laws and regulations to ensure sustainability (Shi et al. 2018; Wu et al. 2019).

Therefore, this paper intends to distinguish between sustainable shipping and green shipping. To do this, the first step is to understand the distinctions between sustainable development and green development. Hence, a structured literature survey is conducted for these four concepts. A comparison of sustainable development and green development is provided based on the existing literature. The current conceptual differences in sustainable shipping and green shipping are also provided. Then, based on the comparative analysis, we propose a concept of green shipping, for the sustainability in the shipping sector.

2 Research methodology and initial results

In this study, a literature review is conducted on definitions of four concepts, namely sustainable development, green development, sustainable shipping, and green shipping. It adopts the approach of structured literature reviews as it is replicable, scientific and rigorous for knowledge exploration than traditional literature review (Massaro et al. 2016). This review includes four steps: data collection, initial search results, refinements of the results, and data analysis (Davarzani et al. 2015; Feng et al. 2017). These four definitions are analyzed and compared through in-depth content analysis (Ahi and Searcy 2013; Seuring and Gold 2012) according to the requirements of sustainability. To enhance the reliability and validity of the content analysis, we collect a great body of data from the Scopus database for its broad coverage, and the "discursive alignment of interpretation" approach (Seuring and Gold 2012) is applied to address ambiguous contents.

2.1 Data collection

In searching for relevant publications, we used four keywords, "sustainable development", "green development", "sustainable shipping", and "green shipping". The defining words such as "define", "defining", and "definition" were added to search criteria to narrow down the search scope. Given vagueness in definitions of green development, sustainable shipping, and green shipping, the keyword "concept" is also used as part of the search criteria. Thus, the combined search formula was created as follows to collect data in the scope of "title, abstract, keywords" in the Scopus database: (1) "sustainable development" AND define OR defining OR definition; (2) "green development" AND define OR defining OR definition OR concept; (3) "sustainable shipping" AND define OR defining OR definition OR concept; (4) "green shipping" AND define OR defining OR definition OR concept. The language was limited to English and Chinese. In addition, data generated from official and enterprise websites by Google search was also included.

2.2 Initial search results and refinements

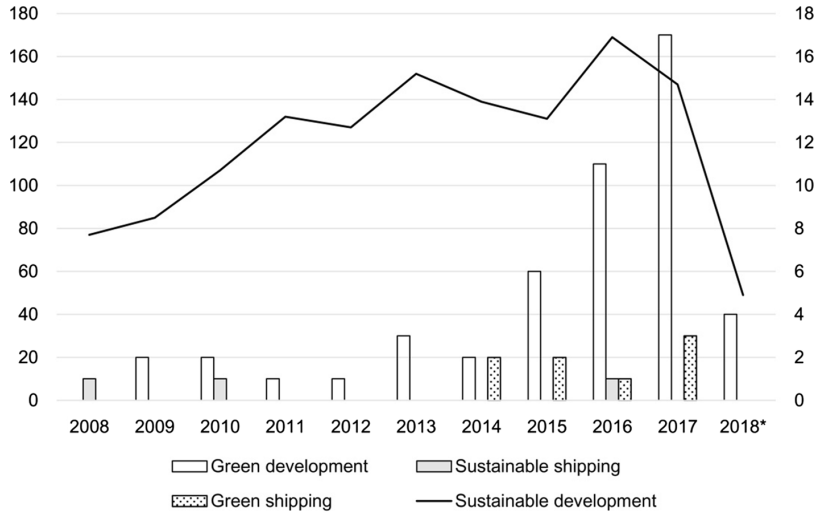
By 9 April 2018, a sum of 6267 publications for sustainable development, 64 for green development, 6 for sustainable shipping, and 12 for green shipping were initially identified from the Scopus searches. After that, the document types of book chapter, editorial, note, short survey, conference review, abstract report, letter, and erratum, and trade publications and book series in the Scopus database were excluded. This reduces the number of publications to 5460 for sustainable development published from 1985 to

2018. Due to the limitation of the export function, we only able to collect the top 2000 publications according to the relevance to the searching criteria. For green development, the number of publications reduced to 54, which are published from 1990 to 2018, 6 for sustainable shipping from 2005 to 2016, and 10 for green shipping from 2005 and 2017. They are all exported to Endnote bibliography software for further refining. In addition, 42 relevant documents from Google search were collected.

