ARTICLES FOR FACULTY MEMBERS

MARITIME TOURISM TRANSPORTATION

Title/Author	**A study of experiential quality, experiential value, trust, corporate reputation, experiential satisfaction and behavioral intentions for cruise tourists: The case of Hong Kong / Wu, H. C., Cheng, C. C., & Ai, C. H. (2018).**
Source	***Tourism Management*** **Volume 66 (June 2018) Pages 200–220** **https://doi.org/10.1016/J.TOURMAN.2017.12.011** **(Database: ScienceDirect)**

Title/Author	**An improved spatial subsidy approach for ecological compensation in coastal seascapes for resilient land-sea management / Li, Y., Xiang, Z., Chen, K., & Wang, X.**
Source	***Journal of Environmental Management*** **Volume 276 (Dec 2020) 111305** **https://doi.org/10.1016/J.JENVMAN.2020.111305** **(Database: ScienceDirect)**

Title/Author	**Business sector involvement in maritime spatial planning – Experiences from the Baltic Sea region / Luhtala, H., Erkkilä-Välimäki, A., Eliasen, S. Q., & Tolvanen, H.**
Source	***Marine Policy*** **Volume 123 (Jan 2021) 104301** **https://doi.org/10.1016/J.MARPOL.2020.104301** **(Database: ScienceDirect)**

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Source	***Tourism Management*** **Volume 77 (April 2020) 104016** **https://doi.org/10.1016/J.TOURMAN.2019.104016** **(Database: ScienceDirect)**

Title/Author	**Massive automatic identification system sensor trajectory data-based multi-layer linkage network dynamics of maritime transport along 21st-century maritime silk road / Yu, H., Fang, Z., Lu, F., Murray, A. T., Zhao, Z., Xu, Y., & Yang, X.**
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Title/Author	**The impact of Covid-19 pandemic: A review on maritime sectors in Malaysia / Menhat, M., Mohd Zaideen, I. M., Yusuf, Y., Salleh, N. H. M., Zamri, M. A., & Jeevan, J.**
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Title/Author	**The sustainability of cruise tourism onshore: the impact of crowding on visitors' satisfaction / Sanz-Blas, S., Buzova, D., & Schlesinger, W.**
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A study of experiential quality, experiential value, trust, corporate reputation, experiential satisfaction and behavioral intentions for cruise tourists: The case of Hong Kong

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HIGHLIGHTS

- This study proposed a multi-dimensional and hierarchical model of experiential quality.
- This study identified the relationships among experiential quality, experiential value, experiential satisfaction and behavioral intentions.
- A survey of a total of 677 tourists who experienced the cruise tour was conducted in this study.
- Results helped cruise management to be aware of the importance cruise tourists place on the dimensions of experiential quality.

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ABSTRACT

The purpose of this study is to identify the dimensions of experiential quality and investigate the relationships among experiential quality, experiential value (emotional value and functional value), trust, corporate reputation, experiential satisfaction and behavioral intentions perceived by cruise tourists. A multi-dimensional and hierarchical approach is used to examine the relationships between these higher order constructs. Analysis of data from 677 respondents experiencing the cruise tour organized by Bauhinia indicates that the proposed model fits the data well. The results of this analysis contribute to the services marketing theory by providing empirically–based insight into the experiential quality and experiential satisfaction constructs in the cruise industry. This study will assist cruise management in developing and implementing a market-oriented service strategy to achieve a high quality of experiences, enhance cruise tourists' experiential satisfaction and create their favorable future behavioral intentions.

1. Introduction

Hong Kong is one of the most popular developing cruise destinations in Asia. The cruise ship industry in Hong Kong has become one of the fast growing sectors of the tourism industry and more and more tourists experience the service on a cruise ship (Yan, 2010). The numbers of tourists who either arrived at or departed from Hong Kong grew from 0.7 million in 2005 to over 1.8 million in 2009 and are expected to increase to 2 million in 2020, making Hong Kong the fifth most frequently visited destination in the world (Invest Hong Kong, 2012; Tourism Commission, 2007). According to Yan (2010) and Yi, Day, and Cai (2014), Hong Kong has great potential to develop its cruise ship industry and to be a leading regional cruise hub in Asia. Young people and family groups with lower to middle levels of monthly income (e.g. below HK$19,999) and with higher educational levels of middle school or above are increasingly becoming new markets in Hong Kong. While the cruise ship industry has become a popular topic, only a few studies on the Hong Kong cruise ship industry have been conducted (Yan, 2010; Yi et al., 2014).

The importance of service quality has been stressed in the tourism literature. However, another related and nuanced factor, service experience, has attracted little attention (Chen & Chen, 2010). Service experience can be defined as the subjective personal reactions and feelings of consumers when consuming or

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using a service. Otto and Ritchie (1996) contend that service experience has an important influence on the consumer evaluation of and satisfaction with a given service. Therefore, a better understanding of experiential phenomena in tourism service is particularly important, and will permit the industry to better perform (Chen & Chen, 2010). The cruise tourism industry, like other leisure and tourism activities, has been viewed to a great extent as a consumer's experience (Qu, Wong, & Ping, 1999; Yi et al., 2014). According to Lewis and Chambers (2000), experience, or more specifically experiential consumption, refers to "the total outcome to the customer from the combination of environment, goods, and services purchased" (p. 46). The nature of these experiences is critical for the tourism industry because intangible experience is the core of the products/services offered by businesses (Yuan & Wu, 2008). The study of consumer experiences in the leisure or tourism industry is of both theoretical and practical importance (Bigne, Andreu, & Gnoth, 2005). Therefore, the quality tourists perceive is closely related to experiences during the process of tours rather than services *per se* provided by the cruise ship organization (Chen & Chen, 2010; Yi et al., 2014). Unlike service quality, however, few studies focus on the experiential quality of specific tourism participation such as cruise tours. To increase cruise tourists' favorable behavioral intentions, cruise managers should set their priorities to provide high quality, satisfying experiences that tourists perceive to be of good value (Lee, Petrick, & Crompton, 2007; Yi et al., 2014).

Experiential quality has been considered to be an antecedent of both experiential satisfaction (e.g. Caruana, Money, & Berthon, 2000; Kao, Huang, & Wu, 2008; Wu & Li, 2015, 2017) and experiential value (Baker, Parasuraman, Grewal, & Voss, 2002; Petrick, 2004; Wu, Li, & Li, 2018) and a good predictor of behavioral intentions (Baker & Crompton, 2000; Wu & Li, 2017). Alternatively, perceived quality, satisfaction and corporate reputation have been considered to be direct antecedents of trust, which in turn, result in behavioral intentions (Bennett & Gabriel, 2001; Jin, Park, & Kim, 2008). On the other hand, corporate reputation reduces perceived risk, which has been considered to be particularly high in the tourism decision making process This way, the reputation of a tourism provider exercises a positive influence on satisfaction through perceived quality, because reputation moulds the expectations that the individual forms before the visit, which will then compare with the actual experience (Bigne, Sanchez, & Sanchez, 2001; Chi & Qu, 2008; Selnes, 1993). Researchers in marketing have long debated the definition of behavioral intentions, but there is consensus regarding the strong effect of corporate reputation on behavioral intentions (Selnes, 1993). Experiential satisfaction is a construct that mediates the effect of experiential quality perceptions on behavioral intentions and other outcomes such as trust and corporate reputation (e.g. Brady & Robertson, 2001; Choi, Lee, Kim, & Lee, 2005; Kao et al., 2008). However, few studies examine experiential quality for the cruise ship industry, including diverse psychological and physical aspects, and the simultaneous links among experiential quality, experiential value, trust, corporate reputation, experiential satisfaction and behavioral intentions (e.g. Brida, Garrido, & Devesa, 2012; Loureiro & González, 2008; Petrick, 2004; Wu & Li, 2017; Wu et al., 2018; Yi et al., 2014).

Several researchers (Parasuraman, Zeithaml, & Berry, 1985; Reichheld & Sasser, 1990; Zeithaml, Berry, & Parasuraman, 1996) identify that providing quality has been considered to be an essential strategy for success and survival in today's competitive environment. In this situation, the primary emphasis of both theoretical and managerial efforts has been on determining what dimensions of quality customers are concerned about and developing strategies to satisfy their expectations. The primary and sub dimensions of quality perceived by customers have been applied in different industries, using multi-dimensional and hierarchical modeling as a robust and testable framework (e.g. Brady & Cronin, 2001; Clemes, Brush, & Collins, 2011a; Clemes, Cohen, & Wang, 2013; Clemes, Gan, & Ren, 2011b; Clemes, Shu, & Gan, 2014; Dabholkar, Thorpe, & Rentz, 1996; Hossain, Dwivedi, & Naseem, 2015). However, several researchers (e.g. Kao et al., 2008; Wu & Ko, 2013; Wu, 2013, 2014; Wu, Cheng, & Hsu, 2014a; Wu, Wong, & Cheng, 2014b; Wu et al., 2018) argue that few studies focus on identifying the primary and sub dimensions of experiential quality using a multi-dimensional and hierarchical model for cruise tourists. In addition, little research focuses on identifying the least and most important dimensions of experiential quality perceived by cruise tourists (Yi et al., 2014).

In this study, there are three research objectives. First, the dimensions of experiential quality perceived by cruise tourists using a multi-dimensional and hierarchical framework are identified. Second, the study examines the relationships between the behavioral intentions of tourists and the other higher order constructs: experiential quality, experiential value, trust, corporate reputation and experiential satisfaction as perceived by cruise tourists. Third, the least and most important dimensions of experiential quality as perceived by cruise tourists are identified.

The contribution of this study is twofold. First, it contributes to the marketing literature by providing an examination of several services marketing constructs. This is an important contribution because it provides a better understanding of cruise tourists' perceptions of experiential quality, experiential value, trust, corporate reputation, experiential satisfaction and behavioral intentions. Second, the study conceptualizes and measures the cruise tourist's perception of experiential quality using a multi-dimensional and hierarchical approach. This approach helps to overcome some of the weaknesses of traditional SERVQUAL (a disconfirmation-based measure of service quality) and SERVPERF (a performance-based measure of service quality) and thus provides a more accurate approach to assessing cruise tourists' perceptions of experiential quality.

2. Literature review

2.1. Service quality

Kotler and Keller (2009) define service quality as "any intangible act or performance that one party offers to another that does not result in the ownership of anything" (p. 789). Service quality in the management and marketing literature is the extent to which customers' perceptions of service satisfy and/or exceed their expectations, for example, as defined by Zeithaml, Berry, and Parasuraman (1990). Therefore, service quality can be intended to be the way in which customers are served in a good or poor organization (Agbor, 2011).

SERVQUAL is designed to measure service quality as perceived by the customer (Asubonteng, McCleary, & Swan, 1996). The SERVQUAL scale represents service quality as the discrepancy between a customer's expectation of a service offered and their perception of the service received (Parasuraman et al., 1985). The SERVQUAL scale consisted of 10 dimensions of service quality when created; tangibles, reliability, responsiveness, communication, credibility, security, competence, courtesy, understanding the customer and access. Later, Parasuraman, Zeithaml, and Berry (1988) reduced the original 10 dimensions to five (tangibles, reliability, responsiveness, assurance and empathy), resulting in the widely used instrument known as SERVQUAL. However, Cronin and Taylor (1992, 1994) consider SERVQUAL as 'unidimensionable' because they do not identify the scale structure.

Cronin and Taylor (1992) propose SERVPERF, which is a more

concise performance-based scale; an alternative to the SERVQUAL scale. Numerous researchers have supported the view that SERVPERF is a better alternative to SERVQUAL (Brady, Cronin, & Brand, 2002; Brown, Churchill, & Peter, 1993; Cronin & Taylor, 1992). However, Nadiri and Hussain (2005) failed to confirm the five dimensions of the SERVPERF scale. In terms of the evaluation of the validity and reliability of SERVPERF, it is not an effective measurement scale (Robledo, 2001).

2.2. Experiential quality

The SERVQUAL and SERVPERF scales have been widely applied in the tourism literature (Bhat, 2012; Fick & Ritchie, 1991; Hudson, Hudson, & Miller, 2004). However, both of the scales cannot adequately address both the affective and holistic factors which contribute to the overall quality of 'service experience'. In Otto and Ritchie's (1996) study, the differences between service quality and experiential quality have been discussed. For example, service quality is objective in terms of measurement while experiential quality is subjective. The evaluation of experiential quality tends to be holistic/gestalt rather than attribute-based, and the focus of evaluation is on self (internal) but not on service environment (external). Also, the scope of experience is more general than specific, the nature of the benefit is experiential/hedonic/symbolic rather than functional/utilitarian, and the psychological representation is affective instead of cognitive/attitudinal. Chan and Baum (2007) demonstrate that the concept of experiential quality encompasses tourists' affective responses to their desired psychological advantages from a visiting experience. In a tourism context, service quality refers to service performance at the attribute level while experiential quality refers to the psychological outcome resulting from the tourist participation in tourism activities (e.g. Chen & Chen, 2010; Crompton & Love, 1995; MacKay & Crompton, 1988). The former has been defined as the quality of the attributes of a service which are under the control of a supplier, while the latter involves not only the attributes provided by a supplier, but also the attributes brought to the opportunity by the tourist (Chen & Chen, 2010; MacKay & Crompton, 1988). In this study, experiential quality is used to replace service quality in the relationships between experiential value, trust, experiential satisfaction and behavioral intentions.

Previous studies (Bryan, 1977; Fedler & Ditton, 1986; Wu & Li, 2017) have indicated that individuals have a range of views about what constitutes experiential quality. Otto and Ritchie (1996) develop an experiential quality scale with four factors, namely, hedonics, peace of mind, involvement and recognition. Kao et al. (2008) describe that immersion, surprise, participation and fun have been considered to be four essential experiential qualities for theme parks. Lemke, Clark, and Wilson (2011) show that the measurement of experiential quality should be made based on the hedonism of the product category, involvement, product complexity and relationality. Pareigis, Edvardsson, and Enquist (2011) argue that experiential quality is made up of customer processes, other customers, physical environment, contact personnel, provider processes and the wider environment. Jin, Lee, and Lee (2015) maintain that experiential quality comprises immersion, surprise, participation and fun. de Rojas and Camarero (2008) propose that experiential quality comprises interaction quality, physical environment quality and outcome quality. Wu and Li (2017) and Wu et al. (2018) claim that perceived experiential quality consists of interaction quality, physical environment quality, outcome quality and access quality. Therefore, several studies (e.g. Jin et al., 2015; Kao et al., 2008; Wu & Li, 2017; de Rojas & Camarero, 2008) determine that experiential quality should be measured using a multi-dimensional and hierarchical model in order to appropriately measure the cruise tourists' perceptions of experiential quality.

2.3. Experiential value

Mathwick, Malhotra, and Rigdon (2001) define experiential value as customers' perceptions of products or services through direct use or indirect observation. In contrast, Holbrook (1999) defines customer value as an "interactive relativistic preference experience" (p. 212), which emphasizes the transaction between products and users from which value is derived. Customers can receive experiential value from different kinds of experiences. Compared with customer value, experiential value focuses on the value that customers retain from these experiences. There are many similarities between customer value and experiential value; however, the research on experiential value remains scarce (Yuan & Wu, 2008). According to Yuan and Wu (2008), most researchers have agreed that emotional and functional features are the main components of customer value. Therefore, the measurement of experiential value in this study is made up of these two concepts.

Functional value is defined as tourists' cognitive trade-off between the costs and benefits (Choi, Kim, Lee, & Hickerson, 2015). In terms of functional value, the perception of utilitarian benefits compared to the investment in them, plays an important role in the evaluation of health and medical products and services, which often require high costs (Goodrich & Goodrich, 1987). In contrast, emotional value is referred to as the feeling or emotional reaction that customers gain during and after experiencing (Berry, Carbone, & Haeckel, 2002). Alternatively, emotional value is derived from the feelings and emotions that the product or service generates in the consumer and the social value increases the social self-concept derived from the product (Choi & Kim, 2013).

Experiential value has been argued to be more individualistic than satisfaction and quality (Oh, 2000) and involves the benefits received for the price paid (Zeithaml, 1988). Furthermore, quality and perceived value are cognitive responses to a service experience, while satisfaction is an affective response (Baker & Crompton, 2000; Cronin, Brady, & Hult, 2000). However, experiential value resulting from quality and its effect on satisfaction is rarely addressed in the cruise ship industry (Petrick, 2004; Wu & Li, 2017; Wu & Liang, 2009; Wu et al., 2018).

2.4. Trust

Rousseau, Sitkin, Burt, and Camerer (1998) define trust as "a psychological state composing the intention to accept vulnerability based on expectations of the intentions or behavior of another" (p. 395). According to Ravald and Grönroos (1996), trust is an aggregate evaluation at some higher level than satisfaction, and that satisfaction in fact is an important source of trust. In essence, trust captures the belief that the seller will stand by their word (Anderson & Narus, 1990) and fulfill promised role obligations (Dwyer, Schurr, & Oh., 1987). Long-term relationships are fostered because trust reduces uncertainty and the likelihood of opportunistic behavior (Hausman, 2001).

Among both researchers and practising managers there is a longstanding recognition that a high level of quality is a necessary condition for strong business-to-business relationships (Crosby, Evans, & Cowles, 1990) and in particular for trust to develop between relational partners (Moorman, Zaltman, & Deshpandé, 1992). In general, satisfaction is a manifestation of the other party's ability to satisfy relational norms, and thereby manifest trust (Ring & Van de Ven, 1994). Anderson and Srinivasan (2003) identify that trust seems especially important for creating behavioral intentions when the perceived level of risk is high. Although trust,

quality, satisfaction and behavioral intentions have been found to be four of the key concepts in services marketing, little effort has been devoted to explaining the relationships between trust, quality, satisfaction and behavioral intentions in the cruise ship industry.

2.5. Corporate reputation

Petrick (2011) argues that corporate reputation is an important concept in the cruise ship industry. Iwu-Egwuonwu (2011) defines corporate reputation as "the objective representation of multiple constituencies' images of an organization, built up over time and based on an organization's identity programs, its performance and how constituencies have perceived its behavior" (p. 199). As confidence is an important factor in the creation of relational trust (Morgan & Hunt, 1994), a high corporate reputation can strengthen customers' confidence and reduce risk perceptions when they make judgments on organizational performance and the quality of products or services. Therefore, customers are more likely to perceive organizations with highly favorable reputations as trustworthy (Keh & Xie, 2009). According to Rogerson (1983), a good corporate reputation, combined with high quality, should ensure the long-term success of service providers, since fewer customers will stop using these service providers and more will arrive because of word-of-mouth. Corporate reputation has been further argued to be one of the most important indicators for service providers to measure as it has been found to be a better predictor of customers' behavioral intentions than satisfaction or quality (Selnes, 1993). Service providers with better reputations are perceived to have more value (Devlin, 2001) and better satisfy their customers (Selnes, 1993), and customers with better perceptions of reputation are more likely to have favorable behavioral intentions (Rogerson, 1983).

2.6. Experiential satisfaction

Previous literature regarding satisfaction often focuses on satisfaction with products or services. Satisfaction is an evaluation rendered that the product or service experience is at least as good as it is supposed to be (Hunt, 1977). Tourists' satisfaction is related to the extent to which general tourism needs and condition-specific needs are satisfied (Dmitrovic et al., 2009). Satisfaction with a specific transaction is the immediate evaluation after purchase or the positive feeling towards recent transaction experiences (Oliver, 1993). Storbacka, Standvik, and Grönroos (1994) indicate that individuals use their personal experiences to form cognitive and effective evaluation of the service relationship and thus form the degree of satisfaction. Anderson, Fornell, and Lehmann (1994) propose that satisfaction has been considered to be the overall evaluation of the purchased products or services based on previous experiences. Mano and Oliver (1993) demonstrate that product-elicited affect is highly correlated with satisfaction in the post-consumption experience.

The experiential satisfaction construct discussed in this study is extended from the concept of service satisfaction, which explores service satisfaction and tourists' affects in specific situations (Kao, Huang, & Yang, 2007). In this study, experiential satisfaction is defined as a tourist's overall satisfaction with the experience while taking a cruise ship, as proposed by Chen and Chen (2010) and Petrick (2004). Experiential satisfaction is conceived of on the basis of the concept of service satisfaction, although it extends beyond service satisfaction in that it focuses on tourists' overall evaluations of their experiences after consumption. Therefore, from an experiential perspective, experiential satisfaction reflects the satisfaction experienced from the service content associated with a specific transaction (Kao et al., 2008). Tourists compare their experiences with prior expectations, which cause positive or negative disconfirmation (Kao et al., 2008). The emotional responses resulting from such positive or negative disconfirmation form the basis for tourist satisfaction or dissatisfaction (Bigne et al., 2005). For example, a tourist whose experience falls below his/her prior expectation will be dissatisfied. In contrast, tourists whose experiences are consistent with or higher than their prior expectations will be satisfied (Chen & Chen, 2010; Dobrota, Nikodijevic, & Mihailovic, 2012). Accordingly, experiential satisfaction is conceptualized as an experiential perspective and defined as the result of tourists' overall evaluation of the contents presented by service providers. Assuming that quality and satisfaction are distinct constructs, there seems to be no clear messages in the literature on the causal ordering of quality and satisfaction, and on which of the two constructs is a better predictor of behavioral intentions (Bolton & Drew, 1991; Cronin & Taylor, 1992). Several researchers (Brady & Robertson, 2001; Wu & Cheng, 2017a, 2017b; Wu & Li, 2017) argue that experiential quality is an antecedent of experiential satisfaction. Since experiential quality is a cognitive evaluation, a positive experiential quality perception results in experiential satisfaction, which may in turn lead to favorable behavioral intentions. However, the relationships between experiential satisfaction, experiential quality and behavioral intentions still remain scarce in the cruise ship industry.

2.7. Behavioral intentions

Intended behavior is closely related to actual behavior and has diagnostic value (Lien, Wen, & Wu, 2011). Therefore, behavioral intentions are important indicators for management to understand whether customers will remain with or defect from the organization (Parasuraman, Zeithaml, & Berry, 1996). Jaccard and King (1977) define behavioral intentions as a perceived notion between oneself and some action. Behavioral intentions represent the repurchase intentions, word-of-mouth, loyalty complaining behavior and price sensitivity (Zeithaml et al., 1996). Zeithaml et al. (1996) compile a list of specific favorable behavioral intentions, including loyalty, switching intentions, willingness to pay more, external response and internal response. In contrast, unfavorable behavioral intentions include customer complaints and a multi-faceted concept, which include voice responses, private responses and third-party responses. More recent research works in the literature on behavioral intentions have focused on the characteristics of tourism in relation to other services (Chi & Qu, 2008). Further research is required to examine variables other than satisfaction to improve the understanding of behavioral intentions (Meng, Liang, & Yang, 2011). In this line, there are some studies analyzing the contribution of such variables as trust, satisfaction and other moderator determinants which can complete the nature of this construct of behavioral intentions in a tourism context (Osman & Sentosa, 2013; Ryu, Han, & Kim, 2008).

3. Research model and hypothesis development

The multi-dimensional and hierarchical model used in this study to synthesize behavioral intentions in the cruise ship industry is based on Wu and Li's (2017) and Wu et al.'s (2018) multi-dimensional experiential quality model (experiential quality, primary dimensions and sub-dimensions) and Clemes, Gan and Kao's (2008) behavioral intentions hierarchical model. Several studies (Wu & Ai, 2016a, 2016c; Wu, Ai, & Cheng, 2016; Wu, Ai, Yang, & Li, 2015; Wu, Cheng, & Ai, 2017a, 2017b; Wu et al., 2018; Wu & Li, 2017; Wu, Li, & Li, 2016; Wu & Wu, 2017) conceptualize experiential quality as a multi-dimensional construct (primary and sub-dimensions); however, the researchers include experiential value,

trust, corporate reputation, experiential satisfaction and behavioral intentions as higher order constructs in their multilevel model. This approach provides a more complete theoretical framework for examining the relationships between experiential quality and the higher order constructs.

To form an overall perceived experiential quality, the multidimensional and hierarchical model reflects the proposition that cruise tourists form their perceptions of each of four primary dimensions: interaction quality, physical environment quality, outcome quality and access quality. In the conceptual research model, a cruise tourist's perception of experiential quality influences experiential value (emotional value and functional value) and trust. In addition, experiential satisfaction is influenced by experiential quality, experiential value and trust. Moreover, experiential quality influences trust. Furthermore, corporate reputation has an influence on experiential quality, trust and experiential satisfaction, respectively. Finally, trust, corporate reputation and experiential satisfaction influence behavioral intentions.

Cronin and Taylor (1994) suggest that the experiential quality dimensions need to be confirmed for each research setting. There are several potential sub-dimensions that can influence cruise tourists' perceptions of the primary dimensions: interaction quality, physical environment quality, outcome quality and access quality. The proposed sub-dimensions of experiential quality in the conceptual research model have been identified by an extensive review of the tourism literature and using the results obtained in focus group interviews.

In this study, interaction quality is the first dimension of experiential quality. This dimension focuses on how the quality is delivered (Brady & Cronin, 2001; Grönroos, 1984). The literature identifies four sub-dimensions of interaction quality: (a) attitude (Clemes, Wu, Hu, & Gan, 2009); (b) behavior (Clemes et al., 2009), (c) expertise (Wu, Lin, & Hsu, 2011); and (d) problem-solving (Wu et al., 2011). These sub-dimensions are assumed to have a positive influence on interaction quality. Therefore, the first hypothesis is proposed:

H1. Attitude, behavior, expertise and problem-solving positively influence interaction quality.

The second dimension of experiential quality in this study is called physical environment quality. This dimension focuses on a constructed facility in which quality delivery occurs, as opposed to the natural or social environment dimension (Bitner, 1992). The literature and focus group interviews identify nine sub-dimensions of physical environment quality: (a) entertainment (focus group sessions); (b) ambience (Wu, 2014); (c) facility (Wu & Li, 2017); (d) food & beverage (Yi et al., 2014); (e) safety & security (Clemes et al., 2009); (f) design (Wu & Ko, 2013); (g) decor (Clemes et al., 2009); (h) souvenir (focus group sessions); and (i) comfort (Wu & Cheng, 2013). These sub-dimensions are assumed to have a positive influence on physical environment quality. Therefore, the second hypothesis is proposed:

H2. Entertainment, ambience, facility, food & beverage, safety & security, design, décor, souvenir and comfort positively influence physical environment quality.

The third dimension of experiential quality is called outcome quality. This dimension focuses on the outcome of the quality act, revealing what customers receive from quality; namely, whether this outcome satisfies the customer's needs and wants (McDougall & Levesque, 1994; Rust & Oliver, 1994). The literature identifies three sub-dimensions of outcome quality: (a) social factors (Wu & Li, 2017); (b) waiting time (Clemes et al., 2009); and (c) valence (Wu & Cheng, 2013). These sub-dimensions are postulated to have a positive influence on outcome quality. Therefore, the third hypothesis is proposed:

H3. Social factors, waiting time and valence positively influence outcome quality.

The fourth dimension of experiential quality, access quality, is referred to as the ease and speed with which tourists can reach their desired location (Shonk & Chelladurai, 2008). Three sub-dimensions made up of access quality have been identified in the literature: (a) convenience (Wu & Cheng, 2013); (b) information (Jones, 2011); and (c) destination (Shonk & Chelladurai, 2008). These sub-dimensions are postulated to have a positive influence on access quality. Therefore, the fourth hypothesis is proposed:

H4. Convenience, information and destination positively influence access quality.

Several researchers (e.g. Brady & Cronin, 2001; Mohi, Wu, & Wong, 2013; Wu & Li, 2017; de Rojas & Camarero, 2008) indicate that overall perceived experiential quality is influenced by four primary dimensions: interaction quality, physical environment quality, outcome quality and access quality. The following four hypotheses have been formulated to examine the effects of the primary dimensions on overall experiential quality as perceived by cruise tourists.

H5. Interaction quality has a positive effect on overall experiential quality.

H6. Physical environment quality has a positive impact on overall experiential quality.

H7. Outcome quality has a positive impact on overall experiential quality.

H8. Access quality has a positive impact on overall experiential quality.

Petrick (2004) and Yuan and Wu (2008) suggest that quality positively affects value. In other words, different quality results in different evaluations (e.g. Andreassen & Lindestad, 1998; Cronin et al., 2000; Fornell, Johnson, Anderson, Cha, & Bryant, 1996). Experiential quality has been considered to be an important factor in influencing the value tourists place on their experiences (Brand, Cronin, & Routledge, 1997; Gooding, 1995; Sweeney, Soutar, & Johnson, 1997). Wu et al. (2018) propose that experiential quality influences experiential value (emotional value and functional value). Therefore, two hypotheses are proposed to test the relationship between experiential quality and experiential value.

H9. Experiential quality positively influences emotional value.

H10. Experiential quality positively influences functional value.

The service management literature argues that satisfaction is the result of perceived value received in a transaction or relationship (Heskett, Sasser, & Schlesinger, 1997). The social science literature indicates that cognitive thought processes trigger affective responses (Weiner, 1986), suggesting that value judgments influence perceived satisfaction. The inclusion of price in a customer's evaluations of service results in a cognitive judgment of perceived value which may have a significant influence on satisfaction (Tarn, 1999). Chen and Chen (2010) and Wu and Li (2017) assert that perceived value has a positive influence on overall satisfaction. Several studies (Lee, Lee, & Choi, 2011; Wu & Li, 2017; Wu et al., 2014a) find that value is considered to be an antecedent of satisfaction in the tourism industry. Wu et al. (2018) argue that experiential satisfaction results from experiential value (emotional value and functional value). Accordingly, two hypotheses are

proposed to test the relationship between experiential value and experiential satisfaction.

H11. Emotional value positively influences experiential satisfaction.

H12. Functional value positively influences experiential satisfaction.

There has been a convergence of opinion that favorable perceived quality results in improved satisfaction (Cronin et al., 2000). Customers' evaluation of quality represents another important factor in their satisfaction (Anderson et al., 1994). There has been a convergence of opinion that favorable quality perceptions result in improved satisfaction (Cronin et al., 2000). According to Kao et al. (2008) and Wu and Li (2017), experiential quality is to be a predictor of experiential satisfaction. Therefore, the following hypothesis is proposed:

H13. Experiential quality positively influences experiential satisfaction.

A great deal of research has indicated that perceived quality positively affects trust (Chenet, Dagger, & Sullivan, 2010; Gounaris & Venetis, 2002). Kantsperger and Kunz (2010) argue that satisfaction is the main antecedent of trust. Alternatively,Yeh and Li (2009) find that satisfaction has a strong impact on trust. Given the intangible nature of service and the fact that it is consumed at the moment of purchase, it can be argued that a high level of trust in the product and/or supplier is required to encourage purchase (Loureiro & González, 2008). Therefore, the following three hypotheses are proposed:

H14. Experiential quality positively influences trust.

H15. Experiential satisfaction positively influences trust.

H16. Trust positively influences behavioral intentions.

Reputation is one of the primary contributors to the perceived quality of products carrying a brand name, with customers expecting consistent quality provision over time (Milewicz & Herbig, 1994). Corporate reputation has been suggested frequently as a factor that contributes to consumer trust (Jin et al., 2008). Helm, Eggert, and Garnefeld (2010) analyze the relationship between corporate reputation and satisfaction and declare corporate reputation to be an antecedent of satisfaction. Organizations with a good reputation are likely to attract more customers, while they will lose their positive reputation—and eventually develop a negative reputation—if they repeatedly fail to fulfill their stated intentions or marketing signals (Milewicz & Herbig, 1994). Therefore, the following four hypotheses are proposed:

H17. Corporate reputation positively influences experiential quality.

H18. Corporate reputation positively influences trust.

H19. Corporate reputation positively influences experiential satisfaction.

H20. Corporate reputation positively influences behavioral intentions.

Several studies (Anderson & Sullivan, 1993; Bitner, 1990; Reichheld, 1996) demonstrate that evidence for the significant impact of satisfaction on behavioral intentions derives from a wide variety of service industries. Satisfied customers tend to give positive referrals or word-of-mouth communication (Boulding, Kalra, Staelin, & Zeithaml, 1993; Chang, Wang, & Yang, 2009; Parasuraman et al., 1996). Wu and Li (2017) claim that experiential satisfaction is an antecedent of behavioral intentions. Accordingly, the following hypothesis is proposed:

H21. Experiential satisfaction positively influences behavioral intentions.

Several researchers (Jin et al., 2015; Kao et al., 2008; Wu & Li, 2017) express the view that cruise tourists perceive that the dimensions of experiential quality are not equally important, and that some dimensions of experiential quality are more or less important than others. The following hypothesis is designed to measure the comparative importance of the dimensions of experiential quality:

H22. Cruise tourists' perceptions of (a) each of the primary dimensions and (b) each of the sub-dimensions differ in their importance.

The multi-dimensional and hierarchical model of experiential quality presented in Fig. 1 summarizes the hypotheses formulated to test each path in the research model.

4. Research design and methodology

4.1. Questionnaire development

This study involved a two-stage design, consisting of focus group interviews and self-administered questionnaires. The first stage consisted of focus group interviews to gain in-depth insights into the tourists' overall cruising experiences in Hong Kong. Krueger (1998) argues that a focus group study is frequently used to design a questionnaire for a quantitative survey. The sub-dimensions pertaining to the four primary dimensions have been identified in the literature review. However, not all of the sub-dimensions can be fully identified. To further identify more sub-dimensions, three focus group interviews were conducted, as suggested by Edmunds (1999). Each group comprised six tourists who were required to have recently experienced a cruise tour in Hong Kong. The participants in the focus groups were recruited using a convenience sample drawn from the Hong Kong population. The focus group participants were males and females of mixed age who represented several occupations, and had varying incomes. Before the focus group interviews were conducted, the researchers telephoned people to confirm whether they were aged 18 or over to ensure that each group member was mature enough to understand the content of the interview questions. During the interviews, the participants were encouraged to list all factors that influenced their perceptions of experiential quality according to their recent cruising experiences in Hong Kong. To develop a self-administered questionnaire, the participants were required to describe the factors they believed were necessary for experiential quality on a cruise ship in Hong Kong after the focus group interviews were conducted. After the focus group interviews were completed, the researchers identified two sub-dimensions of physical environment quality (environment and souvenir) that were not identified in the literature review (see the physical environment quality section). The factors identified in the focus groups were combined with a review of the relevant literature to identify variables, assist in item generation, and recommend the dimensionality of experiential quality on a cruise ship. This process resulted in an initial pool of 62 items of experiential quality.

The second stage consisted of self-administered questionnaires to verify the dimensions of experiential quality for the cruise ship industry in Hong Kong (based on the findings of stage one), the variation of experiential quality perceptions over time and the antecedents and consequences of experiential quality for the cruise

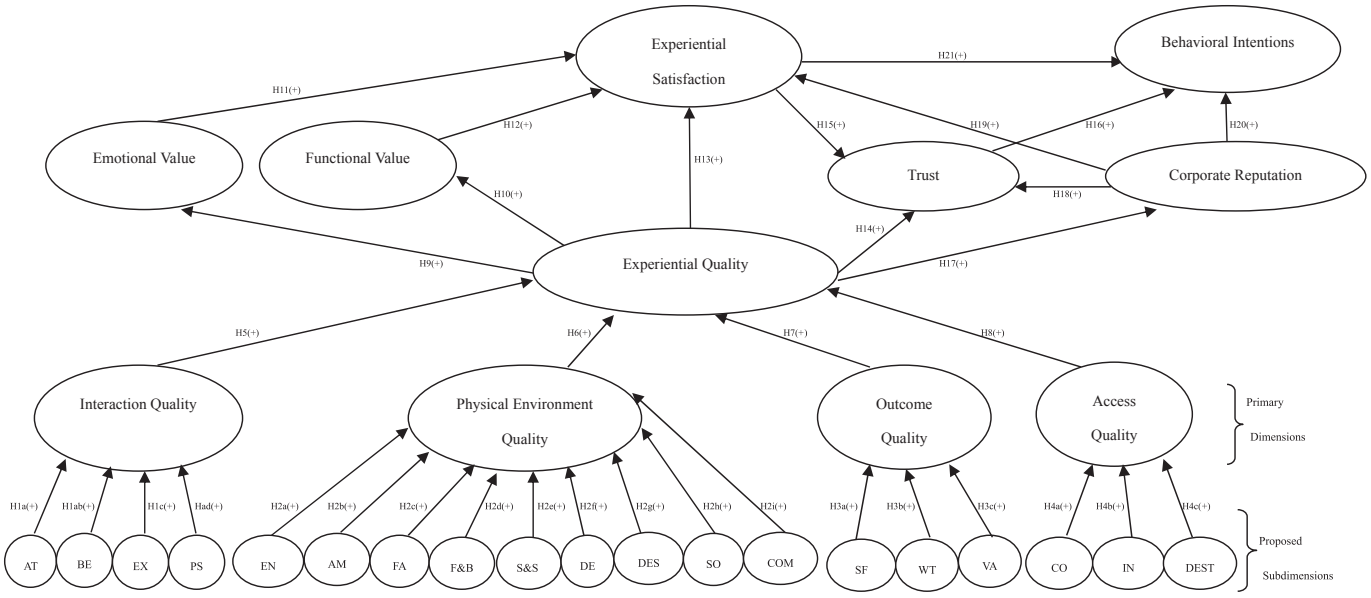


Fig. 1. A conceptual model.
Note: AT = Attitude, BE = Behavior, EX = Expertise, PS = Problem-Solving, EN = Entertainment, AM = Ambience, FA = Facility, F&B = Food & Beverage, S&S = Safety & Security, DE = Decor, DES = Design, SO = Souvenir, COM = Comfort, SF = Social Factors, WT = Waiting Time, VA = Valence, CO = Convenience, IN = Information, DEST = Destination.

ship industry. The questionnaire consisted of six sections. The first four sections included the statements of interaction quality, physical environment quality, outcome quality and access quality. These items were grouped in accordance with each of the primary dimensions, as perceived by the focus group participants. The fifth section focused on questions of experiential quality, experiential value, experiential satisfaction, trust, corporate reputation and behavioral intentions. The items were measured using a seven-point Likert-type scale ranging from seven (strongly agree) to one (strongly disagree). The final section collected demographic information. The questionnaire was developed by reviewing the related consumer behavior studies of other researchers plus advice from services marketing researchers and cruise managers to ensure its content validity. As the questionnaire was developed specifically for this study, a pre-test was conducted with 50 participants who had experienced a cruise tour in Hong Kong in the past 12 months. A period of 12 months was chosen to provide a common time frame as well as to limit the time frame to within the recall ability of most respondents, as suggested by Singh (1990). It was assumed that tourists who had experienced a cruise tour in the past 12 months would be better able to provide meaningful responses as compared to those who had taken a cruise ship a long time ago. During the pre-test procedure, the respondents were encouraged to comment on any questions that they thought were unclear, ambiguous, or to which they were unable to respond. Some minor grammatical changes were made to the questionnaire following the pre-test process.

4.2. Sample and data collection

The data were collected from the convenience sampling of cruise tourists from Bauhinia between September 1 and November 1, 2014. Bauhinia is operated by the Hong Kong Ferry Group and it is a tour operator offering harbor tours of Victoria Harbor in Hong Kong. It is equally popular for overseas tourists and local residents. This cruise tour lasts about 2 h and provides a variety of onboard entertainment and catering services, including a dinner buffet, live singing performances and dancing. This cruise ship has two decks of which the upper deck provides entertainment and catering services. Tourists can enjoy sightseeing and take photos in the lower deck. The students from the Hong Kong Polytechnic University were recruited to work as surveyors and then trained to randomly approach respondents, informing them of the purpose of the survey in advance before they were given the questionnaire. After the respondents agreed to respond to the questionnaire, they were each given one to fill in. The questionnaire was self-completed by the tourists, with assistance available if required. At the end of the trip, each respondent was required to return the completed questionnaire to the surveyors. To increase the response rate, the questionnaire must be as short as possible, taking into consideration, as suggested by Yeung (2012), that respondents may easily lose their patience or may be pre-occupied with other activities after the cruise trip.

Out of 840 questionnaires distributed, 708 (84.3%) were returned and 31 returned incomplete were discarded. The total usable sample of 677 represents an overall response rate of 95.6%. The usable responses were above the minimum sample size of 345, as suggested by Hair, Black, Babin, Anderson, and Tatham (2006). The descriptive statistics of the sample are summarized in Table 1. There were 350 (51.7%) males and 327 (48.3%) females. Most of the respondents (34.6%) were married without children and between 28 and 37 years of age (32.5%). A total of 35.5% of respondents had obtained a college or university degree. In terms of the monthly income before tax, the largest group earned between HK$10,000 and HK$14,999 (roughly between US$1282 and US$1923) (31.2%). Most of the respondents were management and administrative staff (20.8%) and first-time tourists (83.5%). In addition, most of them were traveling with their family (44.2%).

5. Findings

Prior to conducting the factor analysis, four statistical tests were used to ensure the factorability of the correlation matrix: visual examination of the correlation matrix (mostly > 0.3), the anti-image correlation matrix (close to 0), Bartlett's test of sphericity

Table 1
Demographic profile of sample ($N = 677$).

Demographic characteristics	Options	Frequency	%
Gender	Male	350	51.7
	Female	327	48.3
	Total	677	100.0
Marital status	Single	280	41.4
	Married with children	163	24.0
	Married without children	234	34.6
	Total	677	100.0
Age	18–27	175	25.8
	28–37	220	32.5
	38–47	101	14.9
	48–57	98	14.5
	58 or above	83	12.3
	Total	677	100.0
Educational level	Secondary school or below	85	12.6
	High school	102	15.1
	Vocational/technical school	180	26.6
	College or university	240	35.5
	Graduate school or above	70	10.3
	Total	677	100.0
Monthly income before tax (HK$)	$7999 or below	89	13.1
	$8000-$9999	189	28.0
	$10,000-$14,999	211	31.2
	$15,000-$19,999	110	16.2
	$20,000 or above	78	11.5
	Total	677	100.0
Occupation	Management/administrative staff	141	20.8
	White collar	123	18.2
	Professional	68	10.0
	Salespeople	71	10.5
	Service staff	98	14.5
	Housewife	42	6.2
	Student	78	11.5
	Self-employed	21	3.1
	Unemployed	7	1.0
	Retired	18	2.7
	Other	10	1.5
	Total	677	100.0
Previous cruise experience	Experienced tourists	112	16.5
	First-time tourists	565	83.5
	Total	677	100.0
The number of people accompanying you to go traveling	Alone	112	16.5
	With family	299	44.2
	In a group	266	39.3
	Total	677	100.0

Note: HK$7.8 = US$1.

(BTS = 6370.02, $p < .000$), and the Kaiser-Meyer-Olkin (KMO = 0.940) measure of sample adequacy. These results confirmed that the application of exploratory factor analysis (EFA) was appropriate.

The factor structure for the confirmatory tests was derived from an EFA with the VARIMAX orthogonal rotation method (Dagger, Sweeney, & Johnson, 2007). This was applied to the 62 individual item responses as perceived by focus group participants to represent the sub-dimensions of experiential quality, as suggested by several studies (e.g. Brady & Cronin, 2001; Caro & Garcia, 2007; Park, Lee, & Park, 2011; Wu & Li, 2017). The data set was randomly divided into two sub-samples of equal size: sample one and sample two. The data in sample one were used and then analyzed using an EFA. The examination of the scree plot and latent root criterion and the researchers' interpretation of the factor solution indicate that 11 dimensions should be extracted. A thorough analysis of the substantive meanings of the factors and corresponding items was performed to purify the uncovered factors. Items loading highly on each factor were examined carefully so that only those with consistent meanings and a high loading on a single factor were retained for measuring the factors. After the orthogonal rotation was conducted, two items whose factor loadings were less than 0.50 were removed from the EFA. According to Hair et al. (2006), the factor loadings of 0.50 have been generally considered necessary for practical significance. These two excluded items refer to variables that may play an unimportant or insignificant role in the evaluations of experiential quality. These items included TA15 and PR6. A revised EFA was conducted on the remaining 60 items. The retained 11 factors had eigenvalues greater than one, as suggested by Kaiser (1960). In addition, these factors explained a cumulative total of 71.68% of the variance in the data, as suggested by Ford, MacCallum, and Tait (1986) and Nunnally (1970), indicating that a cumulative percentage of variance explained being greater than 50% is the criterion used in determining the number of factors. After the EFA was conducted, the sub-dimensions were identified and renamed: (1) staff performance (6 items), (2) staff ability (6 items), (3) tangibles (14 items), (4) ambience (3 items), (5) decor & design (6 items), (6) entertainment (5 items), (7) souvenir (3 items), (8) pleasant ride (5 items), (9) waiting time (3 items), (10) convenient access (6 items), and (11) information (3 items). All factor loadings for the retained items were above 0.50 (see Table 2).

On the basis of the tests for configural and metric invariance, the results indicated that the sub-dimensional model of experiential quality was equivalent across the two random sample groups. This provided confidence in the consistency of the study results. Given model equivalence and the need for a large sample size to examine

Table 2
Factor loadings, eigenvalues, percentage of explained variance and cumulative percentage of explained variance of scaled items for subdimensions of experiential quality.

Sub-dimension	Item	Statement	Factor Loadings	Eigenvalues	Percentage of explained variance	Cumulative percentage of explained variance
Staff performance (SP)	SP1	The attitude of the staff demonstrates their willingness to help me.	.788	7.735	12.476	12.476
	SP2	I can depend on the staff being friendly.	.772			
	SP3	The attitude of the staff shows me that they understand my needs.	.693			
	SP4	I can count on the staff taking actions to address my needs.	.686			
	SP5	The behavior of the staff gives me trust.	.682			
	SP6	The staff are never too busy to respond to tourists' requests.	.669			
Staff ability (SA)	SA1	The staff understand that I rely on their professional knowledge to satisfy my needs.	.778	5.926	9.557	22.034
	SA2	The staff are able to answer my questions quickly.	.759			
	SA3	I can count on the staff knowing their jobs/responsibilities.	.694			
	SA4	When I have a problem, the staff show a sincere interest in solving it.	.684			
	SA5	The staff are able to handle my complaints directly and immediately.	.672			
	SA6	The staff understand the importance of resolving my complaints.	.654			
Tangibles (TA)	TA1	The cabin is clean.	.896	4.718	7.610	29.644
	TA2	The cabin space is moderate.	.895			
	TA3	The cabin facility is good.	.892			
	TA4	The appearance of this cruise ship is good.	.892			
	TA5	This cruise ship is very reliable.	.891			
	TA6	There are accessible fire exits.	.779			
	TA7	There are noticeable sprinkler systems.	.761			
	TA8	There is a secure safe in the cruise room.	.726			
	TA9	There are a variety of menus in dining.	.667			
	TA10	The quality of the food & beverage is good.	.652			
	TA11	The quality of the service delivery is good.	.645			
	TA12	The dining room is spacious.	.618			
	TA13	The seat in the cabin is comfortable.	.608			
	TA14	I feel comfortable with the actual temperature in the cabin.	.577			
	TA15	This cruise ship has an outstanding facility. [a]	.482			
Ambience (AM)	AM1	On this cruise ship, I can rely on there being a good atmosphere.	.839	4.132	6.664	36.308
	AM2	The ambience is what I am looking for on a cruise ship.	.836			
	AM3	This cruise company understands that its atmosphere is important to me.	.833			
Décor & design (DD)	DD1	The style of décor is to my liking on this cruise ship.	.796	4.091	6.598	42.906
	DD2	The décor of this cruise ship is stylish and attractive.	.796			
	DD3	This cruise ship is aesthetically attractive.	.793			
	DD4	The layout of this cruise ship makes it easy for passengers to move around.	.793			
	DD5	The layout of this cruise ship serves my purposes/needs.	.697			
	DD6	The décor of this cruise ship exhibits a great deal of thought and style.	.680			
Entertainment (EN)	EN1	There are different types of songs.	.884	3.755	6.057	48.964
	EN2	There are singers' performances.	.860			
	EN3	There are interesting shows and entertainment.	.763			
	EN4	There is a variety of entertainment catering for different age groups.	.750			
	EN5	There is a dancing area.	.619			
Souvenir (SO)	SO1	The souvenirs are varied.	.779	3.162	5.100	54.064
	SO2	The souvenirs are high quality.	.695			
	SO3	The prices of souvenirs are reasonable.	.692			
Pleasant ride (PR)	PR1	When I leave this cruise ship, I usually feel that I have had a good experience.	.718	3.145	5.073	59.137
	PR2	I believe that this cruise company tries to give me a good experience.	.677			
	PR3	I believe that this cruise company knows the type of experience its tourists want.	.669			
	PR4	I find that the other tourists on this cruise ship leave me with a good impression of its service.	.558			
	PR5	This cruise company understands that the other tourists on this cruise ship affect my perception of its service.	.515			
	PR6	The other tourists on this cruise ship do not affect its ability to provide me with good service. [a]	.493			
Waiting time (WT)	WT1	This cruise company understands that the waiting time is important to me.	.774	3.067	4.947	64.083
	WT2	This cruise company tries to minimize my waiting time.	.744			
	WT3	I rarely have to wait long to receive the service of this cruise company.	.690			
Convenient access (CA)	CA1	There is convenient transportation around the cruise terminal.	.847	2.463	3.973	68.056

Table 2 (*continued*)

Sub-dimension	Item	Statement	Factor Loadings	Eigenvalues	Percentage of explained variance	Cumulative percentage of explained variance
	CA2	There are convenient food and beverage facilities on this cruise ship.	.802			
	CA3	There are convenient and hygienic restrooms on this cruise ship.	.760			
	CA4	It was not difficult for me to get to Victoria Harbor.	.681			
	CA5	I experienced no problems in getting to Victoria Harbor.	.572			
	CA6	Finding ways to get to Victoria Harbor is not a difficult process.	.562			
Information (IN)	IN1	I can count on the information that this cruise company provides.	.782	1.550	2.501	70.557
	IN2	The staff of this cruise company provide me with accurate times at which they provide service.	.669			
	IN3	The staff of this cruise company understand the information that the tourists need.	.663			

Note: All items were scored on a 7-point Likert-type scale with 1 = strongly disagree and 7 = strongly agree unless stated otherwise. The scaled items for the sub-dimensions of experiential quality were extracted by the varimax orthogonal rotation.