The collected publications are further refined by removing the publications with no author or journal names and duplicated. Finally, the number of publications is 1990 for sustainable development, 53 for green development, 4 for sustainable shipping and 9 for green shipping. The collected 42 relevant documents from Google remain unchanged.

2.3 Trend on the number of publications

The time series distributions of publications on sustainable development, green development, sustainable shipping, and green shipping are illustrated in Figure 1. The number of publications on sustainable development (left axis) is dominant in the literature, while that of other three areas (green development, sustainable shipping, and green shipping) are shown in the left axis. Green development started to increase in 2015. There are very few studies focused on the concepts of sustainable shipping and green shipping. The concept of green shipping, however, attracts more attention than sustainable shipping in recent years.



*Note: Data retrieved from the Scopus database up to 9 April 2018.

Figure 1. Distribution on the number of papers in four areas

3 Results and discussion

3.1 Recognition of sustainable development and green development

3.1.1 Sustainable development

The thinking of sustainable development was derived from the environmental concern of development and the conservation of nature (Adams 2009; Grober 2007; Blewitt 2015). Such concern was being taken as a global discourse after the report of Our Common Future in 1987, in which the sustainable development has been defined as "…the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987), and it is still universally used (Blewitt 2015). This definition contains two key concepts, the essential needs of the world's poor and present and future needs (WCED 1987). Thus, the core concept is on human needs.

As a new approach designed to sustain human development, "the satisfaction of human needs and aspirations" becomes its major objective (WCED 1987). To illustrate, the United Nations Conference on Environment and Development produced an agreement of Rio Declaration on Environment and Development in 1992, which proclaims, "Human beings are at the centre of concerns for sustainable development" and "The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations" (United Nations Conference on Environment and Development 1992). In the outcome document of United Nations Conference on Sustainable Development published in 2012 also highlighted that "We recognize that people are at the centre of sustainable development" (United Nations Conference on Sustainable Development 2012). The United Nations launched an agenda, entitled "Transforming our world: the 2030 Agenda for Sustainable Development", at the Sustainable Development Summit in 2015, which stated that "On behalf of the peoples we serve, we have adopted a historic decision on a comprehensive, far-reaching and people-centred set of universal and transformative goals and targets" (United Nation Conference on Environment and Development 2015).

It is noticeable that a human-centered view appears in sustainable development. The core concept is the needs of present and future generations, and "the satisfaction of human needs and aspirations" has been regarded as the main objective to serve human interests.

Many criticisms, however, have been raised from the "green critiques of developmentalism" which include the opposition to industrialization and the resistance of capitalist penetration, "eco-socialism"

which criticizes the environmental and developmental impacts of capitalism, “eco-anarchism” which notes anti-industrial, anti-bureaucratic, and anti-statist, “deep ecology” which rejects the anthropocentrism and recognizes the equal rights of organisms, and “eco-feminism” which realizes the importance of gender in relations between people and non-human nature (Adams 2009). Global environmental and ecological crisis increasingly threatened human security within recent three decades (Hopwood et al. 2005; Bonnett 2017) and the non-human victims of unsustainability (Kopnina 2016) challenge the approach of sustainable development and the implementation of SDGs.

3.1.2 Green development

The term green development has broadly emerged as a result of the environmental movement in the 1970s (Kline 2011). Since then, growing numbers of people all over the world changed from an anthropocentrism to an ecological worldview and recognized that their survival and thrive require them to act as an integral part of an ecosystem (Spretnak et al. 1986). The influence of the environment and the exhaustion of resources in human history were also described to make human rethink the way of development (Ponting 1993). In 1989, a green development movement began to be embarked on by the initiative of “green economy”, which valued and invested in natural capital and offered financial assistance for the new development pathway (Pearce et al. 1989; United Nations Environment Programme 2011; Allen and Clouth 2012). A Ten Point Plan to Save the Earth Summit was sponsored to consider the United Nation Conference on Environment and Development’s lack of green ideas in 1992 (Greenpeace International et al. 1992). Until 1998, in the real estate industry, green development has been defined by three sub-categories: environmental responsiveness, resource efficiency, and community and cultural sensitivity, to carefully consider social and environmental impacts of development, which respects “the intrinsic value of nature, and minimizes damage to an ecosystem” (Rocky Mountain Institute 1998).

Currently, the definition of green development is still in academic discussion. Zhang (2016) proposed that green development is a non-anthropocentric value that emphasizes that human beings are part of nature and all things are equal. Hu (2014) and Wang (2014) considered that the theory of green development came from the concept of “unity of nature and humanity” in ancient Chinese philosophy. Hao (2012) pointed out that green development criticized the anthropocentrism, considered human beings as part of nature, and regarded natural ecosystem as the fundament of human existence and development. Milburn (2014) put conservation, the root of peace, as a platform for green development.

Adams (2009) considered that the heart of greening development has been identified as "an attempt to redirect environmental and developmental change so as to maintain or enhance people's capacity to sustain their livelihoods and to direct their own engagements with nature", and green development is "not about the way the environment is managed, but about who has the power to decide how it is managed" (Adams 2009). Thus, green development possesses a nature-centered or eco-centered view, which regards human beings are part of nature and aims to maintain or enhance people's capacity to sustain their livelihoods by nature conservation.

Tracing back to 1998, the concept of green development has been applied in the real estate industry in 1998. Four years later, the Organization for Economic Co-operation and Development proposed a guidance document, titled "Greening Development: Enhancing Capacity for Environmental Management and Governance", to assist to move to a greener development path (Organisation for Economic Co-operation and Development 2012). Some countries or cities viewed green development as a choice to transform their development (Stockholm Environment Institute 2002; Fu et al. 2018). For instance, the City of Coquitlam would like to practice green development into the city construction by the Coquitlam Green Development Guide (City of Coquitlam's Community Planning Division 2008). China emphasized green transformation (Fu et al. 2018), and policy projects of Green Transition Strategy Outlook 2020-2050 and China's Role in Greening Global Value Chains in 2006 were conducted (China Council for International Cooperation on Environment and Development 2017). The green development was also initiated by the 13th Five-year Plan for Economic and Social Development of the People's Republic of China in 2016 (National Development and Reform Commission of People's Republic of China 2016).

3.1.3 Distinction between sustainable development and green development

There has been a long debate between anthropocentrism and non-anthropocentrism for the development views. However, it is merely an academic matter for "intramural philosophical debate" (McShane 2007). This study would not address the theoretical argument, but seek their attitudes for development instead.

Anthropocentrism, also known as human exceptionalism or human supremacism, can be traced back to 1950s, many great ancient philosophers insisted that "Man is the Measure of all Things" (Kattsoff 1953). The term anthropocentrism contains two concepts (Merriam-Webster Dictionary 1855):

- "considering human beings as the most significant entity of the universe, and

- interpreting or regarding the world in terms of human values and experiences".

Anthropocentrism holds the view that humans are the center of the universe, in essence, everything is human-centered and serves human interests (Yu 1994; Crist et al. 2014). Only humans have intrinsic value (Norton 1987; Cocks and Simpson 2015). The nonhuman world has value only because, and insofar as, it directly or indirectly serves human interests (McShane 2007; Inglis 2008). The intrinsic value of nonhuman species has not been accepted (Norton 1987).

The term Non-anthropocentrism derived from the denial of anthropocentrism (McShane 2007). "The unity of nature and humanity" in ancient Chinese philosophy has been proposed by Zhuangzi in more than two hundred years before Christ (Hu 2014). Many western philosophers criticized the anthropocentrism since the Renaissance (Lei 2012). Anthropocentrism has been generally acknowledged as the root of environmental issues since the 1960s (Leopold and Udall 1966; Jun 1967; Ehrenfeld 1976; Sessions 1987). Humans have learned their lesson about putting themselves first (Lamb 1996). Non-anthropocentrism argues that human beings are part of nature (The Economics of Ecosystems and Biodiversity 2010; Quinn et al. 2016), and acknowledges the intrinsic value of nature or ecosystem, which is "of someone or something in and for itself, irrespective of its utility for someone else" (Cocks and Simpson 2015; The Economics of Ecosystems and Biodiversity 2010). Non-anthropocentric standpoint is nature-centered or eco-centrism as opposed to human-centered (Eckersley 1992; BALTACI et al. 2015; Hoffman and Sandelands 2005; Washington et al. 2017b). The "nature-centered" view, namely nature first, does not see humans as the governors of all things but views all life as equal (Lamb 1996; Inglis 2008). Nonhuman nature has intrinsic value, and the recognition of intrinsic value is a vital aspect of conservation (Batavia and Nelson 2017; Piccolo 2017; Piccolo et al. 2018).