[a] Items with factor loadings of less than .50 were deleted based on the measurement scale refinement procedure.

the research model, the full data set was used in subsequent analyses. Confirmatory factor analysis (CFA) was used to examine the validity by applying structural equation modeling (SEM). CFA is often the analytic tool of choice for developing and refining measurement instruments, assessing construct reliability and validity, identifying method effects, and evaluating factor invariance across time and groups (Brown, 2006). The data in sample two were used and then analyzed using CFA. The results of the CFA (e.g. measurement model) are presented in Table 3. Cronbach's coefficient alpha estimates for the 11 sub-dimensions of experiential quality ranged between 0.71 and 0.91. This study then applied the standardized factor loadings and average variance extracted (AVE) of each construct to verify the convergent validity. For each construct, the standardized factor loading and the AVE estimate were above 0.50. These results revealed that the instrument had good convergent validity. The composite reliability (CR) for each construct was used to verify the construct reliability. The CRs were greater than the value of 0.60. These results showed that the instrument had good construct reliability. Likewise, the inter-construct correlations were consistent, indicating that nomological validity was present. Therefore, the results of the AVEs CRs, construct correlations and descriptive statistics are presented in Table 3. As Cronbach's alpha is one of the most widely used metrics for reliability evaluation, it is also provided in Table 3. Moreover, a chi-square difference test was used to assess discriminant validity between constructs in the scale (Segars, 1997) that allows the researchers to compare two models; one is referred to as the constructs which are correlated to each other while the other refers to the constructs which are not. When the test is significant, the constructs indicate discriminant validity (Zait & Bertea, 2011). In this study, the results of the chi-square difference test demonstrated that the statistical value of the chi-square difference between the constructs was significant ($\triangle\chi^2 > 10.827$, $p < .001$). The aforementioned results proved that the correlation coefficients between the constructs were not equal to one. Therefore, the constructs of the research model in this study had discriminant validity. The data indicated the strong evidence of construct validity and reliability for the scales of experiential quality, experiential value, trust, corporate reputation, experiential satisfaction, behavioral intentions, and a set of primary and sub dimensions of experiential quality.

As shown in Table 4, the overall fit of the measurement models was adequate. The $\chi^2/d.f.$ ratio of less than 5 is used as the common decision rule of an acceptable overall model fit. The normed χ^2 of model is 2.99, indicating an acceptable fit. Furthermore, other indicators of goodness of fit are RMSEA = 0.05, SRMR = 0.03, CFI = 0.98, GFI = 0.95, IFI = 0.98, NNFI = 0.96, and AGFI = 0.86.

The overall fit measures of the structural model suggest that the hypothesized model provides an acceptable fit to the data (see Table 4). The fit statistics ($\chi^2/d.f.$ = 3.03, RMSEA = 0.06, SRMR = 0.03, CFI = 0.98, GFI = 0.94, IFI = 0.98, NNFI = 0.98, AGFI = 0.84) suggest a satisfactory fit in light of the extremely high statistical power of the model and the consequent need to accept a more relaxed interpretation of fit than is typical, as proposed by McQuitty (2004). The large sample size and the number of parameters estimated contribute to a strong downward bias of the descriptive fit statistics.

To assess cruise tourists' perceptions of the four primary dimensions and extracted 11 sub-dimensions of experiential quality, the measurement items to measure primary and sub dimensions were adapted from several studies (e.g. Caro & Garcia, 2007; Clemes et al., 2009; Shonk & Chelladurai, 2008; Wu & Cheng, 2013; Wu et al., 2011; Wu et al., 2011; Yi et al., 2014). The measurement items of the experiential quality, experiential value, trust, corporate reputation, experiential satisfaction, and behavioral intentions constructs were adopted on the basis of several researchers' results (e.g. Brady & Cronin, 2001; Keh & Xie, 2009; Lee et al., 2011; Meng et al., 2011; Wu & Li, 2017) (see Table 5). Although the sub-dimensions are treated as separate constructs, it is recognized that they are not mutually exclusive. It is therefore necessary to examine whether there is sufficient discrimination between them. Also, it is important to investigate whether experiential quality and experiential satisfaction are empirically separate constructs. In some cases, previous studies have failed to find discriminant validity between them (Spreng & Singh, 1993). The Fornell and Larcker (1981) test was used. This examines whether the average variance extracted for each construct is higher than the squared correlation between that construct and any other construct in the model. In all cases, the tests demonstrate discriminant validity. In concurrence with several studies (Dabholkar, Shepherd, & Thorpe, 2000; Wong, Wu, & Cheng, 2015; Wu & Li, 2017), experiential quality and experiential satisfaction are distinct constructs although they are moderately correlated.

To test the hypotheses in the conceptual research model (see Fig. 1), this study uses SEM through the Analysis of Moment Structure (AMOS) 7.0. Therefore, the results of the hypothesis tests are given in Table 6.

Hypothesis 1 assumes that the sub-dimensions of the interaction quality primary dimension (staff performance, staff ability) positively influence perceived interaction quality. This hypothesis is fully supported by the results. Perceptions of staff performance ($b = 0.34$, $p < .001$) and staff ability ($b = 0.89$, $p < .001$) positively influence interaction quality. The sub-dimensions explain 65.21% of the variation in perceived interaction quality.

Hypothesis 2 postulates that the sub-dimensions of the physical

Table 3
Descriptive statistics and correlation matrix of latent variables.

Construct dimensions		SP	SA	TA	AM	DD	EN	SO	PR	WT	CA	IN	IQ	PEQ	OQ	AQ	EQ	EV	FV	ES	TR	CR	BI
1	SP	1.000																					
2	SA	.77	1.000																				
3	TA	.64	.62	1.000																			
4	AM	.46	.47	.68	1.000																		
5	DD	.57	.58	.86	.66	1.000																	
6	EN	.59	.54	.86	.71	.74	1.000																
7	SO	.52	.51	.69	.50	.67	.66	1.000															
8	PR	.58	.52	.71	.52	.63	.65	.55	1.000														
9	WT	.46	.51	.58	.49	.64	.54	.55	.58	1.000													
10	CA	.54	.55	.67	.57	.67	.63	.58	.64	.70	1.000												
11	IN	.49	.48	.65	.54	.58	.60	.53	.57	.57	.78	1.000											
12	IQ	.65	.80	.58	.47	.55	.48	.43	.47	.47	.51	.49	1.000										
13	PEQ	.97	.04	.04	-.03	.01	.04	.04	.38	-.03	-.02	.01	-.04	1.000									
14	OQ	.59	.59	.69	.58	.70	.65	.58	.62	.66	.70	.61	.55	-.01	1.000								
15	AQ	.18	.15	.30	.18	.22	.26	.16	.29	.09	.12	.16	.16	.07	.13	1.000							
16	EQ	.60	.59	.66	.53	.65	.63	.57	.60	.63	.68	.61	.57	-.03	.69	.11	1.000						
17	EV	.51	.52	.62	.50	.63	.64	.56	.61	.67	.67	.62	.49	.01	.66	.15	.74	1.000					
18	FV	.55	.55	.65	.59	.66	.61	.48	.63	.66	.71	.63	.57	.00	.69	.12	.69	.72	1.000				
19	ES	.47	.48	.62	.57	.61	.57	.47	.59	.58	.62	.57	.51	.01	.62	.21	.62	.71	.81	1.000			
20	TR	.34	.36	.49	.43	.46	.43	.32	.42	.48	.50	.43	.42	-.02	.47	.17	.47	.47	.70	.68	1.000		
21	CR	-.31	-.04	.06	.01	.03	.06	.01	.04	.03	.02	.06	-.01	.05	.03	-.05	.04	-.02	.02	.01	.24	1.000	
22	BI	.03	-.01	.02	-.05	-.02	.01	-.01	-.03	-.10	-.08	-.08	-.04	.14	-.03	-.06	-.04	-.02	-.05	.02	-.02	.22	1.000
	M	4.93	4.79	4.52	5.00	4.90	5.07	5.07	4.89	4.77	4.72	4.72	4.68	4.96	4.89	5.19	4.84	4.85	4.67	4.74	4.69	4.70	4.77
	SD	.94	.88	.73	.89	.90	.93	.97	.66	.98	.86	.92	.92	.96	.93	.79	.99	.94	.98	.91	.81	.99	.70
	Cronbach's alpha	.83	.84	.91	.86	.90	.72	.89	.86	.88	.78	.74	.89	.82	.77	.75	.71	.76	.84	.87	.80	.89	.75
	AVE	.51	.50	.56	.70	.58	.61	.52	.56	.54	.51	.56	.53	.60	.52	.59	.50	.58	.56	.54	.60	.53	.53
	CR	.77	.75	.91	.83	.83	.83	.78	.81	.76	.76	.69	.74	.80	.78	.80	.68	.78	.73	.73	.83	.71	.74

Note: SP = staff's performance; SA = staff's ability; TA = tangibles; AM = ambience; DD = decor & design; EN = entertainment; SO = souvenir; PR = pleasant ride; WT = waiting time; CA = convenient access; IN = information; IQ = interaction quality; PEQ = physical environment quality; OQ = outcome quality; AQ = access quality; EQ = experiential quality; EV = emotional value; FV = functional value; ES = experiential satisfaction; TR = trust; CR = corporate reputation; BI = behavioral intentions; M = Mean; SD = standard deviation; AVE = average variance extracted; CR = composite reliability.

Table 4
Results of the measurement and structural model tests.

Model	x^2/df	*P*	RMSEA	SRMR	CFI	GFI	IFI	NNFI	AGFI
Measurement model	2.988	.000	.052	.030	.98	.95	.98	.96	.86
Structural model -Overall model	3.032	.000	.056	.034	.98	.94	.98	.98	.84
Recommended value	<5.0	–	< .08	≤.08	>.90	>.90	>.90	>.90	≥.80

Note: *P* = *P*-value; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Residual; CFI = Comparative Fit Index; GFI = Goodness-of-fit Index; IFI = Incremental Fit Index; NNFI = Non-Normed Fit Index; AGFI = Adjusted Goodness-of-fit Index.

Table 5
Scaled items for primary dimensions of experiential quality, behavioral intentions and related constructs.

Construct	Item	Statement
Interaction quality	IQ1	Overall, I would say the quality of my interaction with the cruise staff is excellent.
	IQ2	The interaction I have with the cruise staff is of a high standard.
	IQ3	I feel good about the interaction I have with the cruise staff.
Physical environment quality	PEQ1	I believe that the physical environment on this cruise ship is excellent.
	PEQ2	The physical environment on this cruise ship is of a high standard.
	PEQ3	I am impressed with the quality of the cruise's physical environment.
Outcome quality	OQ1	I feel good about what the cruise staff provide to their tourists.
	OQ2	I always have an excellent experience when being on board a cruise ship.
	OQ3	I am impressed by the care provided on this cruise ship.
Access quality	AQ1	I feel free to explore and there are no restrictions to access as tourists.
	AQ2	Access to places is not a problem when being on board a cruise ship.
	AQ3	Coming to Victoria Harbor is so easy.
Experiential quality	EQ1	I believe that this cruise company is going to provide me with an interesting educational and instructive experience.
	EQ2	The quality of this cruise ship could be considered superior when compared to other cruise ships.
	EQ3	Taking a cruise ship is a pleasant experience.
Emotional value	EV1	Taking this cruise ship is pleasurable.
	EV2	Taking this cruise ship makes me feel better.
	EV3	Taking this cruise ship is a wonderful tourist attraction that I enjoy.
Functional value	FV1	Taking this cruise ship is affordable.
	FV2	Taking this cruise ship exceeds my travel expenditure.
	FV3	This cruise ship offers a better value for the money than do other cruise ships.
	FV4	This cruise ship offers better quality/more benefits.
Experiential satisfaction	ES1	Taking this cruise ship exceeds my expectations.
	ES2	Today is really a nice day.
	ES3	I really like this cruise trip.
	ES4	It is worthwhile being on board this cruise ship.
Trust	TR1	This cruise company takes care of my needs as a customer.
	TR2	I trust this cruise company completely.
	TR3	I have confidence in this cruise company.
Corporate reputation	CR1	This cruise company is a highly-regarded company.
	CR2	This cruise company is a successful company.
	CR3	This cruise company is a well-established company.
Behavioral intentions	BI1	I will opt for an identical cruise ship route next time.
	BI2	I will not select another cruise ship.
	BI3	I will recommend my friends purchase this cruise tourism product.
	BI4	I will actively look for recent information about this cruise ship.
	BI5	I will choose a cruise as my first choice for tourism.
	BI6	I will still be willing to pay for a cruise if the price is increased.
	BI7	I will choose this cruise ship in preference to air travel.

environment quality primary dimension (tangibles, ambience, decor & design, entertainment, souvenir) positively influence perceived physical environment quality. The results fully supported this hypothesis. Perceptions of tangibles ($b = 0.69$, $p < .001$), ambience ($b = 0.26$, $p < .01$), decor & design ($b = 0.20$, $p < .01$), entertainment ($b = 0.53$, $p < .001$), and souvenir ($b = 0.38$, $p < .001$) positively influence physical environment quality. The sub-dimensions explain 77.32% of the variation in perceived physical environment quality.

Hypothesis 3 predicts that the sub-dimensions of pleasant ride and waiting time positively influence outcome quality. This hypothesis is fully supported by the results. Perceptions of pleasant ride ($b = 0.68$, $p < .001$) and waiting time ($b = 0.39$, $p < .001$) positively influence outcome quality. The sub-dimensions explain 89.24% of the variation in perceived outcome quality.

Hypothesis 4 assumes that the sub-dimensions of convenient access and information positively affect access quality. The results support the hypothesis that perceptions of convenient access ($b = 0.62$, $p < 0.001$) and information ($b = 0.70$, $p < .001$) positively influence access quality. The sub-dimensions explain 54.29% of the variation in perceived access quality.

Hypotheses 5, 6, 7, 8 and 17 predict that the positive effects of the primary dimensions of experiential quality as well as corporate reputation affect overall experiential quality. In addition to physical environment quality ($b = 0.01$), access quality ($b = 0.04$), and corporate reputation ($b = 0.01$), the results support the hypotheses that perceptions of interaction quality ($b = 0.48$, $p < .001$) and outcome quality ($b = 0.81$, $p < .001$) positively influence cruise tourists' perceptions of overall experiential quality. The four primary dimensions of experiential quality as well as corporate reputation explain 74.21% of the variation in overall experiential quality.

Hypothesis 9 assumes the positive effect of overall experiential quality on emotional value. This hypothesis is not supported by the result. Overall experiential quality ($b = 0.01$) is not a significant predictor of emotional value. This variable explains 35.3% of the

Table 6
Hypothesis test results.

	Hypothesized path	Structural coefficients	Hypothesis supported
H1a:	Staff's performance → Interaction quality	.34***	Yes
H1b:	Staff's ability → Interaction quality	.89***	Yes
H2a:	Tangibles → Physical environment quality	.69***	Yes
H2b:	Ambience → Physical environment quality	.26**	Yes
H2c:	Decor & design → Physical environment quality	.20**	Yes
H2d:	Entertainment → Physical environment quality	.53***	Yes
H2e:	Souvenir → Physical environment quality	.38***	Yes
H3a:	Pleasant ride → Outcome quality	.68***	Yes
H3b:	Waiting time → Outcome quality	.39***	Yes
H4a:	Convenient access → Access quality	.62***	Yes
H4b:	Information → Access quality	.70***	Yes
H5:	Interaction quality → Experiential quality	.48***	Yes
H6:	Physical environment quality → Experiential quality	.01	No
H7:	Outcome quality → Experiential quality	.81***	Yes
H8:	Access quality → Experiential quality	.04	No
H9:	Experiential quality → Emotional value	.01	No
H10:	Experiential quality → Functional value	.89***	Yes
H11:	Emotional value → Experiential satisfaction	.08	No
H12:	Functional value → Experiential satisfaction	.83***	Yes
H13:	Experiential quality → Experiential satisfaction	.05	No
H14:	Experiential quality → Trust	.82***	Yes
H15:	Experiential satisfaction → Trust	.72***	Yes
H16:	Trust → Behavioral intentions	.23*	Yes
H17:	Corporate reputation → Experiential quality	.01	No
H18:	Corporate reputation → Trust	.02	No
H19:	Corporate reputation → Experiential satisfaction	.08	No
H20:	Corporate reputation → Behavioral intentions	.35***	Yes
H21:	Experiential satisfaction → Behavioral intentions	.54***	Yes

Note: *$P < .05$, **$P < .01$, ***$P < .001$.

variance in emotional value.

Hypothesis 10 predicts the positive effect of overall experiential quality on functional value. This hypothesis is fully supported by the result. Overall experiential quality ($b = 0.89$, $p < .001$) is a significant predictor of functional value. This variable explains 79.21% of the variance in functional value.

Hypotheses 11, 12, 13 and 19 postulate the positive effects of emotional value, functional value, experiential quality, and corporate reputation on experiential satisfaction. The hypotheses are partially supported with the exceptions of emotional value ($b = 0.08$), experiential quality ($b = 0.05$), and corporate reputation ($b = 0.08$), functional value ($b = 0.83$, $p < .001$) is a significant predictor of experiential satisfaction. These four variables explain 42.17% of the variance in experiential satisfaction.

Hypotheses 14, 15 and 18 assume the positive effects of overall experiential quality, experiential satisfaction and corporate reputation on trust. These three hypotheses are partially supported by the results. In addition to corporate reputation ($b = 0.02$), overall experiential quality ($b = 0.82$, $p < .001$) and experiential satisfaction ($b = 0.72$, $p < .001$) are significant predictors of trust. These three variables explain 54.12% of the variance in trust.

Hypotheses 16, 20 and 21 postulate the positive effects of trust, corporate reputation and experiential satisfaction on behavioral intentions. These three hypotheses are fully supported. Trust ($b = 0.23$, $p < .1$), corporate reputation ($b = 0.35$, $p < .001$) and experiential satisfaction ($b = 0.54$, $p < .001$) positively influence behavioral intentions. These three variables explain 78.45% of the variance in behavioral intentions.

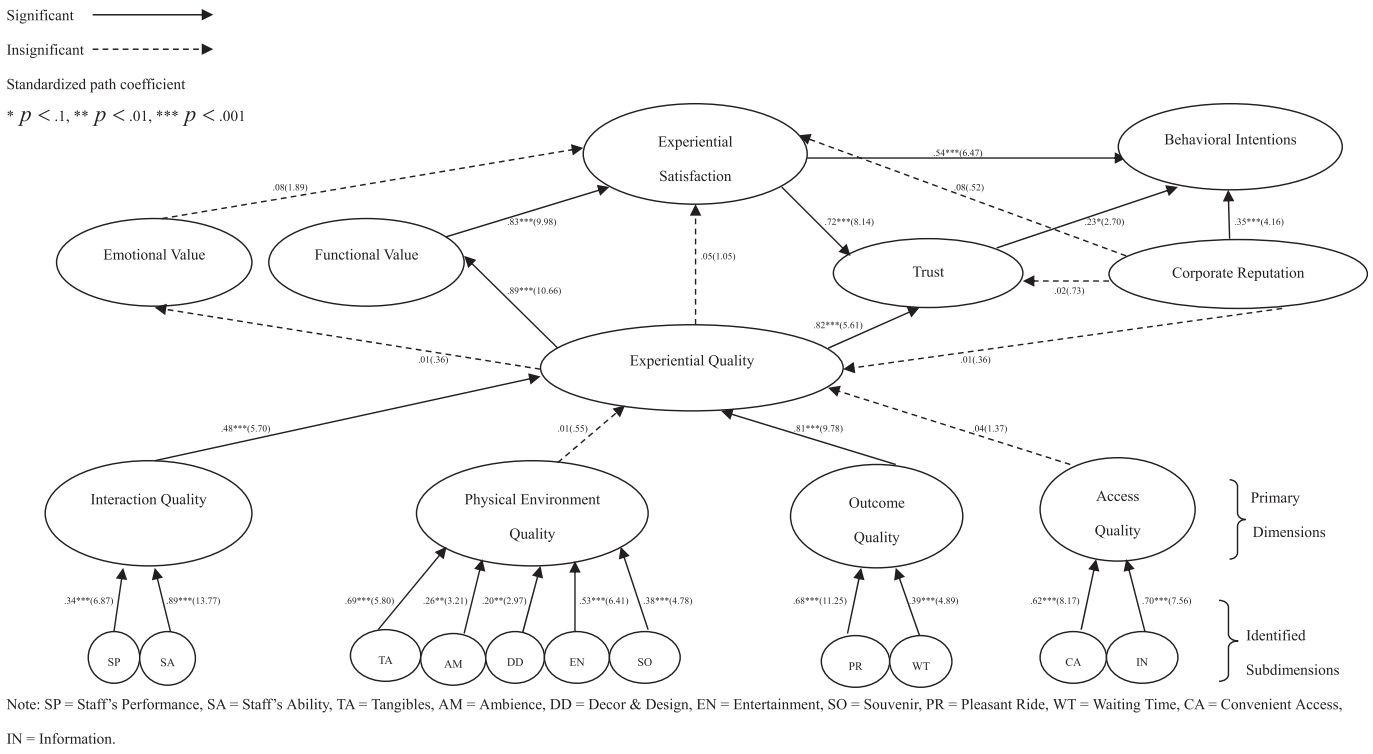
Hypothesis 22 proposes that cruise tourists perceive the four primary dimensions of experiential quality to be more or less important, and that the sub-dimensions of experiential quality also differ in their importance to their related primary dimensions. Except for physical environment quality ($b = 0.01$) and access quality ($b = 0.04$), the results show that outcome quality ($b = 0.81$) is more important than interaction quality ($b = 0.48$). The different levels of b partially support H22a. However, the varied standardized coefficients of the sub-dimensions indicate that H22b is fully supported.

Each path estimate based on the relationships among experiential quality, experiential value, trust, corporate reputation, experiential satisfaction, behavioral intentions, and primary and sub dimensions of experiential quality in the conceptual research model was subsequently tested using CFA to prove the SEM built in Fig. 2.

6. Discussion

The results for hypotheses 1 through 8 provide support for a multi-dimensional and hierarchical dimensional structure of experiential quality (e.g. Brady & Cronin, 2001; Dabholkar et al., 1996; Wu & Li, 2017) as perceived by cruise tourists. The results for hypotheses 1 through 4 support the presence of 11 sub-dimensions of experiential quality as perceived by cruise tourists. The results for hypotheses 5 through 8 substantiate the presence of four primary dimensions of experiential quality: interaction quality, physical environment quality, outcome quality and access quality for the cruise ship industry.

The results of the exploratory factor analysis reduced the 19 sub-dimensions originally proposed to 11 sub-dimensions using a multi-dimensional and hierarchical approach. Some of the sub-dimensions are different in content from those identified for the heritage sector (Wu & Li, 2017), the museum sector (Wu & Li, 2015), the food festival sector (Wong et al., 2015; Wu & Ai, 2016b; Wu et al., 2014b), the higher education sector (Clemes, Gan, & Kao, 2008, 2013), the amusement park industry (Wu et al., 2018), the banking industry (Hossain et al., 2015), the convention industry (Gottlieb, Brown, & Drennan, 2011; Wu, Cheng, & Ai, 2016; Wu, Cheng, & Hong, 2017e), the healthcare industry (Dagger et al., 2007), the sports industry (e.g. Clemes et al., 2011a; Ko & Pastore, 2005; Theodorakis, Alexandris, & Ko, 2011; Wu & Ai, 2016a, 2016c), the accommodation industry (Clemes et al., 2009, 2011b; Wu & Ko, 2013; Wu et al., 2016), the travel and tourism industry



Note: SP = Staff's Performance, SA = Staff's Ability, TA = Tangibles, AM = Ambience, DD = Decor & Design, EN = Entertainment, SO = Souvenir, PR = Pleasant Ride, WT = Waiting Time, CA = Convenient Access, IN = Information.

Fig. 2. The testing results of the hypothetical model.
Note: SP = Staff's Performance, SA = Staff's Ability, TA = Tangibles, AM = Ambience, DD = Decor & Design, EN = Entertainment, SO = Souvenir, PR = Pleasant Ride, WT = Waiting Time, CA = Convenient Access, IN = Information.

(e.g. Caro & Garcia, 2008; Chen, Lee, Chen, & Huang, 2011; Shonk & Chelladurai, 2008; Wu, Cheng, & Chen, 2017c; Wu, Cheng, & Hong, 2017d; Wu et al., 2014a), the transport industry (Caro & Garcia, 2007; Wu & Cheng, 2013; Wu et al., 2011), the coffee shop industry (Wu, 2017), the gaming industry (Wu & Hsu, 2012; Wu, 2014), the quick service restaurant industry (Wu & Cheng, 2017a; Wu & Mohi, 2015; Wu, 2013), the telecommunication industry (Clemes et al., 2014; Fassnacht & Koese, 2006; Lu, Zhang, & Wang, 2009), Brady and Cronin's (2001) study across four service industries (fast-food, photograph developing, amusement parks and dry cleaning), and Pollack's (2009) study across two service industries (hairdressers/barbers and local phones). This finding supports the contentions of earlier studies (Clemes et al., 2009; Pollack, 2009) in which different dimensional structures across service industries were identified.

The results of the exploratory factor analysis reduced the originally proposed 19 sub-dimensions to 11 sub-dimensions using a multi-dimensional and hierarchical approach. The 11 sub-dimensions factored in this study for the cruise ship industry are similar in content to the dimensions identified by other researchers that have focused on the tourism industry (Brady & Cronin, 2001; Durvasula, Lobo, Lysonski, & Mehta, 2004; Yi et al., 2014). However, the 11 sub-dimensions also differ in content and number from those for tourism studies undertaken in Hong Kong (Qu et al., 1999; Yan, 2010; Yeung, 2012). The different sub-dimensional factor structure identified in this study for the cruise ship industry supports the view that the dimensionality of the experiential quality construct is dependent on the tourist experience. These results also support the claims that industry- and culturally-specific measures of experiential quality need to be developed to identify different dimensional structures (e.g. Brady & Cronin, 2001; Wong et al., 2015; Wu & Li, 2017; Wu et al., 2018).

The hypothesized paths (hypotheses 9 through 21) relate to experiential quality, experiential value (emotional value and functional value), trust, corporate reputation, experiential satisfaction and behavioral intentions. The result of this study reveals that experiential quality does not positively influence emotional value. A possible reason is that the overall experiential quality perceived by cruise tourists cannot influence their perceptions of emotional value. This finding does not support the contention of Ivanauskienė, Auruškevičienė, Škudienė, and Nedzinskas (2012) that quality is a key determinant of emotional value. However, the finding of this study indicates that experiential quality positively influences functional value. This finding agrees with the contention of Yuan and Wu (2008) that experiential quality is identified as an important indicator of functional value. The results of this study indicate that only functional value influences experiential satisfaction in addition to emotional value, experiential quality and corporate reputation. The possible reason is that there are competing influences of the dimensions of emotional value, experiential quality and corporate reputation on experiential satisfaction. These findings are not consistent with the contentions of earlier studies (Chen & Hsieh, 2010; Wu & Li, 2017; Yuan & Wu, 2008) that emotional value, experiential satisfaction and corporate reputation are antecedents of experiential satisfaction. However, the finding agrees with the proposition of Petrick (2004) that value positively influences satisfaction in the cruise ship industry. The results of this study indicate that experiential quality and experiential satisfaction positively influence trust except for corporate reputation. These findings support the contentions of Chenet et al. (2010) and Ou and Sia (2003) that quality and satisfaction influence trust. The results of this study indicate that corporate reputation does not positively influence experiential quality and trust respectively. These findings are inconsistent with those of Jin et al. (2008) and Turban and Cable (2003) in which corporate reputation plays a key role in influencing quality and trust respectively. The results of this study indicate that

trust, corporate reputation and experiential satisfaction positively influence behavioral intentions. These findings support the contentions of earlier studies (Forgas-Coll, Palau-Saumell, Sánchez-García, & María Caplliure-Giner, 2014; Keh & Xie, 2009; Wu & Li, 2017) that trust, corporate reputation and experiential satisfaction have been considered to be antecedents of behavioral intentions.

The least and most important dimensions of experiential quality, as perceived by cruise tourists, are identified. Each of the sub-dimensions varies in terms of its importance to the four primary dimensions (see Fig. 2). Outcome quality is identified as the most important dimension of experiential quality perceived by cruise tourists. These results are consistent with the contentions of several studies (Clemes et al., 2011b, 2009; Wu & Li, 2017; Wu, 2013) that outcome quality has been considered to be one of the important attributes of experiential quality. In this study, outcome quality is composed of two significant sub-dimensions, namely, pleasant ride and waiting time. Pleasant ride is found to be the most important sub-dimension of outcome quality. This finding is consistent with the proposition of Hosany and Witham (2009) that cruise tourists' experiences play a key role in influencing their perceptions of quality. Waiting time is found to be the second most important sub-dimension of outcome quality. The result of this study supports the contention of Kwortnik (2008) that waiting for services plays a key role in influencing cruise tourists' overall evaluations of quality.

Interaction quality is confirmed to be the second most important dimension of experiential quality perceived by cruise tourists. In this study, the majority of tourists who have taken a cruise ship are Asian rather than Western people. This finding supports the contention of Hofstede, Hofstede, and Minkov (2010) that Asian cultures are collectivist whereas western cultures are individualist. In addition, the results of this study agree with Donthu and Yoo's (1998) study that collectivistic people do not expect service providers to respect and care about them and show empathy and attention compared with individualistic customers. Interaction quality is composed of two significant sub-dimensions, namely, staff ability and staff performance. Staff ability is the most important sub-dimension of interaction quality in this study. The finding of the study is consistent with the contention of Petrick (2004) that service providers' skills are considered to be a key determinant of overall perception of quality. Staff performance is the second most important sub-dimension of interaction quality. This result supports the propositions of Petrick (2004) and Qu et al. (1999) that service providers' performance seems to directly influence cruise tourists' perceptions of quality, particularly when the service remains unambiguous and easy to evaluate.

Physical environment quality is identified as the least important dimension of experiential quality perceived by cruise tourists. This finding does not support the proposition of Kwortnik (2008) that the shipscape perceived by cruise tourists has an influence on overall evaluations of quality. Physical environment quality is composed of five significant sub-dimensions, namely, tangibles, environment, souvenir, ambience and decor & design. Tangibles are the most important sub-dimension of physical environment quality. The finding of this study is consistent with the contention of Yi et al. (2014) that tangibles have been considered to be a key component of quality in the cruise ship industry. Environment is the second most important sub-dimension of physical environment quality. The finding of this study supports the contention of Kwortnik (2008) that the service environment has been identified as playing a key role in increasing the cruise tourists' overall evaluations of quality. Souvenir is the third most important sub-dimension of physical environment quality. The result of this study is consistent with the contention of Dragin, Jovičić, and Bošković (2010) that the provision of souvenirs may influence the cruise tourists' intentions to take a cruise ship. Ambience is the fourth most important sub-dimension of the physical environment while decor & design is the fifth most important sub-dimension of physical environment quality. This finding agrees with the proposition of Lobo (2008) that ambience and decor & design have been considered to play a key role in influencing cruise tourists' perceived quality.

Access quality is identified as the second least important dimension of experiential quality perceived by cruise tourists. This finding does not concur with the propositions of Shonk and Chelladurai (2008) and Wu and Li (2017) that access quality has been considered to be an important component of quality. In this study, access quality comprises two significant sub-dimensions, namely, information and convenient access. Information is found to be the most important sub-dimension of access quality. The finding of this study supports the proposition of Xu (2014) that the information service influences the cruise tourists to consider whether they should take the cruise ship. Convenient access is found to be the second important sub-dimension of access quality. This finding is consistent with the contention of Xu (2014) that being convenient for those tourists experiencing the cruise tour within a relatively short period of time plays a key role in increasing their overall evaluations of quality.

6.1. Theoretical implications

To the researchers' best knowledge, this study is a pioneer in applying a concept of experiential quality to the context of cruise tourism. This research presents a comprehensive evaluation of cruise tourists' perceptions of experiential quality by developing and estimating a multi-dimensional and hierarchical model. The results of this study support the use of a multi-dimensional and hierarchical approach for conceptualizing and measuring cruise tourists' perceptions of quality, like the models developed by several researchers (e.g. Brady & Cronin, 2001; Dabholkar et al., 1996; Dagger et al., 2007; Ko & Pastore, 2005; Wu & Li, 2017). The results of the measurement model tests indicate that all measurement models for measuring experiential quality and its dimensions have a good model fit. In addition, the results of the reliability and validity tests indicate that the measurement scales for measuring experiential quality and its dimensions reveal adequate reliability and validity. However, it should be noted that the four primary dimensions and 11 sub-dimensions of experiential quality may not be generic for all service industries and cultures. Dimensional structures should be confirmed through the use of an appropriate qualitative or quantitative approach. It is also valuable to compare the derived importance of any primary and sub dimensions in this study with new dimensions of experiential quality identified in future studies.

This study identifies the comparative importance of the four primary dimensions in cruise tourists' overall evaluation of perceived experiential quality. Among the four primary dimensions, only outcome quality and interaction quality positively influence cruise tourists' overall assessment of their experiential quality. The results provide empirical evidence for the notion that outcome quality is significantly and positively associated with perceived quality which in turn, affects satisfaction and behavioral intentions in the cruise ship industry (Chua, Lee, Goh, & Han, 2015). Also, interaction quality has a positive effect on perceived overall experiential quality. According to Chua et al. (2015), maintaining excellent interactions with cruise tourists is a part of employees' job responsibilities, which in turn, influences passengers' overall evaluations of perceptions of interaction quality.

This study provides a theoretical framework for understanding the complex relationships among seven important marketing constructs (experiential quality, emotional value, functional value,

trust, corporate reputation, experiential satisfaction and behavioral intentions). First, experiential quality is empirically tested and confirmed to have a positive impact on functional value. The positive relationship identified between experiential quality and functional value may be interpreted as the higher the experiential quality perceived by cruise tourists, the higher the functional value perceived by them. Second, this study identifies functional value as having a positive effect on experiential value. This may be interpreted as functional value being an antecedent of experiential satisfaction. Third, experiential quality and experiential satisfaction positively influence trust. This may be interpreted as the higher the experiential quality and experiential satisfaction perceived by cruise tourists, the higher the trust perceived by them. Finally, trust, corporate reputation and experiential satisfaction positively influence behavioral intentions. The positive relationship identified between behavioral intentions, trust and corporate reputation may be interpreted as it being likely that cruise tourists will have favorable behavioral intentions to revisit or return to take the cruise ship again after building high trust and corporate reputation in their minds. Also, the positive relationship identified between experiential satisfaction and behavioral intentions may be interpreted as satisfied cruise tourists having favorable behavioral intentions to revisit or return to take the cruise ship again after paying high prices and spending more time to experience high levels of quality on the cruise ship that produced a good image in their minds.

This study identifies 11 sub-dimensions pertaining to the four primary dimensions of experiential quality perceived by cruise tourists. In particular, this study identifies the comparative importance of the 11 sub-dimensions in cruise tourists' overall evaluations of perceived experiential quality. Among the 11 sub-dimensions, staff ability is the most important sub-dimension of the interaction quality primary dimensions and tangibles are the most important sub-dimension of the physical environment quality primary dimensions. In addition, pleasant ride and information are the most important sub-dimensions of the outcome quality and access quality primary dimensions respectively. These four sub-dimensions appear to be important components of the four primary dimensions of experiential quality. When cruise tourists evaluate their overall perceived experiential quality on a cruise ship, they may consider these four sub-dimensions as parts of their overall assessment of experiential quality. Therefore, they should be seriously considered when researchers conduct similar studies of cruise tourists' experiential quality.

6.2. Managerial implications

The multi-dimensional and hierarchical factor structure of experiential quality identified in this study provides practitioners with insights into how cruise tourists in Hong Kong form their perceptions of experiential quality. From a practical perspective, the measurement scale for experiential quality developed in this study provides cruise management with a method to evaluate tourists' perceptions of experiential process on several indicators of quality. Cruise organizations can thereby measure tourists' perceptions of experiential quality on a global level, on the primary dimensional level, on the sub-dimensional level or on all the three levels according to need. For example, cruise managers interested in tourists' general attitude towards their cruise organization's service experiences can use the four global measures to determine tourists' overall perceptions of experiential quality. However, to identify a cruise organization's core competency or any deficiencies of service experiences, cruise management can measure tourists' perceptions of experiential quality at the sub-dimensional level.

The results of this study provide cruise management with valuable information about the complex relationships among experiential quality, emotional value, functional value, trust, corporate reputation, experiential satisfaction and behavioral intentions in the cruise sector. The information will assist cruise management to develop successful services marketing strategies. For example, cruise management should continually try to improve cruise tourists' perceived experiential quality, as improved experiential quality results in favorable perceptions of functional value. In addition, the results of this study provide cruise management with an improved understanding of the effect of functional value on experiential satisfaction, which in turn, results in behavioral intentions. The results indicate that improving cruise tourists' perceptions of functional value can effectively raise experiential satisfaction levels, and higher levels of experiential satisfaction ultimately result in favorable behavioral intentions. In this vein, cruise management should invest more efforts into providing a consistently reliable experience to satisfy tourists' wants and needs. Alternatively, the results of this study provide cruise management with an improved understanding of the effects of experiential quality and experiential satisfaction on trust, which in turn, results in behavioral intentions. The findings reveal that increasing cruise tourists' perceived experiential quality and experiential satisfaction enable them to believe in the cruise company easily. Afterwards, those cruise tourists may attempt to return or revisit the same cruise company next time. In addition, the result of this study indicates that corporate reputation positively influences behavioral intentions, implying that high levels of corporate reputation are perceived to result in increased favorable behavioral intentions and future visitation respectively.

However, the results of the study provide cruise management with an improved understanding of the insignificant effect of experiential quality on emotional value and experiential satisfaction respectively. Cruise management should improve cruise tourists' perceived experiential quality to enhance their perceived emotional value and experiential satisfaction. Also, the study reveals the insignificant effect of emotional value on experiential satisfaction. Cruise management should make an effort to improve tourists' perceptions of emotional value to increase their perceived experiential satisfaction. Moreover, the results indicate the insignificant effect of corporate reputation on experiential quality, trust and experiential satisfaction, respectively. Cruise management should invest more resources to establish good corporate reputation in the tourists' minds to improve their perceived experiential quality, trust and experiential satisfaction.

Moreover, the most and least important sub-dimensions pertaining to each of the four primary dimensions identified in this study also provide valuable information for cruise organizations in Hong Kong. When a cruise organization intends to maintain or improve its performance on one of the four primary dimensions, it should allocate financial and human resources according to the relative importance of the sub-dimensions under the primary dimension. In this study, outcome quality is the most important primary dimension for favorable perceptions of overall experiential quality, followed by interaction quality, access quality and physical environment quality. When designing a measurement to evaluate the cruise tourist perception of experiential quality, cruise management should recognize that the order of importance of the primary dimensions of experiential quality may vary across different cruise organizations. In general, cruise management should concentrate on the sub-dimensions under outcome quality and improve the performance of cruise ships on the sub-dimensions according to the respondents' responses to the survey in this study. However, the sub-dimensions of interaction quality, physical environment quality and outcome quality should also be resourced, as tourists' overall perceptions of the quality of

experiences of taking the cruise ship do not only depend on the staff and tourist relationships, but also on the relationships between the service environment and tourists and between accessibility and themselves.

This study identifies 11 sub-dimensions pertaining to the four primary dimensions of experiential quality perceived by cruise tourists. In particular, it identifies the comparative importance of the 11 sub-dimensions in cruise tourists' evaluation of experiential quality. Among the 11 sub-dimensions, staff performance is considered important for perceived interaction quality, thus particular attention should be paid to the recruitment, selection and training of ongoing attitudes, behavior and expertise of the staff, as suggested by Wu et al. (2018). Tangibles appear important for perceptions of physical environment quality. Cruise management should allocate more resources to improve the tangibles, making an effort to provide a variety to satisfy the cruise tourists' demands and understand what kind of tangibles the majority of cruise tourists prefer to see and use on the cruise ship. Pleasant ride has been identified as an important component of perceived outcome quality. Cruise management should realize that creating the pleasant ride positively influences tourists' overall perceived experiential quality on the cruise ship. Convenient access seems an important component of perceived access quality. To attract more tourists to take the cruise ship, cruise management should provide tourists with the means to easily obtain up-to-date information about activities, promotions and other services. In addition, cruise management may provide tourists with news from mass media and positive word-of-mouth from their friends and relatives to enable them to have easy access to the cruise harbor.

7. Limitations and directions for future research

Although this study provides a number of important contributions to marketing theory and for cruise management, there are some key limitations and directions for future research. First, in spite of the amount of literature on experiential quality, it has been difficult to offer a full description of the nature of the experiential quality construct in the cruise ship industry. Despite this difficulty, the study conducted in-depth focus group interviews to identify and examine all dimensions of experiential quality as perceived by cruise tourists, because focus group interviews are believed to be more useful than relying on only a literature review. However, there may be some other primary and sub-dimensions of experiential quality that have not been identified in the conceptual framework of this study. Future studies should seek to identify additional primary dimensions (e.g. accommodation quality, administrative quality, program quality, venue quality and so on) and sub-dimensions (e.g. amenity, cleanliness, operating time, range of service, reliability support and so on) of experiential quality that significantly influence cruise tourists' perceived experiential quality that have not been identified in this study.

Second, the data were collected from the tourists who completed the cruise tour on Victoria Harbor in Hong Kong only. However, these cruise tourists' perceived experiential quality, experiential value, trust, corporate reputation, experiential satisfaction, behavioral intention, and the primary and sub dimensions of experiential quality may be different from cruise tourists' perceptions of these constructs in other regions or countries. Therefore, the findings cannot be generalized for other regions or countries. When applying the results of this study to other regions or countries, future studies should seriously consider cruise tourists' perceptual differences due to the existence of cultural or regional issues.

Third, since exploratory research and research testing theory are used for this study, the convenience sampling design is a suitable method as it provides a fundamental base for further research. However, caution must be used when generalizing the results of this study from a convenience sample. Future studies should consider developing a systematic design such as probability sampling to better represent the target sample. For example, if possible, the surveyors can stand around the exit of the cruise harbor and then ask every fifth person completing the cruise tour to respond to several questions about their overall experience on the cruise ship. Through the systematic sampling, the researchers can guarantee that each unit of the sample can represent an equal portion of the whole population, as suggested by Jawale (2012).

Fourth, this study does not focus on examining the effects of demographic factors on experiential quality and related constructs as perceived by tourists in the Hong Kong cruise ship industry. Future studies should consider compare cruise tourists' experiential quality and related constructs using demographic factors such as gender, marital status, age, educational level, monthly income and occupation.

Fifth, there are some potential relationships that are omitted from the SEM even though this study examines the relationships among experiential quality, experiential value, trust, corporate reputation, experiential satisfaction and behavioral intentions. For example, several researchers have suggested that there are undoubtedly other constructs which drive cruise tourists' behavioral intentions (e.g. attitudes, flow, image, involvement, enjoyment, emotion, equity and switching cost) (e.g. Clemes et al., 2013, 2009; Hutchinson, Lai, & Wang, 2009; Kang, Tang, Lee, & Bosselman, 2012; Kim, Ahn, & Chung, 2013). These relationships were not explored in this study. Future researchers may use the study as a framework to examine whether these unexplored constructs will influence behavioral intentions in the cruise ship industry.

Note of contribution

Dr. Hung-Che Wu is in charge of this study. He made substantial contributions on the research idea, research design, interpretation of the data results, manuscript writing and revision, and responding to the comments. Dr. Ching-Chan Cheng is the corresponding author and in charge of this paper on the structure and direction, data acquisition and analysis. Dr. Chi-Han Ai contributed this paper in theory development and editing the manuscript. All authors wrote the manuscript, discussed the results and gave final approval of the version to be submitted.

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Research article

An improved spatial subsidy approach for ecological compensation in coastal seascapes for resilient land-sea management

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ABSTRACT

Human activities are considered a critical impact factor for decision-making in coupled human-nature systems, such as conservation of coastal systems. Identifying key human activities that cause significant habitat degradation for coastal species remains challenging. We improved the spatial subsidy approach to identify and prioritize control strategies for human-caused distribution shifts of marine species. We applied this method to a threatened Indo-Pacific humpback dolphin (*Sousa chinensis*) in Xiamen Bay, China. Our results indicate that (1) a significant distribution shift for humpback dolphins from existing nature reserves to peripheral waters occurred from 2011 to 2014; (2) coastal tourism and industrial and urban construction had more significant negative impacts on humpback dolphins than maritime transportation and reclamation; and (3) proactive management should be implemented for maritime transportation and reclamation, while reactive management should be implemented for coastal tourism and industrial and urban construction. Human impact analysis, combined with spatially explicit modeling, contributes to determining the spatial alternatives for conservation planning. In response to possible ecological damage caused by human activities, the improved spatial subsidy results help provide knowledge and platforms for ecological compensation.

1. Introduction

The lack of trade-offs between human exploitation and environmental protection has resulted in increasingly undesirable impacts on the ocean, leading to the degradation and even collapse of marine ecosystems (Frazão Santos et al., 2018; O'Hara et al., 2019; Halpern et al., 2019). Prominent recent initiatives, including the United Nations Sustainable Development Goal 14 (SDG 14), emphasized the importance of sustainable management and protection in avoiding significant adverse impacts on marine and coastal ecosystems. To achieve SDG 14, decision-makers need detailed maps of where to prioritize human activities and mitigate their impacts (Douvere, 2008), as this information is essential to determine the responsibilities for protection and engage stakeholders in co-management. More recent attention has been paid to managing multiple marine spatial uses, especially in coastal areas where human activities highly threaten species and ecosystems (Jones et al., 2020; Todd et al., 2019). However, the human dimension remains a missing layer in decision-making because of the challenges in identifying the human activities that cause habitat degradation (Brown et al., 2017). Scientific attention should be given to understanding and quantifying the relationship between human activities and seascapes (Pittman, 2018).

A spatial subsidy is the net balance between environmental provisions (e.g., support from habitat to species) and human gains (e.g., ecosystem services from species to humans) (Semmens et al., 2011). With the shift from exploitation to conservation on land, the existing spatial subsidy framework has become increasingly important for terrestrial conservation and payment for ecosystem services (McCauley et al., 2015). Based on the spatial distribution of ecosystem services, the spatial subsidy approach incorporates human dimensions into landscape ecology. This approach contributes to establishing payment markets for place-based and species-based conservation (Bagstad et al., 2019).

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However, this approach has seldom been applied in a marine setting due to the complexity in the valuation of marine ecosystem services, especially for ecosystem services such as marine biodiversity maintenance or marine esthetic values. Therefore, it remains difficult to identify stakeholders who receive payment of marine ecosystem services. Meanwhile, the delayed defaunation in the oceans today, resulting from intensifying marine development activities and rapid environmental change, looks similar to that observed on land before the industrial revolution (McCauley et al., 2015). This degradation may represent an ignored threat to conservation. Due to this difference in the pace of habitat degradation, the human impacts on the ocean urgently need to be identified to improve the spatial subsidy approach to further incorporate human dimensions and identify responsible parties.

Marine species with high site fidelity are vulnerable to threats of population declines, particularly when those species occupy habitats with significant anthropogenic threats, such as the Indo-Pacific humpback dolphins (*Sousa chinensis*), which exclusively inhabit coastal and estuarine waters (Gui et al., 2017). This species was categorized as *vulnerable* (VU) in the IUCN Red List of Threatened species. In China, this species was listed as the First Order of the National Key Protected Wild Aquatic Animals. For instance, the continuous rate of population decline in the Pearl River Estuary, China, which has the world's largest population, is 2.46% per year (Huang et al., 2012). Humpback dolphins are susceptible to human activities, including reclamation, vessel traffic, underwater explosions, and land-based pollution (Huang et al., 2019; Xu et al., 2015). However, the specific responsibilities of different parties for the conservation of humpback dolphins are seldom investigated.

In the present study, we focus on the human impacts on the distribution patterns of humpback dolphins and identify the human activities responsible for conservation based on the spatial subsidy approach. The goals of the present study are to (1) characterize the spatial-temporal distribution patterns of humpback dolphins; (2) explain the distribution shifts based on human impacts; and (3) improve the ability of the spatial subsidy approach to identify and prioritize control strategies.

2. Methods

To identify human activities that should be responsible for the distribution shift of humpback dolphins, we improved the spatial subsidy framework to analyze the distribution shifts of humpback dolphins among marine functional zones. We estimated the baseline level for conservation according to the marine functional zone designed for providing the best trade-off between ecological and economic benefits, from which we could identify the positive or negative impacts on humpback dolphins from human activities in other marine functional zones.

2.1. Study area

Xiamen Bay is a semi-enclosed bay located on the southeastern coast of China. Xiamen Bay includes eastern areas (including Tong'an Bay, the Dadeng-Xiaodeng region, and Weitou Bay) with sandy substrate and western areas (including Western Harbor and Jiulong River Estuary), which are characterized by estuarine processes (Wang et al., 2015). As one of the special economic zones in China, Xiamen city has experienced rapid population growth over the past four decades. The ocean features the city's economic resources, with the marine economy being a vital part of Xiamen's economy, such as shipping, ports, coastal tourism, and industry. Meanwhile, the adjacent sea area is home to nearly 2000 marine species, including protected species such as humpback dolphins, finless porpoises (*Neophocaena asiaeorientalis sunmeri*), sea turtles, amphioxi and *Limulus* spp. (Winther et al., 2020). Therefore, Xiamen is a typical coastal city that faces significant challenges to balance economic growth and environmental protection for sustainable development.

Tong'an Bay and Western Harbor, which contained the highest local concentrations of humpback dolphins during the 1990s, were designated core areas of the National Nature Reserve for humpback dolphins in 2000. However, the national nature reserve has already shown mismatches with hotspots for humpback dolphins since 2010 (Fig. 1). Furthermore, intensive human activities such as land reclamation, coastal modification, harbor construction, shipping and dredging (Fig. 1) may change the spatial patterns of coastal characteristics such as the geomorphological and hydrological processes in the home range of humpback dolphins. Therefore, the conservation of marine species such as humpback dolphins may be more complicated than that of terrestrial animals.

2.2. Data collection

We identified human activities in Xiamen Bay according to the "Marine functional zoning of Fujian (2011–2020)". Marine functional zoning is an integrated approach to balance development demands and protection needs by establishing a rational organization of sea use (Douvere, 2008). For humpback dolphins, western habitats mainly comprise tourism zones, ports, harbors, and shipping lanes, while eastern habitats mainly include industrial and urban construction zones, marine protected areas, and special-purpose zones. Reclamation zones (approved by government) and reserved zones are dispersed throughout Xiamen Bay. In particular, special-purpose zones and reserved zones are mainly planned for ecological conservation and rehabilitation in Xiamen, while reserved zones are also planned for human activities (e.g., marine transportation and submarine pipeline construction).

For distribution patterns of humpback dolphins in Xiamen Bay, we used monthly sighting data from field surveys from January 2011 to December 2014, which resulted in a total of 48 census surveys; each survey covered the entire Xiamen Bay (Wang et al., 2015). Overall, a total of 131 sightings of humpback dolphins were recorded, with an average group size of 5.48 $\pm$ 2.85 individuals. The 2nd sighting of the same dolphin group within a single survey was not included in the analysis to ensure the independence of sampling and minimize autocorrelation between sightings. All GPS coordinates were projected to the UTM50N coordinate system using ArcGIS software for subsequent analyses.

2.3. Detecting spatial-temporal population dynamics under human disturbance

2.3.1. Detection of species dimensions

We used the kernel method in ArcGIS v 10.2 (ESRI, Redlands, CA, USA) to quantify the distribution patterns, as this method provides a probabilistic model to fit a smoothly tapered surface and free the estimation from parametric assumptions. We used sightings for groups rather than individuals to estimate the yearly occurrence hotspots of humpback dolphins in 2011, 2012, 2013, and 2014. The 95% and 50% kernel ranges of the sighting position records were selected by the Geospatial Modelling Environment (http://www.spatialecology.com/gme/index.htm) in ArcGIS, which are generally considered the most robust estimators of animals' home ranges and core areas, respectively (Parra et al., 2006). Finally, we obtained the distribution patterns of humpback dolphins in Xiamen Bay by setting an analysis mask. We subtracted any landmass within the kernel range from the final range estimation.

2.3.2. Human dimension detection

To further explore the impacts of different sea use types, we performed overlay analysis based on marine functional zones and the home range of humpback dolphins. Based on the overlapping layers, we (1) generated 50 random points inside polygon features for each sea use type with the Create Random Points tool in ArcGIS (1400 points in total); (2) obtained the kernel density value for each point with the Extract Value to Points tool in ArcGIS (1400 values in total); and (3) performed descriptive analysis and one-way ANOVA in OriginPro 2016.

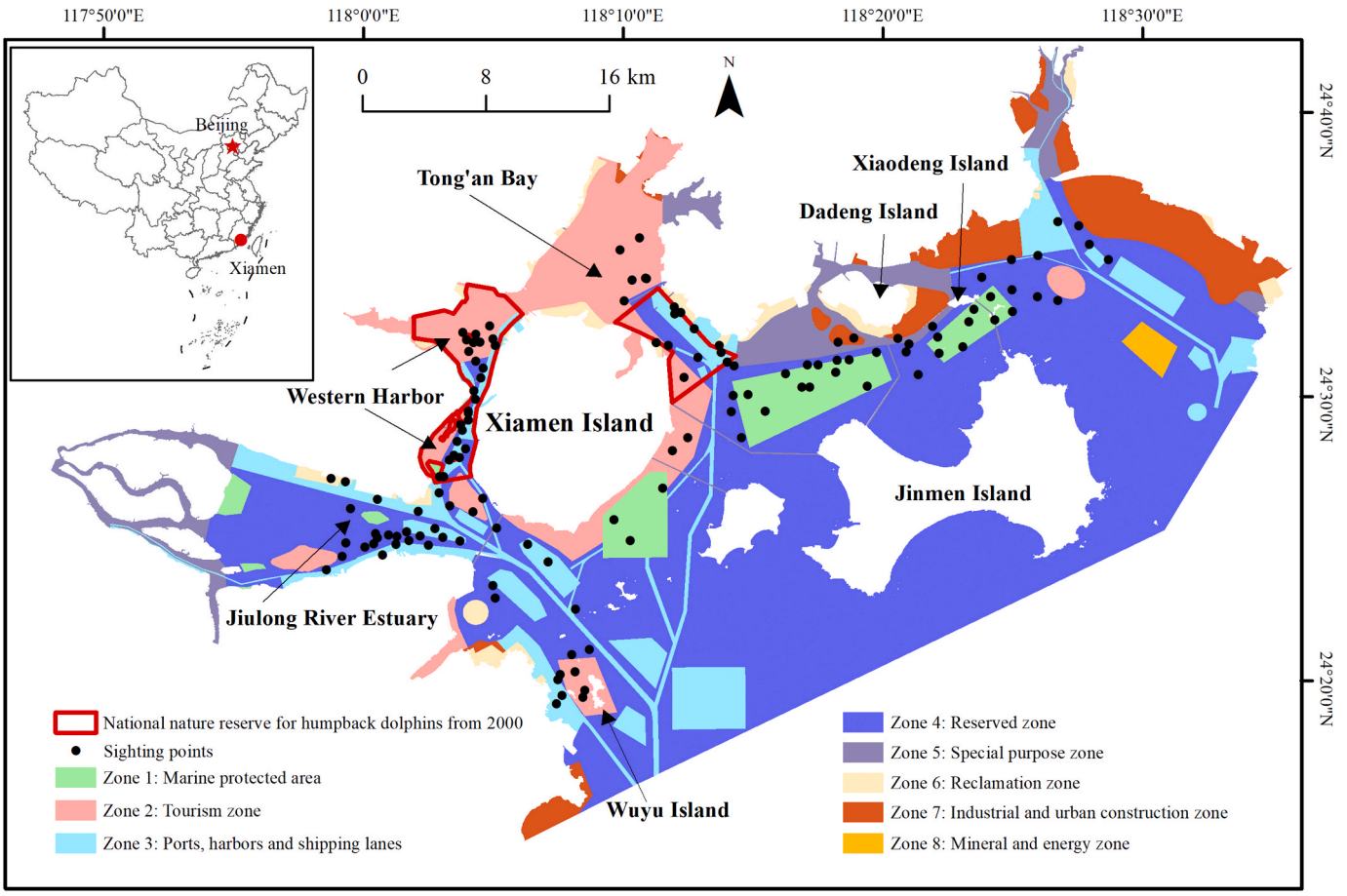

Fig. 1. Location of Xiamen bay.

We also estimated the proximity distances from these random points to the nearest artificial shoreline to explore and exclude the impacts from terrestrial areas.

2.3.3. Connection among different sea use types according to spatial subsidy

We combined the distribution characteristics of humpback dolphins in 2011–2014 into a single metric of human impact (H_i) for each marine functional zone with the following formula:

$$H_i = 0.5 \times KDV_i + 0.5 \times VKDV_i \quad (1)$$

KDV_i is the mean kernel density value in the functional zone i in 2011–2014; $VKDV_i$ is the variation in the kernel density value between 2011 and 2014, and a positive $VKDV_i$ value indicates a net increase in the kernel density value from 2011 to 2014. Considering the negative $VKDV_i$ values, all indices were processed and normalized between 0 and 1 before further processing through formula (2):

$$X_j' = \left(\max(X_j) - X_j\right) \Big/ \left(\max(X_j) - \min(X_j)\right) \quad (2)$$

According to the spatial subsidy approach (Semmens et al., 2018), we quantified the net benefits in marine functional zone i (spatial subsidy, Y_i) by the following formula:

$$Y_i = M_{si} - M_{Hi} = H_m - H_i \quad (3)$$

M_{Si} is the gross support from zone i for the species; M_{Hi} is the gross support from zone i for humans. H_m indicates the human impacts in the marine functional zone m, which balances the economic demands and protection considerations. A positive (or negative) Y_i value indicates that the sea area in zone i provides more (or less) support for dolphin occurrence than the marine functional zone m (Fig. 2).

3. Results

3.1. A shift in the distribution from inner harbors to peripheral waters

Since 2010, humpback dolphins have migrated from inner harbors to southern and eastern waters extending beyond the core zone of the National Nature Reserve. The distribution range of humpback dolphins

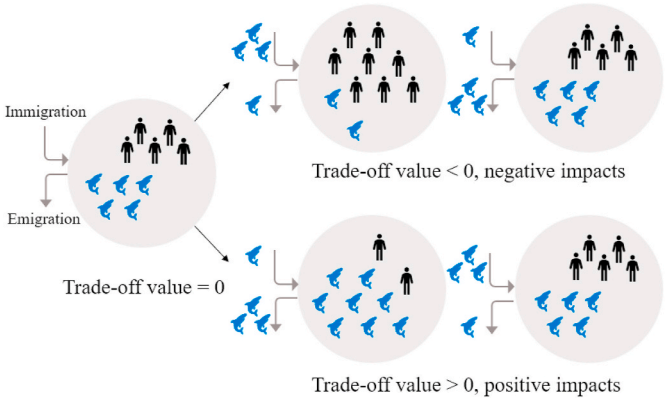

Fig. 2. Five trade-off scenarios at different marine functional zones: trade-off value = 0, marine functional zone m designed to provide the best trade-off between ecological and economic benefits; trade-off value > 0, group density is (will be) higher than that in marine functional zone m; trade-off value < 0, group density is (will be) lower than that in marine functional zone m.

showed an increasing trend from 2011 to 2014, and the home range (95% kernel density range) and core area (50% kernel density range) increased from 446.3 km^2 to 464.9 km^2 and 128.5 km^2 to 160.0 km^2, respectively (Table 1). The core area (140.8 ± 20.6 km^2), which includes the Western Harbor, Tong'an Bay, Wuyu and Dadeng-Xiaodeng regions, is more than twice the size of the core zone of the National Nature Reserve (54.9 km^2) (Table 1). In addition to Western Harbor and Tong'an Bay, which are regarded as the core zones of the nature reserve, humpback dolphins have moved to Dadeng-Xiaodeng waters (permanent hotspots) and Wuyu waters (non-permanent hotspots), which reflect the difference between southern and eastern waters as newly suitable habitats. There was a significant shift in species distribution among marine functional zones: humpback dolphins that used to inhabit sea areas such as tourism zones (28%–13% of the core area from 2011 to 2014) moved to peripheral areas such as reserved zones (32%–52% of the core area from 2011 to 2014) (Fig. 3).

3.2. Distribution shifts among marine functional zones

Sea areas used for maritime transportation and special purposes are of ecological importance to humpback dolphins because of their high group density or growth potential. Except for the relatively high group density (KDV of 0.06), the dolphin population in the sea area used for maritime transportation remained stable according to one-way ANOVA. The KDV increased most in the special-purpose zone (VKDV of 0.01). Moreover, this sea area also supported a relatively high group density (KDV of 0.05). In addition, the group density in sea area for reclamation remained stable (VKDV of 0) and low (Fig. 4).

Nevertheless, a significant decreasing trend of group density was observed in marine protected areas (KDV of 0.06; VKDV of −0.03; VKDVs for tourism zones, reserved zones, ports, harbors and shipping lanes, special-purpose zones, industrial and urban construction zones, and reclamation zones are −0.03, −0.02, −0.01, 0.01, 0.01, and 0, respectively). Meanwhile, the dolphin population showed a decreasing trend of group density in the reserved zone, which is located in southern and eastern open waters (VKDV of −0.02) (Fig. 5). Additionally, the lowest group density was observed in the sea area used for industrial and urban construction (KDV of 0.04), which is near the special-purpose zone.

3.3. Trade-off between environment-species benefits and environment-human benefits

Coastal tourism and industrial and urban construction have more responsibility for protecting humpback dolphins than maritime transportation and special-purpose zones (Fig. 6). We defined marine protected areas as marine functional zone *m* (the trade-off value for marine functional zone *m* is 0), which is designed to provide the best trade-off between ecological and economic benefits. Depending on the trade-off value, the sea areas used for maritime transportation, special purposes, and reclamation have a positive value, indicating that the sea areas for these human activities can provide more support for population viability than the marine protected area. Conversely, the tourism zone and reserved zone, or the industrial and urban construction zone (trade-off values are −0.17, −0.13 and −0.13, respectively) have negative values, indicating a negative impact on humpback dolphins compared to the impact of the marine protected area.

Table 1
Temporal changes in the geographical distribution of humpback dolphins in Xiamen Bay from 2011 to 2014 (km^2).

Year	Home range	Core area
2011	446.3	128.5
2012	453.8	113.4
2013	451.4	161.4
2014	464.9	160.0
Mean ± SD	454.1 ± 6.8	140.8 ± 20.6

4. Discussion

4.1. Incorporation of human impacts into coastal seascapes

Human activities play a progressively critical role in reshaping the seascape structure by potentially altering oceanographic characteristics and impacting regional marine ecosystem functions and hence habitat configuration (Huang et al., 2019). Marine functional zoning of ecological functions and prior use can represent the spatial heterogeneity in marine socio-ecological systems. Hence, we used this approach as an experimental control to identify the regional management units (Barrios-Garrido et al., 2020) and evaluate the impact of extractive human activities on marine ecosystems. Except for the difference in water quality between the eastern and western waters (Su and Peng, 2018), our approach revealed the human causes of the distribution shifts of humpback dolphins. For example, we found that there was no significant difference in distribution patterns between the western tourism zone and the eastern protected area (VKDV is −0.03 for both). Furthermore, we found that humpback dolphins in the eastern waters exhibited different temporal dynamics, with opposite group density dynamics in special-purpose zones (or industrial and urban construction zones) and marine protected areas. Although maritime transportation may cause degradation of water quality (Table 2), it seems that other reasons, such as high-speed vessels, are the primary concern for humpback dolphins, which may disrupt their behavior and social life and even cause vessel collisions and incidental mortality (Chen et al., 2009). As a result, the speed and routing restrictions for marine transportation in Xiamen implemented in 2003 have proved effective for conservation management of humpback dolphins. The proximity distance from marine functional zones to the artificial coastline further showed that the negative impacts were mostly from marine human uses. This conclusion was reached because there was no obvious difference in proximity distance to the artificial coastline between industrial and urban construction zones and special-purpose zones (nearest distances to the artificial coastline were 1058 m and 1166 m, respectively) compared to the reclamation zone (nearest distance to the artificial coastline was 255 m), but industrial and urban construction had more negative impacts on dolphins.

The present study suggested that the conservation plan for humpback dolphins in Xiamen Bay needs to be adjusted because the core area of the National Nature Reserve is not large enough to protect the hotspots with high abundances of humpback dolphins since 2010. Our results revealed that humpback dolphins expanded their range from inner harbors to peripheral waters, which may have been in response to human impacts because of the consistent tendency to avoid artificial shorelines at the same time. Since the shallow-water coastal habitats facilitate natural aggregations of their prey, the shift in dolphin distribution from these areas to peripheral areas results in food scarcity and the co-occurrence of distribution shifts and population decline (Karczmarski et al., 2016), indicating a negative impact from distribution shifts. In terms of habitat loss, indirect impacts of human activities have been neglected, such as food scarcity and thermal stress. Previous studies have proposed that the Wuyu region will become an important area for conservation in the future (Wang et al., 2015); however, we found that the Wuyu region did not overlap with the 50% kernel density range in 2012 and 2013, which does not support the location's ability to be a permanent and long-lasting habitat for conservation. Therefore, future conservation plans should further explore the difference between the two areas to be used as refuge habitats. Humpback dolphins are great indicators of general ecosystem health (Lopes-Lima et al., 2020). Charging for ocean degradation based on human-caused shifts in dolphin distribution can help systematically engage stakeholders to adopt a systematic framework from environmental impact assessments to

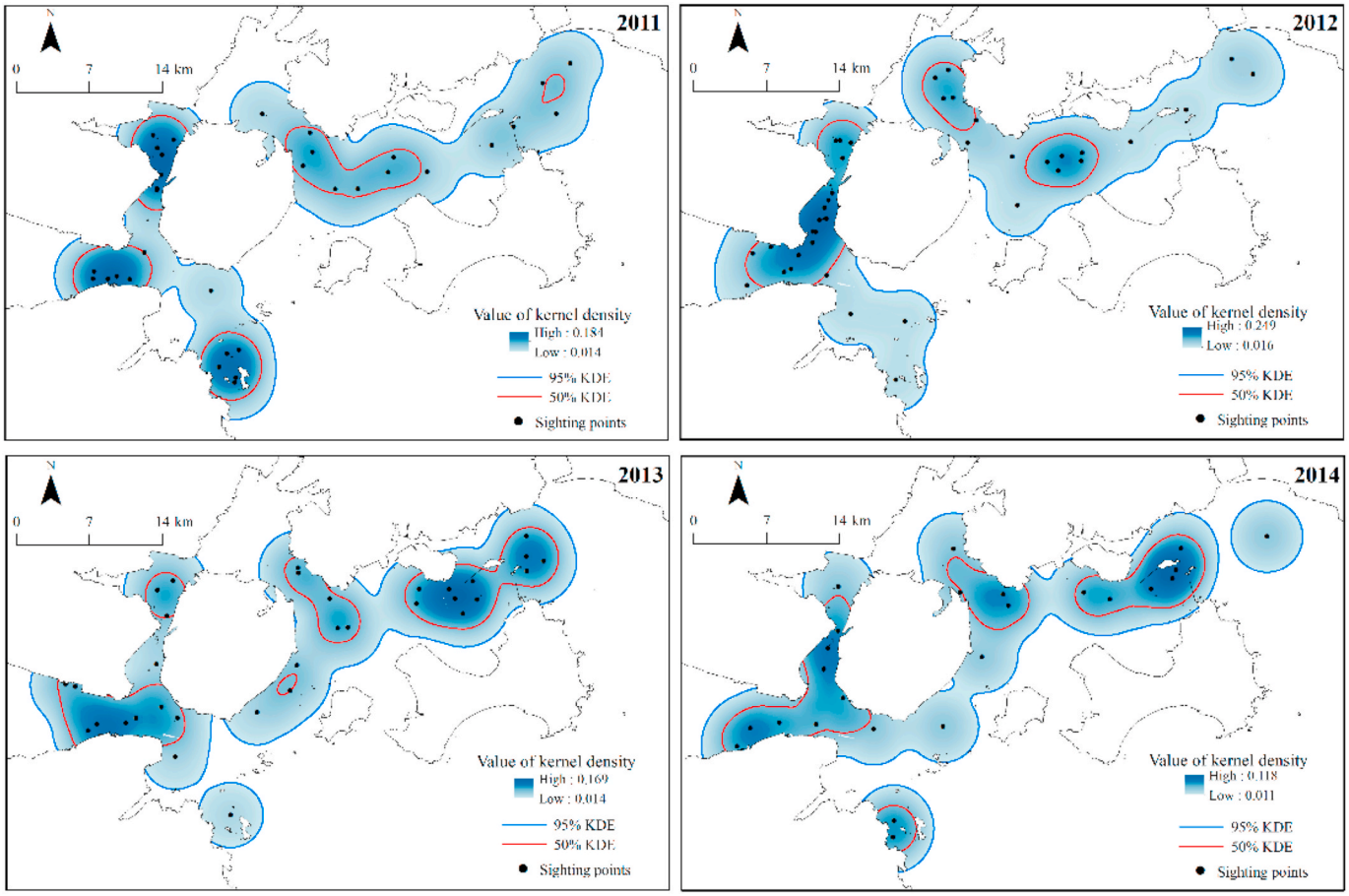

Fig. 3. Spatial patterns of the geographical distribution of humpback dolphins in Xiamen Bay from 2011 to 2014. KDE represents the kernel density estimates of humpback dolphins in Xiamen Bay.

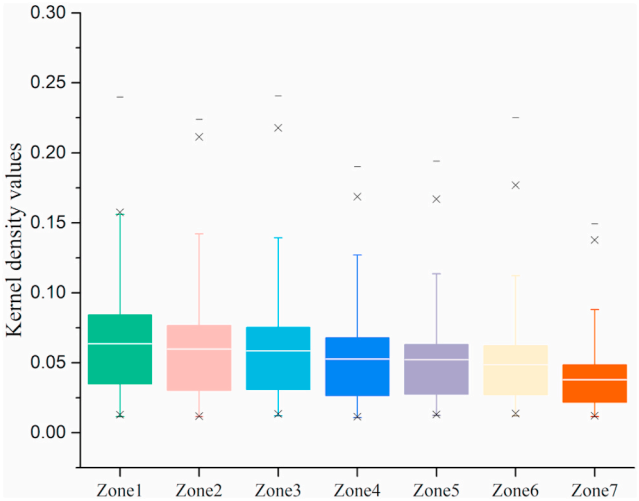

Fig. 4. Differences in the geographical distributions of humpback dolphins among marine functional zones. Zones 1 to 7 represent marine protected areas; tourism zones; ports, harbors and shipping lanes; reserved zones; special-purpose zones; reclamation zones; and industrial and urban construction zones, respectively. The mineral and energy zones have been removed from statistical analysis since this area fell outside the estimated distribution range of humpback dolphins between 2011 and 2014.

environmental mitigation measures. Distribution shifts between different development and utilization zones also indicate the connections among authorities responsible for individual activities or protection. However, a more robust assessment of ocean degradation awaits more biological and ecological essential ocean variables (EOVs) (Miloslavich et al., 2018).

4.2. *Improved spatial subsidy approach in bay areas*

Based on ecosystem services, existing research on spatial subsidy has quantified the ability of habitats to support the population viability of terrestrial species, including Mexican free-tailed bats (*Leptonycteris curasoae*), monarch butterflies (*Danaus plexippus*) (López-Hoffman et al., 2017) and migratory birds (Kleemann et al., 2020). However, since the receivers of marine ecosystem services are located on land, it remains challenging to measure the ecosystem services provided by marine species because of the location mismatches and difficulty in incorporating land-sea connections (Townsend et al., 2018). Moreover, the complexity and dynamics of marine ecosystems make it difficult to evaluate ecosystem services and calculate the spatial subsidy. For example, for humpback dolphins, the challenges that are faced include measuring and experimentally manipulating the number of terrestrial users, their preferences and desires to encounter or see humpback dolphins or their actual costs and willingness to pay for them (Arbieu et al., 2018; Ament et al., 2017; Balmford et al., 2015; Di Minin and Moilanen, 2014; Naidoo et al., 2016). Therefore, we need to propose a new method to quantify environmental supply. Additionally, efforts to preemptively zone human activities that affect marine wildlife can be promoted to enable proactive management.

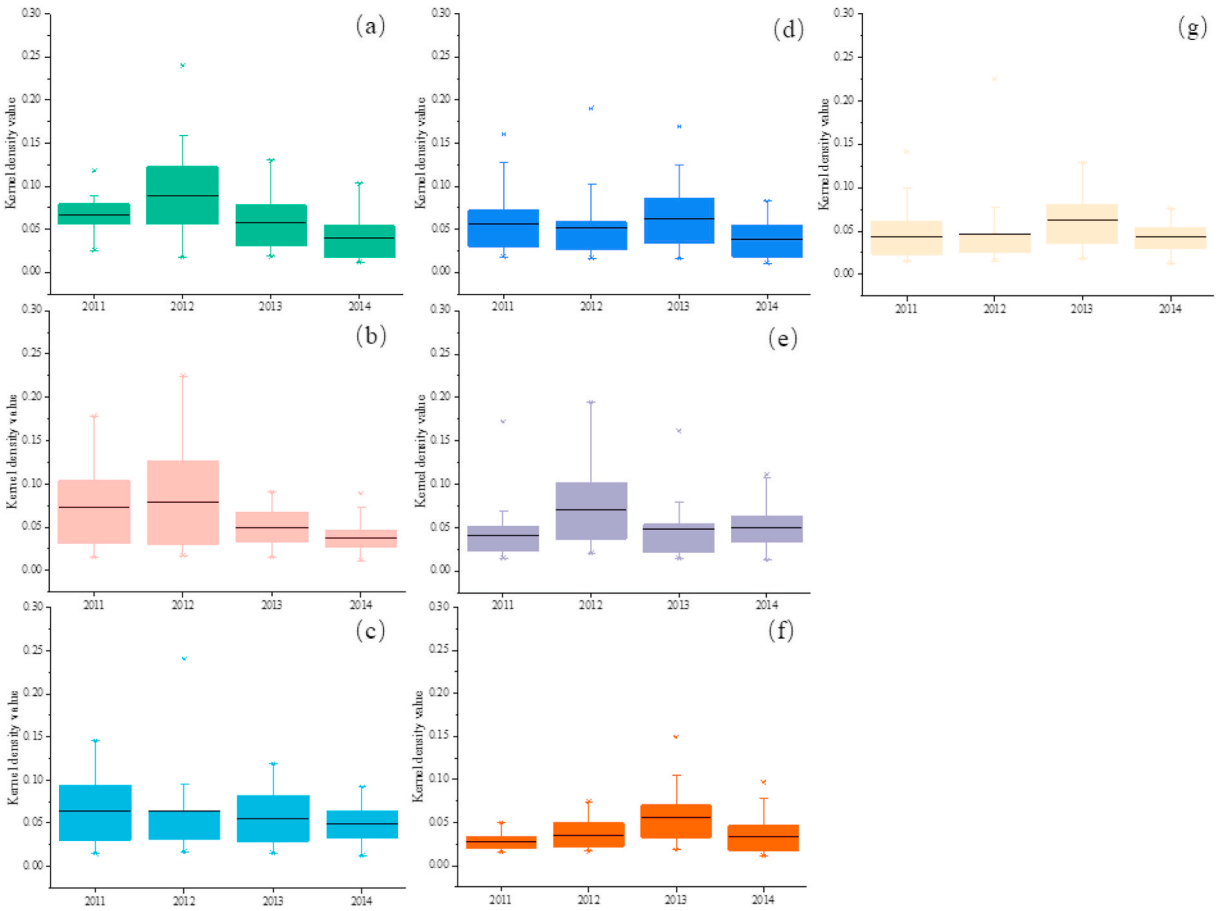

Fig. 5. The differences in the geographical distribution of humpback dolphins among years. (a)–(g) are the kernel density values for marine protected areas; tourism zones; ports, harbors and shipping lanes; reserved zones; special-purpose zones; industrial and urban construction zones and reclamation zones, respectively. Comparing results in 2014 to it in 2011, the kernel density value decreased in graph (a)–(d), the density value increased in (e) and (f), the kernel density value of (g) remained unchanged.

Sufficient data can further develop and incorporate spatial subsidy into conservation planning (Semmens et al., 2018). For migratory species that travel long distances between distinct habitats, the ecological importance of habitats can be estimated by various ecological models (demographic models, metapopulation models, pattern-oriented models, *etc*.) (Wiederholt et al., 2018; Oberhauser et al., 2017). This approach is used because demographic information (e.g., demographic parameters and population numbers) at each stage of the migration cycle is particularly difficult to obtain. Hence, the difficulty in collecting data for each habitat to develop a spatially explicit population model will affect the setting of conservation priorities. Occurrence data could be made more available for those charismatic, endangered, or economically important species that are most well studied and monitored (Semmens et al., 2011) (e.g., humpback dolphins). Therefore, it will become increasingly important to improve the accuracy of the estimation to determine the relative importance of portions of the species' range based on occurrence data (Wiederholt et al., 2013; Earl et al., 2017). Here, through systematically designed surveys, distribution information of humpback dolphins serve as a key baseline to delineate protected area designs, refine impact mitigation measures and define habitat protection plans (Huang et al., 2019). However, it must be noted that environmental and biological data are needed in further studies to explore the impacts on marine habitats caused by pollution and food resources.

Based on the trade-off value, we improved the spatial subsidy approach and revaluated the environmental provisions and human gains. Using ecological damage compensation, we further provide responsible parties with an efficient and flexible way to remedy and compensate for their negative effects on ecosystems, enhancing the practice of the spatial subsidy approach (see Table 3 for proposed measures seperated by zones). Reactive management should be devoted to reserved zones and tourism zones or the industrial and urban construction zones where negative impacts have already occurred. Industrial-urban construction zones are mainly located around new occurrence hotspots. For marine functional zones with negative values, we suggest that the relevant ocean users pay more for the conservation of humpback dolphins than ocean users in marine functional zones that support population viability (e.g., special-purpose zones, marine protected areas, or ports and harbors). Conservation funding should be used for the proactive conservation of sea areas for transportation, special purposes, reclamation and protection to ensure a better environment for the animals, such as regional control of vessel speed (Table 3). In terms of the enhanced spatial subsidy approach for marine species, we do not directly quantify the gross support from the environment to species or the gross support from the environment to humans, which should be explored in future studies.

4.3. *Resilience-based land-sea management*

Using trade-off scenarios for humpback dolphins, we can evaluate ecosystem states according to the interconnected phases in the adaptive cycle. If the trade-off value is lower than 0, there is a decrease in resilience in the marine functional zone, indicating a declining population and finally a relatively low population density when compared to the identified baseline. Taking the industrial and urban construction areas as an example, reactive management is needed to prevent further

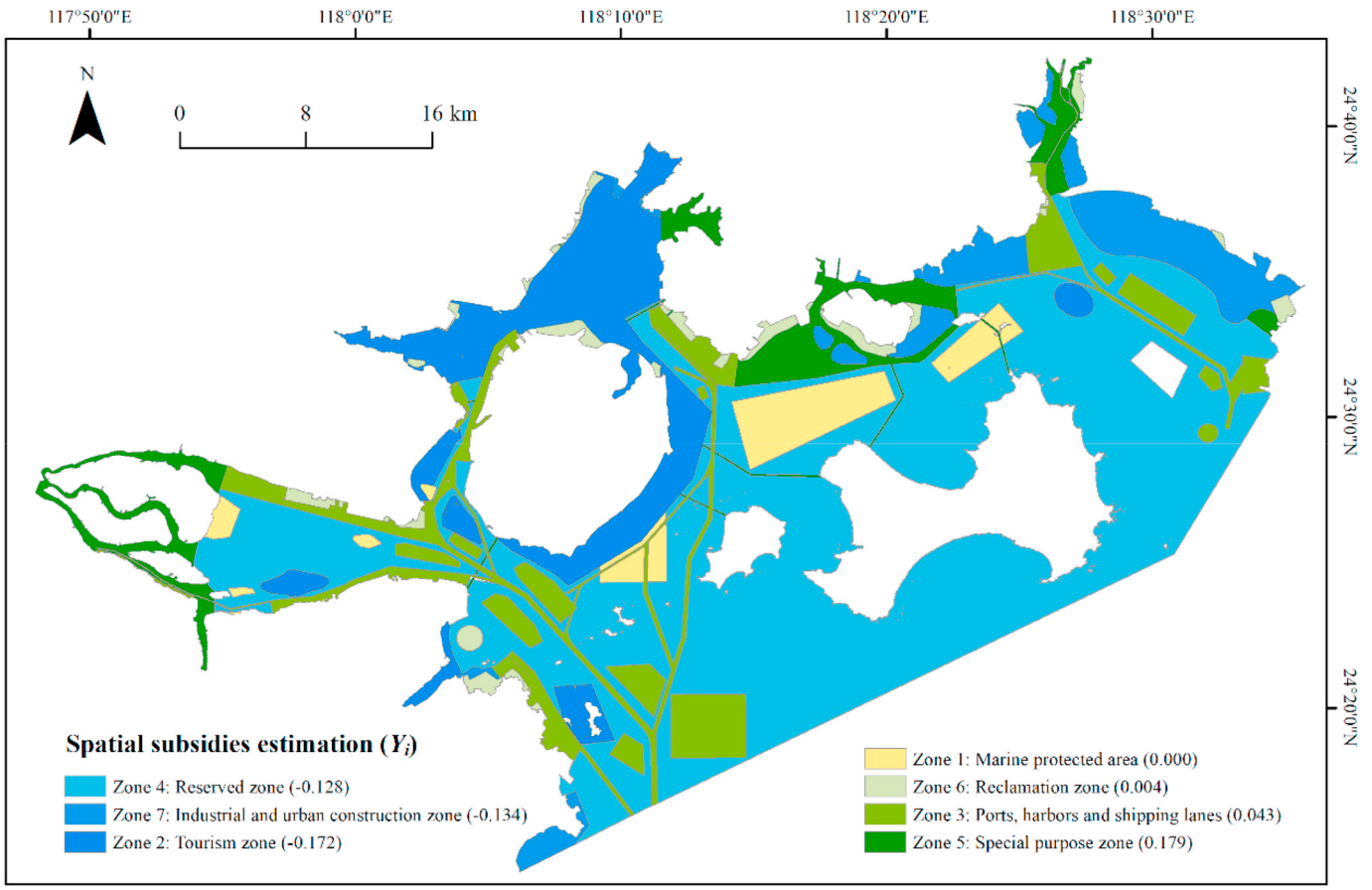

Fig. 6. Spatial subsidy between different marine functional zones. A positive (or negative) Y_i value indicates that the sea area in zone i provides more (or less) support for dolphin occurrence than the marine functional zone m (marine protected area here).

Table 2
Water quality standards for marine protection in marine functional zones (MFZs).

Marine functional zones	Sea water quality standards	Marine sediment quality standards	Marine biological quality standards
Marine protected area	Class 1	Class 1	Class 1
Tourism zone	Class 2	Class 2	Class 2
	Class 2	Class 1	Class 1
Industrial and urban construction zone	Class 3	Class 2	Class 2
Ports and harbors	Class 4	Class 3	Class 3
	Class 3	Class 2	Class 2
Reserved zone	No worse than the current state	No worse than the current state	No worse than the current state
Special-purpose zone	No worse than the current state	No worse than the current state	No worse than the current state
Reclamation zone	/	/	/

Notes: (1) Water quality standards in the marine functional zones are adapted from Fujian Provincial People's Government, 2012, Marine Functional Zoning of Fujian Province (2011–2020); (2) China has 4, 3, and 3 classes with associated designated uses for sea water quality standards, marine sediment quality standards, and marine biological quality standards, respectively. Existing uses in Class I waters have less negative impacts on the environment than those in other classes of water; (3) The design of reclamation zone doesn't involve specific management objectives, and the area will be incorporated into other marine functional zones according to future needs.

worsening of the condition. If the trade-off value is higher than 0, the interactive adaptive changes will upgrade the ecosystem into a desirable and high resilience state. Proactive management is needed for this stage.

Table 3
Summary of marine uses and proposed management measures.

Marine functional zones		Management measures
Low-impact zones	Zone 1: Marine protected areas Zone 3: Ports, harbors and shipping lanes Zone 5: Special-purpose zones Zone 6: Reclamation zones	Proactive measures such as vessel speed and route controls and marine reserve regulations; less payments are needed
High-impact zones	Zone 2: Tourism zones Zone 4: Reserved zones Zone 7: Industrial and urban construction zones	Reactive measures such as regulation of the dolphin watch industry and comprehensive control of land-based pollution; more payments are needed

For instance, we found that maritime transportation may not immediately divert or distort the distribution patterns of the dolphin community in Xiamen Bay. Meanwhile, the adaptive behavior of humpback dolphins can be further visualized by the distribution shifts among marine functional zones. It is necessary to identify the resilience characteristics of critical species in complex socio-ecological systems (Pittman, 2018).

We took land-based activities (e.g., industrial and urban construction, reclamation) into consideration to avoid substantial adverse impacts and strengthen the resilience. Due to the importance of understanding the causes and consequences of spatial patterns for management across spatially complex and interconnected land and sea systems (Álvarez-Romero et al., 2011; Boström et al., 2011), it has been increasingly realized that coastal areas need to be managed in an integrated way since they are complex systems that are under pressure from

both land and sea (Ramesh et al., 2015). However, even though the priority areas we identified enjoy formal protection, the dolphin population residing in those areas is still exposed to numerous threats, such as pollution from upstream areas, indicating the importance of integrated protection incorporating diverse groups of stakeholders on terrestrial areas (Wiederholt et al., 2015).

5. Conclusions

Considering the significant role of marine functional zoning in reshaping the spatial heterogeneity of marine socio-ecological systems, we used it as an experimental control for evaluating human impacts on the ocean. We found that the existing nature reserve boundary covered only half of the hotspots of humpback dolphins due to intensive human impacts. By defining the baseline of human impacts, we built a trade-off indicator to improve the spatial subsidy approach. Our results can guide responsible parties to remedy and compensate for their negative effects on the ocean: marine users in shipping areas, special-purpose areas, and reclamation areas should take preventive measures to maintain dolphin populations. Sea users in degraded sea areas (e.g., reserved and tourism zones or industrial and urban construction zones) should be devoted to reactive conservation. The improved spatial subsidy approach provides an effective way to identify the responsibilities of developers and better operationalize the human dimension in the environmental management of seascapes and enhance financial resources.

The management of land activities to avoid negative impacts on the ocean (e.g., pollution run-off) is urgently needed for the conservation of many coastal marine ecosystems (Halpern et al., 2019). As a result, mitigating the impacts of land-use change on water quality, critical species and coastal ecosystem services based on the land-water-biodiversity nexus (Wang et al., 2018) is important for future research. Environmental and biological data are needed in further studies to explore the terrestrial impacts on marine habitats. Finally, identifying key features (e.g., tipping points, threshold effects, and regime shifts) to make critical species inherently resilient in complex socio-ecological systems will be high priorities in future applications for resilience-based management.

CRediT authorship contribution statement

Yangfan Li: Conceptualization, Writing - original draft. **Zhiyuan Xiang:** Conceptualization, Writing - original draft. **Keliang Chen:** Writing - review & editing. **Xianyan Wang:** Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Business sector involvement in maritime spatial planning – Experiences from the Baltic Sea region

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ABSTRACT

In the European Union, Maritime Spatial Planning (MSP) has been regarded as a means of promoting the sustainable growth of the blue economy. Consequently, where the planning outcomes affect the business operations in marine areas, commercial and industry stakeholders should have an important role in the planning process. However, the business perspective in MSP has gained little attention in stakeholder involvement literature. The aim of this study is to elaborate on the business sector's interest and involvement in MSP in the Baltic Sea region. The findings are based on the first-hand experiences of MSP authorities and experts. Furthermore, perspectives from two sea-use sectors, maritime transport and marine tourism, have been investigated using online questionnaires to discover their views. The study focuses on the questions of who to involve and what are the driving forces promoting business sector involvement. Even though MSP is a form of broad-scale planning, the results indicate that all spatial and organisational scales from local to international and from small enterprises to umbrella organisations should be considered when designing approach to business stakeholder participation. The planning authorities need to consider what are the benefits and challenges of involving different types of business stakeholders. Planners often rely on organisations that represent business stakeholders and individual companies. It is resource effective to interact with representatives as they are considered to have a wide and general knowledge of the respective sector's interests. However, in some cases it is beneficial to also integrate individual companies, especially in local or regional contexts.

1. Introduction

Stakeholder involvement is an inseparable part of the ecosystem approach, which is one of the general principles of the United Nations Convention on Biological Diversity [1]. According to Long et al. [2], the ecosystem-based management *"recognizes coupled social-ecological systems with stakeholders involved in an integrated and adaptive management process where decisions reflect societal choice"*. Maritime Spatial Planning (MSP), which in turn is one of the cross-cutting tools of the European Union's (EU) integrated maritime policies, applies the principle of the ecosystem-based management [3]. Thus, MSP reflects the paradigm shift from authoritarian government to governance which includes societal actors [4]. This highlights the need to increase democracy in decision-making and the role of the stakeholders in the effective promotion of sustainable development [3,5,6].

While the definitions of the term 'stakeholder' vary, in broad terms the stakeholders in MSP are individuals or groups of people having an interest in or being affected by the outcomes of the MSP (e.g. [3,5,7,8]). One of the key questions in stakeholder analysis and inclusion is to define who is entitled to participate, and in which phases of the MSP process (e.g. [5,9]). According to Morf et al. [4], the consideration of 'who' should be involved is based on the question 'why' the stakeholders are involved in the first place, which further influences the decision on 'how' to involve them. The objectives of the planning therefore should have a profound influence on the stakeholder selection [10]. Guidelines and recommendations on 'how' to include stakeholders in both national and transboundary MSP are available (e.g. [7,11,12]). Despite the general principles and guidance, the realities of the participatory processes and stakeholder involvement vary in different countries, and gaps between MSP theory and its practical implementation have been observed (see [8,9,13–21]).

The EU's integrated maritime policy regards MSP as a means of

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promoting the growth of the blue economy [22]. Potentially, MSP is a tool which can integrate and address the growth potential of both the emerging sectors and the traditional branches of blue economies [23]. On the other hand, criticism towards the neoliberalist logic of the blue growth concept and its inconsistencies with the environmental and social sustainability has been expressed (e.g. [16,17]). In the complex realm of marine activities, where different stakeholders have a variety of motivations for participating, as well as differing capacities and resources, the stakeholders may not be able to participate as expected or have ambivalent attitudes towards MSP [24]. The more capable and powerful stakeholders may be overrepresented in planning processes and may have a strong effect both on the objectives as well as the results of the MSP (e.g. [16]). The leading authorities should acknowledge these imbalances and "level the playing field" for different types of stakeholders [18,25–27].

The business sector is stated to be one of the most versatile and difficult group of key stakeholders to involve in MSP (e.g. [4]). Nonetheless, commercial and industry stakeholders should have an important role in MSP, as such planning affects the prerequisites of business operations in the marine and coastal areas. Their participation is important to supply the economic data as well as to reveal the scale and scope of the businesses [28]. Furthermore, as the blue businesses are the fundamental part of the coastal and maritime communities and culture, their inclusion assists the development of the welfare of the communities, and the conservation and sustainable use of the coastal and marine resources [23]. For the business sectors, especially those composed of mostly local, small and medium-sized companies, the stakes of the MSP may be high (e.g. [16,24]).

The stakeholders of MSP have been addressed in a great number of studies, covering a variety of aspects in relation to their engagement in the marine management processes (e.g. [15,21,29–36]). There are also linkages to the discussion on the participatory approaches in environmental management in general (e.g. [6] and references therein). The business sectors' perspectives have been studied, often focusing specifically on a certain business sector's views on MSP, such as fishery or offshore energy (e.g. [15,24,27,37,38]). Since the blue economy is urged to grow and as MSP has a direct and indirect impact on the operational environment of blue businesses, the role of the business community in MSP processes deserves further attention.

The aim of this study is to further elaborate on the business sector's involvement in MSP from the perspective of the organisers of the participatory activities in MSP. In other words, the study presents an overview of the planning authorities and experts who have first-hand experience of stakeholder involvement in MSP around the Baltic Sea. They are responsible for the implementation of the participatory processes in national MSP and transboundary MSP projects, which makes them key actors in the practical application of MSP. To attain the perspectives of the marine businesses, reflections regarding the involvement and interest in MSP were collected from two different types of business sectors: maritime transport and marine tourism. While both these sectors utilise marine and coastal waters nationally and in cross-border contexts in all parts of the Baltic Sea region, they have profound differences in their level of organisation and the characteristics of their business operations at sea.

2. Material and methods

2.1. MSP in the Baltic Sea region

The study was conducted in the Baltic Sea region, where the national MSP processes are in different phases of the planning cycle. The Baltic Sea coastal countries apart from the Russian Federation are member states of the EU. According to the EU's MSP directive [3], the member states need to finalise their first plans by 31 March 2021. The MSP directive represents a 'new generation' of EU legislation with broad boundaries and imprecise requirements, which allow the member states to develop very different MSP frameworks [39].

In the Baltic Sea region, national planning systems differ from each other, for instance, in terms of scale and the peremptory nature of the plans, as well as in the planning cycle frequency. Apart from Sweden and Finland, the other countries typically have legally binding national plans. In Finland and Sweden as well as partly in Germany and Latvia, MSP is conducted on a regional or local level, to some extent also overlapping with legally binding land-use planning [40].

One of the mandatory components of the MSP directive is a specification for a competent authority, which may have an effect on planning prioritisations and on how the actual planning is performed, for example in a centralised or decentralised manner [3,39,40]. The responsibility for the national MSP process has been addressed to ministries with an environmental focus (Finland, Latvia, Lithuania, Sweden) or to ministries with a more economic focus (Denmark, Estonia, Germany, Poland).

Maritime transport and marine tourism have a different status in EU's MSP directive, as the former is mentioned in the list of obligatory themes and the latter as a voluntary theme [3]. Maritime transport is an important stakeholder group as the Baltic Sea is one of the most heavily trafficked sea areas in the world [41,42]. The cargo volumes are predicted to grow simultaneously with the sizes of the ships and increasing autonomous shipping [42]. The growing vessel sizes and the optimisation of the routes will have an effect on MSP through the potential competition for space with other uses, together with a need for larger shipping lanes and more anchoring areas (e.g. [43]). The coastal and marine tourism sector, on the other hand, covers a complex web of sub-sectors including accommodation, food and drink, and leisure activities [43–45]. The importance of the tourism sector is expected to grow and is already quite substantial locally, especially in the southern Baltic Sea [46]. In general, the sustainable approach to the development of tourism in the Baltic Sea region is seen as a strength, and there is considerable potential for the development of nature tourism destinations [46], which in coastal and marine waters potentially belongs to the scope of the MSP.