Based on its core concept of human-center, or human first, and meeting human needs (WCED 1987; Lamb 1996), sustainable development has an anthropocentric attitude (Kopnina 2013; Kopnina 2014), in contrast, based on the nature-centered or eco-centered view, green development criticizes the anthropocentrism and recognizes that human is a part of nature (Hao 2012). To be sure, anthropocentrism and non-anthropocentrism have been identified as the theoretical basis of sustainable development and green development, respectively.

In addition, "the satisfaction of human needs and aspirations" has been recognized as the major objective of sustainable development (WCED 1987), while green development puts human as a part of nature and aims to maintain or enhance people's capacity to sustain their livelihoods (Adams 2009) for

its long-term and ultimate goal of development. The objective of sustainable development drives humans to pay more attention to address environmental issues for future generations, but not for nature itself. Green development, however, focuses on nature itself by conserving biodiversity and nature health to maintain natural intrinsic value (Washington et al. 2017a; Batavia and Nelson 2017; Piccolo 2017) towards sustainability.

More specifically, the concept of sustainable development which regards nature as a resource (Lamb 1996), and regards humans are the governors of all things. It values the nonhuman nature because the nature ecosystem serves human interests, and has intentions to meet the present and future generations' needs by human governance (Organisation for Economic Co-operation and Development 2012). Yet green development regards human as a part of nature and views all life as equal, namely "nature first" (Lamb 1996). It acknowledges the intrinsic value of nature which is irrespective of human preferences or valuation (The Economics of Ecosystems and Biodiversity 2010), and targets to maintain the intrinsic value of natural ecosystem for its ultimate goal by nature conservation, where the species are conserved for their own sake, independent of their values for human beings (Batavia and Nelson 2017). For examples, in the case of green real estate, ecological thinking has been integrated to real estate through some ways, such as whole-system thinking, which recognizes that everything is part of the ecosystem, and least-cost concerns by reusing an abandoned building, reducing the size of building, and using less material (Rocky Mountain Institute 1998). Another case is the Coquitlam Green Development Guide, where the site planning including selecting a formerly developed site close to existing supporting uses to protect undeveloped lands, has been recommended for the resource conservation (City of Coquitlam's Community Planning Division 2008). To sum up, Table 1 presents the convergences and divergences of the two concepts.

Table 1 The convergences and divergences in sustainable development and green development

	Sustainable development	Green development
	Both are considered approaches to sustainability	
Theoretical bases	Anthropocentrism	Non-anthropocentrism
Objectives	To meet the present and future generations' needs	To maintain the intrinsic value of natural ecosystem
Implications	• Acknowledging the separation of human and nature; • Viewing humans as the governors of all things, i.e., "humans first"; • Denying the intrinsic value of nonhuman nature; • Targeting to meet human beings' needs, i.e., people-centred; • Through human governance.	• Acknowledging that human beings are part of nature; • Viewing all life as equal, i.e., "nature first"; • Acknowledging the intrinsic value of nonhuman nature; • Targeting to maintain the intrinsic value of the natural ecosystem, i.e., nature-centred; • Through nature conservation.

Sustainability has been expressed as "the perpetuation and enhancement of the living world, man's natural environment, and the natural resources on which all living things depend" (International Union for Conservation of Nature 1970). It means "the ability to be maintained at a certain rate or level to avoid the depletion of natural resources in order to maintain an ecological balance" (Oxford Dictionaries 2017). To achieve sustainability, we must live within the Earth's ecological carrying capacity (Engelman 2013). But the anthropocentrism could not guarantee the maintenance of nonhuman nature or ecosystem due to human preferences (McShane 2007). It has been generally acknowledged as the root of environmental and ecological issues (Leopold and Udall 1966; Jun 1967; Ehrenfeld 1976; Sessions 1987). The human governance would fail to fundamentally conserve and maintain nature because of the limitations on human capacity (Whitman 2005). Besides, the different desires and needs of multi-jurisdictional governments or different people bring about great barriers for the implementation of SDGs, which could be illustrated in the cases of the late agreement of IMO strategy on GHG emissions and the withdrawal of United States from the Paris Agreement. Rees (2010) and Rees (2017) recognized that we need to override the innate human nature and cognition which block the sustainability. Some scholars, especially conservationists, insisted that the nature-centered or eco-centric worldview is the key pathway to reach sustainability (Washington et al. 2017a; Washington et al. 2017b), and we should care the ecological value and intrinsic value of nonhuman nature (Kopnina 2013; Kopnina 2014; Batavia

and Nelson 2017; Sheng et al. 2019). Based on the fact that planet earth and nature is an end-in-itself (Piccolo 2017), and the ethical view that people are part of nature or ecosystem (Batavia and Nelson 2017; The Economics of Ecosystems and Biodiversity 2010; Millennium Ecosystem Assessment 2003), authors tend to acknowledge the non-anthropocentrism or eco-centrism, and take the approach of green development.