2.2. Survey methods

2.2.1. Interviews

The study is founded on the interviews with planning authorities and experts. The main group of interviewees represented the maritime spatial planning agencies responsible for implementing MSP. A total of 13 people were identified via an internet search, comprised of representatives from all eight EU member states around the Baltic Sea. As a result, the interviewees represented five countries: Denmark, Estonia, Finland, Germany, and Latvia. To provide a wider perspective about the issues of the stakeholder involvement outside the limits of the formal planning processes, ten researchers who have worked in projects related to MSP, stakeholder involvement, and the selected sea use sectors were invited. They were identified from the webpages of Baltic Sea related projects. While the interviewed researchers were located in Finland, Germany, Poland, and Sweden, their research has an international character. Further in the text, the interviewees are referred to only as planners and researchers to assure anonymity as the interviews were confidential to enable the interviewees to speak freely. A total of 15 planners and researchers were interviewed.

The semi-structured thematic interviews were conducted during autumn 2018 and were concerned with stakeholder identification and engagement in MSP, as well as the business sector's involvement in these processes (Table 1). The background information on the study and the list of the main topics and questions were sent to the interviewees in advance. While the interviewees were allowed to talk rather freely, the list was used to guide the discussion towards the predetermined topics. Consequently, all the interviewees covered all the main themes but the individual question were answered in varying degrees and lengths. The interviews were conducted in English and the countries were represented by one planner, except for Finland, where planners from all three

Table 1
The overall topics covered in the interviews with the planners and researchers together with the main questions related to the respective topics.

Interview topics	*Main questions*
Stakeholder selection	What kind of stakeholders were involved in general, and specifically regarding the tourism and maritime transport sectors?
Perceived activity of the business sector in MSP	Which [stakeholder involvement] methods were especially functional for business representatives?
The role of companies in MSP	What is your impression about the role of companies in the MSP process?
Business sector's expectations	In your opinion, what are the business sectors' expectations regarding the MSP process?
Motivation	Can you identify any factors that affected the willingness of business stakeholders to share their knowledge?

regional planning areas were interviewed in the national language. The discussions were recorded and detailed notes were later compiled based on the recordings. The topics outside of this study were removed and the remaining notes were analysed and compiled into thematic groups.

The majority of the interviewees had been involved in MSP for several years and they embraced various fields of expertise, either through their educational background or their occupation (Table 2). Most of the respondents had some background in planning or management. One third had studied geography or had expertise in Geographic Information Systems (GIS). Political sciences and economics were also represented, as well as some disciplines of natural sciences.

2.2.2. Online questionnaire

To capture comparative insights and the perspective of the business community, an online questionnaire was prepared for companies, associations, and other organisations representing the two case sectors. The potential respondents were found via an internet search, and the invitations to participate in the survey were sent via email either directly to a suitable person in the management or to the general address of the organisation to be distributed further. The original surveys were open during winter 2018–2019, and a supplementary round with the same questions was re-opened in January 2020.

There were two versions of the questionnaire: a more comprehensive one and a reduced one. Both versions included multiple choice questions as well as statements to be assessed in a five-level Likert-type scale (strongly disagree; disagree; neither agree nor disagree; agree; strongly agree). The topics were related to the business community's familiarity with MSP, their impressions of their sector's role in the planning process, as well as their expectations of and possible drivers for participating in the planning process.

Table 2
Background information on the interviewees (n = 15). The reported years refer to the official MSP processes, in addition to which some respondents had experience of spatial planning and the development phases preceding the regulation of MSP. Expertise may include several fields for an individual respondent, and therefore the total number exceeds the number of interviewees.

Role in MSP process	
Planner / authority	8
Expert / researcher	7
Involved in MSP	
0 – 2 years	4
3 – 10 years	9
> 10 years	2
Field of expertise	
Planning / management	10
Geography / GIS	5
Natural sciences / ecology	2
Political sciences / economics	4

For the more comprehensive questionnaire, a total of 71 representative unions and organisations operating in the EU member states around the Baltic Sea were identified, 13 of which represented the maritime transport sector and 58 the marine tourism sector. The latter was regarded as including a wide array of recreational activities ongoing in marine areas, ranging from commercial nature tourism to leisure boating, diving, and underwater cultural heritage. In total, 17 representatives answered at least part of the questionnaire, which results in a response rate of 24%. The shorter version of the questionnaire was sent to 172 companies operating in the EU member states in the Baltic Sea, including commercial ports, local guest harbours, shipping companies and ship-owners, operators of passenger ferries and cruise lines, as well as nature-based tourism companies such as kayaking and diving operators. The questionnaire received altogether 14 responses and thus a response rate of 8%. In both versions, the response rates varied considerably among the sub-sectors (Table 3). Responses were received from all around the Baltic Sea (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Sweden), the respondents ranging from one person companies to international business support organisations.

3. Findings

3.1. The views of planners and researchers on engaging the business sector in MSP processes

3.1.1. The involved stakeholders

At the time of the interviews, a majority of the Baltic Sea countries were still in the early phases of their national planning processes. Therefore, the stakeholder involvement issues related to the first round of planning, and at times the first stages of the planning process were emphasised in the discussions. These early phases of the planning cycle are nevertheless important as the early involvement of stakeholders is seen as critical for the successful participatory process and the social acceptance of the plans [5,18].

In the interviews, the planners named stakeholder groups that have participated in the planning processes in their respective countries. In general, the listed stakeholders mostly represented local or national levels. Efforts to involve international, cross-border stakeholders were rare in the official MSP processes. As mentioned by one of the planners, *"the cross-border issues are more for the MSP planners to discuss."* Similar results have been observed in other recent studies in the Baltic Sea region [32,35]. While the planners state the need for transboundary planning efforts, the main impediment to transboundary stakeholder involvement is the lack of a legal framework and resources [32]. The

Table 3
The numbers of survey invitations and the respective response rates divided by the sub-groups within the case sectors of maritime transport and marine tourism.

	No. of invitations	***No. of responses***	***Response rate***
Representative organisations, associations, etc.	***71***	***17***	***24%***
Ship-owners' associations	8	1	13%
Port organisations	5	3	60%
Tourism organisations	42	6	14%
Leisure boating associations	7	3	43%
Diving associations	4	1	25%
Underwater cultural heritage organisations	5	3	60%
Companies	***172***	***14***	***8%***
Commercial ports	33	6	18%
Shipping companies and ship-owners	79	3	4%
Operators of passenger ferries and cruise lines	7	0	0%
Local guest harbours	36	3	8%
Nature-based tourism companies	17	2	12%

planners highlighted the role of research projects for encouraging the interaction among neighbouring countries. It has been noted that the international MSP projects in the Baltic Sea region have increased the transboundary interaction of planners and some self-motivated key stakeholders through informal contacts [34].

The most commonly mentioned stakeholder groups were municipalities, business support organisations and associations, non-governmental organisations (NGOs), governmental organisations (especially ministries), as well as representatives of research and education sector. The business sector was typically reported to be represented by business support organisations, unions, associations, and other umbrella organisations representing specific sectors. While individual companies are, in general, less frequently involved, the practices and level of involvement varied among the countries. In some cases, companies participate in MSP as consultants or invited speakers at stakeholder events. Typically, the participation of small companies was especially infrequent.

Westholm [40] anticipated that the selection of the responsible ministry may have an impact on the national emphases as regards how the actual planning is performed as more weight could be put on either the perceptions of the blue economy representatives or the environmental issues. The planning culture related to sustainable development has already been noted to be influenced by the professional identity of the planning authority (i.e. environmental, economic, or general planning) [47]. The planner and researcher interviews nevertheless revealed no major differences in the involvement of the business community between countries that have addressed the responsibility for the MSP to the ministries responsible for environmental issues or to ministries with a more economic focus. However, it should be noted that the impact of the national organisation on the MSP planning results can be fully identified only after the first round of planning is finalised. As the selection may affect the very foundations of the MSP process and its results, the issue should be transparently assessed in the evaluation phase of the planning process.

The planners further identified organisations that tend to represent the two case example sectors of this study. Shipping administration typically represents the maritime transport sector. Several planners also mentioned ports. However, their involvement activity varied considerably from country to country. Occasionally, the shipping sector interests were additionally raised by the municipalities that operate the ports in order to secure the accessibility and the operations of the respective ports. The marine tourism sector was found to be more complicated to involve than the maritime transport sector because the former is more diversified than the latter. According to the interviewees, the tourism sector has been represented by, for example, investment and development agencies, ministries responsible for tourism, and local tourism organisations. In some countries, the feedback covering the needs of the tourism sector also come from the local municipalities, especially in areas where coastal tourism is very important for the local economy.

3.1.2. Business sectors' involvement through representative organisations

The interviewees were asked whether the business sector ought to be represented by organisations representing a certain business sector's interests (such as associations, interest groups, and umbrella organisations) or by the individual companies themselves. They appreciated the representative organisations because of their wider view on the respective sectors. The organisations were regarded to have general knowledge and understanding about the sectors' needs, instead of focusing on the revenues of individual companies. This view was elaborated by one planner: *"In spatial planning, we try not to consider single interests of a single person or a single company. Shipping as such is important – I am not interested in who operates the ship, I just want to have space for ships."* The view was supported by a researcher who considered it important to focus on the umbrella organisations, because the business sector has a tendency to lead the discussion towards their own interests.

One planner observed that in the early phases of MSP, it is important to raise awareness of the process among the stakeholders, and the associations and representative organisations may play a major role in distributing information further to their members. The importance of the umbrella organisations is highlighted especially when planning large areas. In national scale planning, the national level associations are more important than the small local ones. As one business sector might be comprised of hundreds or thousands of individual actors, companies or local associations, involving them all directly would be extremely resource consuming, if not impossible. A planner compared the situation with a land-use planning process, where the agricultural issues are not discussed separately with every farmer and forest owner in the area but rather with the interest organisation representing them. Another planner found the role of interest organisations especially useful for the small companies, which might have difficulties in discussing with the policy-makers at the relevant level. The organisation can act as an intermediary in converting the language of local company problems to a societal discussion about the issues that needs to be addressed in the MSP processes. According to the planner, it is easier for the larger companies to participate in the discussion without intermediaries.

A concern was also raised that interest organisations may not always be able to represent all the views of the respective sectors. A planner noted that there might be individuals whose contacts with the representative organisations are loose or non-existent. The views of these individuals might be missed if the planners discuss only with the organisations and not with the individuals themselves. Other studies have similarly noted that the dissemination of information and interaction with all members may be inadequate [31,37]. However, several other interviewees found it crucial that they could trust the organisations to be able to represent their sectors. The assumption is that discussions have already taken place within the sector before their answers and needs are presented to the planning process. In the Polish example, the fishers' organisations had failed to distribute information to their members, leaving planners in a difficult position with limited resources and problems handling the high expectations and misconceptions of the fishers [37].

3.1.3. Involvement of individual companies

While the role of umbrella organisations was appreciated, there were also views supporting the direct involvement of companies. One planner considered that benefits are gained when entrepreneurs with strong and versatile societal views are involved in the stakeholder process. Having these influencers included in the stakeholder participant listings increases the credibility of the process. This also reflects the view that associations and interest organisations do not always represent the entire sector or even its members' opinions uniformly, therefore, there may be dominant or locally important actors that may have to be taken into account separately. The planning organisation's knowledge concerning the stakeholder groups thus affects the results of the stakeholder consultations.

Some planners found that the need to involve companies is situation-specific. For instance, if there is an acute conflict situation that cannot be ignored, the companies affected by the situations should, naturally, be included in the discussion. It was seen beneficial to communicate directly with the companies that have high stakes or considerable influence in a certain area or regarding some activities included in the MSP. A local example of such a case could be a company with an existing sediment extraction permit. On a national or transnational scale, the largest cruise ship companies were mentioned as possible stakeholders, because they have a strong impact on tourism in the cruise ports and cities.

In general, the planning processes are organised in a way that allows all the interested parties to participate in stakeholder activities. Information on stakeholder events and public hearings is distributed through a variety of means (e.g. internet, social media, newspapers), with the aim of reaching all potential interest groups and making involvement possible for all. Thus, even though the companies in many cases are not

specifically invited to stakeholder workshops, they are welcome to participate if they are willing and interested. The problem is that the companies cannot be forced to participate if they are not willing to do so. The challenge was put into words by a planner: *"We have an obligation to tell and listen, and we have an obligation to process their suggestions. It's clear that it's important that they are involved, but we cannot force them to be interested in our plan."* Another planner asked for a realistic assessment of expectations as regards company participation as company representatives are typically too busy to participate in MSP processes. Here the motivation of the stakeholders to participate is highlighted. Motivational aspects are further discussed in the following chapters.

Overall, there were no incentives to solely involve companies rather than associations and interest organisations. While both were welcomed on a general level, participation of the organisations was regarded as more important. Involving only companies was not supported. As a planner summarised, *"having only single companies, partly also competing companies, […] you have lot of discussions that might not support your planning process but that are leading into different directions"*. The strictest opinion was given by an experienced researcher who simply stated that, while the case sectors should be involved, the companies should not. According to the researcher, *"the individual companies […] don't need to be involved"* as the sectors are represented by other means. The tourism sector, for instance, is commonly represented by the local municipalities. At the same time, many planners found it important to obtain better representation from companies. As the planners play a central role in the MSP processes, their variable and subjective views on the stakeholders may affect the emphasis of the stakeholder interaction.

For established and well organised sectors, such as maritime transport, integrating national and international organisations could be the feasible level of involvement: strong organisations guarantee the input of knowledge and an expression of interest representing the whole sector. However, if the planners know of niches in the sector not represented by the organisations, they can invite individual companies from these niches to ensure representation of their interests and needs which may be outside of the mainstream [48]. For sectors such as the coastal and marine tourism, with many small companies, which often do not have strong business support organisations, more inclusive methods might be needed to ensure good representation of the different sub-sector interests.

3.2. Driving forces behind business sector involvement

3.2.1. Awareness of the effects of MSP

According to some of the interviewed planners, the main issue is that the companies do not know what MSP is: either they are not aware of the process at all, or alternatively they do not regard it as important for them. This lack of knowledge or interest, in turn, leads to inactivity in the stakeholder involvement process. As one of the planners expressed it: *"I have a feeling that they don't see MSP as a tool for them, and that's why they are silent."* The low response rate of the online survey (24% for representative unions and organisations; 8% for companies) may reflect this inactivity. The opinions of active organisations may be overly represented in the results as, according to the survey answers, 63% of representative organisations (n = 16) and 36% of companies (n = 14) had participated in some MSP process. Those that had not participated, stated that they had either not been invited or they did not know about any possibilities to participate.

The tourism sector, which is flexible and constantly under changes, may especially have difficulties in identifying the potential benefits derived from the MSP process. The planners considered that the stakeholders sometimes have misconceptions about the results of the MSP processes. For example, even if offshore wind power parks are planned, the plans are not necessarily implemented – at least not immediately. On the other hand, the stakeholders may ignore the consequences that the future plans can have on their businesses [37]. According to the interviews, it is a challenge for the planners to clarify to the business community what are the realities of the planning process. This was exemplified by a planner: *"They have this tendency to ask for more quick, and clear, and easy solutions, and sometimes it was hard to explain that the process is pretty long."*

Another challenge that may arise from the lack of understanding about the MSP process is related to trust in the process. If the sector considers that MSP will increase the regulations against it, the sector representatives will not be interested in stakeholder involvement. A researcher therefore highlighted the importance of communicating to the stakeholders what will happen if they do not participate and what the consequences of being left out are. Furthermore, the planners need to be careful with the wording when inviting business sector stakeholders to avoid giving false impressions of the stakeholder involvement process and the possibilities to influence the planning decisions.

3.2.2. Potential gains and losses as motivational aspects

The planners highlighted the role of motivation in all stakeholder activities. The motivational aspects tend to be especially underlined when talking about businesses. The business sector representatives are regarded as busy people with few incentives to participate in activities that are not relevant to their operations. According to the interviewees, the willingness to participate increases when the stakeholders have the impression that they may gain something. A researcher stated that those who see the opportunity of having an influence on the regulations or recommendations are active. Furthermore, one planner expected that the business sector participates only if there are concrete decisions made about concrete issues relevant to their business operations. According to this planner's previous experience, *"they do not participate for fun"*, which means that the business sector representatives do not participate in general discussions without direct linkages to their operations. The stakeholders typically want to participate in those stages of the MSP process where "gains and losses are fought over" [9]. This also illustrates the scale of MSP and the level of abstraction for the business stakeholders. As the companies or business organisations address the specific local issues, they may not need to interfere with the national MSP unless it involves issues directly influencing the company.

The scale of planning greatly affects the concreteness and relevance perceived by the stakeholders, which, in turn, affects their willingness to become involved. According to the interviewees, stakeholders lack interest if the planning takes place on too general level. For instance, an entrepreneur with local interests will most likely find the national level planning issues irrelevant to his or her business operations. Similarly, companies, which usually operate close to the shoreline, might lack interest towards the planning efforts in the exclusive economic zone (EEZ). In some cases, the stakeholders may find MSP redundant as the issues that are relevant to the companies have already been solved elsewhere (e.g. in regional or local land use planning). In the Baltic Sea region, the scale of planning also has an effect on the integration and coherence of transboundary MSP co-operation as the regulatory systems vary among the neighbouring countries [49,50]. Consequently, these different scales should be acknowledged and the involved stakeholder groups should be selected accordingly [51].

Another crucial aspect influencing the interest of the business sector is how peremptory the planning results will be. It has been assumed that if the process leads to a non-binding, strategic MSP, stakeholders will be less committed to it than if the plan is a binding document or an enforceable law.

The interviewees were further asked about their impressions of the expectations that the business sector have about the stakeholder activities. In general, the planners regarded the business sector as being more guided by the fear of losing opportunities than having an interest in looking for new ones. However, this too is sector specific. It was mentioned that, while the maritime transport sector is more afraid of losing space to operate, the energy sector sees the MSP process as a possibility to get its operations on the map. It is typically regarded that the old and traditional sectors want to keep the situation unchanged.

They want to make sure that the MSP process does not create new restraints, bans, or risks as regards their operations. The emerging sectors, on the contrary, see MSP more as a possibility; thus, they are active in participation, as they want to ensure that their operations are included in the plans.

Moreover, the presence of other sea use sectors seems to increase interest towards stakeholder participation. Seeing the interest other users have in the same sea areas helps the business sector to understand that they are not there alone. This may raise interest towards securing their own activities in the increasingly crowded sea areas. However, there are discrepancies in the perceptions between well-established industries and the newcomers (e.g. offshore energy) seeking room for themselves [30]. Furthermore, the motivational aspects of stakeholder groups may be linked to their divergent viewpoints towards the sea area. For the shipping and mining sectors the sea appears as a physical space and resource, whereas for nature conservationists it is a living environment and dynamic ecosystem [33].

According to the survey, internal competition seems not to be a major problem for the business representatives. Especially the tourism sector rather more disagreed (57%, n = 14) than agreed (7%) with the following statement: "Competition within the sector weakens its co-operation possibilities regarding the maritime spatial planning process". A similar overall trend applied to the shipping sector as well (46% disagreeing, 18% agreeing, n = 11). In both groups, 36% of the respondents neither agreed nor disagreed with the statement. The overall disagreement with the statement could indicate that while internal competition is not regarded as problematic, the companies do not consider it necessary to participate themselves but find it reasonable to be represented by the representative organisations and associations. In total, 48% of the 25 respondents agreed and only 20% disagreed with the statement "the sector is better represented in maritime spatial planning process by umbrella organisations than individual actors (citizens or companies)". In general, this matches the planners' perspective. While the majority agree that participation through organisations and associations is preferable, those individual companies who find direct involvement necessary are also welcome to participate in the process.

The survey further asked about the business community's expectations of the MSP processes and any possible drivers for their participation. While the answers of the marine tourism sector (n = 15) were rather evenly distributed in general, gaining visibility to the business sector and its needs, and acquiring information and knowledge of other marine activities were notably more strongly emphasised by the tourism sector than the maritime transport sector. The maritime transport sector (n = 12) especially highlighted the possibilities of solving or avoiding conflicts among other sea users and finding synergies or collaboration possibilities. On average, the maritime transport sector valued securing business opportunities over learning about new ones, whereas for the marine tourism sector there was a slight preference for the opposite (Fig. 1).

Finally, the participation of companies was seen to be directly linked to the personal motivation and interest of the personnel responsible. As reasoned by one planner, *"the employee participates if the boss tells them to do so, but in these cases the participation may be very different than if the participation is derived from a personal motivation instead of being forced to"*. Sometimes personnel changes within the organisations affect the level of participation in the MSP process. It was noted by the planners that a perceived lack of interest by a stakeholder organisation may at times stem from one individual in the company. Therefore, the level of individual motivation was regarded as being very important for the commitment of the organisations.

3.3. The considerations of why and who to involve

While public participation as such is required by the EU directive [3], the stakeholder involvement can serve several purposes and the purposes should dictate 'who' to include [4]. Two main approaches to the 'why' when involving stakeholders can be discerned: 1) to promote stakeholders' democratic rights (normative reasons) or 2) to fulfil a particular purpose within the MSP process such as legal requirements or to gain knowledge from stakeholders (instrumental reasons) [10]. The interviews revealed that in the Baltic Sea region, both main approaches have been considered, often simultaneously.

Regarding the business sector involvement, many of the interviewees supported the aim to include both the representative organisations and individual companies as their involvement provide different benefits – as well as challenges (Table 4). The interviews confirmed that, for different purposes, the planners find certain organisational levels more suitable than the others. The business representative organisations, for example, may help with information dissemination and distributing knowledge from the planners to the companies and vice versa. Business organisations can also strengthen the democracy of the MSP process by helping companies that lack resources to participate or by acting as their representative at higher levels of planning. However, the democratic aspirations fail if the business representatives are not able or willing to present the diversity of the business sectors' needs and opinions uniformly.

The planners hope to increase the business community's acceptance and compliance towards the plan by the legitimation of the process and its results, and by empowering stakeholders to formulate their interests and to make their voices heard (see [4,35,52]). However, several studies have revealed that the real-world planning examples deviate from the ideals of the literature and guidance on stakeholder involvement (e.g. [8,17]). The interview findings are in line with this notion, as the planners stated that it is not easy to obtain the companies' interest in

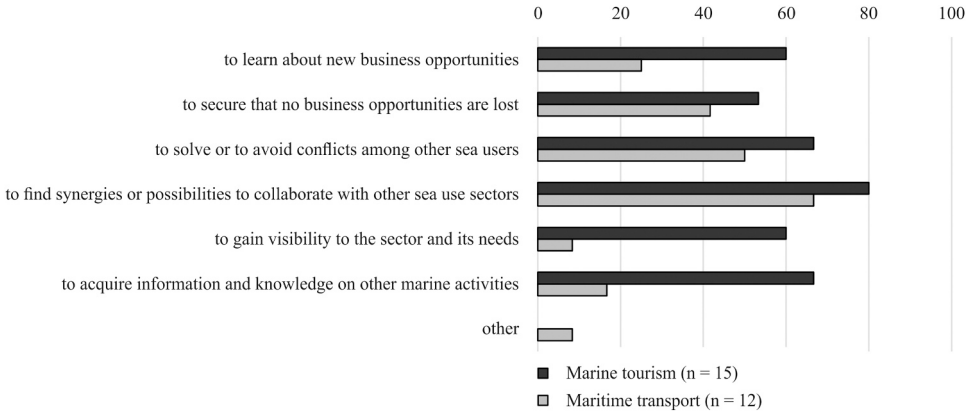

Fig. 1. The survey responses to the question that mapped the sectors' expectations and possible drivers for participating in the maritime spatial planning processes. The responses of the representative organisations and the companies are combined to cover the proportion of their respective sea use sectors (n = 27).

Table 4
A summary of the potential benefits (+) and challenges (-) encountered when involving either associations and interest organisations or individual companies in the MSP processes. The findings are based on the interviews conducted with the planners and MSP researchers around the Baltic Sea.

Organisations representing business sectors	Companies
+ Providing a wider view on the needs and interests of the respective sea use sector	+ Enhance the interaction among companies as well as other sea use sectors
+ An intermediary actor between companies and planning authorities	+ Searching for potential synergies among sea users
+ Communication of MSP information to the sector at large	+ Discussion about conflicts that directly affect business operations
+ A representative for companies who lack resources or skills to participate themselves	+ Increasing societal credibility by involving individual entrepreneurs
+ Capacity to represent a business sector at national and international levels	+ Acknowledging the needs of the local and regional economy
- May not reach all the voices of the respective sector	- Reaching all individual actors is resource consuming if not impossible
- Not always able to present the interests and opinions of the members uniformly	- May lead the focus to be placed on narrow interests and individual needs or opinions

participation. While involving them might be ideal for certain instrumental and normative reasons, in the real-world planning, the 'who' might actually dictate the 'why' as the planners need to adjust their practices according to the list of willing participants.

4. Conclusions

While the MSP processes are stated to be open to all, practical reasons, such as available time and resources might affect the operative measures of the stakeholder involvement. The planning authorities often rely on a variety of organisations that represent business stakeholders, as they are considered to have a better general knowledge and understanding of the respective sector's interests and not prone to focusing on the interests of individual companies. Involvement of the latter is seen to be more situation-specific. The drivers necessary for the business community to become involved in MSP are, in general, connected to the potential gains and losses it will cause.

The in-depth analysis of the stakeholders is an important early step of the MSP cycle. Regarding the business community, this analysis means acquiring a comprehensive knowledge of the business environment and the economic structure of the planning region. The planners should be aware of the character and strength of the representative organisations in order to evaluate their contribution to the MSP process. However, despite the planners' aspirations and attempts, the business stakeholders are often not willing to participate. This underlines the need to promote the MSP process to the business community well before the planning starts. Moreover, the business community and the authorities operate on very different timescales. While MSP is an iterative process that takes time, the business representatives tend to hope for quick and definite solutions. This may cause contradictions between the business stakeholders' expectations and the nature of the planning processes.

CRediT authorship contribution statement

Hanna Luhtala: Conceptualization, Methodology, Investigation, Writing - original draft, Writing - review & editing, Visualization, Project administration. **Anne Erkkilä-Välimäki**: Conceptualization, Methodology, Writing - original draft, Writing - review & editing. **Søren Qvist Eliasen**: Conceptualization, Writing - review & editing. **Harri Tolvanen**: Writing - review & editing, Funding acquisition.

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Declaration of interest

None.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2020.104301.

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Evaluating the impact of air transportation, railway transportation, and trade openness on inbound and outbound tourism in BRI countries

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ABSTRACT

This study investigates the effect of air transportation, railway transportation, and trade openness on inbound and outbound tourism in 140 Belt and Road Initiative countries from 1996 to 2020. Principal Component Analysis was utilized to generate inbound and outbound tourism indexes. For long-run estimation, fully modified ordinary least squares and dynamic common correlated effects were utilized. The findings revealed that air and railway transportation, including trade openness, positively affect inbound and outbound tourism in the long run. Granger causality test confirmed a bidirectional relationship exists between inbound tourism with air transportation, railway transportation, travel services, and trade openness. However, a unidirectional relationship exists between inbound tourism and transport services. Outbound tourism has a bidirectional linkage with air transportation, railway transportation, travel services, transport services, and trade. This paper recommends that the BRI countries need to take advantage of the trade route for tourism development and transportation services for easy accessibility.

1. Introduction

From a global point of view, various researchers evaluate travel and tourism in different countries. Tourism is a leading economic growth factor for developed and developing countries. According to growth theory, economic growth is related to (1) high intensity of R&D and high productivity; on (2) large scale. In general, countries with high tourism do not share these characteristics. Contrarily, the tourist industry does not require much technological advancement, and countries specializing in tourism are typically small (Sequeira and Maçãs Nunes, 2008). Tourism booms trade, which increases growth and welfare. Tourism involves the trade of goods and services between countries. Tourism exports have increased 11 percent in recent decades (Faber and Gaubert, 2019). Trade links with the transport sector because it creates opportunities for an increasing mode of transportation and shifts goods and services, promoting people-to-people connectivity (Badulescu et al., 2020). A well-designed transportation system promotes economic growth and transportation at a low cost, reducing production costs. Tourism arrival is one of the country's significant drivers of economic growth (Banister and Berechman, 2001).

However, there is a significant need to focus on other transportation modes closely related to tourism, such as railway transportation, travel, transportation systems, etc. The tourism sector's contribution to global GDP is up to 10.3% through direct and indirect activities. It also improves market integration and raw materials logistics and facilitates tourism. Improvement in transportation infrastructure will lead to efficient resource allocation, a better business environment, and efficient international trade (Chi and Baek, 2013). Government spending on transportation infrastructure is advantageous for foreign direct investment, generating employment and tourism (Yu et al., 2012). However, the connection between transportation infrastructure and economic growth is vice versa (Perles-Ribes et al., 2017). There are gains from the agreement over infrastructural developments among the nations; these developments lead to enhancement in technology and trade liberalization. Trade liberalization will lead to cost-effective production among nations and, ultimately, economic growth in the country (Bond, 2006). Employment opportunities get towering with the construction of highways, tunnels and, railways etc. (Rietveld, 1989).

At the inception of the Belt and Road initiative in 2013, 65 counties joined the BRI; after passing the years, these countries expanded (Zhai, 2018). As of January 2021, 140 countries are listed on the online portal of the BRI. China plans to develop a network of infrastructure projects connecting Asia, Africa, and Europe through the BRI countries to foster a global trade system. Connectivity, including infrastructure, is a critical component of the global economic transition (Blanchard and Flint, 2017). By 2018, Chinese companies had invested more than $90 billion

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(in 2018 dollars) in countries along the BRI and had completed more than $400 billion in foreign planned projects for countries along the route (Zhang, 2019). Only a few latest studies, such as Li et al. (2020), examined whether BRI promotes the tourism economy. BRI has increased 17.2% inbound tourists and generated inbound tourism revenue by 8% in the Belt & Road countries. However, this study ignored transportation. So, I fill this gap with more economic variables. Although the BRI has had a considerable influence on the regional travel and tourism industry, few systematic empirical studies have evaluated the impact of the BRI on tourism and transport development. As a result, this study fills a research gap by assessing the extent to which BRI influences tourism development and contributes to the elements that influence transportation development.

The main purpose of this study is to check the long-run relationship between tourism, transportation, and trade openness in BRI countries in the long run. Many studies discussed this topic, but there is a gap in the study in BRI countries. This study fills in the gaps and aligns with past research with a certain novelty to be placed on their distinct mark. The present study used the principle component analysis (PCA) to generate the composite index derived from the international tourism indicators available from the tourism database (Khan et al., 2017), such as international tourism arrivals, tourism receipts from passengers, tourism receipts from travel items, tourism receipts from current US dollars, and tourism receipts percentage of exports for the inbound tourism index, and the outbound tourism index included international tourism expenditures, international tourism expenditures from passengers, international tourism expenditures from transport items, and tourism expenditures from travel items. In addition, this study included air transportation, railways transportation, travel services, transport services, and trade openness to estimate the impact on international tourism in 140 BRI countries from 1996 to 2020.

This work's main contribution is finding a relationship between inbound and outbound tourism, transportation, and trade in BRI countries. In previous studies, there is a gap in investigating the relationship between inbound and outbound tourism with transportation infrastructure in BRI countries. The deficiency in the previous study motivates further analysis. The research questions are; what is the impact of air and railway transportation on inbound and outbound tourism? Does the long-run relationship exist between tourism, transportation, and trade openness in BRI countries? Is there causality between inbound and outbound tourism, transportation, and trade openness in BRI countries? We utilized principle component analysis (PCA) (Akanbi, 2014) to find the inbound and outbound tourism indexes to achieve the first goal. To achieve the second goal, we utilized fully modified ordinary least squares (FMOLS) analysis. For robustness, we utilized dynamic common correlated effects (DCCE) (Chudik and Pesaran, 2015). To achieve the third goal, we used the granger causality test.

Our paper related to the broad empirical literature on air transportation, railway transportation travel services, transport service, and trade openness (Faber and Gaubert, 2019; Blonigen and Cristea, 2015). In particular, some studies have looked at the effect of transportation and economic growth (Allroggen and Malina, 2014; Bilotkach, 2015). This literature mainly focuses on tourism and transportation growth with the effect of trade openness; as such, it is mainly on the country and cross-country levels. In contrast, we divide tourism into inbound and outbound and link our study with air transport and railway transport. By doing so, we also have a substantial debate on trade openness. In comparison, air transportation and railway transport impact economic development in the region (Campante and Yanagizawa-Drott, 2018). Such as transport links with economic growth and trade openness (Brugnoli et al., 2018). We differ in that group. Our approach allows a causal relationship between air and railway transportation and trade openness on inbound and outbound tourism. Our results highlight the potential effect of inbound and outbound tourism in BRI countries. In the first step, we estimate the air and railway transportation variables separately with dependent variables of inbound and outbound tourism to check the long-run relationship between the variables. We estimate all these variables together. It shows a positive long-run linkage between inbound and outbound tourism with air transportation, railway transportation, and trade openness. Travel services and transport services also have a positive impact on tourism. The robust outcome also confirmed our previous results.

Our study is described in the following section. Section 2 discusses the related theoretical context of tourism, transportation, and trade openness. Section 3 shows the data and methods, and section 4 is about the results and discussion, followed by concluding remarks.

2. Theoretical context

This study focused on inbound and outbound tourism in Belt and Road countries. Many studies discussed inbound and outbound tourism with many other explanatory variables. The importance of inbound and outbound tourism has increased because it is a vital tool to increase the business sector between countries (Wang, 2009). We link inbound and outbound tourism with transport and trade. Tourism industries impact government and business agencies (Pappas, 2019). Therefore policymakers need to improve the demand for inbound and outbound tourism (Law et al., 2011).

2.1. Belt & Road, and tourism

The Silk Road and the BRI are strongly intertwined. The Silk Road tourism initiative began in 1993 and was expanded in 2014 to include the New Maritime Silk Road. This tourist initiative aimed to generate inbound and outbound tourism along the Silk Road's historic route. It also helped to promote tourism and trade between members on a cross-border basis with states and other geographical areas (UNWTO/GTERC, 2014). The implementation of this project increased the Silk Road's tourist attraction. Suppose national and international institutions actively extend the concept of a tourism destination through their tourism networks. In that case, the tourism sector will grow and attract more tourists, becoming essential for developing the tourism industry (Gibson et al., 2005). People-to-people connectivity is one of the five essential characteristics of BRI, and it symbolizes the spirit of cooperative friendship. China's Belt and Road Initiative will make the Xinjiang, Uygur Autonomous Region, a tourist destination (Koh and Kwok, 2016). More than 500 global historic sites may be connected through the belt and road, and many tourists are coming towards heritage reserves.

According to Koh and Kwok (2017), the Shanghai Cooperation Organization's (SCO) regional tourism development plan, political, economic, and BRI would provide employment and enterprises for the development of the tourist industry in Central Asia, and social cooperation would act as a stimulant for its growth. This regional tourist development strategy would also collaborate among geopolitical parties (Koh and Kwok, 2016). Deng and Hu (2018) evaluated the impacts of China's outbound tourist flow using the spatial panel model, employing 55 BRI nations and found a robust positive spillover effect between geographically neighboring nations. Wang et al. (2019) found that BRI is favorable for protection and geo-tourism. The Belt and Road Initiative has strengthened the security, road infrastructure, financial investment, and economic growth of nations along the route; nevertheless, there are discrepancies in the development of the tourism sector along the belt and road. In Central Asia, for example, tourist infrastructure is inadequate, tourism experts are unprofessional, and service is terrible (Koh and Kwok, 2017).

2.2. Transport and tourism

The studies describe the importance of air transportation on tourism demand. Button and Taylor (2000) discuss US air cargo and air passenger transportation legislation. Air liberalized, and open sky initiative has beneficial for the market economy. Evidence provides that airline traffic services are an essential factor in urban economic development

(Brueckner, 2003; Percoco, 2010). For regional development, Blonigen and Cristea (2015) find that increased air traffic growth by 50% can increase the income of the people at the rate of 7.4% of real GDP, cost and pricing also increase aviation performance (Gillen and Morrison, 2015). Airport service and infrastructure depend on the opportunity cost of airport capital (Allroggen and Malina, 2014). Air traffic and the number of destinations are the leading indicators of urban economic development in the United States of America (Button et al., 1999). Nonstop flights have a clear and robust impact on the economic growth in the region (Bilotkach, 2015). An efficient air transport service system boosts economic development by facilitating labor mobility and trading goods (Brugnoli et al., 2018).

Air transportation is an essential factor for regional economic growth. The region needs a well-connected air transport network to develop the economy (Antunes et al., 2020). From the perspective of Mauritius, transport infrastructure is a factor for development. Tourists from America and Asia are sensitive to island transport, but those from Europe are also sensitive to non-transportation infrastructure (Khadaroo and Seetanah, 2007). An increase in the quality of tourist items in terms of infrastructure, services, communications, and other factors significantly affects the development of the tourist economy of global tourism (Navickas and Malakauskaite, 2009). Aguiló et al. (2012) suggest that public transport facilities are more beneficial for tourists than private transport. In Spain, Guirao and Campa (2015) estimated 1176 cities' high-speed rail (HSR) data with tourism variables, and found that high-speed rail positively impact on tourism arrivals. High-speed railways significantly impact tourism development in Spain. High-speed railways, directly and indirectly, affect development in urban and station locations (Yin et al., 2015). Duval (2013) estimated tourism and air transportation. Their findings suggest that tourist destinations increase the economic value of commercial air transportation. Peeters (2013) estimated global data from 1900 to 2005. The long-run estimation method delivers global numbers of trips, modes of transportation, distance, travel time, and behavior. Seetaram et al. (2013) estimated the United Kingdom's outbound market from 2008–2010. An autoregressive distributed lag model was utilized for developing the income, tax elasticity's and prices estimated. The estimated tax elasticity suggests that the implementation of air passenger's duty has a negative effect on UK outbound travel.

The study by Chen and Haynes (2014) investigated the impact of high-speed rail in China. The empirical results found that the overall impact of HSR on China's economy is positive. A revealed preference survey was conducted by Pagliara et al. (2015) in 2013 in Madrid. The results find that Spanish high-speed rail effect tourist destinations positively, but the choice of Madrid as a tourist destination is not affected by the presence of high-speed rail. From the perspective of Henan province of China. Tourists make the destination choice based on transport infrastructure conditions. Railways, expressways, and other modes of transportation play a significant role in improving Henan province tourism. Increasing the quality of tourist products, services, innovations in transportation, communications, and other factors significantly increase the development of global tourism. The tourism market grows with other related markets such as retail stores, hotel networks, and restaurants (Navickas and Malakauskaite, 2009).

2.3. Trade and tourism

Trade and tourism industry data were utilized by Yao et al. (2020) of China and found that trade and tourism in vegetables contribute to 33% of the income of rural residents. The study by Gulistan et al. (2020) analyzed the impact of economic growth, trade openness, and tourism in 122 countries. The results find that tourism is harmful to the environment and trade openness has not statistically robust. Khalid et al. (2021) explored the 163 destinations of the world and used the gravity model. The results confirm that the regional trade agreements on bilateral tourism are positive and significant on average in different regions. These findings prove that countries' economic growth and international tourism flow are improving. Tang (2020) estimated the correlation between inbound tourism and trade from the perspective of japan. Findings suggest that Japan's inbound tourism strongly depends on the Asian market. China has the most significant tourism inbound for japan. The random effect model suggests increasing trade facilities will increase inbound tourism in Japan. Furthermore, Japan needs to increase its international tourism income by facilitating a transport system and visa-free facilities to boost inbound tourism efficiency. To investigate Thailand's a trade and tourism. ARDL, VECM, and Granger causality approaches were used for long and short-run estimations. Granger causality confirms the bidirectional relationship between economic growth and trade openness (Kongbuamai et al., 2020).

The study of Akbulaev and Mirzayeva (2020) investigated the role of tourism on trade openness in Azerbaijan from 1995 to 2018. The authors used correlation regression analysis and a pair regression model. Based on the statistical analysis, with a 1% increase in international tourism, the exports increased by 0.59%. These results give significant results for tourism and trade. The concepts of sustainable and "inclusive" growth are central to one of the three UN Sustainable Development Goals (SDG 8-Decent Work and Growth) established by the UN World Tourism Organization's (UNWTO) 2030 sustainable tourism agenda. It offers a Marxist-inspired political economics criticism of the UNWTO's endorsement of SDG-8, highlighting the UNWTO's inclusive growth-driven SDG agenda's gaping hole on issues of equity and social justice (Bianchi and de Man, 2020). A study by Shan and Wilson (2001) analyzed the role of international tourism and trade in the case of China. The study uses the VAR model and considers previous studies related to tourism forecasting. The finding confirmed the two-way Granger causality between international tourism and international trade, implying trade flow links with tourism in the case of China. Santana-Gallego et al. (2011) investigated tourism and trade in a suitable framework in 195 countries. The authors used Hu et al. (2020) approach to check the tourism flows. The results show that with a 1% increase in tourist arrivals, the export will increase by 9%. The findings also confirm that tourism increases trade between the two countries.

3. Data and methods

3.1. Data

The study constructed the travel and tourism competitiveness index using the following global tourism indicators: international tourism arrivals, tourism receipts from passengers, tourism receipts from travel items, receipts from current US dollars, and tourism receipts percentage of exports for the inbound tourism index, while the outbound tourism index included international tourism expenditure, international tourism expenditure from passengers, international tourism expenditure from transport items, and tourism expenditure from travel items. In addition, this study included air transportation, railway transportation, travel services, transport services, and trade openness to evaluate the impact on international tourism in 140 BRI countries from 1996 to 2020. Appendix table 1 shows the names of the countries. Table 1 shows the descriptive statistics and description of variables. The data is taken from World Bank (2021).

3.1. Variables definitions

3.1.1. Inbound tourism

Inbound tourism describes the activities of foreign visitors who come to the host nation only for entertainment and enjoyment. In order to reflect incoming tourism in this study, five primary indicators were used: the number of tourist arrival in the country, tourism receipts for passenger transport items, tourism receipts from travel items US dollar, tourism receipts current US dollar, and tourism receipts percentage of total exports.

Table-1
Descriptive statistics and description of variables.

Variables	Symbol	Measurement	Obs	Mean	Sd	Skewness	Kurtosis
Dependent variables							
International Inbound Tourism Index	INBINDEX	It is the combination of:					
		- International tourism, no of arrivals (ITA)	3500	11.258	5.758	−0.215	−0.980
		- International tourism, receipts for passengers transport items (current US$) (ITRP)	3500	12.078	8.729	−0.569	−0.495
		- International tourism, receipts for travel items(current US $) (ITRT)	3500	16.816	7.490	−0.608	−0.042
		- International tourism receipts (current US$) (ITRD)	3500	15.598	8.653	−0.145	−0.533
		- International tourism receipts (% of total exports) (ITRE)	3500	1.543	1.480	−0.110	−0.514
International Outbound Tourism Index	OUTBINDEX	It is the combination of:					
		- International tourism, no of departures (ITD)	3500	5.754	7.080	0.473	−0.328
		- International tourism expenditures for passengers transport items (ITEP)	3500	12.674	8.432	−0.765	−0.733
		- International tourism expenditures for travel items (current US$) (ITET)	3500	16.348	7.503	−0.548	−0.820
		- International tourism expenditures (current US$) (ITED)	3500	15.045	8.752	−0.056	−0.295
Independent Variables	Symbol	Measurement					
- Air Transport	AT	Passengers carried	3500	10.877	6.102	−0.047	−0.479
- Railways transportation	RAIL	Passengers carried (million passengers-km)	3500	2.724	3.785	0.933	−0.341
- Trade Travel and Transport services							
Travel services	TS	% of service exports	3500	2.783	1.559	−0.954	−1.459
Transport services	TRS	% of commercial service exports	3500	2.394	1.414	−1.797	−0.587
Trade	TRADE	% of GDP	3500	3.951	1.358	−0.233	−0.357

Source: author's calculation

3.1.2. Outbound tourism

Outbound tourism refers to the activities of a resident of one nation who travels to another country only for entertainment. This study used four leading indicators that described outbound tourism, including the number of residents who departed from the country, tourism expenditures from travel items, tourism expenditures from the transport items when visited outside the country, and tourism expenditures in the US dollar. Tourism expenditures for residents' transportation and travel items are the costs of visitors' departures to other countries, which logistics support covers during tourists' visits to a country.

3.2. Principle component analysis (PCA)

The INBOUND variable in this study is a composite index derived from the number of tourist arrivals in the country, tourism receipts for passengers transport items, tourism receipts from travel items US dollar, tourism receipts current US dollar, and tourism receipts percentage of total exports, for the OUTBOUND variable, we used international tourism expenditures, international tourism expenditures from passengers, international tourism expenditures from transport items, and tourism expenditures from travel items using principal component analysis (PCA). As a result, we'll need to fit a specific index to the residuals after performing a regression on that index to create the composite index of INBOUND and OUTBOUND. When all regression models have finished creating new residuals, PCA combines all residual series. The PCA method entails extracting a set of high-dimensional indicators and transposing them into a new set of indexes that reflect different components and are uncorrelated to one another (Akanbi, 2014). The linear combination resulting from the PCA and eigenvectors (loading matrix) is first employed as the needed weights, and then the aggregated index (regressed index) is calculated using the resulting values: This is the resultant linear combination that PCA finds

$$\boldsymbol{INBOUND} = \gamma_1\ \boldsymbol{ITA} + \gamma_2\,\boldsymbol{ITRP} + \gamma_3\,\boldsymbol{ITRT} + \gamma_4\,\boldsymbol{ITRD} + \gamma_5\,\boldsymbol{ITRE} \quad (1)$$

Where $\gamma_1, \gamma_2, \gamma_3, \gamma_4$ *and* γ_5 are the eigenvectors from the PCA and number of tourist arrival in the country, tourism receipts for passengers transport items, tourism receipts from travel items US dollar, tourism receipts current US dollar, and tourism receipts percentage of total exports users synthesize INBOUND variable.

$$\boldsymbol{OUTBOUND} = \gamma_1\ \boldsymbol{ITD} + \gamma_2\,\boldsymbol{ITEP} + \gamma_3\,\boldsymbol{ITET} + \gamma_4\,\boldsymbol{ITED} \quad (2)$$

Where $\gamma_1, \gamma_2, \gamma_3,$ *and* γ_4 are the eigenvectors from the PCA and international tourism expenditure, international tourism expenditure from passengers, international tourism expenditure from transport items, and tourism expenditure from travel items users synthesize the OUTBOUND variable.

The study follows Prideaux (2000) theoretical framework for the transport cost model, which is the association between total holiday expenditures and transport access cost in a simplified form of a model; however, this study expanded the transport cost model to include air transportation, railway transportation, trade openness, travel, and transport services. In addition, the study used a PCA matrix to create inbound and outbound tourism indicators, which served as the study's 'response' variable. The study estimates the following relationship in 140 BRI countries:

$$ln\ (\boldsymbol{INBINDEX})_{i,t} = \alpha_0 + \alpha_1\, ln\ (\boldsymbol{INBINDEX})_{i,t-1} + \alpha_2 \ln (\boldsymbol{AT})_{i,t} + \alpha_3 \ln (\boldsymbol{RAIL})_{i,t} + \alpha_4 \ln (\boldsymbol{TS})_{i,t} + \alpha_5 \ln (\boldsymbol{TRS})_{i,t} + \alpha_6 \ln (\boldsymbol{TRADE})_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$ln\ (\boldsymbol{OUTBINDEX})_{i,t} = \alpha_0 + \alpha_1\, ln\ (\boldsymbol{OUTBINDEX})_{i,t-1} + \alpha_2 \ln (\boldsymbol{AT})_{i,t} + \alpha_3 \ln (\boldsymbol{RAIL})_{i,t} + \alpha_4 \ln (\boldsymbol{TS})_{i,t} + \alpha_5 \ln (\boldsymbol{TRS})_{i,t} + \alpha_6 \ln (\boldsymbol{TRADE})_{i,t} + \varepsilon_{i,t} \quad (4)$$

Table-2
Unit root test.

Unit Root Test							
Unit Root Test at Level	AT	RAIL	TS	TRS	TRADE	INBOUND	OUTBOUND
Levin, lin & Chu t*	−39.84***	−47.182***	−50.86***	−44.77***	−51.11***	−38.23***	−47.18***
Im, Pesrarn and Shin W-stat	−41.26***	−45.26***	−48.57***	−45.21***	−47.70***	−42.09***	−46.26***
ADF – Fisher Chi-Square	1898.40***	2040.86***	2284.20***	2119.32***	2216.19***	1938.76***	2141.93***
PP – Fisher Chi-square	2140.40***	2240.84***	2460.42***	2272.01***	2371.66***	2129.22***	2377.73***
Unit Root test at First Difference							
Levin, lin & Chu t*	−62.55***	−54.61***	−57.93***	57.08***	−65.47***	−66.95***	−57.62***
Im, Pesrarn and Shin W-stat	−72.51***	−64.72***	−69.62***	−69.97***	−75.14***	−74.41***	−68.08***
ADF – Fisher Chi-Square	3396.15***	2998.31***	3337.32***	3351.91***	3620.56***	3495.58***	3204.21***
PP – Fisher Chi-square	13707.0***	13465.6***	16687.8***	14954.5***	18952.7***	14544.5***	15930.2***

Notes. Values in parenthesis is estimated by t-statistics in parentheses***p < 0.01, **p < 0.05, *p < 0.1.

Table-3
Correlation matrix.

INBINDEX						OUTBINDEX				
Variables	ITA	ITRP	ITRT	ITRD	ITRE	Variables	ITD	ITEP	ITET	ITED
ITA	1.0000					ITD	1.0000			
ITRP	0.4238	1.0000				ITEP	0.2680	1.0000		
ITRT	0.5721	0.6247	1.0000			ITET	0.3690	0.6746	1.0000	
ITRD	0.4888	0.7792	0.6024	1.0000		ITED	0.2715	0.8582	0.6755	1.0000
ITRE	0.3503	0.5137	0.4759	0.6074	1.0000					

Source: author computation

Where INBINDEX indicates international inbound tourism index, OUTBINDEX indicates international outbound index, AT represents air transport freight, RAIL represents railways passengers carried, TS represents travel services, TRS represents transport services, TRADE indicates trade openness, 'ln' represents natural logarithm, 'i' represents cross-section identifiers i.e., 1 to 140 countries, 't' represents time period from 1996 to 2020, and 'ε' indicates white noise error term.

This study employed panel Granger causality via Wald F-statistics. For equations (1) and (2), the panel Granger causality is as follows:

$$\triangle ln\,(INBINDEX)_{i,t} = \varphi_{1i} + \sum_{j=1}^{m} \varphi_{11_{ij}} \triangle ln\,(INBINDEX)_{i,t-j} + \sum_{j=1}^{m} \varphi_{12_{ij}} \triangle \ln\,(AT)_{i,t-j} + \sum_{j=1}^{m} \varphi_{13_{ij}} \triangle \ln\,(RAIL)_{i,t-j} + \sum_{j=1}^{m} \varphi_{14_{ij}} \triangle \ln\,(TS)_{i,t-j} + \sum_{j=1}^{m} \varphi_{15_{ij}} \triangle \ln\,(TRS)_{i,t-j} + \sum_{j=1}^{m} \varphi_{16_{ij}} \triangle \ln\,(TRADE)_{i,t-j} + \varepsilon_{i,t} \quad (5)$$

$$\triangle ln\,(OUTBINDEX)_{i,t} = \varphi_{1i} + \sum_{j=1}^{m} \varphi_{11_{ij}} \triangle ln\,(OUTBINDEX)_{i,t-j} + \sum_{j=1}^{m} \varphi_{12_{ij}} \triangle \ln\,(AT)_{i,t-j} + \sum_{j=1}^{m} \varphi_{13_{ij}} \triangle \ln\,(RAIL)_{i,t-j} + \sum_{j=1}^{m} \varphi_{14_{ij}} \triangle \ln\,(TS)_{i,t-j} + \sum_{j=1}^{m} \varphi_{15_{ij}} \triangle \ln\,(TRS)_{i,t-j} + \sum_{j=1}^{m} \varphi_{16_{ij}} \triangle \ln\,(TRADE)_{i,t-j} + \varepsilon_{i,t} \quad (6)$$

4. Estimated results

To begin our estimation, first of all, we apply a unit root test to check the stationary of the variables. We utilized the Levin-lin-chu (LLC) (Levin et al., 2002), Im-Pesaran-shin (IPS) (Im et al., 2003), Fisher ADF, and PP – Fisher Chi-square unit root test for this purpose, and the findings are shown in Table 2. These findings demonstrate similar consequences at the level and the first difference. The unit root test successfully simplifies the null hypothesis and demonstrates the stationary condition of all variables.

4.1. Inbound and outbound results of the correlation matrix and principal component analysis

This study used principal component analysis (PCA) to create an index of the inbound and outbound index before explaining the analysis results. There are five factors in the inbound index: international tourism arrivals, tourism receipts from passengers, tourism receipts from travel items, receipts from current US dollars, and tourism receipts percentage of exports. There are four factors in the outbound index: international tourism expenditures, international tourism expenditures from passengers, international tourism expenditures from transport items, and tourism expenditures from travel items. Table 3 shows the correlation matrix for the inbound and outbound tourism indicators, revealing that

Table- 4
Panel (A) Principle Component results.

INBINDEX			
Component	Eigenvalue	Proportion	Cumulative
Comp1	3.19758	0.6395	0.6395
Comp2	.710613	0.1421	0.7816
Comp3	.513731	0.1027	0.8844
Comp4	.378053	0.0756	0.9600
Comp5	.200026	0.0400	1.0000
OUTBINDEX			
Comp1	2.64145	0.6604	0.6604
Comp2	.855011	0.2138	0.8741
Comp3	.361762	0.0904	0.9646
Comp4	.14178	0.0354	1.0000

Source: author computation

the indicators are significant. The correlation coefficients between these variables are quite high, indicating a strong relationship. Because of the high degree of collinearity across all variables, we used PCA to create the inbound and outbound indexes. As shown in Table 4, the results of the PCA and the eigenvalues of each component are shown clearly. Table 5 shows the eigenvectors' results.

Additionally, we kept the component with an eigenvalue of more than one, the eigenvectors linked with variables whose absolute value exceeded 0.40, and the component with an eigenvalue of more than one (Chen, 2014). After computing factor scores based on the eigenvalue of the first component. This index assesses the progress of inbound and outbound tourism.

4.1.1. Factor analysis for inbound and outbound tourism

Table 6 uses factor analysis to verify the correctness of the PCA matrix. The 'principle extraction approach' retrieved a single component with a higher factor value, such as more than 82 percent for the inbound tourism index and 81 percent for the outbound tourism index. Furthermore, Kaiser-Meyer-Olkin (KMO) factor values of around 0.799 and 0.726 validate the measure of sample adequacy for both inbound and outbound tourism, respectively. If the KMO score is greater than 0.65, it represents a measure of sampling adequacy, indicating that our PCA index is valid in a panel of countries.

4.2. Cointegration test

After the confirmation of the stationary of the variables, the cointegration in our data is detected using Kao (1999), Pedroni (2004), and Westerlund (2007) methods, respectively. We estimate the cointegration of the inbound and outbound indexes separately. To estimate the precise

Table 5
Panel (B) Principle Components (eigenvector) results.

INBINDEX				
Variable	Comp1	Comp2	Comp3	Comp4
ITA	0.3868	0.7580	0.3029	0.4055
ITRP	0.4763	−0.2292	−0.5330	0.1504
ITRT	0.4602	0.2848	−0.1360	−0.8140
ITRD	0.4942	−0.2347	−0.2160	0.3756
ITRE	0.4093	−0.4865	0.7477	−0.0966
OUTBINDEX				
ITD	0.3031	0.9324	0.1970	0.0031
ITEP	0.5601	−0.2579	0.3474	0.7064
ITET	0.5291	0.0073	−0.8485	0.0005
ITED	0.5607	−0.2533	0.3471	−0.7078

Source: author computation

Table- 6
factor analysis for inbound and outbound of tourism.

Inbound		Outbound	
Variables	KMO	Variables	KMO
ITA	0.8210	ITD	0.8147
ITRP	0.7641	ITEP	0.6763
ITRT	0.8309	ITET	0.8530
ITRD	0.7559	ITED	0.6766
ITRE	0.8773		
Overall	0.7997	Overall	0.7263

Source: author's calculation

findings, we used the Stata15 package. Table 7 shows the findings of the panel cointegration analysis which was performed. The Kao test results confirm cointegration in the model, as shown by the five test statistics and p values obtained from the test. The results disproved the null hypothesis of no cointegration, which was rejected by the results. The Pedroni cointegration test finds cointegration in the model when all three test statistics and p values are significant, demonstrating that the findings correctly reject the null hypothesis and show cointegration. This cointegration examination is further validated by the Westerlund test, which we use for further assurance. In Westerlund, the t-statistic and the p-values are all significant at 1%. This impact also rejects the null hypothesis; our model is cointegrated due to this effect. The cointegration test procedure described above indicates that both inbound and outbound indexes confirm long-term cointegration connections between the variables.

Table- 7
panel cointegration test.

Inbound tourism cointegration test		
Kao (1999), cointegration test		
	Statistic	P-value
Modified Dickey-Fuller t	−1.465***	0.0000
Dickey-Fuller t	−56.748***	0.0000
Augmented Dickey-Fuller t	−34.180***	0.0000
Unadjusted modified Dickey-Fuller t	−16.255***	0.0000
Unadjusted Dickey-Fuller t	−62.427***	0.0000
Pedroni (2004), cointegration test		
	Statistic	P-value
Modified Phillips-Perron t	−58.695***	0.0000
Phillips-Perron t	−57.319***	0.0000
Augmented Dickey-Fuller t	−57.102***	0.0000
Westerlund (2007), cointegration test		
	t-Statistic	P-value
Variance ratio	7.332***	0.0000
Outbound tourism cointergartion test		
Kao (1999), cointegration test		
	Statistic	P-value
Modified Dickey-Fuller t	−10.334***	0.0000
Dickey-Fuller t	−61.217***	0.0000
Augmented Dickey-Fuller t	−40.999***	0.0000
Unadjusted modified Dickey-Fuller t	−16.994***	0.0000
Unadjusted Dickey-Fuller t	−63.936***	0.0000
Pedroni (2004), cointegration test		
	Statistic	P-value
Modified Phillips-Perron t	−56.633***	0.0000
Phillips-Perron t	−57.432***	0.0000
Augmented Dickey-Fuller t	−57.354***	0.0000
Westerlund (2007), cointegration test		
	t-Statistic	P-value
Variance ratio	6.750***	0.0000

Note; *** indicate statistically significant at 1%.

4.3. FMOLS results

After confirmation of the long-run relationship between variables, we apply the FMOLS technique (Pedroni, 2001). Table 8 shows the FMOLS results. According to the results, air transport passengers carried and inbound tourism index have a positive relationship. If there is a 1% increase in air transport, inbound tourism will increase by 0.10%. Railway transport and inbound tourism have positive and significant relationships. With a 1% increase in railway passengers, the inbound tourism index will increase by 0.09%. Travel and transport services have a significant positive linkage with the inbound tourism index, but travel services have more share in inbound tourism than transport services. There was a 1% increase in travel services, and transport services increased inbound tourism by 0.55% and 0.19%, respectively. Trade openness increases the inbound tourism index by 0.13%. Column 4 shows that the outbound tourism index positively relates to air transportation. If there is a 1% increase in air transportation, outbound tourism will increase by 0.09%. In column 4, railway transportation and outbound tourism also link positively. With a 1% increase in railway passengers, outbound tourism will increase by 0.10%.

Travel services magnitude is more than transport services, and both positively affect outbound tourism. An increase in trade openness causes to increase in outbound tourism by 0.08%. Column 6 shows the combined results of air transport and railway transport, and the results confirm the positive linkage between air transport and railway transport with inbound tourism. Travel services, transport services, and trade openness have a positive relationship with the inbound tourism index; with a 1% increase in travel services, transport services, and trade openness, inbound tourism increased by 0.56%, 0.18%, and 0.12%, respectively. Column 7 shows the outbound tourism relationship with air transport and railway transport. With a 1% increase in air transport and railway transport, outbound tourism will increase by 0.07% and 0.06%, respectively. Travel and transport services also show a positive linkage with outbound tourism. If there is a 1% increase in travel and transport services, outbound tourism will increase by 0.42% and 0.25%, respectively. Trade openness and outbound tourism have a positive relationship. With a 1% increase in trade liberalization outbound tourism index will increase by 0.07%.

4.4. Dynamic correlated coefficient effects

To check the robustness, we use the latest approach, DCCE, by Chudik and Pesaran (2015), which considers cross-section dependence and heterogeneity in the parameters. Table 9 represents the results of DCCE. The outcome verifies our previous results. The results of air transportation, railway transportation, travel, and transport services positively link inbound and outbound tourism indexes. But trade liberalization with outbound tourism has a negative significance. Moreover, the estimation techniques such as MG, AMG, FMOLS, and DOLS results are conflicting. DCCE works efficiently in the presence of cross-sectional dependence.

4.5. Granger causality test

Stationary is essential for estimating the causality test. As a result, all of our variables are stationary at the level and the first difference. The regression panel cannot estimate the causality test without a unit root test. The causality test identifies the relationship between the variables that are observed. It is significant because it serves as a policy direction. Table 10 displays the estimated findings. The findings suggest that there is a bidirectional relationship between inbound tourism and air transportation, between railway transportation and inbound tourism, between travel services and inbound tourism, and between trade and inbound tourism. Transport services and inbound tourism have a unidirectional relationship.

Table 11 shows the outbound tourism index causality test. The

Table- 8
FMOLS results.

VARIABLES	INBOUND (Air Transportation)	INBOUND (Railway Transportation)	OUTBOUND (Air Transportation)	OUTBOUND (Railway Transportation)	INBOUND (Air & Railway Transportation)	OUTBOUND (Air & Railway Transportation)
L.INBINDEX	0.157***	0.219***			0.153***	
	(5.62)	(6.20)			(5.14)	
L.OUTBINDEX			0.113***	0.168***		0.107***
			(3.90)	(4.51)		(3.22)
AT	0.103**		0.094***		0.088***	0.077***
	(11.69)		(11.43)		(8.89)	(7.65)
RAIL		0.099***		0.103***	0.052***	0.061***
		(5.73)		(6.30)	(3.40)	(3.96)
TS	0.550***	0.592***	0.404***	0.451***	0.567***	0.422***
	(14.61)	(12.17)	(11.45)	(9.72)	(14.09)	(10.35)
TRS	0.195***	0.278***	0.270***	0.336***	0.183***	0.256***
	(4.54)	(5.14)	(6.69)	(6.53)	(3.99)	(5.50)
TRADE	0.131***	0.154***	0.081**	0.092**	0.120***	0.072*
	(3.43)	(3.13)	(2.26)	(1.97)	(2.96)	(1.74)
Constant	−3.635***	−3.184***	−3.115***	−2.707***	−3.589***	−3.069***
	(-20.41)	(-14.51)	(-18.66)	(-12.93)	(-18.98)	(-16.02)
Observations	3474	3474	3474	3474	3474	3474
R-squared	0.254	0.119	0.258	0.129	0.117	0.111

Notes. Values in parenthesis is estimated by t-statistics in parentheses***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table –9
DCCE robustness results.

VARIABLES	INBOUND (Air Transportation)	INBOUND (Railway Transportation)	OUTBOUND (Air Transportation)	OUTBOUND (Railway Transportation)	INBOUND (Air & Railway Transportation)	OUTBOUND (Air & Railway Transportation)
L.INBINDEX	−1.012***	−1.013***			−1.010***	
	(-144.41)	(-147.79)			(-146.99)	
L.OUTBINDEX			−1.013***	−1.014***		−1.013***
			(-159.55)	(-159.90)		(-153.38)
AT	0.018***		0.011**		0.019***	0.010**
	(3.40)		(2.37)		(3.42)	(2.42)
RAIL		0.015**		0.018*	0.014**	
		(2.39)		(1.79)	(2.19)	
TS	0.424***	0.421***	0.325***	0.333***	0.426***	0.333***
	(17.94)	(18.69)	(13.51)	(14.27)	(18.21)	(13.98)
TRS	0.170***	0.192***	0.172***	0.175***	0.172***	0.166***
	(6.31)	(6.72)	(8.03)	(8.32)	(6.58)	(8.72)
TRADE	0.021*	0.019*	−0.026**	−0.033***	0.019	−0.030**
	(1.78)	(1.68)	(-2.09)	(-2.86)	(1.58)	(-2.47)
Observations	3475	3475	3475	3475	3475	3475
R-squared	0.159	0.162	0.173	0.173	0.158	0.170

Notes. Values in parenthesis is estimated by z-statistics in parentheses*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

outcomes show a bidirectional relationship between air transport and outbound tourism, railway transportation and outbound tourism, travel and transport, and trade and outbound tourism.

5. Conclusion

The link between tourism and transportation has been a highly debated issue for decades; however, only a few studies have attempted to develop a travel and tourist competitiveness index using a variety of variables that broadly describe the tourism competitiveness index. The study used a unit root test, cointegration test, and FMOLS. For robustness, we employed DCCE. For the causality test, we used the granger causality test. The results show a positive relationship between air transportation and with inbound and outbound tourism index, whereas travel and transportation services increase the inbound and outbound tourism indexes. Trade openness also increases the inbound and outbound tourism indexes. The causality between transportation and tourism indexes confirms the feedback relation with air transportation and travel services, whereas trade and inbound tourism have a unidirectional relationship. The outbound tourism index verified the feedback hypothesis with air transportation, railway transportation, travel and transport services, and trade openness.

The following policy recommendations are derived from the overall findings that the importance of transportation modes played a critical role in strengthening the international tourism system; as a result, policies should be prepared with suitable destination choices to make places more easily accessible and reachable while lowering freight charges and making it easier to transport goods to their vacation destinations. Policies to support travel and transportation services are equipped with educated human capital and resource management, fluent in foreign languages, and suitable guidance offered to visitors on possible risks and possibilities in the target places. International trade has expanded with the potential tools to improve international tourism. Trade liberalization policies must be flexible and adaptable to build the more substantial global tourism infrastructure required for healthy and prosperous tourism worldwide. It is recommended that transportation charges, passengers transport, and goods transportation expenses are charged equitably since this has an impact on tourist visits and length of stay decisions. This overall exercise helps to link international tourism, air transportation, railway transportation, trade openness, travel services, and transportation services in a panel of selected BRI countries and to arrive at the conclusion that tourism is a global phenomenon. As a result, all of us must conserve our natural environment and care for it through proper policy instruments to expand the international tourist infrastructure to benefit people and their lives. We must band together to protect this natural blessing for our future health. Finally, four factors contributing to the BRI's impact on tourism development are identified: macroeconomic factors, transportation factors, destination factors, tourism policy and promotional factors. The BRI countries need to take advantage of the trade route for tourism development.

There are some limitations to this study. The study first emphasized 140 Belt and Road nations from 1996 to 2020. Nevertheless, the number of nations joining the BRI is gradually rising. Further investigation is necessary to compare the various sectors involved in tourism and transportation with those in other nations. Second, our study examined the long-term relationship between tourism, transportation, and trade openness. Our model can be expanded by applying other econometric causal inferences, such as difference in difference, regression discontinuity, etc. To develop a comprehensive understanding of tourism, future research should carry out a broad-ranging, cross-regional comparative study and offer universal regulations on the tourism in many nations or cultures.

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Table- 10
granger causality test for INBINDEX.

variables	$\sum \triangle ln\ (INBINDEX)_{t-1}$	$\sum \triangle \ln\ (AT)_{t-1}$	$\sum \triangle \ln\ (RAIL)_{t-1}$	$\sum \triangle \ln\ (TS)_{t-1}$	$\sum \triangle \ln\ (TRS)_{t-1}$	$\sum \triangle \ln\ (TRADE)_{t-1}$
$\triangle ln\ (INBINDEX)_t$	–	3.273**	7.543***	15.017***	1.226	4.123***
$\triangle \ln\ (AT)_t$	29.927***	–	5.941***	9.472***	6.839**	7.855***
$\triangle \ln\ (RAIL)_t$	13.087***	13.500***	–	27.937***	25.156***	2.239
$\triangle \ln\ (TS)_t$	58.528***	3.209**	0.227	–	2.694**	13.176***
$\triangle \ln\ (TRS)_t$	3.020**	4.482***	4.795***	0.610	–	4.914***
$\triangle \ln\ (TRADE)_t$	14.438***	1.676	4.190***	12.089***	32.458***	–

Notes. Values in parenthesis is estimated by t-statistics in parentheses***p < 0.01, **p < 0.05, *p < 0.1.

Table- 11
granger causality test for OUTBINDEX.

Variables	$\sum \triangle ln\ (OUTBINDEX)_{t-1}$	$\sum \triangle \ln\ (AT)_{t-1}$	$\sum \triangle \ln\ (RAIL)_{t-1}$	$\sum \triangle \ln\ (TS)_{t-1}$	$\sum \triangle \ln\ (TRS)_{t-1}$	$\sum \triangle \ln\ (TRADE)_{t-1}$
$\triangle ln\ (OUTBINDEX)_t$	–	12.255***	4.875***	3.709**	7.977***	2.331*
$\triangle \ln\ (AT)_t$	22.477***	–	5.941***	9.472***	6.839***	7.855***
$\triangle \ln\ (RAIL)_t$	20.311***	13.500***	–	27.937***	25.156***	2.239
$\triangle \ln\ (TS)_t$	38.293***	3.209**	0.227	–	2.694*	13.176***
$\triangle \ln\ (TRS)_t$	0.477	4.482***	4.795***	0.610	–	4.914***
$\triangle \ln\ (TRADE)_t$	17.019***	1.676	4.190***	12.089***	32.458***	–

Notes. Values in parenthesis is estimated by t-statistics in parentheses***p < 0.01, **p < 0.05, *p < 0.1.

Author statement

Muhammad Noshab Hussain: Write the whole draft of this manuscript and solely work on this manuscript.

Data availability

Data will be made available on request.

Acknowledgment

Author read and approved the final manuscript.

Appendix

Table- 1
list of BRI countries

Afghanistan	Dominica	Libya	Saudi Arabia
Albania	Dominican Republic	Lithuania	Senegal
Algeria	Ecuador	Luxembourg	Serbia
Angola	Egypt, Arab Rep.	Madagascar	Seychelles
Antigua and Barbuda	El Salvador	Malaysia	Sierra Leone
Armenia	Equatorial Guinea	Maldives	Singapore
Austria	Eritrea	Mali	Slovak Republic
Azerbaijan	Estonia	Malta	Slovenia
Bahrain	Ethiopia	Mauritania	Solomon Islands
Bangladesh	Fiji	Micronesia, Fed. Sts.	Somalia
Barbados	Gabon	Moldova	South Africa
Belarus	Gambia, The	Mongolia	South Sudan
Benin	Georgia	Montenegro	Sri Lanka
Bolivia	Ghana	Morocco	Sudan
Bosnia and Herzegovina	Greece	Mozambique	Suriname
Botswana	Grenada	Myanmar	Tajikistan
Brunei Darussalam	Guinea	Namibia	Tanzania
Bulgaria	Guinea-Bissau	Nepal	Thailand
Burundi	Guyana	New Zealand	Timor-Leste
Cabo Verde	Hungary	Niger	Togo
Cambodia	Indonesia	Nigeria	Tonga
Cameroon	Iran, Islamic Rep.	North Macedonia	Trinidad and Tobago
Chad	Iraq	Oman	Tunisia
Chile	Italy	Pakistan	Turkey
China	Jamaica	Panama	Uganda
Comoros	Kazakhstan	Papua New Guinea	Ukraine
Congo, Dem. Rep.	Kenya	Peru	United Arab Emirates
Congo, Rep.	Kiribati	Philippines	Uruguay
Costa Rica	Korea, Rep.	Poland	Uzbekistan

(*continued on next page*)

Table- 1 (*continued*)

Afghanistan	Dominica	Libya	Saudi Arabia
Cote d'Ivoire	Kuwait	Portugal	Vanuatu
Croatia	Lao PDR	Qatar	Venezuela, RB
Cuba	Latvia	Romania	Vietnam
Cyprus	Lebanon	Russian Federation	Yemen, Rep.
Czech Republic	Lesotho	Rwanda	Zambia
Djibouti	Liberia	Samoa	Zimbabwe

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Managing sustainable practices in cruise tourism: the assessment of carbon footprint and waste of water and beverage packaging

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ABSTRACT

This paper's aim is to present an analysis of the carbon - dioxide emissions and waste associated with water and beverage packaging. The assessment of the packaging's carbon footprint (CF) and waste is also considered for all passengers who visit Italian ports on cruise ships. These factors are considered at two points in time (2010 and 2018) to allow for the evaluation of changes due to technological innovations in the packaging sector. Finally, a best-case framework scenario for the management of water and beverage packaging materials is identified to evaluate whether the use of appropriate strategies can reduce CF and waste in this sector. The results indicate that adequate changes in packaging can minimize waste and reduce the consumption of materials and energy resources in the packaging production cycle, thus creating environmental benefits.

1. Introduction

In the last 15 years, the cruise sector has had particularly high growth and has been one of the most attractive sectors of the tourism industry; in 2018, this sector had a global economic impact of €134 billion (CLIA, 2018 and, 2019; MedCruise, 2018). In Europe, the cruise sector's revenues amounted to about €50 billion, including over €13 billion in Italy, which was the most popular Mediterranean destination, followed by Spain, Greece, and France (CLIA, 2018). Companies in this sector have made many investments to improve and differentiate their offerings, to set very high standards, to provide high-quality services, and to initiate new models of propulsion (Parnyakov, 2014).

As a result, the cruise industry has diversified into new forms, which has caused further pressures on ecosystems (MacNeill & Wozniak, 2018; Popiolek, 2014) and contributed to climate change. Generally, tourism comprises a set of social and economic activities that use large amounts of natural capital and that generate significant environmental impacts (Aljerf, 2015). For this reason, some international organizations, such as the United Nations World Tourism Organization, the United Nations Environment Program, and the Organization for Economic Cooperation and Development, as well as host countries and other stakeholders, are analyzing tourism's contributions to greenhouse gas (GHG) emissions in order to identify a suitable approach that can minimize such effects (Rico et al., 2019).

In any case, the cruise sector, due to its constant structural growth and global spread, requires greater international coordination than it currently has, as well as a tighter pollution-control framework, to stimulate the adoption of sustainable models (which, at present, are largely voluntary).

A new trend has been started since December 2016, when the Directive 2014/95/EU entered into force in the European States Members (European Parliament, 2014). It requires the "non-financial and diversity information by certain large undertakings and groups" to be included in the management report.

So a non-financial statement containing information to understand the performance, position and impact of companies' activity relating also to the environmental and social matters must to be published and controlled by supervisory bodies.

The main cruise companies are certainly among the categories of companies identified by the directive, so for the European ones started the obligation to report some environmental information, like the use of energy and water resources and greenhouse gas and pollutant emissions.

Caric & Mackelworth (2014) underline that "the absence of any international coordination of the industry at the region level leaves it open to exploitation, especially considering the lack of effective pollution control mechanisms in most States"; in addition, the United Nations Environment Program noted that cruise ships are among the most significant polluters of the sea ecosystem (Allsopp, Walters, Santillo, & Johnston, 2005). The cruise sector produces large quantities of waste and pollution, consumes significant natural resources, incites ecosystem

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changes and biodiversity loss, and has significant impacts on the landscape. For instance, this sector is responsible for a large quantity of solid waste (Mwanza, Mbohwa, & Telukdarie, 2018), especially that due to packaging (Klein, 2011), comprising about 25% of the waste produced by the total merchant fleet, despite having only 1% of all ships (Herz, 2002; Strazza, Del Borghi, Gallo, & Maran, 2013).

Moreover, cruise ships are increasing in size (and consequently, carrying more passengers), which is increasing the pressure on ports and host communities. Large vessels require significant infrastructure, including for waste management. Ports play a very complex role. On the one hand, they seek inclusion in cruise itineraries in order to attract more traffic and thus maximize the economic benefits that the port and its residents experience; on the other hand, ports seek to minimize the environmental impacts associated with those cruises (Karlis & Polemis, 2018).

In recent years, many cruise companies have voluntarily adopted various measures to reduce their impacts by minimizing waste, both on the ship and on land. The main waste streams are wastewater, grey water (that from wells, showers, and kitchens) (Gossling et al., 2012), solid waste, ballast water, and atmospheric emissions (Copeland, 2008; Sweeting & Wayne, 2011).

Cruise-ship waste is managed according to international protocols (e.g., the International Convention for the Prevention of Pollution from Ships, or MARPOL[1]), national laws and local regulations, as agencies at all those levels are involved in the disposal of cruise-ship waste. Furthermore, Caric & Mackelworth (2014) stressed that "the pollution they create it is difficult to attribute to a source, especially within the Mediterranean where multiple states and jurisdictions are located in close proximity." In addition, organic waste can only be legally disposed of beyond 12 nautical miles from the coast of the Mediterranean Sea, and (under Annex V of MARPOL) directly disposing of plastic in the sea is strictly prohibited. Despite these rules, cruise ships' waste disposal is usually difficult to control, and onboard waste storage is an important issue (Svaetichin & Inkinen, 2017) due to the ships' limited space. This is aggravated when port facilities lack adequate disposal systems. Hence, many newly produced ships use onboard waste incinerators for solid waste and some plastics[2] (Gallo, Strazza, & Del Borghi, 2015). Nowadays, the adoption of policies to reduce such negative externalities is a major challenge for the territories involved, as well as for cruise-tourism companies.

In the early 2000s, the European Union (EU) passed Directive 2000/59/EC, which was meant to protect the marine ecosystem by restricting ships' ability to dump waste and residue in the ocean, by enhancing port facilities, and by requiring ships to consign waste before departing from a port. To find an adequate balance between the smooth operation of maritime transportation and the protection of the natural ecosystem (Neele et al., 2017), this rule was amended to allow waste to be transferred to another port, provided that there is sufficient storage capacity on the ship (European Commission, 2000; Zuin, Belac, & Marzi, 2009). In 2015, the EU introduced a new, more detailed categorization of waste so as to include of data on the quality and quantity of waste that ships produce and that is then consigned to ports' reception facilities. According to the European Commission (2015) "This new categorization of garbage is reflected in IMO [International Maritime Organization] Circular MEPC.1/Circ.644/Rev.1, providing a standard format for the advance notification form for waste delivery to port reception facilities, as well as in IMO Circular MEPC.1/Circ.645/Rev.1, providing a standard format for the waste delivery receipt following a ship's use of port reception facilities." Generally, however, sustainable practices still must be developed to further reduce waste and increase recycling and reuse, with the aim of efficiently managing waste.

Cruise-ship tourism also causes various forms of pollution and impacts tourist destinations; most importantly, as cruise visits to host destinations typically last a single day or a half-day, their environmental and social impacts on these places are very concentrated (Caric & Mackelworth, 2014; Copeland, 2008).

Therefore, it is often difficult for cruise companies to manage and protect the host destinations. Evidence of cruise ships' impacts include the high disparity between cruise ships' environmental standards and the host destinations' own pollution indicators. Damage to the destinations' ecosystems and social frameworks is not transferred to the cruise businesses because doing so could cause the cruise companies to choose other destinations.

The cruise sector could provide an advanced model for tourism management and development because of its specific characteristics (e.g., moving and intensive pollution), which provide a significant opportunity to tackle sustainability issues and to reduce negative externalities (Caric, 2016).

Hence, the idea of sustainable tourism has spread and stimulated cruise companies to address their burden on the environment and on communities (Caric, 2016; United Nations Environment Program & United Nations World Tourism Organization, 2005) so as to satisfy the needs of consumers who are aware of these environmental issues.

Regarding sustainability in the tourism sector, the European Commission deliberated in 2003 on the economic, social, and environmental sustainability of European tourism; in 2007, it adopted an agenda for a more sustainable tourism policy, with the purpose of "improving the competitiveness of the European tourism industry and creating more and better jobs through the sustainable growth of tourism in Europe and globally" (European Commission, 2007). The agenda also contained an analysis of the crucial role that tourism plays in the EU economy (Blancas, Lozano-Oyola, & Mercedes, 2015).

More European regulations were implemented in 2010, when the European Commission offered strong support for a framework to improve the sustainability and competitiveness of European tourism in order to retain that region's leading position in the tourism industry (Europe, the world's no 1 tourist destination - a new political framework for tourism in Europe. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 2010). Afterward, in 2014, the EU produced "A European Strategy for more Growth and Jobs in Coastal and Maritime Tourism," which underlined that the effects of climate change are exacerbating stresses in coastal and maritime areas and are potentially reshaping the geography and seasonality of the tourism industry (Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - a European strategy for more growth and jobs in coastal and maritime tourism, 2014).

Thus, for the EU, sustainable tourism provides a chance to implement services, products, and business models that will attract eco-focused tourists. The European Commission thus "invites Member States, regions, industry and other stakeholders to implement the Integrated Coastal Management Recommendation and Protocol," which is a new framework to minimize environmental stresses (e.g., those related to biodiversity); to increase tourism's economic benefits to natural areas; and to enhance resource efficiency, reduce waste, and restrict pollution in tourist regions. This framework provides sustainable management for tour operators and promotes environmentally friendly strategies, actions, and tools. Furthermore, the EU's water-efficiency measures (from its Water Blueprint) still need to be adopted. Coastal and maritime tourism could be an important economic driver, but it requires the implementation of these valuable European regulations, as this kind of

[1] The International Maritime Organization, an agency of the UN, adopted this document in 1973 and amended it in 1978 (MARPOL 73/78).

[2] These incinerators produce ash and air emissions, which can contain toxic residues, including heavy metals and dioxins. As a result, MARPOL "recommends, but does not demand, that ash from incineration of some plastics not be discharged into the sea." In light of this consideration, incinerator ash should be analyzed to determine whether it should be categorized as solid waste or hazardous waste.

tourism requires environmentally, economically, and socially adequate policies.

Moreover, in 2015, a conference entitled "Pan-European Dialogue between Cruise Operators, Ports and Coastal Tourism Stakeholders" promoted improved synergies and more structured dialogues on cruise tourism as best practices for this sector. The participants, which included stakeholders from various sectors of the cruise industry, agreed with the aims of the Europe 2020 Strategy, which stressed the relevance of sustainable cruise, coastal, and maritime tourism to the growth of the European economy. The participants also highlighted "the need to involve all the tourism chain in the benefits and deliveries for cruise tourism and recognized the contribution of cruise, coastal and maritime tourism to the social and economic development of coastal and insular destinations, the importance of coastal and insular destinations as touristic attractions and the need to preserve their authenticity and heritage" (AA.VV, 2015).

Despite the cruise sector's growth and its increasing environmental impact, the scientific literature about this topic is still quite limited, as Fig. 1 illustrates. Only a small portion of studies on tourism are focused on cruise tourism (including on its environmental burden) in particular.

We conducted a literature search using Web of Science and on the basis of the five main topics listed in Fig. 1, we found a shortage of papers, amounting to 670 from the last 20 years (1998–2018).

The first topic (which has 174 papers that have been cited 1836 times) includes subjects such as eutrophication due to food consumption patterns, carbon footprint, the life cycles of food packaging, the sustainability of agricultural products, and the impacts of recyclable and renewable materials.

The second topic includes food safety and the bio-optical characteristics of phytoplankton; it has only 29 publications, which have been cited 85 times.

The third topic, cruise ships' CFs, has only 13 publications, which have been cited a limited number of times (about 130); these studies focus on oceanographic measurements and data analysis.

The fourth topic has the greatest number of publications (304) and citations (3868) of the five topics, but the studies in this area are not very relevant to our research. Many of these articles are focused on the general impacts of tourism, including with regard to air traffic, air pollution, ocean acidification, PM10 application, air quality, and wastewater discharge. This topic also includes the use of gas turbines for power generation and the general energy efficiency of passenger ships.

The 147 studies on the last topic (cruise waste) have been cited 1865 times. This area includes articles that focus on the monitoring of vulnerable marine ecosystems (e.g., coral reefs), the prevention of pollution (e.g., wastewater discharge), and the operation of garbage-collection systems on cruises. For example, in terms of environmental impacts, some authors (e.g., MacNeill & Wozniak, 2018) have considered three areas that impact natural capital: waste, as measured by the frequency of withdrawal; sewage, as assessed on the basis of the number of passengers and impacts on the ecosystem, as measured with secondary qualitative data.

We proposed this analysis because the majority of the past studies have not dealt with the topic of this research. Our goals are to provide further insights in this area and to increase the scientific production on this topic; this research will be useful to cruise companies, public agencies, consortia from the industries involved in the production of beverage packaging, and other stakeholders who pay attention to environmental issues. Moreover, as European institutions have placed increasing attention on the need to reduce plastic pollution by restricting single-use plastic products, there is a need to rethink the issue by designing a new, sustainable approach also for the production and use of beverage packaging (Communication from the Commission to the

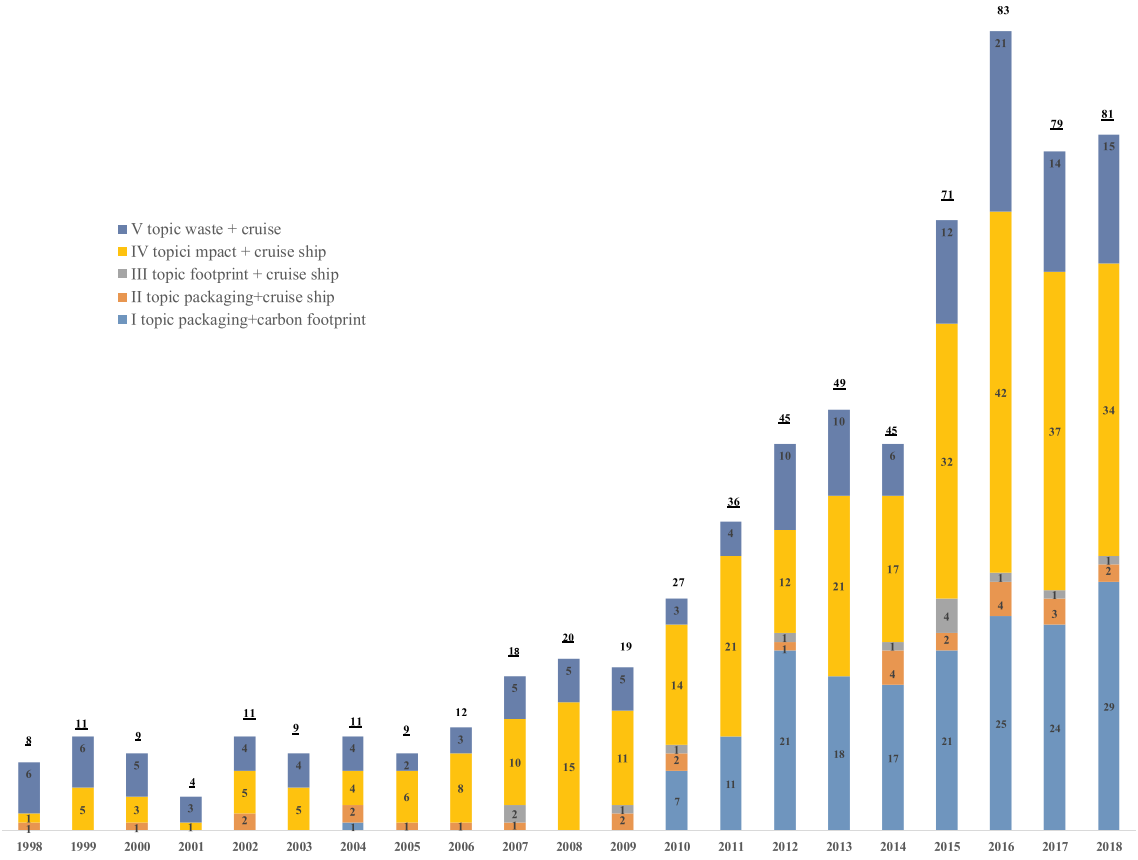

Fig. 1. Evolution of scientific literature according to the topic enquiry on Web of Science on 05 January 2019.

European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A European strategy for plastics in a circular economy, 2018; 2018b). Keeping in mind the last consideration, it has to be stressed that the passenger is an important stakeholder who must share the environmental responsibility and play a leading role to shift the quality of the cruise supply towards more sustainable approach. Therefore, a suitable building of his awareness about the environmental issue becomes significant (United Nations World Tourism Organization, 2016).

In light of the aforementioned considerations, this study is meant to consider the impact of cruise tourism in terms of environmental issues, particularly the reduction of GHG emissions and packaging waste.

On cruise ships, the consumption of food and drink is an essential experience, especially for families. Therefore, both the production and consumption of food and drink are important concerns in the promotion of sustainable tourism development. Despite the obvious lack of empirical studies on CF in the tourism industry, it is clear that food production and consumption are key issues in climate-change mitigation. Scholars such as Gossling, Brian, Aall, Hille, & Peeters (2011) have confirmed the need to further study the role that food and drink play in tourism. The interrelationships between the production and consumption of food and drink, particularly in terms of packaging, should be a point of focus in tourism studies (Grunert, Hieke, & Wills, 2014). Analyzing these interrelationships is important to creating sustainable tourism because at least a third of tourist spending is on food and drinks and, thus, especially on cruise ships, this topic is very important.

In particular, this paper is meant to assess cruise ships' beverage and water packaging, in terms of its CF and waste, in order to identify ways of better managing such packaging by providing a more sustainable mix of materials and by evaluating the implementation of various measures for reducing packaging's impact.

The analysis focuses on solid waste, particularly glass, polyethylene terephthalate (PET), and aluminum, which are the main types of primary water and beverage packaging.

Packaging represents a high share (Gallo et al., 2015) of the total solid waste generated on cruise ships, so a minimization strategy for this waste type is necessary. The methodology adopted in this study involves a CF indicator. The term *CF* was coined in the 1990s, and it is based on the concept of an ecological footprint. A carbon footprint is meant to be a measurement of an item's climate change impact. This generally refers to human activities' impacts on the environment; in this paper, the focus is on tourism which affects climate conditions in terms of GHG emissions. CF is based on GHG emissions and it is necessary to manage and reduce such emissions (Wiedmann & Minx, 2008). CF measurements help scholars to identify weaknesses, such as high-emission areas, that can be eliminated or improved. Therefore, CF is an indicator of sustainable development (Radu, Scrieciu, & Caracota, 2013).

To provide replicable analysis, we chose a functional unit that corresponds to the use of water packaged in PET and glass, as well as beverage packaged in aluminum cans, on a per person, per day basis (Butt, 2007; Zuin et al., 2009). In addition, we extended the calculation of CF and waste to include all the passengers who come through Italian cruise ports. We used two points in time (2010 and 2018) to allow for a comparison of the data; this comparison reveals significant changes, which are due mainly to technological innovations in the packaging sector. Thus, we applied a best-case framework scenario (B_{est}) for the management of water and beverage packaging materials in order to determine whether the use of appropriate strategies can reduce CF and waste in this sector. The results indicate that adequate changes in packaging materials can minimize waste and generate environmental benefits (in terms of reduced GHG emissions) thanks to the reduced consumption of materials and energy in the packaging production cycle.

2. Materials and methods

This paper includes an assessment of cruise-ship passenger flows, particularly for Italian ports. It also includes measurements of packaging products' carbon dioxide equivalent (CO_2eq) emissions and weights, based on the published environmental product declarations (EPDs) for each type of packaging (Strazza, Del Borghi, Magrassi, & Gallo, 2016). In addition, for the missing data, we studied the literature related to this sector. Hence, we applied the CF methodology, with functional units as a reference, in terms of the consumption of water and beverages per cruise passenger per day. Based on the amount of CO_2eq emissions per person, we assessed the total emissions per weeklong cruise and the total amount produced by cruise passengers at Italian ports each year. We also measured the quantity of packaging waste produced for the identified categories.

We carried out this analysis according to various assumed use rates for the chosen formats and materials (particularly for water packaging). First, we considered a baseline scenario that cruise companies have used for many years, including during the reference period of 2010–2018; we also created a hypothetical B_{est} framework in which the best practices concerning packaging materials would be applied.

This analysis is twofold. First, we measured the amounts of packaging-related waste and CO_2eq emissions in the reference period, including an evaluation of decreases in these values due especially to technological innovation. Second, we assessed the potential for a more significant reduction in these indicators as a result of changes in the management of packaging materials (in the B_{est} scenario).

2.1. Methods

Before calculating the levels of GHG emissions, the types of primary water and beverage packaging must be identified so that the weights and emissions (in CO_2eq) per packaging type can be computed for the reference years (2010 and 2018).

The present analysis used secondary data, gathering from EPDs (EPD, 2010a; EPD, 2010b; EPD, 2017a - EPD, 2017c) for water packaging types and literature (Amienyo, Gujba, Stichnothe, & Azapagic, 2013; Del Borghi, Gallo, & Magrassi, 2016) for the other beverages respectively. The EPDs are based on the ISO 14040 and ISO 14044 standards and on the Product Category Rules specification (Environdec, 2011).

The EPDs consider emissions for the whole material cycle, according to the Life Cycle Assessment (LCA) methodology; the functional unit in the EPD considered is represented by 1 L of mineral water bottled in PET (sizes 0.5 L and 1.5 L) and glass (size 1 L) packaging. System boundaries include stages related to raw materials, production, filling, transportation for distribution and end of life of mineral water. As regards the impact assessment categories, the value of the Global Warming, expressed in CO_2eq emissions, has been only considered for our hypothesis, based on the energy-flow model of packaging for the entire cycle, including the upstream, core and downstream phases.

In brief, the upstream phase entails the production of the materials for the primary, secondary, and tertiary packaging and it has the most significant CO_2eq emissions. The core phase includes the production of the packaging, the bottling and labeling processes, and the application of the secondary and tertiary packaging materials. The downstream phase concerns the disposal of the packaging materials and the end of the product's life. The primary packaging represents 90% of the total emissions related to packaging, so we considered only this kind of packaging in this paper. It has to be noted that more detailed information of LCA, for each kind of packaging considered, can be found in the EPD references of this paper.

To assess the impact of primary packaging emissions in the cruise sector, we used the Carbon Footprint Indicator, which the Intergovernmental Panel for Climate Change (2007) created, as well as the principles stated in the ISO/TS/14067 standards of 2013 (Pandey, Agrawal, & Pandey, 2011; Pattara, Salomone, & Cichelli, 2016). In this indicator, the total GHG emissions that are directly or indirectly associated with a commodity or service are expressed in tons of CO_2eq (Galli et al., 2012); this can be with reference to the entire life cycle or to only

part of it. GHG emissions relate to global warming potential which, according to the Intergovernmental Panel for Climate Change, is the potential that a kilogram of GHG has in terms of climate change effects over a 100 year time horizon (Lucchetti, Romano, & Arcese, 2012; Mancini et al., 2016).

We applied the data on the CO_2eq emissions and packaging weight, as illustrated in Fig. 3, to the functional unit. We used the resulting values, with some simplifications to support our hypotheses, to measure the GHG emissions of water and beverage packaging, in addition to the quantity and quality of the packaging waste produced in the reference years. We also extended the analysis to include the cruise passengers who passed through Italian ports in the same years. We compared the data from the two reference years to identify any changes that occurred over time. We carried out this first analysis according to the assumptions, regarding the use rates of the chosen packaging formats and materials, which have been in use with regard to cruise ships for many years. In the second step of the analysis, we evaluated whether the actual figures from 2010 to 2018 could be improved using the B_{est} scenario for instance, by applying a mix of packaging materials (for water in particular), thus significantly reducing the use of glass and 0.5 L PET bottles on cruise ships.

2.2. Materials

2.2.1. Market data

In the last 15 years, the cruise sector has been characterized by exponential growth. The Caribbean is the leading area in this market, and Europe is second; the Mediterranean is the favorite destination of European tourists.

The passengers who passed through Mediterranean ports grew by over 216% between 2000 (8.6 million) and 2018 (27.2 million) (Fig. 2). Visitors to Italy represented about 40% of this Mediterranean traffic; this nation showed an even more significant increase between 2000 and 2018: over 360%. As can be seen from Fig. 1, the highest growth took place between 2006 and 2011, when the number of passengers landing in Italian ports almost doubled; in recent years, however, the trend has been more stable. In 2018, among the main Mediterranean ports, Barcelona had the most passengers, at almost 3 million; it was followed by Civitavecchia, with 2.4 million passengers. Among the other Italian ports, Venice registered over 1.47 million passengers, Naples had almost 1.1 million, Genoa had 1 million and Savona had 0.873 million.

2.2.2. Input data

First, it was necessary to estimate the consumption per person per day during a weeklong cruise; it was then necessary to identify the type and format of packaging. This first analysis covered only some types of packaging (those relating to water, which are analyzed in particular detail, as well as those relating to beverages). The data on consumption were based on the beverage packages that are most commonly distributed on cruise ships. This corresponded to a recommended daily water intake of 2 L. The assumed daily consumption of other beverages was about 0.66 L.