3.2 Concepts in current literature on sustainable shipping and green shipping

3.2.1 On sustainable shipping

In the recent decade, many scholars, international organizations, and NGOs have discussed the concept of sustainable shipping (Pike et al. 2011; Breitling and Leader 2010). Cabezas Basurko et al. (2008) defined sustainable shipping or sustainable waterborne transport as a cost-effective commercial activity, where the environmental load does not exceed the limit that the environment can bear, and social community is not being affected negatively. European Commission in 2011 proposed to use Sustainable Waterborne Transport Toolbox to formulate medium and long-term measures for a truly smart, sustainable and more competitive shipping sector that can support economic growth with minimized environmental impacts (European Commission 2011). In the IMO World Maritime Day of 2013, IMO advocated sustainable development from three pillars perspectives, namely economy, society, and environment in the "Sustainable Development: IMO's contribution beyond Rio+20" (IMO 2013). European Maritime Safety Agency defined sustainable shipping as a holistic management concept for sustainable development, applied to the shipping sector, incorporating environmental and social responsibility (European Maritime Safety Agency 2017). Finally, the Sustainable Shipping Initiative, an independent charity organization formed by shipping industry leaders, brought together leading companies to plan a sustainable shipping future with the Case for Action to fit the economic, social, and environmental challenges (Kimmins et al. 2011).

From the literature, the current practice in sustainable shipping usually includes three main pillars: environment, society, and economy, following the requirements of sustainable development. As sustainable development is charged with being human-centric, the concept of sustainable shipping attempts to fulfill the needs of present and future generations (Cabezas Basurko et al. 2008; IMO 2013; Yuen et al. 2017), which is also human-centered. Considering the anthropocentrism fails to explore the essence of sustainability as it was discussed above, sustainable shipping may face similar argument as

334 sustainable development.

335 **3.2.2 On green shipping**

336 Green shipping initiative, formulated in 2004, refers to a collection of proactive efforts to improve
337 environmental management in the shipping industry (Pike et al. 2011). Turtiainen (2005) stated that
338 green shipping should meet tighter environmental regulations while improving fuel efficiency. Feng and
339 Xu (2011) argued that green shipping is not just the balance the economic efficiency and environmental
340 protection in ship operation. More importantly, it should put more emphasis on the coordination
341 between shipping return and environment, so that the long-term welfare of future generations are not
342 sacrificed. Lai et al. (2011) defined "Green Shipping Practices (GSPs)" in handling and distributing
343 cargoes, taking into account such environmental issues as waste reduction and resource conservation in
344 performing shipping activities. Chang and Danao (2017) followed the concept of GSPs and defined the
345 scope with four dimensions, namely "the company's policy and procedure, shipping equipment,
346 shipping materials, and shipping design and compliance". Wan et al. (2016) stated that the future is
347 green shipping, which means efficient marine transport with minimal health and ecological damage.

348 In addition, E.E. Mitropoulos, Secretary-General of IMO in 2011, said that the current focus of
349 green shipping is very much on atmospheric pollution and greenhouse gas emission, but the oil pollution
350 was always the case (Mitropoulos 2011). Research priorities of reduction of greenhouse gases, sulfur
351 oxide, nitrogen oxide and particulate matter, reduction of underwater noise and hazardous substances,
352 combating invasive species, oil spills and post-accident cleaning to green waterborne transport were put
353 forward by European Commission to make European waterborne transport greener (European
354 Commission 2012). Maritime Singapore Green Initiative was taken to reduce the environmental impact
355 of shipping and related activities in Singapore (Maritime and Port Authority of Singapore 2015).

356 From above, it is clear that there is no precise definition of the concept of green shipping. The
357 activities under the umbrella of green shipping are driven by the requirements and improvements of
358 environmental management. Some researchers attempted to define the green shipping following the
359 concept of sustainable development, e.g. Feng and Xu (2011) and also emphasizing the ecological
360 perspective (Wan et al. 2016). Although it is not the objective of this study to judge which one is right,
361 the lack of awareness of green development does exist in the current practice under the tag of green
362 shipping.