We considered these quantities per person and per day of a weeklong cruise in the Mediterranean Sea during the spring or summer. The formats and types of packaging that we considered were 0.5 L and 1.5 L PET bottles (Iacovidou, Velenturf, & Purnell, 2019) and 1 L glass bottles for water, and only 0.33 L aluminum cans for other beverages. Hence, for each packaging types, we identified the reference EPDs. We used the same brand of product for each type of packaging, with regard to the EPDs for the years 2010 and 2018, as this enabled us to show the reductions in both CF and weight during this period (Fig. 3). Respectively, we used data from San Benedetto for the PET water bottles, from Cerelia for the glass water bottles, and from the literature for the aluminum beverage cans (Amienyo et al., 2013; Niero & Olsen, 2016).[3] The EPD data, as the references indicate, refers to studies conducted from 2010 through 2017; however as these studies' data are the most recent available, we counted them for our calculations concerning the reference years 2010 and 2018.

The CO_2eq emissions of all these packaging types depend on the use of recycled inputs in their production processes (in the upstream phase) and on the waste management during the end-of-life process (in the downstream phase). In the consulted EPDs, the percentages of recycled material used in the production of these types of packaging are 10% for plastic materials, between 27 and 48% for aluminum, and 0% for glass (as Cerelia states in its EPD that it uses 100% virgin glass). These determinations are valid for both the reference years.

With regard to the end-of-life assumptions in the downstream phase, the EPDs from Italy usually referred to the percentages of waste disposed of in various ways.[4]

Hence, based on the packaging types' CO_2eq emissions and weights (from the EPDs and from data in the literature), we determined measures of both CF and waste per cruise passenger per day.

As mentioned in Section 2.1, the measurements for both CF and waste for the water bottles were based on the percentages of use in the reference years 2010 and 2018: 50% glass bottles, 25% 0.5 L PET bottles, and 25% 1.5 L PET bottles. For the B_{est} scenario, these values were 5% glass bottles, 35% 0.5 L PET bottles, and 60% 1.5 L PET bottles. Both the GHG emissions and the weights for each type of packaging were the same in the B_{est} scenario as in the 2018 measurements.

Regarding aluminum cans for beverages (Arena, Sinclair, Lee, & Clift, 2017), we applied the same rate of use in each calculation (2010, 2018, and the B_{est} scenario). This included both the production of waste and the CO_2eq emissions. We did not assume for this study that such cans would be replaced with other packaging materials, as that will be the topic of our next study.

[3] The primary packaging consists of not just the main material (PET or glass) but also the materials in the cap (often high-density polyethylene), glue, and label (almost always polypropylene). However, the share of PET or glass can be as high as 90% of the total emissions from the primary-packaging production. In addition, for ease of transportation, the primary packaging is also typically accompanied by secondary packaging (e.g., shrink film) to hold the bottles together and even tertiary packaging (e.g., a wooden pallet). However, such additional packaging comprises only a small percentage of the total GHG emissions related to the packaging as a whole. In fact, 60–90% of these emissions (depending on the packaging materials) are related to the production of primary packaging. Thus, it is appropriate to simplify the process and to consider only primary packaging: PET, glass, and aluminum.

[4] The end-of-life statistics for each material are as follows. PET packaging can be recycled (28.4% in 2010 vs. 37.9% in 2016) or converted to energy (10% in 2010 vs. 17.6% in 2016), but it is still often sent to a landfill (61.6% in 2010 vs. 44.5% in 2016). Glass, on the other hand, is recycled more often (56.9% in 2010 vs. 70.3% in 2016) and has seen a sharp increase in energy-conversion treatment (3.5% in 2010 vs. 29.7% in 2016); it is no longer sent to landfills (39.6% in 2010 vs. 0% in 2016). Aluminum is recycled most of the time (72.4% in 2010 vs. 69.9 in 2016) and is sometimes converted to energy (5.5% in 2010 vs. 5.6% in 2016) or sent to a landfill (22.1% in 2010 vs. 24.5% in 2016) (ISPRA, 2011, 2015, 2017).

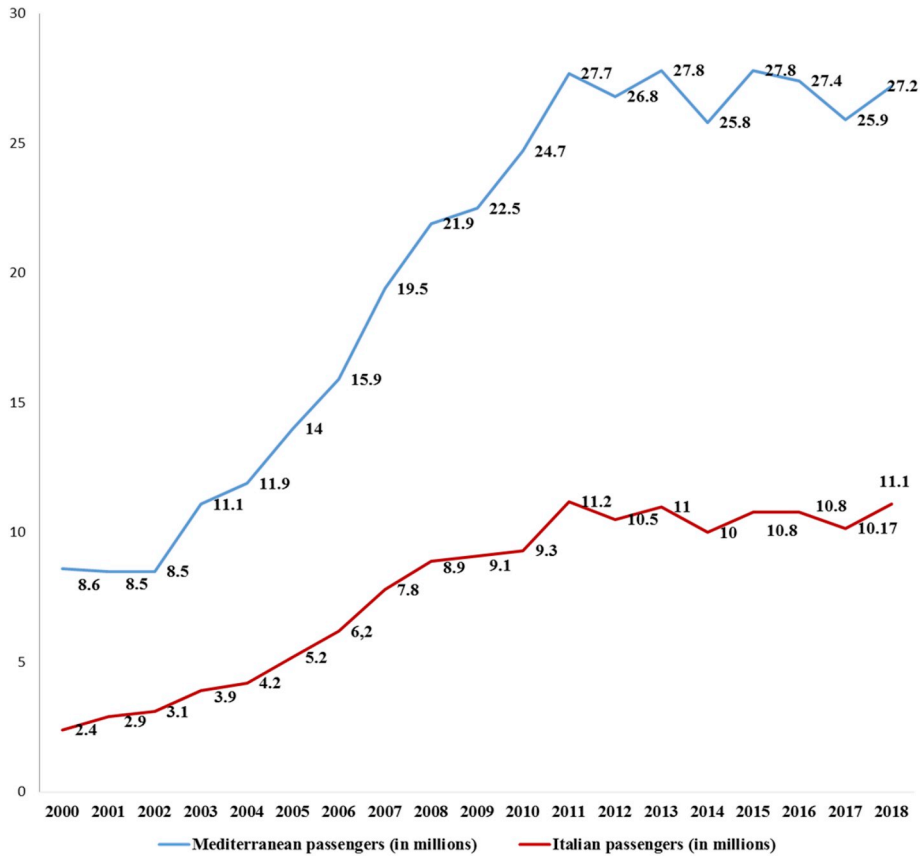

Fig. 2. Passengers in Mediterranean and Italian ports (millions).
Sources: Author's elaboration on data MedCruise (2016 and 2018), RisposteTurismo (2017 and 2018) and Italian Cruise Watch (2018).

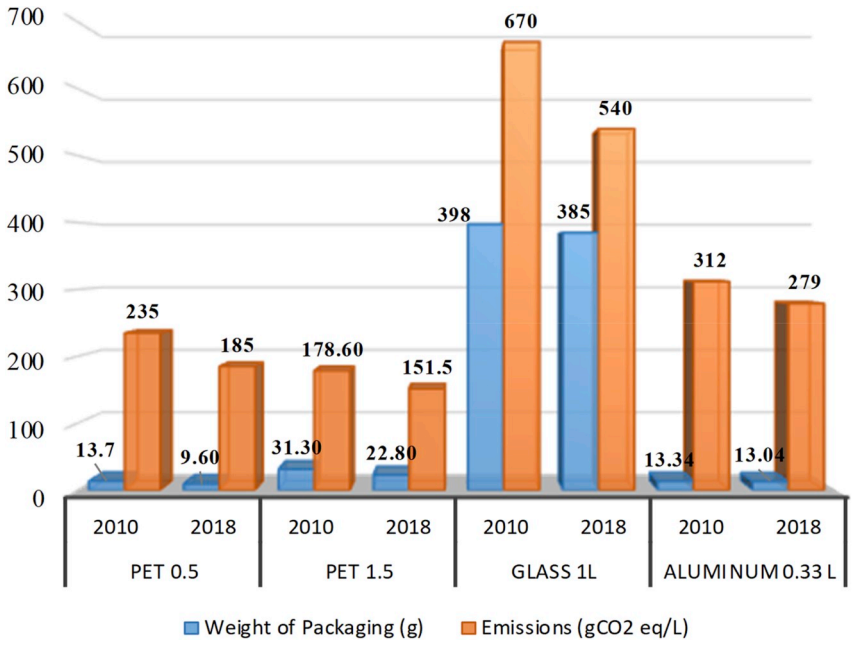

Fig. 3. Beverages packaging weight and emissions (gCO_2eq/L). Comparison years 2010–2018.
Sources: 2010: *PET 0.5*-EPD, 2010a; EPD, 2010b; *PET 1.5*-EPD, 2010a; *Glass*- EPD, 2010b; ICF International, 2016; *Aluminum*- Amienyo et al., 2013, 2018: *PET 0.5*-EPD, 2017a; EPD, 2017b; *PET 1.5*–2017b; EPD, 2017c; *Glass*- ICF International, 2016; *Aluminum*- Niero Olsen, 2016. The Aluminum Association, 2014.

Therefore, we assessed the CF and the waste of the primary packaging for the total number of people on a given ship during a weeklong cruise. With regard to the number of passengers, in our calculation, we assumed a tonnage between 110,000 and 140,000 tons, which matches the values reported by the Costa, MSC, and Royal Caribbean cruise lines, as well as a total of 4300 people (3300 passengers and 1000 crew

members) per ship. We included the crew in the calculations because we considered only basic consumption, and the crew would also consume water and beverages.

3. Results and discussion

The evolution of packaging weights and a reduction of GHG emissions from packaging have been illustrated in Fig. 3 and elaborated upon in the EPDs and the data from the literature. As the data show, glass has the highest weight and the most emissions of the main material types; as a result, its rate of use is reduced in the B_{est} scenario. However, the situation changes when other indicators are used. For instance, in 2018, for the ratio between emissions and packaging weight, the highest value was for aluminum (21.4 g of CO_2eq per gram of packaging), followed by 0.5 L PET bottles (19.4 g of CO_2eq per gram of packaging), 1.5 L PET bottles (with 6.6 g of CO_2eq per gram of packaging); glass had the lowest ratio (1.4 g of CO_2eq per gram of packaging).

Considering the total weight of the individual packages, each person produces about 3.14 kg of waste during an entire cruise trip (Table 1), according to data from 2010. This is in line with other findings: in particular, Caric (2016) assessed this factor and found that, "on board a large ship, 20 tons of solid waste are produced per week of cruising, for an average of over 4 kg/passenger." The average waste declined to 2.9 kg per passenger in 2018 and is only 0.67 kg per passenger in the B_{est} scenario. As a consequence, the total weight of waste per weeklong cruise decreased from 13,509 kg in 2010 to 12,891 kg in 2018. The B_{est} scenario would lead to an even more drastic reduction, with only 2, 900 kg of waste (Table 1).

Based on the number of cruise passengers who pass through Italian ports (Fig. 1), it is possible to measure the packaging waste generated on their cruises: 29.2 kt (thousand tons) of waste in 2010 and 33.3 kt of waste in 2018; this quantity is much lower, just over 7.44 kt, in the B_{est} scenario (Table 2). This comparison reveals a 14% increase in waste between 2010 and 2018; nevertheless, the number of passengers increased by 19.35% in this time. For the total waste in Italian ports, the B_{est} scenario would produce a decrease of 77.67% relative to the 2018 figure.

Hence, we calculated the CF. Table 3 highlights the reduction achieved over time and the potential improvements that could be made by changing the mix of packaging used for water and beverages. In particular Table 3 reveals the 17% reduction of CO_2eq emissions for all packaging materials on a per person, per week basis between 2010 (7.58 g of CO_2eq) and 2018 (6.25 g of CO_2eq). The emissions for the B_{est} scenario (3.85 g of CO_2eq) are 38% lower than those from 2018 and almost 50% lower than those from 2010.

We thus were able to multiply the per person emissions for a weeklong trip by the number of people on the ship to produce the CF of the reference packaging. This value was equal to 32.6 t of CO_2eq in 2010 and 26.8 t for 2018. For the B_{est} scenario, the emissions would be only 16.5 t CO_2eq per weeklong cruise. On the basis of the emissions per person per week, we compared the CF of all cruise passengers who passed through Italy (as shown in Fig. 2) in the two reference years (Table 4).

As the results highlight, in 2010–2018, the 19.35% growth in passengers did not correspond to an increase in emissions related to packaging considered, as the latter value actually decreased by 1.62%. This divergent trend is even clearer when comparing the emissions from 2010 with those from the B_{est} scenario, which indicates a reduction of almost 40%; this is equal to an GHG emissions saving of 27.8 kt.

Table 2
Water and beverage packaging waste generated by the passengers in the Italian ports (kt).

Packaging	2010	2018	B_{est}
PET 0.5	0.9	0.8	1.0
PET 1.5	0.7	0.6	1.4
GLASS	25.8	29.9	3.0
ALUMINUM	1.8	2.0	2.0
TOTAL	**29.2**	**33.3**	**7.4**

This analysis showed that the cruise sector has a relevant CF, even if that value has significantly decreased in the period investigated.

This study's results demonstrate that a different strategy in terms of the selection of packaging materials would lead to better environmental sustainability within the cruise sector. Indeed, both CF and waste declined between the reference years of 2010 and 2018 (Tables 1 and 3), mostly due to technological innovations that reduced the weight and GHG emissions of this packaging. However, an even more significant reduction in both indicators would occur with the adoption of best practices, such as the partial substitution of glass with plastic packaging. Moreover, as the results from the last columns of Tables 1 and 3 indicate, the largest reduction in both CF and waste would occur when both of these factors (the use of technological innovations and the adoption of best practices) are considered together. A similar investigation about the environmental issue of the packaging has been made by Amienyo, Camilleri, and Azapagic (2014) which analyzing the UK wine packaging sector underline that "several options for reducing the impacts from wine have been considered based on the identified hot spots: shipping of bulk rather than bottled wine, increased recycling and light-weighting of glass bottles as well as using carton packaging instead of bottles". The switching from glass to bulk allowed to reduce of 13% CO_2eq emissions; for the second option, every 10% increase in the quantity of recycled glass reduced by about 2% and for the third option the reduction of glass packaging weight by 10% allowed a reduction by 4% of the CO_2eq emissions. In general it has to be highlighted that lack of efficient and common assessment guidelines for the environmental burden of packaging production and recycling is a critical issue, which makes difficult a comparison among unlike data.

As highlighted above, our paper represents only a part of an extensive analysis concerning the cruise sector, so the results are partial. Indeed, this analysis has some limits due to its evaluation of only one part of a cruise ship's environmental impacts, so its results may not apply to a more complete CF and waste assessment. A further research analysis could be extended to the measurements of the total cruise impacts according to the innovative methodology of Touristic Ecological Footprint (TEF) (Aljerf, 2015).

In any case, monitoring of these indicators will allow for constant auditing and analysis of any changes, as well as the implementation of efficient environmental and economic management for selected areas of the cruise business. A suitable support to sustainable strategies

Table 1
Water and beverage packaging waste generated in the cruise (kg).

Packaging	Waste/person/day			Waste/person/cruise			Waste/cruise/day			Total waste for cruise			%		
	2010	2018	B_{est}	2010	2018	B_{est}	2010	2018	B_{est}	2010	2018	B_{est}	a	b	c
PET 0.5	0.01	0.01	*0.01*	0.10	0.06	*0.09*	59	41	*58*	412	289	*405*	*−29.9*	*40*	*−1.8*
PET 1.5	0.01	0.01	*0.02*	0.07	0.05	*0.13*	45	33	*78*	314	229	*549*	*−27.1*	*139.7*	*74.8*
GLASS	0.40	0.38	*0.04*	2.78	2.70	*0.27*	1711	1656	*166*	11980	11589	*1159*	*−3.3*	*−90*	*−90.3*
ALUMINUM	0.03	0.03	*0.03*	0.19	0.18	*0.18*	115	112	112	803	785	*785*	*−2.2*	*0*	*−2.2*
TOTAL	**0.45**	**0.43**	***0.10***	**3.14**	**2.9**	***0.67***	**1930**	**1842**	***414***	**13509**	**12891**	***2897***	***−4.6***	***−77.5***	***−78.6***

a: 2018/2010; b: B_{est}/2018; c: B_{est}/2010.

Table 3
Carbon Footprint of water and beverage packaging of the cruise (kg CO_2 eq).

Packaging	Emissions/person/day			Emissions/person/cruise			Emissions/cruise/day			Total emissions for cruise			%		
	2010	2018	B_{est}	2010	2018	B_{est}	2010	2018	B_{est}	2010	2018	B_{est}	a	b	c
PET 0.5	0.11	0.09	*0.13*	0.82	0.65	*0.91*	505	398	*557*	3537	2784	*3898*	−21.3	*40*	*10.2*
PET 1.5	0.09	0.08	*0.18*	0.63	0.53	*1.27*	384	326	*782*	2688	2280	*5472*	−15.2	*140*	*103.6*
GLASS	0.67	0.54	*0.05*	4.69	3.78	*0.38*	2881	2322	*232*	20167	16254	*1625*	−19.4	*−90*	*−91.9*
ALUMINUM	0.21	0.18	*0.18*	1.44	1.29	*1.29*	885	792	*792*	6198	5543	*5543*	−10.6	*0.0*	*−10.6*
TOTAL	**1.08**	**0.89**	***0.54***	**7.58**	**6.25**	***3.85***	**4656**	**3837**	***2363***	**32590**	**26861**	***16538***	−17.6	*−38.4*	*−49.3*

a: 2018/2010; b: B_{est}/2018; c: B_{est}/2010.

Table 4
CF of water and beverage packaging used by the passengers in the Italian ports (kt CO_2 eq).

Packaging	2010	2018	B_{est}
PET 0.5	7.6	7.1	10.1
PET 1.5	5.8	5.9	14.1
GLASS	43.7	42.0	4.2
ALUMINUM	13.4	14.3	14.3
TOTAL	**70.5**	**69.3**	**42.7**

implementation is the environmental management system (ISO 14001:2015), which can represent a key driver towards a sustainable innovation. Some cruise companies have just implemented it, even if only few years ago. In the next years this is going to become a management tool, allowing to differ from competitors and acquire new market shares.

The management actions that should be adopted to reduce and prevent packaging waste are twofold. For the first, an enhanced use of dispensers and packaging reusable, as tertiary packaging (e.g., pallets), are some management measures which can be used to minimize the use of certain primary packaging types, such as those with major impact (glass bottles, 0.5 L PET bottles, and aluminum cans). For the second action, measures, as recycling that uses technology to granulate PET waste and/or incinerators on board to recovery energy, can be introduced to tackle some environmental issues related to packaging.

Generally, end-of-life management for packaging (and other waste, such as organic waste) can be improved through the onboard use of technologies such as compactors, energy-recovery plants, and anaerobic digesters that allow for reduced packaging volume and more efficient energy recovery. The correct integration of these measures can lead to better management of packaging, thus helping to minimize its impacts.

In general, the waste hierarchy, clearly identified by the European Union regulations, listed the best practices to be used for the waste streams, considering the incineration and landfill the last disposal options. To enhance the packaging recycling, the collection on board has to be efficiently carried out, through a suitable separation of waste in the upstream phase, when passengers throw the packaging.

Indeed, some companies in the cruise sector have already applied such measures; in particular, Costa Crociere (an Italian company), Royal Caribbean (an American company), and AIDA Cruises (a German company) have each adopted unique but sustainable waste management policies (Wang, X.Li, & Yi Xiao, 2019).

Costa Crociere (2017) focused on a circular economic strategy: the reduction, recycling, and reuse of materials that otherwise would be disposed of. The company's Waste Management Plan, which has been adopted on all the units in its fleet, is essential to the company's sustainable development objectives. This plan goes well beyond the international regulatory standards (e.g., MARPOL). This plan starts with the categorization of 100% of ships' waste. Costa worked to facilitate the recovery of waste materials such as aluminum by establishing partnerships with third parties to ensure the correct start-up of the process and the correct use of the harnessed raw materials. Moreover, Costa was already involved in a project it called Sustainable Cruises, the aim of which was to measure the CF of the packaging used during its cruises (Costa Crociere, 2010).

Royal Caribbean Cruises (2018) also applied a virtuous model of sustainability standards. It aimed to reduce waste by cooperating with suppliers to reduce packaging materials and to use more sustainable resources. It also reuses many such materials by participating in container return programs. Royal Caribbean crew members are fully engaged in this process, which includes manually sorting the waste during the recycling step. Its ships also feature storage structures that allow the employees to keep recyclable materials so as to ensure optimal recycling, either onboard or at Green Loading hubs. The company has set up these hubs throughout all of its North American and Northern European routes (Royal Caribbean Cruises, 2018). Approximately 75% of the waste produced on Royal Caribbean ships does not reach a landfill, and the company's goal is to reduce landfill waste per passenger by 85%, thus reaching zero waste.

AIDA Cruises collects each type of waste separately; compacting is done in a designated room on each ship. Metal, paper, and plastic are compacted, whereas glass is crushed. Food waste is first compacted and then dehydrated for disposal, as it is a biodegradable substance. Oil waste, on the other hand, is collected separately and then transferred to a waste management company. To guarantee high standards, AIDA's environmental officers periodically visit the local waste management companies to carry out audits and inspections. The company's goal is to monitor the processing and localization of the company's waste. If environmental managers find that the waste management companies have not complied with the agreed upon standards, specific conditions are immediately imposed. AIDA's plan is to generate as little waste as possible by significantly reducing waste generation per guest (AIDA Cruise, 2019).

These companies' policies with regard to environmental and sustainable practices are efficient as long as both the crew members and the passengers are truly involved and have adequate information and training.

In light of the CF and waste measurements in this paper, it would be useful to inform passengers and crew members about the GHG emissions and waste that their lifestyles generate, the consumption of goods in particular, in order to increase their awareness of direct and indirect emissions, both in ports and on the ships. Generally, consumer behaviors should also be considered during packaging design. In particular, Gustavo, Pereira, Bond, Viegas, and Borchardt (2018) suggested "that a better packaging design/redesign requires a combination of actions that may: embrace the external demands (consumers, retailers and suppliers); facilitate technical improvements (on materials, design or properties); and lead to the adoption of better management practices." As regards the environmental issue of the packaging, Del Borghi et al. (2016) underlined that glass is perceived as a sustainable packaging by the consumers, not evaluating its high environmental impact. This issue affects materials advances, because if stakeholders do not require a change, decision makers and manufacturers don't make it. So, these authors suggested both to increase renewable energy sources for reducing the environmental burden of the glass bottle and to develop technological innovations and new materials in the glass production (e.g. weight reduction and alloys).

The role of the consumer is significant in the implementation of sustainable practices, but generally the merchandising policy of the cruise companies tend to weaken or counteract it. Brida and Zapata (2009) underlined that "A cruise ship represents all four faces of the tourism industry: transportation, accommodation (including food and beverages), attractions and tour operators". As a consequence, sale of products, provision of services and form of entertainments more and more newer, usually not included in the cruise package, spur many passengers to stay on the ship even during the on shore time.

Indeed, the onboard revenues account for 20–30% of the total revenues for the cruise lines. This issue linked with the many purchases of goods on a duty-free basis during the on a shore tours, can reduce effective contribution to activities more sustainable by the passengers (Polat, 2015).

In Fig. 4 we provided an action plan summarizing the implementation of sustainability planning for cruise tourism. It involved four levels of interest: environment, public policies and government measures, stakeholders (firstly, the passengers and then, the crew members), companies policies.

It has also been noted that cruise tourism generates levels of consumption that are much higher for passengers than for the local people in the host communities. For this reason, greater coordination is necessary among technological, natural, and social scientists so as to better understand the relationships among the ecosystem, local human populations, and tourists. A suitable coordination policy is necessary because, although cruise tourism can improve local communities' economic stability, especially in developing countries, they also generate hidden costs for the environment and in terms of natural resource use (Caric & Mackelworth, 2014).

In light of these considerations, cruise operators should spend significant amounts on upgrading to modern and efficient waste-collection systems and other infrastructure (Di Vaio, Varriale, & Trujillo, 2019) so as to reduce costs for the local residents and protect the local environment and economy.

Otherwise, "cruise tourism is likely to yield benefits only to foreign investors and local elites while the local community have no significant net gain and the environment suffers a negative impact," as MacNeill and Wozniak (2018) emphasized. The same authors also underlined that these kinds of outcomes could be implemented via governmental or market based options; for instance, sustainable ports could be given a label or trademark similar to the blue flag that is used for environmentally friendly beaches.

It has to be noted that the implementation of the sustainability issue in the company's activity can find some barriers, above all due to the complexity of functions and competitive needs. Hence, it could be advisable that policy makers adopt incentive schemes or other public support for companies implementing sustainable practices and strategies; so, they could be encouraged to invest in environmental friendly activities. Furthermore, evidence of the environmental policies and performance by the cruise companies could be well evaluated by the investors in their analysis.

From different point of view, other public measures could be suitable to decrease the environmental burden of the cruise sector. MacNeill and Wozniak (2018) evaluated the tax policy in Honduras and underlined that an high fees, taxes on cruise arrivals/passengers, payed for local development, allowed to reinvest in protection activities and monitoring, resulting in a minimum territorial burden, unlike where the low taxation and scarce investments in regional ecosystem conservation have been unable to preserve it.

4. Conclusions

The results of this analysis highlight the degree to which the cruise sector needs new management policies that will move it toward a reduction in the use of materials and energy throughout the entire system.

It is critical to identify methodologies and indicators that can achieve high impact improvements within this sector, both on ships and on land. The CF methodology allowed us to assess some of the impacts of complex goods and services, such as water and beverage packaging,

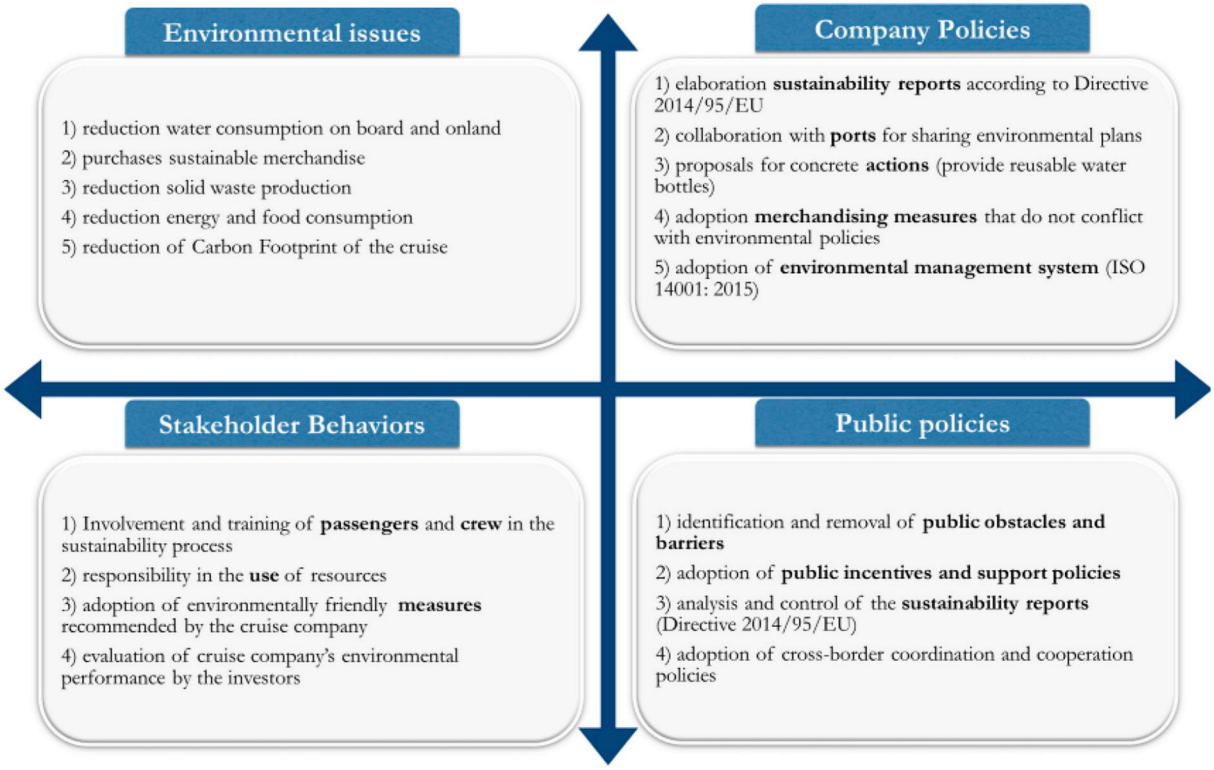

Fig. 4. Action plan towards sustainability implementation in the cruise sector.

specifically for the cruise sector, as that sector's features differentiate it from other economic sectors. This paper is the first step in an extensive analysis of the cruise sector; the aim of this project is a total assessment of the sector's environmental impacts. This study's results are, however, still representative of the multiple impacts of that sector. It is important to underline that monitoring the emissions and waste connected with the cruise sector allows for both better analysis of its relative impacts and the implementation of corrective measures. The scenario built into this analysis, for example, can provide useful information on best practices that can be adopted in the short and medium terms. Moreover, this study's results reveal that packaging materials, in particular, have to be constantly monitored also due to the current EU guidelines, which are meant to address climate change and to reduce plastic pollution through restrictions on single-use plastic products.

Finally, with regard to transboundary pollution from cruise ships, both international and regional frameworks are required if any significant improvement in sustainable practices (both on land and on ships) is to occur. In addition, any programs, actions, and proposals that are meant to enhance sustainability and tackle environmental and social challenges, such as the Horizon 2020 program and the EU's Blue Growth initiative, can be useful when implementing and coordinating research in this sector.

Furthermore, it also has to be noted that the cruise sector was based on specific and organized itineraries across the ports, differently from other form of touristic offer which usually promote a single and isolated destination. The interrelationship among the destinations and ports makes a cooperation and coordination very plausible in order to implement cross-border waste policies and benchmark data and practices on the environmental issue. This allows to trace waste streams across the territories involved and to implement coordinated waste disposal procedures and plants (United Nations World Tourism Organization, 2016). Probably, a supervisor committee could be able to monitor and control a standardized waste collection system on shore, ensuring that its environmental and economic performances are legal as well efficient.

Authors contribution

The authors' contribution is as follows: Paiano: section 1, section 2, section 3 and section 4. Crovella: subsection 2.2, section 3 and Bibliography; Lagioia: section 1 and section 4.

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Massive Automatic Identification System Sensor Trajectory Data-Based Multi-Layer Linkage Network Dynamics of Maritime Transport along 21st-Century Maritime Silk Road

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Abstract: Automatic Identification System (AIS) data could support ship movement analysis, and maritime network construction and dynamic analysis. This study examines the global maritime network dynamics from multi-layers (bulk, container, and tanker) and multidimensional (e.g., point, link, and network) structure perspectives. A spatial-temporal framework is introduced to construct and analyze the global maritime transportation network dynamics by means of big trajectory data. Transport capacity and stability are exploited to infer spatial-temporal dynamics of system nodes and links. Maritime network structure changes and traffic flow dynamics grouping are then possible to extract. This enables the global maritime network between 2013 and 2016 to be investigated, and the differences between the countries along the 21st-century Maritime Silk Road and other countries, as well as the differences between before and after included by 21st-century Maritime Silk Road to be revealed. Study results indicate that certain countries, such as China, Singapore, Republic of Korea, Australia, and United Arab Emirates, build new corresponding shipping relationships with some ports of countries along the Silk Road and these new linkages carry significant traffic flow. The shipping dynamics exhibit interesting geographical and spatial variations. This study is meaningful to policy formulation, such as cooperation and reorientation among international ports, evaluating the adaptability of a changing traffic flow and navigation environment, and integration of the maritime economy and transportation systems.

Keywords: maritime network; multi-layer dynamics; traffic flow

1. Introduction

The global maritime transportation network is a composite system using ship movement (i.e., bulk, container, and tanker) to serve trade by different complementary and technical means [1,2]. The multi-components (nodes, links, networks, and traffic flows) and multi-layers (bulk, container, and tanker) behave differently according to various transportation modes, such as tramp shipping with demand-based voyages from the origin to the destination market, and liner shipping with regular schedules. Moreover, differences exist in geographic extent regarding marine spaces, such as the geographic scope of different activities, and the social-spatial and socio-cultural dimensions of the marine unit [2,3]. Current geographic conceptualization treats marine space as components linking social and marine systems, useful to explain the complexity of relationships and dynamics [4,5]. Geographic methodologies are therefore important for understanding maritime network dynamics.

Automatic Identification System (AIS) data include an abundance of information both of dynamics navigation (e.g., latitude and longitude coordinates of ships, timestamp record, course over ground, and speed over ground) and static information (e.g., ship flag, Maritime Mobile Service Identity, International Maritime Organization, ship type, ship name, and ship size) for vessels' spatiotemporal movements [6]. The AIS data could support global maritime network dynamics analysis and modelling, and supplement most of current studies on maritime transportation network, because current research mostly focuses on sample case studies, selected scenarios analysis, sparse empirical data-oriented, and the container network. The 21st-century Maritime Silk Road Initiative (MSRI) is an important concept and plan announced by the People's Republic of China. It involves more than 60 countries to enhance trade activities, connecting China with Europe and Africa as well as other parts of Asia [7–9]. The global AIS data enable maritime network of the countries along the 21st-century Maritime Silk Road (21C-MSR) and other countries to be investigated, and differences between these two groups to be examined, which may provide insights on the possible effects derived from the 21st-century Maritime Silk Road Initiative initiated (MSRI) by China in 2013. However, there are some challenges to figure out the possible impact of MSRI based on the differential dynamics of maritime network of 21C-MSR and other countries, including designing comprehensive manner, collecting enough data to figure out the difference before and after MSRI, and investigating what make them different.

An improved understanding of maritime transportation network changes would aid in evaluating possible and potential effects related to strategy development, and give insights on dynamic trend prediction. This would be a benefit to policy developers and decision makers in designing effective, comprehensive, and adaptive investment strategies, adjusting and optimizing the global maritime transportation and logistics network. This paper proposes a multi-layer spatial-temporal dynamics framework to understand maritime activity. The study presented here is innovative for the following reasons. First, this paper uses massive AIS Sensor trajectory data to construct and analyze maritime shipping network that extends the application of localization and object tracking technology based on sensors systems. Second, this paper extends the timeline method [10] by taking traffic flow into account to characterize maritime network structure. Third, this paper measures global maritime network dynamics by means of disaggregation across several components (nodes, links, network, and traffic flow), and investigates the flow stability. Finally, this paper examines spatially varying impacts by means of interaction dynamics. It also develops lenses for understanding maritime network dynamics. Such results provide reference information for operators in maritime transportation, investors in maritime trade markets, and officers in maritime management.

The remainder of this paper is organized as follows. Section 2 reviews literature on maritime network and time dynamics. The experimental framework used to reveal multi-layer maritime network dynamics is described in Section 3. Section 4 firstly presents the study area and dataset; then, findings are described. Finally, Section 5 presents conclusions.

2. Literature Review

Research on maritime network structure mostly focuses on topology using indicators derived from graph theory, such as node degree, shortest path lengths, clustering coefficient, and others, see Table 1. Other indicators can also be used to study network structure, including linkage intensity, linkage tightness, spatial isolation, and linkage concentration [11]. Maritime network topology structure evolution can be further studied through the changes of indicators over time [12–17]. The maritime network topology structure studies seek to reveal connectivity, polarization, clustering, robustness, vulnerability, regional inequality, and spatial variation [1,14,18–22].

Most current studies focus on container shipping network, with few considering multi-layer networks [2,23–25]. Kaluza et al. [23] revealed that bulk, container, and tanker maritime networks all follow heavy-tailed distribution for connectivity. Ducruet [24] pointed out that coupling of different types of maritime networks through shared common links. Ducruet [2] analyzed the overlap of different types of maritime networks based on linkage analysis, centrality, eccentricity, clustering coefficient, and assortativity coefficient. Peng et al. [25] investigated the vulnerability of the multilayer maritime network through shortest-path and clustering coefficient changes after a cascading-based attack. However, the traffic flow stability of nodes and links and yearly multilayer maritime network dynamics have rarely been studied. This is very useful to reveal the event-related maritime network dynamics. Automatic Identification System (AIS) data could support ship movement pattern extraction and prediction [26], ship behavior analysis [27–29], and maritime network construction and analysis [23,30,31]. This paper approaches evaluation of multi-layer maritime network dynamics by means of disaggregation and comparison across nodes, links, network, and traffic flow using global AIS trajectory data. The differences between the maritime network dynamics of 21C-MSR and other countries in 2013 and 2016 are revealed and analyzed. Additionally, the differences in maritime shipping between before and after 21C-MSR included by 21st-century Maritime Silk Road are illustrated. The maritime network dynamics are critical for understanding cross-regional cooperation and maritime trade pattern changes. Such research offers the potential for identifying complementary advantages with joint collaboration and exchanges in maritime shipping and trade, the very goals of the MSRI.

Table 1. Summary of research on maritime network structure.

Reference	Focus	Network Types	Indicators	Other Methods	Area
Li et al. [12]; Ducruet and Notteboom [13]; Xu et al. [14]	Structure and evolution	Container	Number of nodes, path length, mean journeys; degree, centrality, weighted centrality, clustering coefficient, eccentricity, rich-club coefficient, modularity, beta index, gamma index, gini coefficient, comprehensive centrality		World
Laxe et al. [15]	Structure and evolution	Container;			Sample of world fleet
Liu et al. [18]; Woolley-Meza et al. [19]; Lhomme [20]	Structure and spatial heterogeneity; Structure and robustness	Singer layer			World
Ducruet [2]	Structure and dynamics	Multilayer			World
Zhao et al. [32]; Caschili et al. [33]	Structure	Container;			Sample of world fleet
Ducruet [24]	Structure and diversity	Multilayer			world
Kaluza et al. [23]	Structure	Multilayer		Gravity model	Sample of world fleet
Tsiotas and Polyzos [34]	Structure and node aggregation	Tourism			Greece
Ducruet et al. [35]	Structure	container			East Asia
Kosowska-Stamirowska et al. [16]	Structure and evolution	Trade		Random walk	world
Liu et al. [21]; Calatayud et al. [22]	Structure and robustness	Container		Borda count	Maersk shipping line; Americas
Peng et al. [25]	Structure and robustness	Multilayer			world
Peng et al. [17]	Structure and evolution	Crude oil			world
Yu et al. [11]	Structure	Trade	Linkage intensity, linkage tightness, spatial isolation index, linkage concentration index		China

3. Methodology

Proposed in this paper is an analytical framework for revealing the multi-layer maritime network dynamics of 21C-MSR and other countries, and is illustrated in Figure 1. This framework combines port spatial map and AIS trajectory data to construct a global maritime network based on the origins and destinations of ships using ports. Secondly, the traffic flow characteristics of ports and links can be revealed by means of their shipping capacity and stability. This framework is used to analyze the spatial-temporal dynamics of the maritime network structure and shipping capacity weighted network dynamics for individual countries. Detailed descriptions are provided in the subsections that follow.

3.1. Construction of a Maritime Network

This section details construction of a time-varying maritime network based on AIS data. Latitude and longitude (location) information for each vessel is known using the AIS data. An example showing ships 1, 2, and 3 is shown in Figure 2a. The time-series locations of these vessels between ports can be viewed as trajectories. Specifically, trajectories exist among ports AE, EC, CD, and DF for ship 1, among ports FC, CA, AE, ED, and DB for ship 2, and among ports AF, FB, BA, AB, BG, GD, DF, and FG for ship 3. Thus, a time-varying maritime network between ports emerges by connecting port pair trajectories as linkages within a pre-specified time unit, such as days, months, seasons, years, or multi-years. Each linkage includes certain properties, such as voyage number and shipping capacity. Figure 2b shows attributes k1, k2, etc. plotted near its corresponding links. The maritime networks for sampled countries, including those of the 21st-century Maritime Silk Road (21C-MSR) and others, are illustrated in Figure 2c. The maritime network of one specific country is based on the criteria that the connections between ports inside the country and between the ports one inside the country and another located in other countries. The connection between the specific country and other countries can be summarized based on the connection between ports one inside the country and another located in other countries.

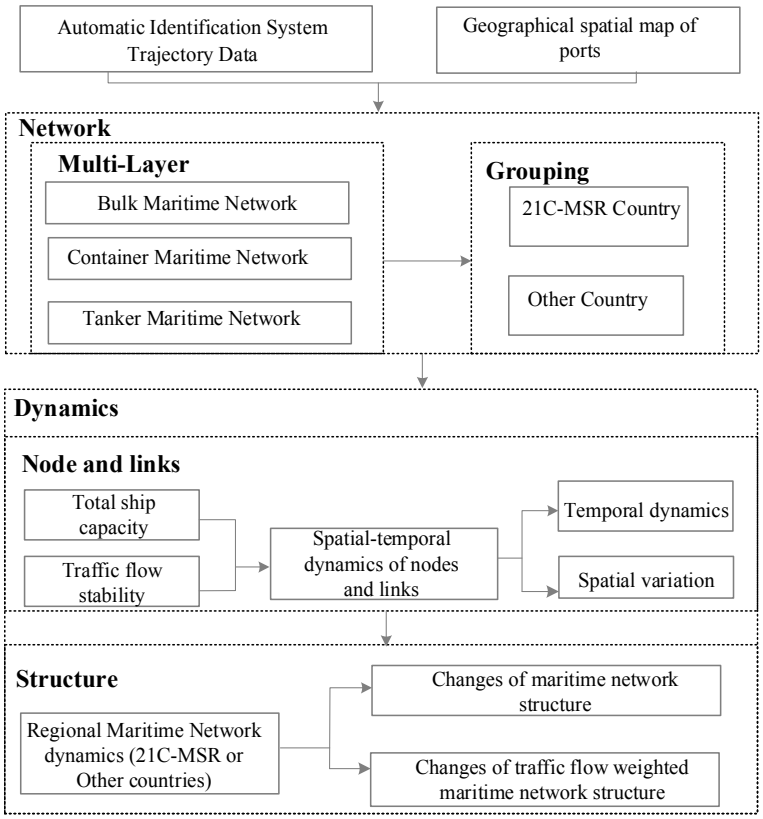


Figure 1. Proposed analytical framework.

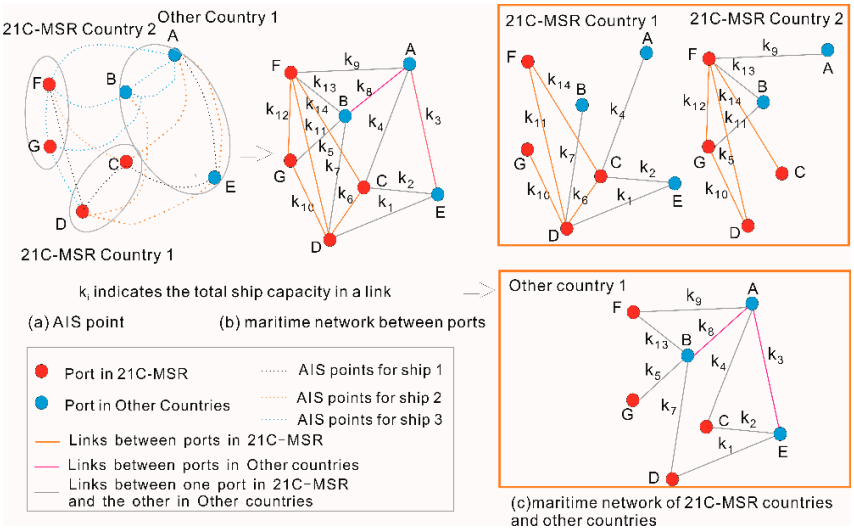


Figure 2. Constructing a maritime network from Automatic Identification System (AIS) data. (**a**) AIS point, (**b**) maritime network between ports, (**c**) maritime network of 21C-MSR countries and other countries.

3.2. Maritime Network Dynamics

The global maritime network can be represented by $G = (V, E)$, where V represents the node set and E represents the link set. This paper proposes a spatial-temporal approach for revealing the multi-component and multi-layer dynamics in the maritime network based on the characteristics of nodes, links, structure, and traffic flow.

3.2.1. Characteristics of Nodes and Links

Transport capacity and stability is very useful for authorities considering strategies for managing maritime traffic, and also for shipping companies to optimize shipping routes. For example, if a port has a highly dynamic transport capacity, this indicates that port authorities need to record and evaluate usage across different time periods in order to improve efficiency. Therefore, this paper uses the transport capacity and stability to characterize dynamics of nodes and links. The following describes transport capacity [22] for node V_k or link L_k in time T_i:

$$\begin{cases} CP_{(V_k \text{ or } L_k, T_i)} = \sum_{n=1}^{N(V_k \text{ or } L_k, T_i)} (S_n^{(V_k \text{ or } L_k, T_i)} Q_n^{(V_k \text{ or } L_k, T_i)} F_n^{(V_k \text{ or } L_k, T_i)}) \\ LogCP_{(V_k \text{ or } L_k, T_i)} = Log(CP_{(V_k \text{ or } L_k, T_i)}) \\ \qquad = Log(\sum_{n=1}^{N(V_k \text{ or } L_k, T_i)} (S_n^{(V_k \text{ or } L_k, T_i)} Q_n^{(V_k \text{ or } L_k, T_i)} F_n^{(V_k \text{ or } L_k, T_i)})) \end{cases} \quad (1)$$

where $CP_{(V_k \text{ or } L_k, T_i)}$ represents the transport capacity in node V_k or link L_k in T_i; $N(V_k \text{ or } L_k, T_i)$ is the total number of services in node V_k or link L_k in T_i, $S_n^{(V_k \text{ or } L_k, T_i)}$, $Q_n^{(V_k \text{ or } L_k, T_i)}$, and $F_n^{(V_k \text{ or } L_k, T_i)}$ equal the vessel size, vessel number, and sail frequency in individual service n, respectively; and $LogCP_{(V_k \text{ or } L_k, T_i)}$ represents the logarithm of capacity for node V_k or link L_k in T_i.

Capacity stability for nodes and links can be calculated using the model proposed by [36]. Firstly, the monthly traffic flow curves can be divided into segments using crest or trough, and each segment either monotonically increases, decreases, or remains unchanged. This is shown in Figure 3. The stability of one segment takes into account the trend from the start and end points of an individual segment as well as fluctuation along the segment. This can be characterized as follows:

$$\Delta\bar{F} = \frac{\sum_{j=1}^{p} \Delta F_j}{p} = \frac{\sum_{j=1}^{p} (CP_j - y_j)}{p} = \frac{\sum_{j=1}^{p} \left\{CP_j - \left[\frac{CP_e - CP_s}{T_e - T_s}(T - T_s) + CP_s\right]\right\}}{p} \tag{2}$$

$$S_{(V_k \text{ or } L_k, SEG_i)} = f_{(V_k \text{ or } L_k, SEG_i)} \cdot g_{(V_k \text{ or } L_k, SEG_i)} = e^{-\left|\frac{CP_e - CP_s}{T_e - T_s}\right|} \cdot e^{-\frac{\sqrt{\frac{1}{p}\sum_{j=1}^{p} (\Delta F_j - \Delta\bar{F})^2}}{T_e - T_s}} \tag{3}$$

where CP_s and CP_e are the capacity at the beginning time T_s and ending time T_e of the segment, respectively;$p$is the number of sample points in SEG_i; ΔF_j is the difference between the real transport capacity CP_j and calculated trend value y_j; and $\Delta\bar{F}$ represents the average value of ΔF_j. Equation (2) describes the mean value of the differences between estimation based on the trend and the real capacity, and Equation (3) measures stability calculated by the trend change and the standard deviation of the differences between the estimated and real capacity. Thus, the stability of the link at T_i can be derived from the stability of all segments as follows:

$$S_{(V_k \text{ or } L_k)} = \frac{\sum_{i=1}^{m} S_{(V_k \text{ or } L_k, SEG_i)}}{S_{(V_k \text{ or } L_k, SEG_1)} + \sum_{i=2}^{m} \left|S_{(V_k \text{ or } L_k, SEG_i)} - S_{(V_k \text{ or } L_k, SEG_{i-1})}\right| + S_{(V_k \text{ or } L_k, SEG_m)} + \sum_{i=1}^{m} \Delta T_{(V_k \text{ or } L_k, SEG_i)}} \tag{4}$$

where $S_{(V_k \text{ or } L_k)}$ represents the capacity stability of node V_k or link L_k; m represents the segment number of node V_k or link L_k; and $\Delta T_{(V_k \text{ or } L_k, SEG_i)}$ represents the duration for the corresponding SEG_i.