3.2.3 Distinction between sustainable shipping and green shipping in literature

Based on the above review and summary, sustainable development contributes very much to the concept of sustainable shipping. The sustainable shipping approach is also reactive and attempts to address the issues from three pillars perspectives by human governance (Walmsley 2012). This definition of sustainable shipping is very similar to the "light green" (Bramall 2012), which is still anthropocentric. Based on the previous distinction between sustainable development and green development, the anthropocentric approach is not a good choice to achieve sustainability. The anthropocentric approach should be abandoned according to Biely et al. (2018), especially for moral beings (Batavia and Nelson 2017).

The current key drivers of green shipping are the requirements and improvements in environmental management. Most researchers are not aware of the differences between green shipping and sustainable shipping, but some researchers recognize that green shipping should reduce ecological impacts. We can see that green shipping combines the anthropocentric and eco-centric perspectives, which may be regarded as being at a greener level (Bramall 2012). The objective of current green shipping tends to satisfy the human needs and tries to preserve the ecology. Nonetheless, it is not "dark green" where eco-centrism is the belief (Bramall 2012). The distinction between green shipping and sustainable shipping can be identified in their different theoretical bases and different objectives.

3.3 Proposed definition of green shipping

Since green development, rather than sustainable development, is a better approach towards sustainability, the concept of green shipping is suggested to follow the concept of green development. Theoretically, it should be non-anthropocentric or eco-centric, i.e. nature-center or nature first, and the objective should be to maintain the intrinsic value of the natural ecosystem from multi-scalar aspects such as fossil fuel (Piccolo et al. 2019). The green shipping view, human beings are an integral part of nature and actively search the ways for nature and ecosystem conservation (Bramall 2012), should be adopted. Thus, green shipping should be integrated into the strategic decision-making process with the view to conserving nature towards sustainability. Following this definition, green shipping approach should be used:

- to set up and implement strategic decision for long-term goal towards sustainability, rather than fragmentized initiatives (Walmsley 2012);

- to emphasize the view of nature-center or nature first to maintain natural ecosystem health, not to meet the human needs and aspirations (Kuhlman and Farrington 2010), and;
- to use the approach of ecosystem intrinsic value to evaluate the objective ecosystem value, not subjective ecosystem service value, for maintaining the intrinsic value of nature (Zhang et al. 2015; Sheng et al. 2019) towards sustainability.

4 Conclusion

Sustainability has been recognized as the long-term and ultimate goal of human beings, and its essence is to sustain the natural ecosystem. For humanity's survival and thrive, the shipping industry has to meet with the requirements of sustainability. Confronted by the threat of climate change and the slow progress of emissions reduction in international shipping, the usual approach to achieve sustainability, that is, sustainable development, faces the challenge. A similar situation exists for sustainable shipping and green shipping.

This paper reviewed the existing publication on the definitions of sustainable development, green development, sustainable shipping, and green shipping, and discussed their similarities and differences. The key differences in sustainable development and green development are embodied in their different theoretical bases, objectives, and implications. The theoretical difference between sustainable development and green development is whether it is centered on the human being. Sustainable development focuses on the needs of the present and future generations, and attempts to meet the needs of human first, while green development focuses on nature itself, to maintain the natural intrinsic value, to sustain ecosystem by conserving nature. Based on the fact that earth is an end in itself and the ethical views that all life is equal, we endorse green development as a better approach towards sustainability.

We also find that sustainable development affects the concepts of sustainable shipping, and passed on to it the anthropocentric perspectives. Concerning such perspective provides no guarantee to the achievement of sustainability, better approaches are needed. In contrast, the analysis showed that current concept of green shipping in the published literature is actually in the middle of the anthropocentric and eco-centric perspectives, but it is not the pure eco-centric view.

Based on the differences in two pairs of concepts, objectives, and implications, we define green shipping as non-anthropocentrism or eco-centrism and its purpose is to conserve nature for the long-term and ultimate goal of sustainability. Future research will explore the subsequent methods and

measures for green shipping, where human beings are part of nature and conserve the natural ecosystem health, and apply them to the case of shipping. The ecosystem intrinsic value assessment on the impacts of shipping activities needs to be conducted. Then, effective measures towards sustainability could be suggested for strategic decision-making and the relative policies setting.

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