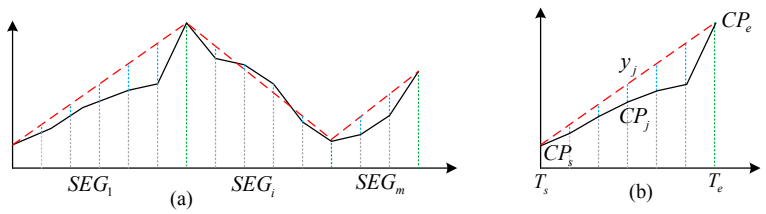


Figure 3. Variation in the capacity of a node or link. The dashed red line indicates the trend in capacity, the black line indicates the real capacity, and the dashed blue line represents the differences. (**a**) Segments division and (**b**) difference calculation for one segment).

3.2.2. Structure Changes

The timeline method can be employed to evaluate even-related network structure dynamics [10]; thus, this paper compared yearly changes of maritime network structure to reveal the differences between 21C-MSR before and after included by 21st-century Maritime Silk Road, as well as the differences between 21C-MSR and other countries. Consistent with work in this area, considered here is the yearly temporal granularity according to route regularity [37]. The change of one node from time i to $i+1$ year can be calculated as follows:

$$\widetilde{d}_{(T_i, T_{i+1})}(v) = \begin{cases} \left|\log \frac{d_{(T_i)}(v)+1}{1}\right|, v \in V(Out\ Node) \\ \left|\log \frac{1}{d_{(T_{i+1})}(v)+1}\right|, v \in V(In\ Node) \\ \left|\log \frac{d_{(T_i)}(v)}{d_{(T_{i+1})}(v)}\right| + \left|\log \frac{adj_{T_i}(v) \cap adj_{T_{i+1}}(v)}{adj_{T_i}(v) \cup adj_{T_{i+1}}(v)}\right|, v \in V(Stable\ Node) \end{cases} \tag{5}$$

where $\widetilde{d}_{(T_i, T_{i+1})}(v)$ is the changes in network structure contributed by node v, $d_{(T_i)}(v)$ means the degree of node v at T_i; $d_{(T_{i+1})}(v)$ represents the degree of node v (the count of nodes that have links with node v) at T_{i+1}; $adj_{T_i}(v)$ represents the neighbors of node v (the collection of nodes that have links with

node v) at T_i; $adj_{T_{i+1}}(v)$ denotes the neighbors of node v at T_{i+1}; $V(Out\ Node)$ represents the collection of nodes in the maritime network at T_i but not in the maritime network at T_{i+1}, namely as missing nodes; $V(In\ Node)$ represents the collection of nodes not in the maritime network at T_i, but rather in the maritime network at T_{i+1}, namely as new nodes; and $V(Stable\ Node)$ represents the collection of nodes both in the maritime network at T_i and T_{i+1}, namely as stable nodes. The change in network structure can be defined as follows:

$$\widetilde{\sigma}_{(T_i,T_{i+1})} = \begin{cases} \frac{\sum_{\forall v \in V(OUT)} \widetilde{d}_{(T_i,T_{i+1})}(v)}{\left|V(g_{T_i}) \cup V(g_{T_{i+1}})\right|} \\ \frac{\sum_{\forall v \in V(IN)} \widetilde{d}_{(T_i,T_{i+1})}(v)}{\left|V(g_{T_i}) \cup V(g_{T_{i+1}})\right|} \\ \frac{\sum_{\forall v \in V(STABLE)} \widetilde{d}_{(T_i,T_{i+1})}(v)}{\left|V(g_{T_i}) \cup V(g_{T_{i+1}})\right|} \end{cases} \tag{6}$$

where $\widetilde{\sigma}_{(T_i,T_{i+1})}$ is the maritime network structure changes from T_i to T_{i+1} after normalization, including the changes for missing nodes after normalization $\frac{\sum_{\forall v \in V(OUT)} \widetilde{d}_{(T_i,T_{i+1})}(v)}{\left|V(g_{T_i}) \cup V(g_{T_{i+1}})\right|}$, for new nodes after normalization $\frac{\sum_{\forall v \in V(IN)} \widetilde{d}_{(T_i,T_{i+1})}(v)}{\left|V(g_{T_i}) \cup V(g_{T_{i+1}})\right|}$, and for stable nodes after normalization $\frac{\sum_{\forall v \in V(STABLE)} \widetilde{d}_{(T_i,T_{i+1})}(v)}{\left|V(g_{T_i}) \cup V(g_{T_{i+1}})\right|}$ $\left|V(g_{T_i}) \cup V(g_{T_{i+1}})\right|$ represents the union of the node sets of maritime network at T_i and T_{i+1}, and can be used to normalize the maritime network structure changes by reducing the differences derived from the network size; $\sum_{\forall v \in V(STABLE)} \widetilde{d}_{(T_i,T_{i+1})}(v)$ indicates total changes for stable nodes from T_i to T_{i+1}; $\sum_{\forall v \in V(IN)} \widetilde{d}_{(T_i,T_{i+1})}(v)$ is the total changes for new nodes from T_i to T_{i+1}; and $\sum_{\forall v \in V(OUT)} \widetilde{d}_{(T_i,T_{i+1})}(v)$ is the total changes for missing nodes from T_i to T_{i+1}.

3.2.3. Weighted Structure Changes

The conventional timeline method can capture the yearly node-link connected structure changes. However, yearly maritime networks may have the same structures, and different transport capacity loaded on nodes and links. Transport capacity changes can reflect the efficiency of maritime transportation, and is very important to maritime policy development. Thus, the weighted structure changes are proposed to analyze both structure and flow changes.

The transport capacity is an important component in maritime network; thus, the transport capacity cannot be ignored. This paper also analyzes the transport flow evolution by means of the proposed capacity weighted timeline method. The transport flow change derived from one node from time i to $i+1$ can be calculated as follows:

$$\widetilde{d}_{(T_i,T_{i+1})}(v)' = \begin{cases} \left| \log \frac{\sum_{v_i \in E_{(T_i)}(v)} CP_{(v,v_i)} + 1}{1} \right|, v \in V(Out\ Node) \\ \left| \log \frac{1}{\sum_{v_i \in E_{(T_{i+1})}(v)} CP_{(v,v_i)} + 1} \right|, v \in V(In\ Node) \\ \left| \log \frac{\sum_{v_i \in E_{(T_i)}(v)} CP_{(v,v_i)}}{\sum_{v_i \in E_{(T_{i+1})}(v)} CP_{(v,v_i)}} \right| + \left| \log \frac{\sum_{v_i \in E_{(T_i)}(v)} CP_{(v,v_i)} \cap \sum_{v_i \in E_{(T_{i+1})}(v)} CP_{(v,v_i)}}{\sum_{v_i \in E_{(T_i)}(v)} CP_{(v,v_i)} \cup \sum_{v_i \in E_{(T_{i+1})}(v)} CP_{(v,v_i)}} \right|, v \in V(Stable\ Node) \end{cases} \tag{7}$$

where $\widetilde{d}_{(T_i,T_{i+1})}(v)'$ means the change in the transport flow contributed by node v; $\sum_{v_i \in E_{(T_i)}(v)} CP_{(v,v_i)}$ represents the capacity of node v at T_i; $\sum_{v_i \in E_{(T_{i+1})}(v)} CP_{(v,v_i)}$ represents the capacity of node v at T_{i+1}; $\sum_{v_i \in E_{(T_i)}(v)} CP_{(v,v_i)} \cap \sum_{v_i \in E_{(T_{i+1})}(v)} CP_{(v,v_i)}$ indicates the overlap of the capacity of node v between T_i and T_{i+1}; and $\sum_{v_i \in E_{(T_i)}(v)} CP_{(v,v_i)} \cup \sum_{v_i \in E_{(T_{i+1})}(v)} CP_{(v,v_i)}$ means the integration of the capacity of node v between T_i and T_{i+1}. $V(Out\ Node)$ represents the collection of nodes in the maritime network at T_i, but not in the maritime network at T_{i+1}, namely as missing nodes; $V(In\ Node)$ represents the collection of nodes not in the maritime network at T_i, but rather in the maritime network at T_{i+1}, namely as new nodes; and $V(Stable\ Node)$ represents the collection of nodes both in the maritime network at T_i and T_{i+1}, namely as stable nodes. The transport flow changes $\sigma_{(t_i,t_{i+1})}{}'$ from T_i to T_{i+1} can be calculated as follows:

$$\widetilde{\sigma}_{(T_i,T_{i+1})}{}' = \begin{cases} \frac{\sum_{\forall v \in V(OUT)} \widetilde{d}_{(T_i,T_{i+1})}(v)'}{\left|CP(g_{T_i}) \cup CP(g_{T_{i+1}})\right|} \\ \frac{\sum_{\forall v \in V(IN)} \widetilde{d}_{(T_i,T_{i+1})}(v)'}{\left|CP(g_{T_i}) \cup CP(g_{T_{i+1}})\right|} \\ \frac{\sum_{\forall v \in V(STABLE)} \widetilde{d}_{(T_i,T_{i+1})}(v)'}{\left|CP(g_{T_i}) \cup CP(g_{T_{i+1}})\right|} \end{cases} \quad (8)$$

where $\widetilde{\sigma}_{(T_i,T_{i+1})}{}'$ is the transport flow change from T_i to T_{i+1} after normalization, including the changes for missing nodes after normalization $\frac{\sum_{\forall v \in V(OUT)} \widetilde{d}_{(T_i,T_{i+1})}(v)'}{\left|CP(g_{T_i}) \cup CP(g_{T_{i+1}})\right|}$, for new nodes after normalization $\frac{\sum_{\forall v \in V(IN)} \widetilde{d}_{(T_i,T_{i+1})}(v)'}{\left|CP(g_{T_i}) \cup CP(g_{T_{i+1}})\right|}$, and for stable nodes after normalization $\frac{\sum_{\forall v \in V(STABLE)} \widetilde{d}_{(T_i,T_{i+1})}(v)'}{\left|CP(g_{T_i}) \cup CP(g_{T_{i+1}})\right|}$; $\left|CP(g_{T_i}) \cup CP(g_{T_{i+1}})\right|$ represents the integration of capacity between T_i and T_{i+1}, and can be used to normalize the transport flow changes; $\sum_{\forall v \in V(STABLE)} \widetilde{d}_{(T_i,T_{i+1})}(v)'$ represents the total transport flow changes for stable nodes from T_i to T_{i+1}; $\sum_{\forall v \in V(IN)} \widetilde{d}_{(T_i,T_{i+1})}(v)'$ is the total transport flow changes for new nodes from T_i to T_{i+1}; and $\sum_{\forall v \in V(OUT)} \widetilde{d}_{(T_i,T_{i+1})}(v)'$ is the total transport flow changes for missing nodes from T_i to T_{i+1}.

4. Results and Discussion

4.1. Study Area and Dataset

AIS data from January 1, 2013 and December 31, 2016 (available at: http://www.myships.com/myships/ and http://www.shipfinder.com/, July 27, 2017) were employed to create an origin–destination (OD) dataset for vessels and connecting ports worldwide. The tanker vessels include transport crude oil, refined oil products, and other chemical oil products. The data categories for each ship are listed in Table 2. All AIS locations for each ship were simplified as a sequence of ports, according to dataset records.

The AIS is compulsory for most commercial ships through the International Convention for Maritime Safety, but loading rates and cargo amount are unavailable [22]. The global maritime network derived from AIS ship data in 2013, 2014, 2015, and 2016 is summarized and can be decomposed by bulk, container, and tanker types to reveal multi-layer dynamics. Figure 4 clearly indicates the different connection patterns and highlight high transport capacity in 2013 and 2016 with the map scale on the bottom right. This paper analyzes the spatial-temporal dynamics of nodes and links, maritime network structures, and traffic flow of 21C-MSR in comparison with those of other countries. 21C-MSR countries include China (CN), Australia (AU), New Zealand (NZ), Republic of Korea (KR), Fiji (FJ),

Papua New Guinea (PG), Democratic Republic of Timor-Leste (TL), Brunei (BN), Philippines (PH), Thailand (TH), Indonesia (ID), Cambodia (KH), Malaysia (MY), Laos (LA), Burma (MM), Singapore (SG), Vietnam (VN), Djibouti (DJ), Eritrea (ER), Kenya (KE), Yemen (YE), Oman (OM), United Arab Emirates (AE), Saudi Arabia (SA), Kuwait (KW), Iraq (IQ), Qatar (QA), Iran (IR), Jordan (JO), Turkey (TR), India (IN), Pakistan (PK), Maldives (MV), Sri Lanka (LK), Bangladesh (BD), Morocco (MA), Algeria (DZ), Spain (ES), Italy (IT), France (FR), Greece (GR), Cyprus (CY), Israel (IL), Russia(RU), Romania (RO), and Egypt (EG) [38]. Among these countries, AU, FJ, TL, PH, MA, ES, IT, FR, GR, CY, and SA have been included in 21st-century Maritime Silk Road in 2015, KR, PG, and ER have been included in 2016, and the remaining countries have been included in 2014. Other countries are the remaining countries.

Table 2. Data categories in OD dataset of vessels.

Item	Meaning
Maritime Mobile Service Identity (MMSI)	Unique ID for the vessel
Start Time (Ship entering the port)/End Time (Ship leaving the port)	Second-level timestamp (e.g., 2015-06-10 01:16:58)
ship's Location	Longitude and latitude of the ship location
Vessel_type	Type of vessel (bulk/container/tanker)
Vessel_name	Name of the vessel
Grosstone	Gross tonnage of the vessel
Length	Length of the vessel
Width	Width of the vessel
Draft	Draft of the vessel
Deadweight	Dead Weight of the vessel

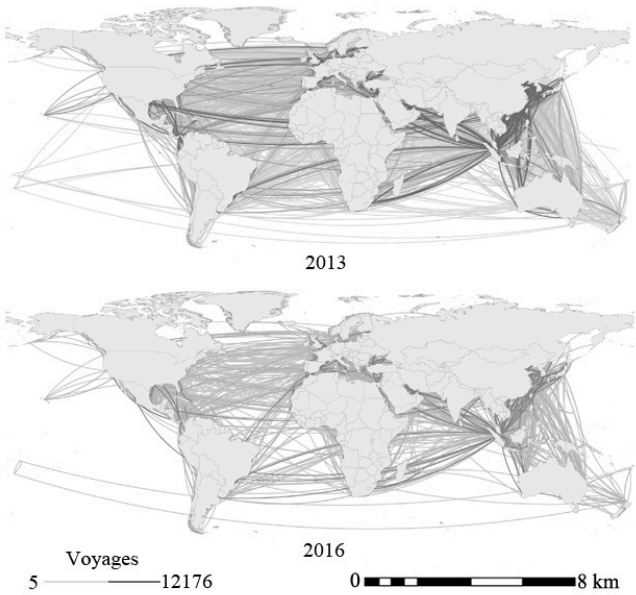


Figure 4. Global maritime network derived from AIS data in 2013 and 2016.

4.2. Maritime Network Dynamics of 21C-MSR and Other Countries

4.2.1. Spatial-temporal Dynamics of Nodes and Links

The global shipping networks across the study period by bulk, container, and tanker capacity and stability for ports are displayed in Figures 5 and 6. MSRI have been initialed in October, 2013, and corresponding countries continuously have joined the 21C-MSR from 2014. Thus, the contrastive analysis of capacity and stability of ports in 21C-MSR and others countries between 2014 and 2016 have been figured out. Figure 5a,c,e indicate there are more ports that have high bulk, container, and tanker capacity in 21C-MSR than in other countries in 2014. The proportion of ports in 21C-MSR

with large bulk, container, and tanker capacity are higher than those in other countries, respectively. There are lower proportions for the ports in 21C-MSR that have low bulk, container, and tanker capacity. The differences between the proportions of ports with high bulk, container, and tanker capacity in 21C-MSR and other countries was narrowed down in 2015 and 2016 compared to 2014 as shown in Figure 6a, which may be related to that newly countries included in 21C-MSR in 2015 and 2016 have a number of ports with lower capacity. Figure 5b,d,f illustrate more ports in 21C-MSR have high changes in bulk, container, and tanker traffic flow in 2014. For example, the proportion of ports with less stable bulk traffic flow in 21C-MSR is higher than that in other countries, but the proportion of ports with more stable bulk flow is lower than that in other countries, the same as container and tanker flow. That indicates some of ports in 21C-MSR present highly dynamics in traffic flow compared to other countries in 2014. Furthermore, the differences between the proportions of ports with high bulk, container, and tanker flow changes in 21C-MSR and other countries was narrowed down in 2015 and 2016 compared to 2014 as shown in Figure 6b, which may be related to that newly countries included in 21C-MSR in 2015 and 2016 have a number of ports with lower flow dynamics.

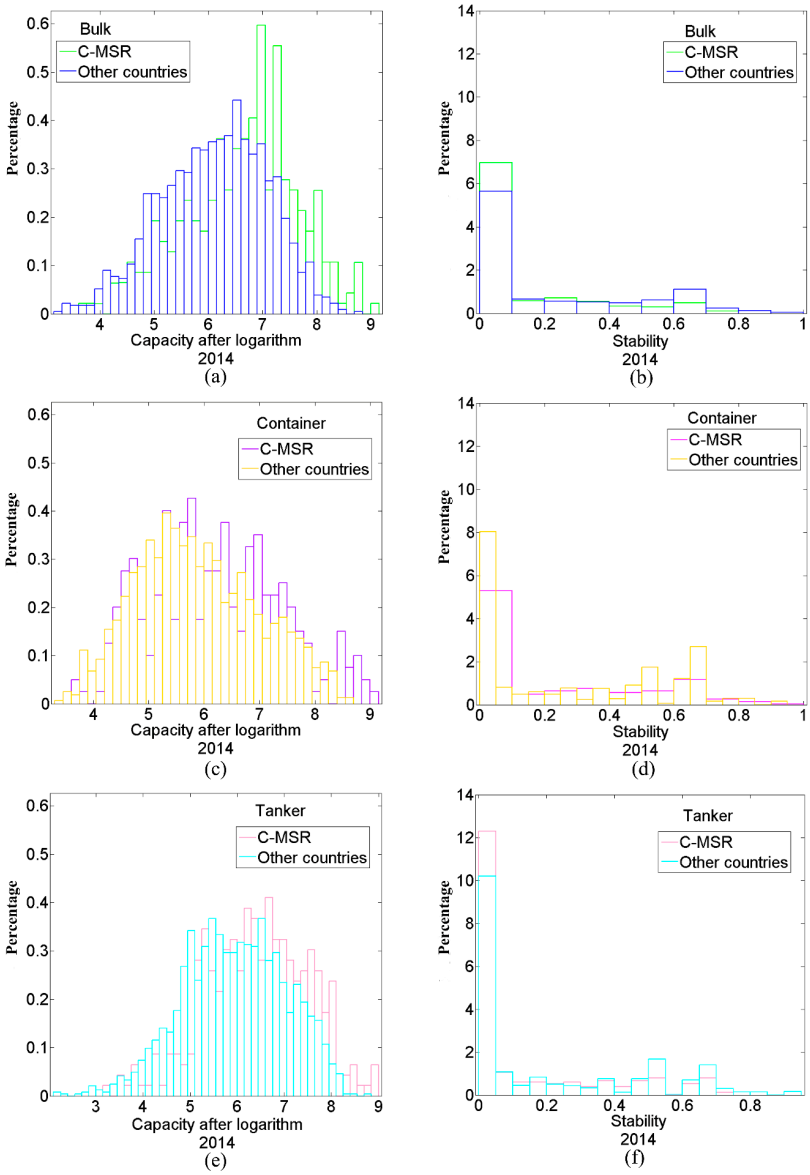


Figure 5. Capacity and stability of ports in 21C-MSR and other countries (sample in 2014). (**a**–**f**) represent bulk capacity after logarithm, bulk flow stability, container capacity after logarithm, container flow stability, tanker capacity after logarithm, and tanker flow stability, respectively.

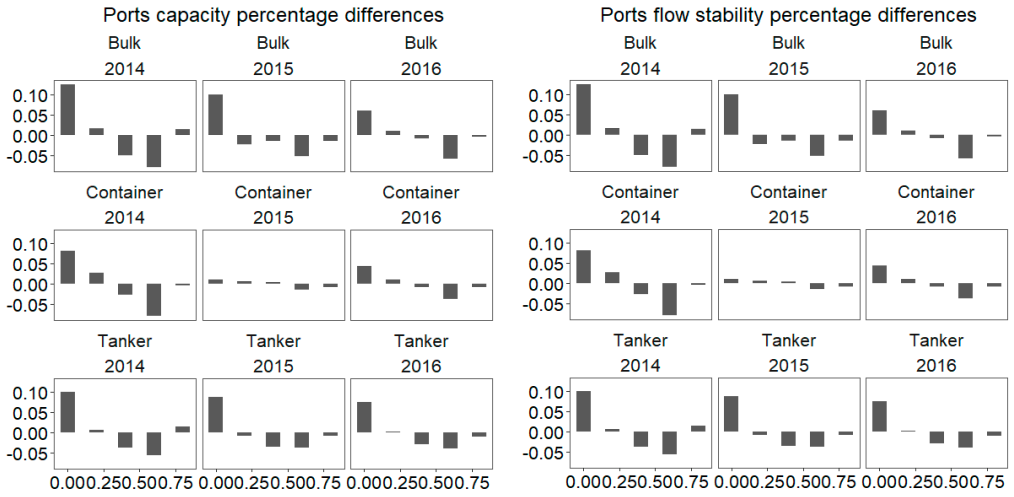


Figure 6. Ports average capacity and stability probability differences between 21C-MSR and other countries. (**a**) Ports capacity percentage differences and (**b**) ports flow stability percentage differences.

The ports average capacity and stability in 21C-MSR before and after included by 21st-century Maritime Silk Road are illustrated in Figure 7. Most of the countries have higher average capacity after being included by 21C-MSR than before being included by 21C-MSR. That may be related to more frequent interaction between ports in 21C-MSR after being included by the 21st-century Maritime Silk Road. In more than half of the countries, there exist bigger traffic flow dynamics after being included by 21C-MSR. That indicates that the shipping interaction among ports changes after these countries are included by 21C-MSR.

Figure 8 illustrates container hub and feeder ports with highly flow dynamics between 2014 and 2016 with map scale on the bottom right. The hub ports are the top 100 container ports according to definitive ranking of the world's largest container ports by Lloyd's List; the remaining ports are feeder ports. Obviously, there are countries continuously include by 21C-MSR between 2014 and 2016, as well as more ports included by 21C-MSR. In 21C-MSR and other countries, 60.90 % and 50.79%, 57.20% and 55.81%, as well as 62.39 % and 56.62% had container ports with flow stability lower than 0.2 in 2014, 2015, and 2016, respectively. Additionally, there are more hub ports in 21C-MSR than other countries with high flow dynamics. For example, 55 and 32 hub ports with high flow dynamics were located in 21C-MSR and other countries in 2015, respectively.

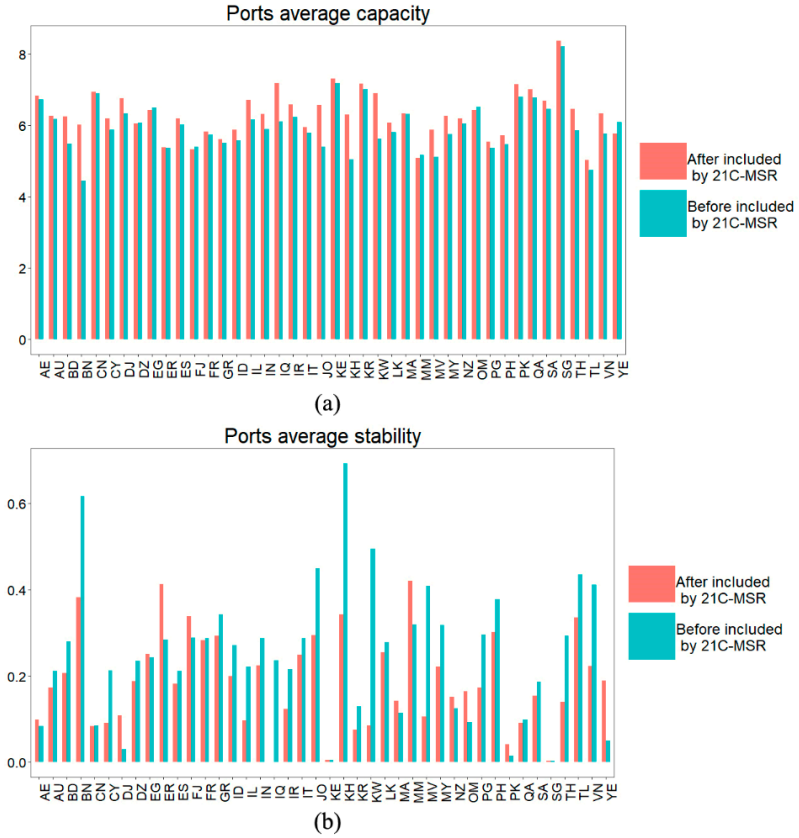


Figure 7. Ports average capacity and stability before and after included by 21C-MSR; (**a**) Port average capacity and (**b**) port average stability.

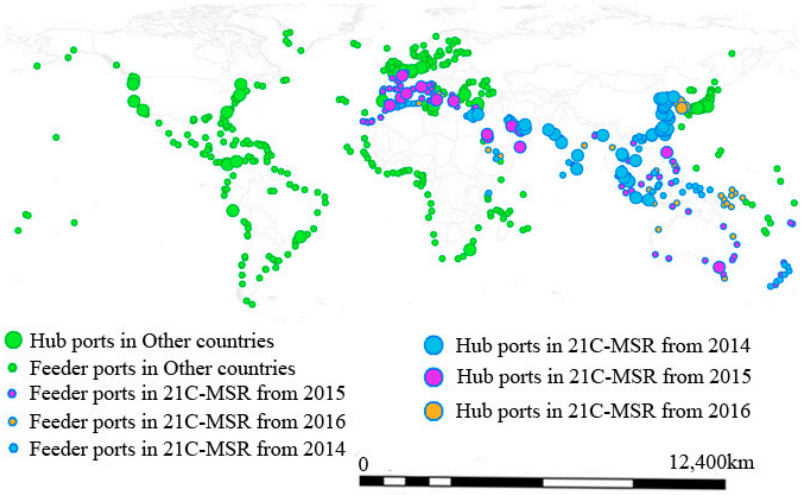


Figure 8. Container ports with low stability in 21C-MSR and other countries.

Table 3 illustrates that the links of capacity are continuously increasing across the study period in the bulk and tanker layer. There are more links with continuously increasing capacity in bulk maritime network of 21C-MSR than in other countries. The bulk and tanker links with continuously increasing capacity in 21C-MSR represent higher average increased capacity than in other counties. For example, the average increased capacity of bulk and tanker links in 21C-MSR are 3,125,407.29 Dead Weight Tonnage (DWT) and 1,696,798.74 DWT, respectively, whereas in other countries they are 1,243,252.48 DWT, and 1,408,144.76 DWT.

Table 3. Links with continuously increasing capacity.

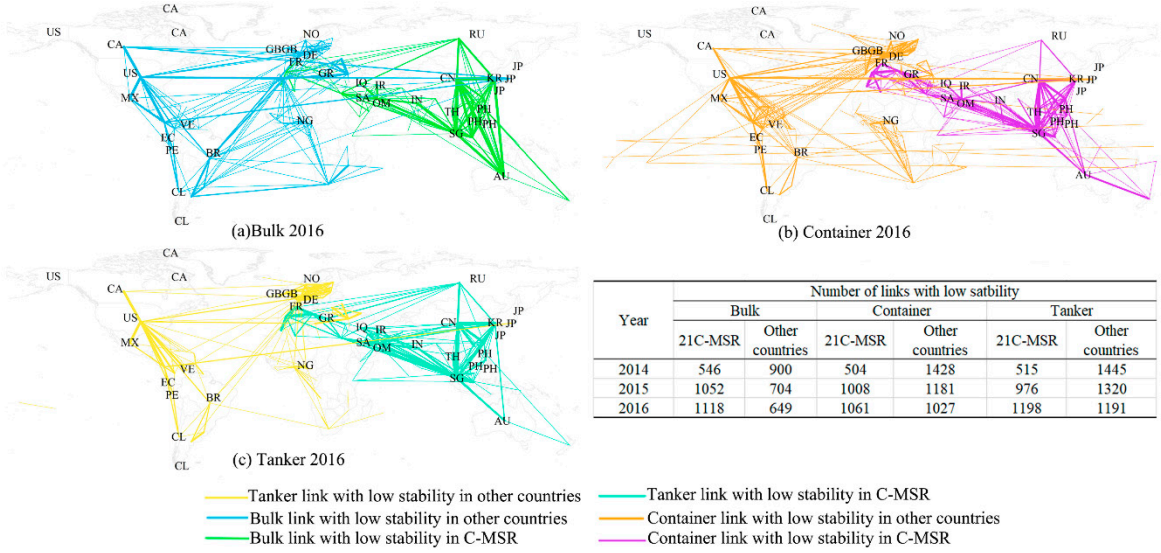
Type	Number	Average Increased Capacity	Main Countries
Bulk links with continuously increasing capacity in 21C-MSR.	345	3,125,407.29	AU, CN, ID, KR, SG
Bulk links with continuously increasing capacity in other countries.	236	1,243,252.48	Canada (CA), Ukraine(UA), United States (US)
Tanker links with continuously increasing capacity in 21C-MSR.	448	1,696,798.74	AE,CN, KR, KW, SG
Tanker links with continuously increasing capacity in other countries	450	1,408,144.76	Belgium(BE), Denmark(DK), United Kingdom(GB), the Netherlands (NL), Panama(PA), Sweden (SE), US

Table 4 illustrates the links of total ships capacity are continuously increasing across the study period in the container layer. There are more links with continuously increasing capacity in container maritime network of 21C-MSR than in other countries, and these container links in 21C-MSR represent higher average increased capacity than in other counties. For example, the average increased total ships capacity of container links in 21C-MSR is 3,524,387.11 DWT, whereas in other countries it is 2,320,540.44 DWT. 38 of 250 links with continuously increasing capacity in other countries are those connected with US and other countries (not considering Origin-Destination in the US), whereas 88 of 388 links with continuously increasing volume in 21C-MSR are those connected with CN and other countries (not considering Origin-Destination in CN). That indicates that CN has more links than the US with continuously increasing container capacity across the study period.

Table 4. Links with continuously increasing container capacity.

Type	Number	Average Increased Capacity	Main Countries
Container links with continuously increasing volume in 21C-MSR	388	3,524,387.11	CN, KR, MY, SG, TH
Container links with continuously increasing volume in other countries	250	2,320,540.44	CA,GB, NL, PA

Figure 9 illustrates the spatial differentiation of links with evident flow dynamics (stability lower than 0.2) in the bulk, container, and tanker maritime network. As indicated in Figure 9a–c, there are some links that have high bulk flow dynamics between other countries (i.e., Ghana-United States, Panama-Colombia, among others) across different continents in 2016. The majority of the links around the Strait of Malacca presented high dynamics in the bulk maritime network, including the links among CN, SG, ID, and MY in 2014, AU, CN, SG, ID, and MY in 2015, as well as KR, AU, CN, SG, ID, and MY in 2016. In comparison with bulk links, the container links with high dynamics between other countries across Africa and South America and between 21C-MSR countries around the Strait of Malacca both decreased as illustrated Figure 9b. As illustrated in Figure 9c, the links between other countries around the English Channel, the straits in Turkey, Gulf of Mexico, and Panama Canal, as well as the links between 21C-MSR around the Strait of Gibraltar and the Strait of Malacca appeared to have high dynamics in tanker maritime network in 2016. This spatial variation might be driven by the different supply-demand structure and trends for different types of cargo transportation among multiple routes. Additionally, there are continuously increasing links with low stability in all of bulk, container, and tanker layers of 21C-MSR maritime network between 2014 and 2016, while other countries show an opposite trend.



Year	Number of links with low satbility					
	Bulk		Container		Tanker	
	21C-MSR	Other countries	21C-MSR	Other countries	21C-MSR	Other countries
2014	546	900	504	1428	515	1445
2015	1052	704	1008	1181	976	1320
2016	1118	649	1061	1027	1198	1191

Figure 9. Links with low stability in 21C-MSR and other countries; (**a**) Bulk links with low stability in 2016, (**b**) container links with low stability in 2016, and (**c**) tanker links with low stability in 2016.

4.2.2. Spatial-temporal Dynamics of Maritime Network Structure

Spatial-temporal dynamics of maritime network structures of 21C-MSR and other countries are summarized in Figure 10. The nodes represent different countries with different degree in the maritime network, and the widths of the links are characterized through their increasing accumulative weights derived from total capacity after normalization (divided by the maximum capacity). There are some differences in the overall evolutionary patterns of 21C-MSR in the time periods from 2014 to 2016. For example, China (CN) enhances the connection with Australia (AU), Malaysia (MY), and Indonesia (ID), and United Arab Emirates (AE) strengthens the interaction with India (IN), Kuwait (KW), Qatar (QA), Saudi Arabic (SA), and Singapore (SG). This indicates some countries in 21C-MSR enhanced the shipping connection between other countries in 21C-MSR between 2014 and 2016. Although there are corresponding countries continuously included by 21C-MSR, there are still many weak connections between 21C-MSR. This indicates it will still take a long tie for 21C-MSR to enhance mutual cooperation in their maritime shipping industry. The highest shipping connection between other countries is relatively low in comparison to 21C-MSR, and the highest increasing accumulative weights is also lower than 21C-MSR, as indicated figure 10. The maritime network structure of other countries consist of two centralities, one for United States (US) connected with Canada (CA), Colombia (CO), Mexico (MX), and Panama (PA), and another for European countries (e.g., United Kingdom (GB), Germany (DE), the Netherlands (NL), Belgium (BE)). There are no significant changes for shipping connections among other countries between 2014 and 2016.

The maritime network can be decomposed into bulk, container, and tanker layers. The analysis will focus on the countries with network structure dynamics located in the top 20%. These countries carry out new business with additional ports (nodes) in 21C-MSR, and these new nodes contribute to the larger dynamics of the maritime network structure than the new nodes of other countries. However, these countries appear to reduce business with fewer ports in 21C-MSR, as missing nodes contribute to smaller dynamics of the maritime network structure than the missing nodes with other countries. This indicates that these countries exhibit evident dynamics in maritime network structures, especially for the shipping structure with 21C-MSR, which may be related to supply-demand shipping structure adjustment and carrying out new business with additional ports in 21C-MSR. It is obvious that there are more countries with a higher dynamic bulk, container, and tanker shipping network in 2016 than in 2014 and 2015. This is maybe related to the fact that the 21st-century Maritime Silk Road is still under construction and in the initial stages in 2014 and 2015, and the effectiveness of MSRI have been gradually presented since 2016. The maritime network structures with obvious dynamics include

the bulk, container, and tanker of AU, MY, ID, and Japan (JP), bulk and container of CN, bulk and tanker of AE, bulk of TH, container of IT, PT, SG, and TR, and tanker of SA, as shown in Figure 11 (Note that "MSR_Sta" and "Other_Sta" represent the maritime network dynamics derived from the stable nodes with 21C-MSR countries and other countries, respectively; "MSR_In" and "Other_In" represent the maritime network dynamics derived from the new nodes with 21C-MSR countries and other countries, respectively; moreover, "MSR_Out" and "Other_Out" represent the maritime network dynamics derived from the missing nodes with 21C-MSR countries and other countries, respectively). In addition, JP presents high dynamics in all layers of maritime network structure although it wasn't included by 21C-MSR. Japan has held a skeptical attitude toward MSRI, and developed some policies and measures to maintain competitiveness in the international shipping industry.

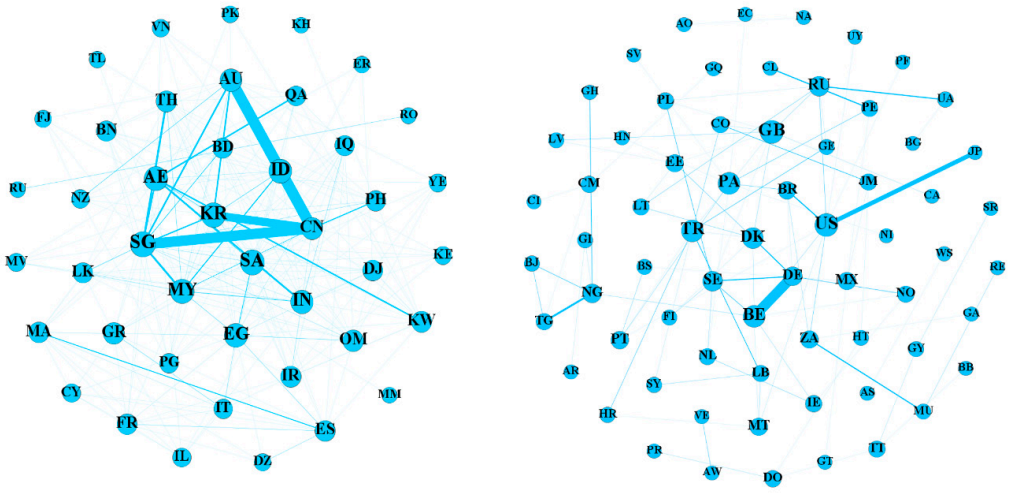


Figure 10. Maritime network structure variations; (**a**) 21C-MSR and (**b**) other countries.

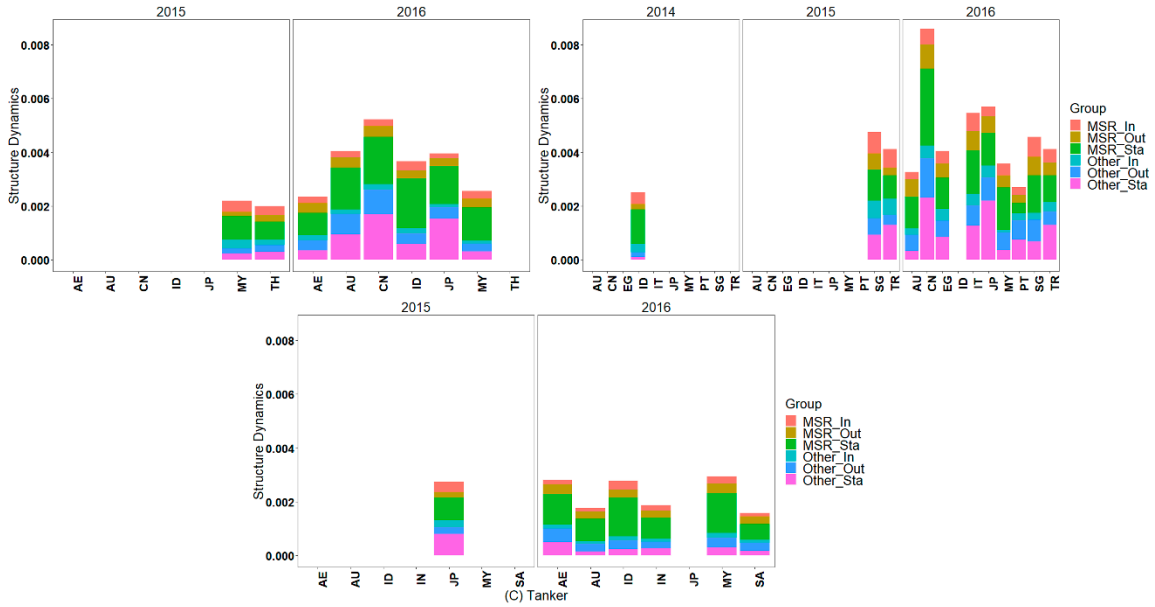


Figure 11. Maritime network structure with evident dynamics; (**a**) Bulk network, (**b**) container network, and (**c**) tanker network.

4.2.3. Spatial-temporal Dynamics of Traffic Flow Weighted Maritime Network Structure

The countries that have traffic flow weighted maritime network structure dynamics that ranked in the top 20% are illustrated in Figure 12. Additionally, these countries carry out new business with additional ports (nodes) in 21C-MSR, and these new nodes contribute larger dynamics of the traffic flow weighted maritime network structure than the new nodes with other countries. However, these countries close business with fewer ports in 21C-MSR, and these missing nodes contribute smaller dynamics of the traffic flow weighted maritime network structure than the missing nodes with other countries. This indicates their traffic flow weighted maritime network structures exhibit evident dynamics, especially for the shipping structure and capacity with 21C-MSR, which may be correlated with carrying out additional business with 21C-MSR. The traffic flow weighted maritime network structures emerging obvious dynamics include the bulk, container, and tanker of AU, MY, ID, and JP, bulk and container of CN, bulk and tanker of AE, container of EG, IT, PT, SG, and TR, and tanker of SA.

The bulk and container of CN, bulk container, and tanker of AU, MY, ID, and JP, bulk and tanker of AE, container of IT, PT, SG, and TR, and tanker of SA all exhibit evident dynamics in both the maritime network structure and traffic flow weighted maritime network structure, as illustrated in Figures 11 and 12. This suggests that these countries built corresponding new shipping relationships with the ports in 21C-MSR, and these new linkages carried a significant amount of traffic flow between 2013 and 2016. The bulk of TH exhibit evident dynamics in the maritime network structure, but small dynamics in the traffic flow weighted maritime network structure. Therefore, TH built new bulk shipping linkages with numerous ports in 21C-MSR, but these new linkages carry only a small part of the traffic flow. The container of EG exhibits small dynamics in the maritime network structure but evident dynamics in the traffic flow weighted maritime network structure, which indicates that EG builds new container relationships with certain ports in 21C-MSR, and these new linkages carry significant traffic flow.

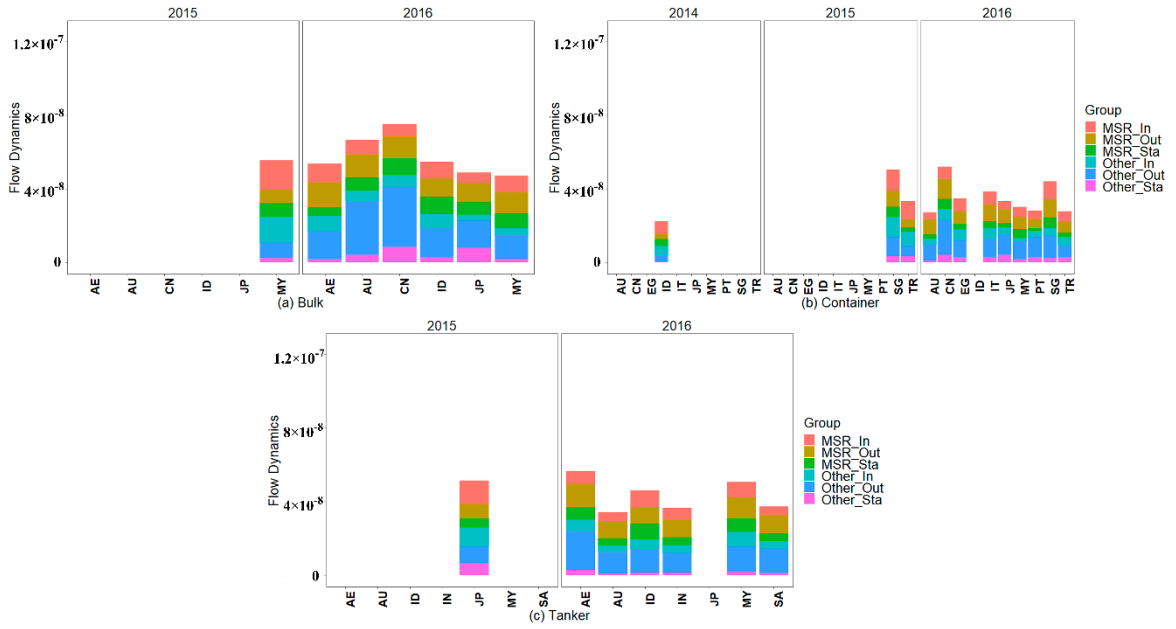


Figure 12. Traffic flow weighted maritime network structure with evident dynamics. (**a**) Bulk flow weighted maritime network, (**b**) container flow weighted maritime, and (**c**) tanker flow weighted maritime network.

5. Conclusions

Understanding multi-layer maritime network dynamics is an initial step to predict change trend [1]. In this study, we have proposed a spatial-temporal framework to explore multi-layer maritime network

dynamics, implemented the proposed framework using complex network theory and traffic flow stability, and investigated the spatial-temporal dynamics of nodes, links, network structure, and traffic flow between 2013 and 2016. The results are as follows. First, there are more ports in 21C-MSR countries that have high bulk, container, and tanker capacity and high changes in bulk, container, and tanker traffic flow between 2013 and 2016. This indicates in some ports in 21C-MSR countries, there exists a high shipping dynamic between 2013 and 2016. Additionally, most of the countries have a higher ports average capacity and stability after being included in 21C-MSR, which may be related to more frequent interaction between ports inside 21C-MSR. Second, there are more links with continuously increasing transport amount in all layers of maritime network in 21C-MSR countries compared to other countries, and these bulk, container, and tanker links in 21C-MSR countries present a higher average increased capacity compared to other counties. This illustrates that some of the linkages between 21C-MSR countries present an incremental shipping capacity between 2013 and 2016. Third, there are more links that have a big flow dynamics in bulk, container, and tanker maritime networks between 21C-MSR countries than between other countries. This indicates there are more links under the 21C-MSR geographic scope existing flow variation between 2013 and 2016. Fourth, the global maritime network dynamics exhibit geographical and spatial variations. For example, there are fewer container trade linkages with high dynamics between 21C-MSR countries around the Strait of Malacca than bulk linkages. Finally, certain countries (CN, SG, AU, and AE) have established new corresponding shipping relationships with some ports in 21C-MSR, and these new linkages carry substantial traffic flow between 2013 and 2016.

Although this research is investigating the spatiotemporal changes of the maritime network, extension may be possible. Geographical heuristics, place, and ship interaction dynamics in maritime transportation management and planning may be informative as would accounting for national shipping transportation strategies taking geopolitics into consideration. This research nevertheless provides policy insights. First, incremental transport amount of some ports and links in 21C-MSR countries between 2013 and 2016 may be relative to the shipping strategy adjustment. However, it is still premature whether 21C-MSR countries will become more competitive than other countries, and possibly hold a better position in the maritime trade. This indicates that the maritime transportation infrastructure, operational efficiency, and shipping routes for 21C-MSR countries can be further improved. The enhanced capacity for some ports maybe have potential effects for the nearby ports due to competitiveness, thus, maritime shipping policy development will need to account for the possibility of benefits conflicts among some ports in 21C-MSR countries. Second, maritime network dynamics are very useful for guiding global maritime shipping network improvements towards better utilization, including reducing friction in maritime trade and network shockwave both in 21C-MSR and other countries. Third, global maritime network dynamics provide some guidance for policy makers and stakeholders in decisions making as complicated maritime transportation markets reflect important structure and traffic flow evolution. For example, the ports or links with incremental transport capacity will cause transit time changes for shipping companies, thus, the adjustment is needed to maximize the benefits.

There are some limitations that should be noted. First, we only examine the global maritime network dynamics between 2013 and 2016, the difference between 21C-MSR and other countries, and the differences between before and after included by 21C-MSR across study period. The differences between before and after the MSRI was announced can be further explored if the long run AIS data are available. The spatial-temporal dynamics can be further evaluated if the complete data source is accessible. Second, this paper only focused on the multi-layer maritime network changes, and some uncertainty and challenge remains regarding implications for the actual impact of the MSRI on the maritime network. Third, there are some differences between shipping capacity and actual cargo amount owing to unknown cargo amount and loading rate. Fourth, this paper could not access the detail classification of goods and fixed importing and exporting countries for different products (e.g., crude oil and refined oil), which can be fulfilled in the future research.

In the future, the proposed approach could be enhanced by combining comprehensive information on maritime natural resource utilization data, social-cultural factors, and economic activities in order to provide a powerful and mutually consistent explanation for the manner in which geopolitical initiatives have different impacts on maritime shipping planning and management [39]. Furthermore, future research should explore a deeper understanding of the mechanisms driving the structural and spatial and regional dynamics in global maritime networks, analyzing the urban transportation contributed by the geopolitical policy, and connecting these changes to the corresponding maritime network types.

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The dynamics of handcart as a means of informal transportation in support of logistics and tourism

The case of downtown Kingston, Jamaica

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Abstract

Purpose – The use of technology has remained a staple in modern day industry because it creates an enabling environment, which promotes innovation that has propelled globalization. Maritime and tourism are two such critical sectors that have benefited from such technology and stand to benefit more in light of the fourth industrial revolution. The handcart has been used by humans for centuries as a mode of transportation. It has remained relevant to this day, more so a positive contributor to public market experience in developing countries. Notwithstanding, this phenomenon remained largely under-explored and informal with little to no integration in the planning of public markets or market districts. As such, little study or research exists to inform policies to improve and integrate the handcart profession in the overall planning and rejuvenation of downtown Kingston, Jamaica. Therefore, the purpose of this paper is to understand the characteristics and benefits of the handcart logistics by investigating the socioeconomic and spatial dynamics surrounding the operations of this mode of transportation.

Design/methodology/approach – Qualitative and quantitative techniques were used to completely grasp the complexity of factors that influence and sustain the handcart trade within the coronation market as well as its contribution to Jamaica's economy. Collection of data was achieved via the administration of questionnaires supported by observations and interviews. Geographic Information System (GIS) was used along with satellite images to integrate spatial representations in the analysis and discussions of results.

Findings – Consistent with the reviewed literature, the results and analyses revealed that, despite the handcart's informality and inadequate infrastructural support, handcarts are generally perceived as beneficial to market districts. They fill the transportation gaps where formal governance operations failed and contribute to the local economy by providing employment for low-skilled persons. The handcart industry has been sustained because of the need for the service by mostly vendors and shoppers but more so because of the economic benefits that have been accrued by builders, owners and operators.

Research limitations/implications – The research focused on handcarts used to convey goods and not carts used as mobile vending carts. In addition, the geographical scope of the research is restricted to the Coronation Market in Kingston. Obtaining knowledge about the sector poses a challenge because some or all aspects of informal activity are not recorded. Various opportunities exist for the improvement of handcarts. As such, they must be incorporated in any future transportation improvement plans in the city of Kingston, Jamaica.

Practical implications – Despite the attempts to regularize the handcart phenomenon in the downtown Kingston market district, the handcart operators are still not incorporated in various plans and improvement initiatives. Notwithstanding, the benefits to the transportation gap and local economy warrants the need to pay keen attention to this phenomenon and promote regularization. With the introduction of Kingston as a UNESCO Creative City in 2016 and the advent of Airbnb, the potential exists for exponential growth in

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cultural and community tourism in downtown Kingston. The use of the handcart can therefore be leveraged and integrated in the tourism package to facilitate the movement of tourist luggage from bus terminals and parking lots to their destination in the downtown communities.

Originality/value – The handcart system is a prominent feature of market districts in Jamaica and, as such, this research bears high levels of significance because it can be replicated or used as a basis to inform handcart policies and the design to improve logistics in any tourism destination. The research serves as a body of knowledge to "all and sundry" because it unearthed some of the handcart's attributes and contribution to the local economy, can contribute to adequate layout of Market districts by government to incorporate the handcart system, facilitate their integration in cultural and community tourism and facilitate the handcart trade being viewed by society as a profession. At the advent of this Fourth Industrial Revolution, an upgraded design of the handcart may appear.

Keywords Urban planning, Logistics, GIS

Paper type Research paper

Introduction

The Fourth Industrial Revolution (Industry 4.0) builds on digitization and big data along with the use of technology to improve efficiency. According to Interreg North Sea Region and European Union (2018), this industrial digitization "is the merging between the physical and digital worlds to significantly enhance performance and productivity." The use of technology has remained a staple in Industry 4.0, thus creating the enabling environment that promotes innovation, resulting in exponential development of new technologies and accelerated globalization. According to Schwab (2015):

> [. . .] these possibilities will be multiplied by emerging technology breakthroughs in fields such as artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing.

This new revolution has implications for all sectors and areas of human existence. It is, therefore, necessary that its potential be exploited while managing its risk (Schwab, 2015). Maritime and tourism are two such critical sectors that stand to benefit from Industry 4.0 and stand to benefit even more once we have fully grasped and realized the potential of leveraging this new revolution. There are no exceptions to small island developing states such as Jamaica, which are highly dependent on the tourism and maritime industries. However, to adequately reap the benefits of Industry 4.0, integration of all stakeholders must be incorporated to limit the marginalization of people. Therefore, to maximize the potential benefits of Industry 4.0, it is best to look backward while focusing onward.

In looking backward while focusing onward, in developing countries such as Jamaica, the handcart has survived all three previous Industrial Revolutions and has remained relevant in the onset of the fourth one. The handcart has been used by humans for centuries as a mode of transportation (Tresemer, 1985; Hein, 2004). It has remained relevant to this day, more so as a positive contributor to public market experience and low-income communities in developing countries. Public markets and their related infrastructure have become important resource in the fabric of urban life. Project for Public Spaces (2014) indicated that "historically our towns and cities grew up around markets, which served as our original civic centres." Transportation has always been a constant element in the public market environment.

Cooke(2017, D3) claims that:

> [. . .] the handcart is one of the most basic means of transportation, powered by sheer human muscle and willpower to ferry goods and sometimes people over short distances where it is impractical or impossible for motor vehicles to reach.

In support, Njau (2000) highlighted that the handcart system facilitates a direct link between point of origin and point of destination by reducing travel time. Njau further argues that the handcart has the "ability to link-up areas not directly served by motorized modes of travel" and offers environmental benefits because of its non-motorized nature (p. 103).

It was revealed that a significant example of the handcart phenomenon in Jamaica is represented in the Coronation Market located in proximity to the community of Tivoli Gardens in downtown Kingston. The informal handcart has perpetuated overtime because of the lack of adequate designated parking for consumers, producers and vendors close to public markets in downtown Kingston. Moreover, public transportation centres (PTC) are dispersed within the downtown area and not all public transport traverses the route where markets are located. This continuous neglect perpetuated the use of the handcart as an unconventional transportation mode by filling the gaps where formal governance operations have failed. Within this spatial and social dynamic, the handcart has emerged as an important transportation mode within public markets and the entire downtown area, which is buffered in the south by the Kingston Harbour, the seventh largest natural harbour.

The handcart is not only a feature of public markets but also supports other commercial business and travellers. Njau (2000, p. 100) indicated that handcarts move various goods, ranging from "agricultural products such as vegetables, fruits, cereals, etc, to non-agricultural goods such as office equipment, stationery, furniture, crates of beer and travellers' luggage." Kim (2016) indicates that handcarts can be found within markets and on the outskirts of urban areas where they are used to carry water to settlements and move the belongings of the urban poor whenever there is a need to relocate. Gayle (1994, p. 3) in an article published in the Jamaica Gleaner indicated that handcarts came to the rescue on a rainy day in downtown Kingston by assisting individuals to cross flooded roadways for a small fee. More recently, in the Jamaica Gleaner, Jackson (2017) captured handcarts in Falmouth, Trelawny being used to transport tourists who could not cross high waters after a heavy downpour.

Despite its longevity, negative social and spatial perceptions are attached to handcart operators in downtown Kingston. Concerns are related to their contribution to traffic congestion, damage to motor vehicles, injury to pedestrians, vulgar and disrespectful behaviour and theft.

Conversely, one businessman in the downtown area of Kingston indicated that even though they cause problems, the area would be "unimaginable" without them because of the transport services they provide (Gleaner, 2002, A14). Njau (2000) agreed by asserting that the handcart not only supports the transportation needs but also the need for employment. On the other hand, Kim (2016) mentioned a study by Sunni Biandra who indicated that handcart are a thing of the past and an inhumane activity.

Despite its existence for centuries and positive contributions, many issues about its nature remain largely under-explored or unresolved and, as such, the handcart system was never fully understood. The activity is tolerated by the authorities, the police and people in general because of its noticeable benefits. The existing literature on handcarts is sparse, principally because limited research has been done to understand the characteristics and relevance of the handcart, particularly in small island developing states such as Jamaica. As such, little study or research exists to inform policies to improve and integrate the handcart profession in the overall planning and rejuvenation of downtown Kingston. There is therefore a need to truly understand the characteristics and benefits of handcart logistics by investigating the socioeconomic and spatial dynamics surrounding the operations of the handcart mode of transportation within the Coronation Market and to a wider extent downtown Kingston. In doing so, the government will be better able to create more informed

policies and regulations to improve the handcart trade and incorporate and mainstream their operations in the overall design and layout of market districts to support logistics. The research can therefore inform tourism policies in the downtown area. With the introduction of Kingston as a UNESCO Creative City in 2016 and the advent of Airbnb, the potential exists for exponential growth in cultural and community tourism in downtown Kingston and the handcart can become an integral feature.

Methodology

To fully understand the characteristics of the handcart trade and the environment within which it operates and its contribution to the local economy both qualitative and quantitative techniques were used to fully grasp the complexity of factors that influence and sustain the handcart trade. This was achieved via the administration of questionnaires supported by observations and interviews. Geographic Information System (GIS) was used along with satellite images to integrate spatial representations in the analyses and discussions.

Data from the Kingston and St Andrew Municipal Corporation (KSAMC) indicated that as of November 2013, approximately 92 handcart operators operated in the Coronation Market and its Annex in downtown Kingston. It was noted though that it is highly possible that more handcart operators exist. However, 92 operators were used as the benchmark for this study because there is no other official documentation. As such, to increase the confidence level of the research, a sample size of 80 handcart operators were selected to represent the entire handcart population that uses the Coronation Market. However, only 73 completed the questionnaires, which represents a 95 per cent confidence level with a margin of error of plus or minus 5 per cent.

The result

The below section presents a synopsis of findings and analysis extracted from the research. Data collection revealed that the strength required to load, push and offload a handcart lies within the specific sex and age groups that were highly represented. Responses from handcart operators revealed that males dominate the trade, accounting for 99 per cent of operators. The majority of operators are between the ages of 18-40 (60 per cent) and in that age range, seven (7) were between the ages of 18-20; twenty (20) were between the ages of 21-30, followed by seventeen (17) between the ages of 31-40. The lowest represented age range was over seventy-one (71) (Figure 1).

Analysis revealed that 56 per cent of operators have been operating handcarts for more than five years in the Coronation Market. The origin of the majority of handcart operators was not originally a part of the research but incidentally most indicated that they live in rural areas and transit to Kingston to push a handcart: 62 per cent indicated that they became a handcart pusher because they saw no other means of earning an honest living that could take care of their basic needs; 22 per cent of respondents revealed other reasons why they push handcarts such as the entrepreneurial opportunity and freedom that exist in the handcart profession; a few indicated that they once had different jobs but saw the handcart as a more attractive means of earning an income; and 16 per cent simply joined their family business.

It was revealed that the handcart has sustained over the years because of its reliability and necessity. Vendors and shoppers constitute 63 per cent of the handcart client base. Interviews further revealed that there are two categories of operators: one category works at night and the other works during the day. Some handcart operators highlighted that they may work both days and nights on various occasions. Shoppers predominantly use the service during the day, but vendors mostly use the service during the night. Based on the

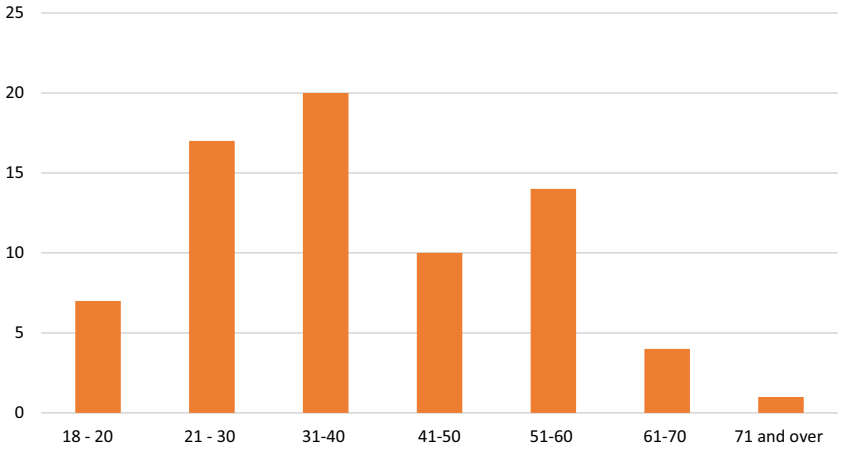

Figure 1.
Age distribution of handcart operators

dynamics of the market system and the need to transport goods during both night and day, the handcart has been the constant element in the market that efficiently facilitates the flow of goods. Night operators take shorter trips and heavier loads only to vending stalls in the Coronation Market. This intensifies at ~11 p.m. when market trucks begin to enter the market district to offload on nights before busy market days. However, day operators move with shoppers and second-hand vendor's goods to specific points in and around the coronation market. Day operators mainly transport goods to bus terminals and parking lots for shoppers. Moreover, handcarts convey goods to and from commercial businesses to vendor stalls and market trucks. Because of the reliability of handcarts, there is a high dependency on the service in the Coronation Market and, as such, the majority of operators usually work over 9 h on the days or nights that they work.

Responses reflect that the majority of handcart operators work on busy market days: Wednesdays, Thursdays, Fridays and Saturdays. Of the 73 respondents fifty-one (51) work on Fridays, followed by forty-four (44) who operates on Saturdays, forty-three (43) on Thursdays and thirty-three (33) operate on Wednesdays. Thirteen (13) respondents indicated that they work all seven days of the week.

Interviews revealed that a majority of handcarts were owned by a small percentage of individuals who were solely in the business of renting and or building handcarts and may own up to 20 carts. 60 per cent of respondents owned at least one handcart while the remaining 40 per cent rent handcarts daily. Of the 60 per cent who owned a handcart, 22.7 per cent rent their handcart to other operators. Therefore, handcart owners provide a source of employment in the informal sector for individuals who are not able to obtain a job in the formal sector. Handcart rentals occur daily by operators who usually pay between $300 and $500 (Jamaica Dollars - JMD). Individuals who rent handcarts per week indicated that they may pay between $1600 and $2500 (JMD) for the week. Interviews with handcart owners also revealed similar fees. Similarly, based on price range provided to rent a handcart, analysis suggests that if a handcart owner rents all his 20 handcarts per day, he would generate revenue as low as $6000 or as high as $10000 (JMD) depending on the cost to rent. Taking the four busiest days of the week, i.e. Wednesdays, Thursdays, Fridays and Saturdays, if he rents all his 20 handcarts during those four days, he might generate revenue as low as $24000 or as high as $40000 (JMD) over the period. This is a substantial amount compared to other formal activities.

Handcart builders, some of whom are also owners, classify their profession as handcart engineers. Findings revealed that two types of handcarts exist: iron axle and board axle. The differentiation is dependent on material used to construct the wheels of the handcart. Handcarts can be custom built; however, the standard size is 7 feet long by 2.3 feet (28 inches) wide. Handcart engineers indicated that it takes great precision to build a handcart and requires three (3) individuals to complete the final product. Most of the materials used to build handcarts are recycled items taken from various scrap metal yards. These recycled items are purchased from suppliers by handcart builders. In describing the process to build the iron axle handcart, the first step is for the welder at the machine shop to "smooth out the metal" that will be used as the wheel. Once that is done a second specialist is responsible for cutting the rubber from old tires and wrapping and nailing the rubber around the metal forming a wheel. In addition, the steering is also created in these two processes. The process to build the wheel may cost approximately $16,000 (JMD) and is the most expensive component of a handcart. A third individual completes the handcart by building the wooden frame and attaches the wheels, steering and rope that then controls movement. Interviews performed with handcart builders and owners revealed that the price for a handcart is dependent on the type of axle. Iron axle is a higher quality handcart and it usually costs between $30,000 and $35,000 (JMD) or even more. The board axle is of a lower quality in comparison and cost between $20,000 and $25,000 (JMD).

Handcart owners and builders are therefore enablers of the handcart profession. Note that additional investigation revealed that ninety-two per cent (92 per cent) of handcart operators are able to take care of their family needs from revenues gained by pushing a handcart. The remaining 8 per cent indicated that the revenue is not sufficient. The fees to convey goods is dependent on the distance travelled and the number of bags carried. Because it is related to the distance travelled, sixty-eight (68) operators said that they charge between $100 and $200 (JMD) over short distances. This can, however, be increased depending on the number of bags that are being carried. Five (5) respondents indicated that they charge between $300 and $400 (JMD) over short distances. In administering this question, eight (8) operators indicated that they do not work long distances because they only off load trucks at nights and take to stalls within the market. As such, they were not included in this analysis. Of the remaining sixty-five (65) respondents, forty-six (46) (71 per cent) revealed that they charge between $300 and $600 (JMD) for long distances. Moreover, the cost is dependent on the number of bags carried. A total of thirty-four (34) operators revealed that from handcart operations they usually take home between $2000 and $3000 (JMD) dollars daily; this reflects 47 per cent of the total respondents. This response is followed by nineteen (19) (26 per cent) respondents who indicated that usually they take home between $4000 and $5000 (JMD) daily. Thirteen (13), i.e. 18 per cent of operators, indicated that they take home over $6000 (JMD) daily and the remaining seven (7) take home less than $2000 (JMD) daily. Interviews further uncovered that some operators had other jobs such as farming and vending and that the handcart is only a side job to earn extra income. Notwithstanding, taking the four busiest days of the week, i.e. Wednesdays, Thursdays, Fridays and Saturdays, an operator can take home as low as $8000 or as high as $24000 (JMD) over the period. This is also dependent on the number of days and hours worked and the season, e.g. Christmas.

All seventy-three (73) operators indicated that they use their revenue to buy groceries. The other major categories are as follows: 51 indicated that they pay utility bills, 45 use their revenues to contribute to the development of their children, 30operators use the revenue to maintain their handcart (s) and 63 indicated that they use their revenue to invest, by invest they mean to put money in the bank or "partners." This is followed by 17 operators who

indicated that they either built a house or contributed to renovation on family lands. This indicates that, despite the handcart's informality, operators contribute indirectly to public taxes by paying GCT on food items and utility bills.

Observation revealed that handcarts typically use motor vehicle thoroughfares and pedestrian pathways to move from one location to the next. In addition to operating in the Coronation Market, many operators visit other markets, transport terminals, parking areas and the business district and go as far as the waterfront along the Kingston Harbour. The analysis revealed that 78 per cent of handcart operators believed that the design of the Coronation Market can adequately facilitate the flow of handcarts and shoppers. However, they do not feel integrated in the space as there are no specific areas for handcarts to park or to move goods.

Research limitations/implications

The research is restricted to the Coronation Market and its periphery and the handcart drivers who use the facility. Moreover, gathering knowledge about the sector poses a challenge because some or all aspects of informal activity are not recorded. The researcher suspected that there was a tendency by operators to understate their revenue for fear that the disclosure could invite taxation from the government.

There is also need for research to be carried out on the engineering features of handcarts. Can the handcart features be improved? One area for improvement is that because handcarts operate at nights, they should be built with lights to adequately facilitate night transport because this is currently not the case. This is consistent with recommendation that was put forward by the vendors who operated in the markets. In addition, a gap that exists in handcart research is the value of goods that handcarts move on a daily or nightly basis. Although this research does not quantify the value of goods conveyed, this is an area for future research.

Most handcart owners are builders who are located at the southern end of the market in makeshift structures. Their location in the market makes them easily accessible to renters and to perform maintenance work. This is a risk and an area for future research because handcarts are not insured and if an incident strikes, they lose all carts with no means of seamless recovery.

In relation to outside the market periphery, handcarts use motor vehicle thoroughfares and pedestrian sidewalks because there are no designated rights of way. This contributes to traffic congestion, especially on busy market days. To improve the overall market district, holistic planning must be considered and all contributors to the life of the market district must be included in any plans. Given the relevance of the handcart to the logistics of goods within the market and market district, they must be incorporated in any future transportation improvement plans and the tourism plan.

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About the author

Sherona Tasheka Campbell is an Urban Planner having experience for over eight years in the government service in Jamaica. During this time, I have focused on building the capacity of local government entities to improve sustainable development planning at the local level. To enhance my skill set, I completed a PGC in Geographic Information Systems (GIS) from the University of Leeds, UK, and went on to study a Masters in Logistics and Supply Chain Management at the Caribbean Maritime University, Jamaica. I endeavor to use these three complementing skill sets (urban planning, GIS and logistics) to promote smart communities and improve quality of life.

This article was informed by the thesis titled The dynamics of Handcart as a means of informal transportation of goods: The case of Coronation Market, Jamaica, which was completed in Partial Fulfillment of the Requirements for at the Caribbean Maritime University, Jamaica. Sherona Tasheka Campbell can be contacted at: sheronacampbell87@gmail.com

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The impact of Covid-19 pandemic: A review on maritime sectors in Malaysia

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ABSTRACT

The coronavirus disease 2019 or Covid-19 pandemic has affected many operations worldwide. This predicament also owes to the lockdown measures imposed by the affected countries. The total lockdown or partial lockdown devised by countries all over the world meant that most economic activities, be put on hold until the outbreak is contained. The decisions made by authorities of each affected country differs according to various factors, including the country's financial stability. This paper reviews the impact of Covid-19 pandemic on maritime sectors, specifically shipping, fisheries, maritime tourism, and oil and gas sector. The period of this study covers economic activities between the month of January towards the end of July 2020. Also discussed in this journal, is the analysis of the potential post-outbreak situation and the economic stimulus package. This paper serves as a reference for future research on this topic.

1. Introduction

Novel Coronavirus or Covid-19 was first discovered in Wuhan, China on December 31, 2019. Since the first outbreak in Wuhan, the number of cases has spiked in that region. The Chinese government imposed a lockdown for the entire region to contain the spread of this contagious virus. Whilst China reached peak Covid-19 cases of around 80,000 cases at the end of February 2020, other countries around the world had just discovered and learned about Covid-19 cases in their respective countries. Most countries realised the presence of Covid-19 between the end of February and the middle of March 2020.

Despite some early calls for every country to implement control measures to contain the spread of the coronavirus, considering the chaotic outbreak experienced by the Chinese government, the outbreak has spread faster than most people expected. On March 11, 2020, the World Health Organization (WHO), declared the Covid-19 outbreak a pandemic based on assessments and the increasing number of cases globally (118,000), at that time with 144 countries affected. As of early April 2020, the highest cases recorded was in the United States of America (USA), amounting to 215,344 cases followed by Italy and Spain at 110,574 and 104,118 cases respectively (Worldometer, 2020). At that point in time, the outbreak had affected 203 countries and two international conveyances, with 939,131 confirmed cases and 47,331 deaths. This was the worst outbreak in the world since 1990, besides posing a higher magnitude than the Ebola outbreak in 2014, which largely affected west Africa (Bowles et al., 2016; Huber et al., 2018). There were several actions implemented by the affected countries to contain the virus, including imposing total lockdowns, partial lockdowns, and movement control orders. These measures were not economically friendly. The managing director of the International Monetary Fund (IMF), Georgieva (2020) in her speech stated that retail, hospitality, transport, and tourism might face substantial consequences. In fact, Georgieva (2020) foresees a severe economic impact arising from the pandemic; "It is already clear, however, that global growth will turn sharply negative in 2020, as you will see in our World Economic Outlook next week. We anticipate the worst economic fallout since the Great Depression". Furthermore, she stated that 170 countries might face negative per capita growth.

Moving on from the alarming declaration by the IMF managing director, this study is aimed at reviewing the impact of the Covid-19 outbreak on developing countries, such as Malaysia. In particular, this article will focus on the impact during and post-Covid-19 outbreak.

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Looking at the reliance of the Malaysian economy on maritime sectors, it was certain that the pandemic would have serious implications on individuals and organisations. Besides that, this study also looks into the economic stimulus packages that were introduced to ensure the sustainability of business sectors. Fig. 1 illustrates an overview of the study.

2. Covid-19 scenario in Malaysia

In Malaysia, the first confirmed case of Covid-19 was recorded on January 25, 2020, involving three Chinese nationals. Responding to these cases, the Covid-19 patients were treated and isolated at a hospital in Johor Bharu. These confirmed cases were considered under control as all businesses and operations were conducted as usual. The first Covid-19 case involving a Malaysian was recorded on February 4, 2020 (BERNAMA, 2020), which took Malaysia's cumulative Covid-19 cases to 10 cases.

On March 16, 2020, the movement control order (MCO), was announced by the prime minister of Malaysia following the increase in number of positive Covid-19 cases. The MCO was effective from 18 to March 30, 2020. The number of positive Covid-19 cases during the date of the announcement, was at 553 (Ministry of Health, 2020). Under the MCO, six main orders were enforced; i) prohibition of any mass gatherings, ii) prohibition of movement of Malaysians from going abroad, iii) prohibition of movement of foreigners into Malaysia, iv) closure of all schools and kindergartens, v) closure of higher educational institutions and skills development centres, vi) closure of all government and private premises except for those involved in essential services (Prime Minister of Malaysia speech, March 16, 2020). The first phase of MCO was initially until March 30, 2020 but ended up being extended several times until May 12, 2020. To strike the balance between public health concerns and economical needs, on May 1, 2020, the prime minister announced the conditional movement control order, or CMCO. The CMCO phase, which took effect on May 4, 2020, allowed the majority of economic sectors to begin operations, subjected to strict Standard Operational Procedures (SOP) (Prime Minister Office, 2020). However, businesses and other recreational activities that involve mass gatherings were not allowed.

Following this, recovery movement control order (RMCO) was introduced, owing to the need of striking balance between economical needs and public health. The choice to implement the RMCO was discussed carefully and decided based on the low number of daily cases (19) on June 7, 2020. This RMCO measure was supposed to take place from the tenth of June until the end of August 2020. During this phase, most activities and business operations are allowed, but have to adhere to the Covid-19 SOP outlined by the government. These include maintaining a physical distance of 1 m, wearing a face mask in close public premises, and the requirement of temperature taking before entering any premises. Adding to that SOP was the recording of details, such as name and contact number via MySejahtera - an application developed by the government of Malaysia, that helps the authorities in conducting contact tracing in the event of a new Covid-19 case (MySejahtera, 2020). Table 1 summarises the MCO, CMCO and RMCO implemented by the Malaysian government, including the durations, announcement date and number of cases. The 'Number of cases' column consists of the number of daily cases with total number of cases (in parentheses), followed by the number of 'active' cases - after subtracting the number of recovered cases.

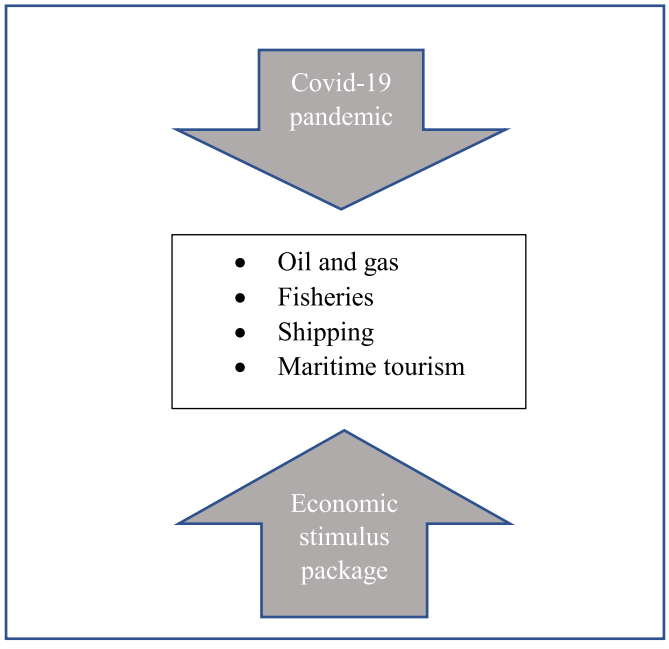

Fig. 1. Overview of the study.

3. Maritime industry

Kwak et al. (2005), classified the maritime industry into four main sectors, which are i) marine transportation, ii) harbour, iii) fisheries and marine products, iv) shipbuilding and other marine transportation. In Malaysia, maritime sectors play a vital role in improving the local economy. Malaysia's oceans serves as host shipping routes, providing a medium for potential economic activities, such as transportation, tourism, shipbuilding and ship repairing, and port services (Kaur, 2015). This sector contributes to 40% of Malaysia's gross domestic product, where 15% is from oil and gas, followed by fisheries at 9.4% (Hamzah, 2019). The remaining percentage accounted for maritime-related sectors including tourism. The most important maritime sectors according to economic contributions are; i) ocean and coastal shipping, ii) shipbuilding and ship repairing, iii) port services, iv) oil and gas, v) fisheries, and vi) naval defence and other enforcement agencies (Saharuddin, 2001). However, the last sector (naval defence and other enforcement agencies), was cited by the author because of its public contributions, and not from direct economical perspectives. In Malaysia, maritime industry classification is still ambiguous. For the purpose of this analysis,

Table 1
Covid-19 control measures in Malaysia.

Covid-19 measures	Period	Announcement date	Number of cases	References
MCO Phase 1	March 18 to March 30, 2020 (2 weeks)	March 16, 2020	125 (553) active: 511	Prime Minister Office (2020)
MCO Phase 2: 1st extension	April 1 to April 14, 2020 (2 weeks)	March 25, 2020	172 (1796) active:1578	Prime Minister Office (2020)
MCO Phase 3: 2nd extension	April 15 to April 28, 2020 (2 weeks)	April 10, 2020	118 (4346) active: 2446	Prime Minister Office (2020)
MCO Phase 4: 3rd extension	April 29 – May 4, 2020 (1 week)	April 23, 2020	71 (5603) active: 1966	Prime Minister Office (2020)
CMCO	May 4 – May 12 (1 week)	May 1, 2020	69 (6071) active: 1758	Prime Minister Office (2020)
CMCO 2 (1st extension)	May 12 – Jun 9, 2020 (4 weeks)	May 10, 2020	67 (6656) active: 1523	Prime Minister Office (2020)
RMCO	Jun 10 – Aug 31, 2020	Jun 7, 2020	19 (8322) active: 1531	Prime Minister Office (2020)

this study will focus on four maritime sectors: i) shipping, ii) oil and gas, iii) fisheries, and iv) maritime tourism.

3.1. Shipping sector

Malaysia's strategic location with coastal lines, has been regarded as added value to its development and prosperity. As one of the country that rely on the seaborne trade, shipping sector is prominent to Malaysia, making Malaysia a leading maritime nation (Mohd Zaideen, 2019). Malaysia hosts the Strait of Malacca, one of the most important shipping lanes in the world. This strait is considered to be among the most heavily used straits for international navigation, with more than 80,000 ships traversing these sea lanes annually (Mohd Zaideen et al., 2019), carrying an estimated 25% of the world's traded goods. This has allowed Malaysia to place itself firmly as a major world transhipment hub, with a regular port of call for different types of vessels. VLCC, tanker vessels, LNG carriers, cargo vessels, container vessels, bulk carriers, passenger vessels, and fishing vessels are among vessels that navigate the strait in accordance to the analysis of the vessel characteristics reporting to the ship reporting system, STRAITREP (Marine Department Malaysia, 2020). Government-owned ports, such as Port Klang and Port of Tanjung were ranked 12th and 18th among the busiest ports in the world (World Shipping Council, 2020), a witness to Malaysia's distinction in the maritime sector. The merit of shipping and port division has contributed to the expansion of the Malaysian economy, hence making Malaysia a developing maritime nation.

Malaysia depends greatly on the seas to facilitate its trade while providing lots of economic opportunities to the coastal communities. Many economic activities are carried out at sea, and the sector has also provided a potential source of employment and career opportunities.

Covid-19 pandemic is affecting world shipping businesses and markets in terms of growth and fleet development. The collected data from a global network of Automatic Identification System (AIS) receivers, shows a depletion in world shipping activity from the month of March to June 2020, when the most severe restrictions were enforced. These restrictions produced a variation of mobility quantified between −5.62% and −13.77% for container ships, between 2.28% and −3.32% for dry bulk, between −0.22% and −9.27% for wet bulk, and between −19.57% and −42.77% for passenger ship (Millefiori et al., 2020). Like many other countries, Malaysia has also responded to the pandemic by imposing lockdown measures and restricting movement. Putting the country into lockdown caused demand to drop across the board, and lead to disruption of transportation networks encompassing the maritime sector specifically the port and shipping sector, rail, air, and trucking industries (Loske, 2020). It is reported that Malaysia's exports decreased by 25.5%year-on-year in May 2020 - the hardest decline since May 2009, while imports dropped by 30.4% year on year (BERNAMA, 2020). The Covid-19 pandemic has also showcased the flaw of port efficiency and hinterland connectivity in Malaysia's response to crises. For example, vendors fail to pick up their cargo at port due to the closure of their warehouses, and some ports have reduced workforce, which exacerbates the cargo congestion. The shortage of workers is taking a toll on global shipping with interruptions in transit, delays, and accumulation of cargo both at the origin and destination ports. This has indirectly caused interference to the supply chain, especially on the movement of essential goods like food and medical supplies. Also during the MCO, the movement of goods has been rather limited, which then results in the high stacks of containers for non-essential goods, especially in Port Klang as reported by the Federation of Malaysian Freight Forwarders (Shankar, 2020). Problems like this often lead to port disruptions apart from the slowdown in supply chains, thus interrupting all links of international trade.

International trade plays a large role in the Malaysian economy. Malaysia mainly exports electrical and electronics (E&E) products and commodity-based products, especially petroleum, crude petroleum and rubber products (Department of Statistics Malaysia, 2020). One of Malaysia's main trade partners in 2019 was China with 14% of total exports. The slump in demand for goods from China is generating a ripple effect on everything from container ships to oil tankers (Berti, 2020). These challenges have weakened the efficient movement of trade flows and supply chain operations worldwide, which can significantly erode the transport services trade liberalisation and trade facilitation gains achieved over the years (UNCTAD, 2020). As a result of that, Malaysia's total trade is expected to register a decline due to softer global demand caused by unfavourable economic conditions during MCO. Although the shipping sector is regarded as essential services, and was allowed to operate, Malaysia Shipowners' Association (MASA) chairman, Datuk Abdul Hak Md Amin, mentioned that shipping companies suffered heavy losses during the MCO, with an average potential short-term loss of between RM15 million and RM30 million for normal operations due to the decline in revenue (Malaysia Shipowners' Association, 2020). The decline in trade during the pandemic was similar in other regional countries, such as Singapore, Thailand, and Indonesia. This decline fuelled the prediction that many jobs would be wiped out by the downturn brought by the pandemic. The increase in unemployment would further prolong the downturn in economic activity. In fact, due to control measures and travel restrictions, there are 300,000 seafarers stranded at sea because of the crew change crisis (International Transport Workers Federation, 2020). Despite all that, Malaysia still relies on shipping operations for the supply of Covid-19 personal protective equipment (PPE), which received increased demand during the pandemic.

Malaysia's shipping industry is still battling to cope with the fragility of the global supply chain. What shipping will look like post-Covid-19 is unpredictable as Malaysia enters the RMCO phase up until August 31, 2020. Governments are called upon to assist and provide financial support for businesses that have been impacted by the Covid-19 outbreak.

3.2. Oil and gas sector

The operating locations of the oil and gas exploration and production activities are concentrated near Kelantan and Terengganu, two states in the East Coast region of Peninsular Malaysia (PricewaterhouseCoopers, 2015). The other two operating areas are Sabah and Sarawak on the island of Borneo. Fig. 2 illustrates the demand for petroleum products across different sectors in Malaysia. It can be observed that petroleum products are largely consumed for transportation. Indeed, the amount of petroleum products consumed for transportation did not display a drastic change for more than 20 years.

However, the implementation of MCO has drastically reduced the usage of automobiles, industrial activities, shipping, and transportation. This impact was immediately felt by Malaysia's oil and gas sector. The drop in demand was estimated to be more than 30% in April 2020. Lack of physical demand for crude oil quickly resulted in the plunge of oil prices. LNG prices, which were already under pressure from weak fundamentals, have also fallen further as working from home arrangements has caused a sharp decline in the usage of electricity in Malaysia. Towards the end of mid-June 2020, the lockdown restrictions began to ease and the slow return of the market to normal conditions is underway. The same occurrence was observed for the oil and gas sector as demands increased across the world where it was mostly utilised for transportation purposes. Covid-19 pandemic has impacted the world's crude oil price per barrel, due to low consumption from lockdowns and restricted movement around the world. The decline in oil consumption was attributed to the low consumption used domestically and in commercial transportation, including international flights. It is reported that the Brent crude oil price plummeted by 30%, the sharpest drop since the Gulf War in 1941, to around $34 per barrel (Scheneider and Domonoske, 2020).

Until early April 2020, none of the Malaysian oil and gas companies issued a statement on employee layoff. This may be due to the fear of

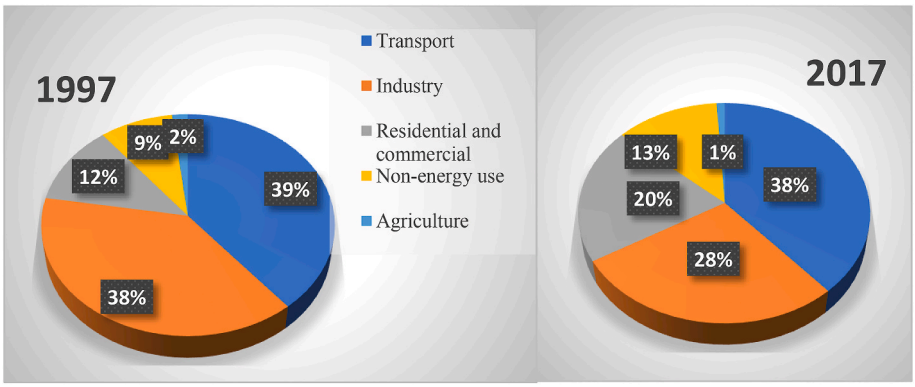

Fig. 2. Malaysia's energy consumption according to sector.
Sources: Energy Commission (2019).

public backlash. Having said that, Aker Solutions, a Norway based company, which has operations in Malaysia had declared a plan on employee sanctions to reduce the company's costs. In their statement, they mentioned about staff reduction, which will involve the company's Malaysia branch in Port Klang. Subsequent to this, Shahril Samsudin, Chief Executive Officer of Sapura Energy Berhad, a multinational oil and gas company in Malaysia, has been reported to introduce fifty steps in cost reductions. These include a 50% salary cut for higher management with immediate effect, and reduction of manpower (Malaysia National News Agency, 2020). Recently, Sapura Energy CEO had announced to lay off 800 of their workforce as one of the cost reducing steps (Aziz, 2020). Another major oil-related multinational company, British Petroleum (BP), cut 15% of its workforce equivalent to 10,000 out of the total staff worldwide (Nasralla and Bousso, 2020). This staff reduction will involve BP staff worldwide including Malaysia, which will take place by the end of 2020. On top of that, BP CEO had reported shifting to renewable energy following the severity of the coronavirus crisis. Based on the current scenario of MCO and lockdowns around the world, the oil and gas sector will only be able to recover once the pandemic is over. Given the projection of the cease in Covid-19 cases is expected to be after six months, or until the end of 2020, this sector will not recover anytime soon. While most countries shut their borders, demand for petroleum products mainly from transportation will remain stagnant.

3.3. Fisheries sector

Malaysia lies on the shallow continental Sunda Shelf, which is a productive area for marine biotic resources that local fishers have harvested for centuries (Forbes, 2014). The shallowness allows the rays of the sun to penetrate the depth of the waters, hence generating the growth of plankton, which is a natural diet for many types of fish (Rusli, 2012). The marine fisheries industry in Malaysia contributes extensively to the national Gross Domestic Product (GDP) as well as to the national economy in terms of income and foreign exchange. This sector generates employment, provides sources of protein for food, while contributing to the Malaysian economy locally and through the export potential (Solaymani and Kari, 2014). A study on fishermen in east coast Malaysia indicated that 70% of their household income came from fishing (Solaymani and Kari, 2014). In addition to that, fishing has been the sole source of income and food for island communities in Malaysia (Islam et al., 2017). The total export value of fish and fishery products in 2017 were RM3.157 billion or $738 million (Department of Fisheries Malaysia, 2017), while the import value was RM4.34 billion or $1.01 billion. The total fish consumption recorded in the same year was 35.4 kg per person per year (Fish Development Authorities Malaysia, 2016). From a global perspective, the fisheries sector is highly driven by international trade. Therefore, the closure of some country borders severely affected the import and export activities (Food and Agriculture Organization of the United Nations, 2020). Furthermore, the lockdown imposed by most countries affected by the pandemic, had reduced the demand for fish products, especially from restaurants, hotels, and other tourism attractions.

Looking at the import and export values of the fisheries sector in Malaysia, this sector is dependent on global trade. Therefore, the control measures imposed by many countries had restricted international trade. In other words, there will be a drop in earnings from fish and fishery products exported to other countries, and disruptions of supply from the imported fish and fish products due to the closure of the borders. For instance, in mid-February 2020, the seafood export from Malaysia to Singapore was already down by 50% (Aruno et al., 2020). From another perspective, local consumers have to shift their consumption from a combination of local fish and imported fish to focusing on local fish. This disruption of export and import activities predominantly affected the income of fishermen from the first until the fourth phase of MCO (refer Table 1). In the first phase of MCO, the income of Malaysian fishermen declined by 50% due to the fear of them being contracted by Covid-19 virus, adding to the low demand by Malaysians who preferred to spend more time at home during this phase (Berita RTM, 2020). It was found that the small scale fishermen were most affected by the pandemic, especially those residing in the island far from access to larger communities (Jomitol et al., 2020). The price of fish sold to the middle person was reported to be 50–70% lower than before the implementation of MCO (Jomitol et al., 2020). Moreover, there are 33% of fisheries' sector workers in Malaysia reported to have lost their job as a result of slow demand of fish and fish-related products (Waiho et al., 2020).

The demand for fish and fish-related products from local consumers may have improved since the announcement of CMCO, which took effect from May 4, 2020. However, the earnings from exported fish and fish-related products will require more time to recover as some of the main exported countries, such as the Republic of Iran and the United States of America are currently battling the pandemic (Worldometers, 2020).

3.4. Maritime tourism

Maritime tourism or also known as marine tourism or coastal tourism, is referring to the activities comprising of sea transportation such as cruising, beach activities, scuba diving, snorkelling, fishing sport, and other recreational activities that occur in the marine environment (Kizielewicz, 2012). In Malaysia, islands are among the most popular maritime tourism spots (Mapjabil et al., 2015). Tourism value earned through Redang Island marine park alone was recorded at RM10.1 million annually. Out of all the tourists that visit Redang Island marine park, more than 40% are foreigners while the rest are local tourists (Marine Park of Malaysia, 2017).

Malaysia hopes to see a soar in the tourism industry in the year 2020

through the Visit Malaysia 2020 campaign, but all hopes have been turned upside down since the pandemic hit China. The chief executive officer of Malaysia Hotel Association estimated more than 60% losses. Wage cut and unpaid leave were executed for companies to survive through this pandemic. However, the same could not be done by a smaller company (Bethke, 2020). In general, 50% of foreign tourists are mainly from Singapore and China. Thus, the pandemic, which initially took place in China, had caused a huge drop in the number of tourists to Malaysia (Foo et al., 2020). Around 170,000 hotel bookings had been cancelled from early January to the middle of March 2020, which caused a total loss of RM68 million (Foo et al., 2020). This figure did not include the amount of losses preceding that period until CMCO was implemented. In regard to this, it is reported that many hotels had ceased operations which led to countless hotel staff being left unemployed. According to the report of The Star Malaysia, a sample size of 56, 299 workers in the hotel industry was taken and found that 2041 staff were laid off while 9773 (17%) were asked to take unpaid leave, and 5054 (9%) got pay cuts due to the pandemic (Karim et al., 2020).

The announcement by the prime minister to reopen local tourism had provided hope to this sector (Prime Minister Office, 2020). Despite the country's border remaining closed due to the pandemic, the surge in domestic tourism showed a positive sign in this sector. In general, domestic tourism can be described as people travelling within the country. According to the Department of Statistics in 2019, a total of 239.1 million domestic tourists were recorded with a growth of 8.1% as compared to the previous year in 2018 (RM221.3 million). There are various domestic tourism campaigns initiated by the Ministry of Tourism as other agencies offer discounts and promotions to attract more local tourists (Ministry of tourism arts and culture Malaysia, 2020; New Straits Times, 2020; The Star, 2020). As such, the recovery plan is essential for the improvement of domestic tourism in the country. The government has taken efforts to boost domestic tourism in Malaysia, such as encouraging Malaysians to travel domestically. The closing of the border had put Malaysia into two scenarios. First, Malaysia might lose profit from foreign tourists, but at the same time, Malaysians had no choice except to spend their vacation in Malaysia. This eventually will improve the economy. Nevertheless, opening the border would not be an option at the moment as many countries are still struggling to contain the pandemic with higher Covid-19 cases reported daily. Looking at this situation, maritime tourism has to rely solely on local tourists to compensate for the drop in foreign tourists.

4. Economic stimulus package

The Malaysian government has introduced economic stimulus packages to ease the burden of individuals and business organisations affected by the Covid-19 pandemic. In general, the stimulus packages serve three main purposes; to protect the *rakyat* (nation), support businesses, and strengthen the economy as summarised in Tables 2–5.

The first aim, protecting the *rakyat,* is designed to reduce the burden of the nation affected by the pandemic through one-off cash aids. Other efforts include providing special monthly allowances to motivate frontliners directly involved in combating the virus, as well as towards various agencies assigned in enforcing MCO. There is also a moratorium offered by banking institutions for six-month periods on specific loans.

The second aim, supporting businesses, listed out stimulus packages for all business sectors (Table 3). Among these initiatives are financing facilities for all SMEs, a moratorium on loan repayment, and other grants to encourage business sustainability. From the listed packages, there are several efforts directly focused on the fisheries sector. These include a RM40million grant to enable fishermen and other agriculture businesses to sell their product directly to the consumer, RM1 billion towards Food Security Fund through various assistance to increase domestic production, and RM100,000–200,000 for development of agro-based products towards farmers' associations and fishermen's associations. These initiatives not only to ensure the survival of fishermen, but also help to achieve food security in Malaysia.

Table 2
Stimulus package towards protecting the *rakyat* (nation).

- One-off cash assistance between RM500 to 1600 with an allocation of RM10 billion based on household earnings.
- One-off cash assistance of RM200 per student with the total support of RM270 million.
- One-off RM500 cash assistance for E-Hailing Drivers
- One-off cash incentive of RM600 in April 2020 for active taxi drivers, tour bus drivers, tour guides and trishaw drivers registered since December 31, 2019.
- One-off cash assistance of RM500 for more than 1.5 million civil servants in Grade 56 and below, including contract workers and 850,000 pensioners.
- Special monthly allowance of RM600 for medical personnel directly involved in curbing and preventing the outbreak.
- Special monthly allowance of RM200 for the military, police, customs, immigration, firefighters, Civil Defence Forces, and The People's Volunteer Corps (RELA), who are directly involved in enforcing the MCO.
- RM25 million towards food assistance, healthcare, and shelters, with a total allocation for vulnerable groups such as senior citizens and children in shelters, the disabled, homeless, and orang asal (aborigines).
- A six-month moratorium from financial institutions.
- mySalam hospitalisation benefit for low income group (B40) patients infected with COVID-19 and patients under investigation (PUI) with income replacement claims of RM50 per day for a maximum of 14 days.
- Private Retirement Scheme (PRS)- pre-retirement withdrawals from Account B of PRS, up to RM1,500 per member are allowed without any tax penalties between April and December 2020.
- RM110 million allocated for the salaries of contract service workers under government contracts during MCO, such as cleaning and supplying food in government agencies.
- Exemptions and Postponement on Housing and Business Premise Rentals owned by the federal government.
- Tiered discount system for households is introduced. The discounts range between 15% and 50% according to electricity usage, with a maximum of 600 kW per month.
- Telecommunication service incentives - free internet services to all customers during the MCO period starting April 1, 2020, involving a value of RM600 million.

Source (Ministry of finance, 2020; Prime Minister Office, 2020).

Apart from the fisheries sector, there are various initiatives concentrated on supporting the tourism sector. These include microcredit facilities with a 4% interest rate with delayed repayment of instalment, and 15% discount rates for electricity bills for the tourism sector. Besides that, a RM500 million government provision for travel discount vouchers, tourism encouragement in Malaysia through matching grants, and tourism promotions. This will boost local tourism after three months of close down. Further, the Malaysia government has also introduced some initiatives aimed at strengthening the economy. Apart from upgrading current facilities, it is expected to provide more work for local companies.

Other than that, there are some tax-related initiatives introduced to benefit individuals and business sectors (Table 5). For instance, individual and business firms are eligible for postponement of income tax payment. Tax deduction on the purchase of PPE will ensure staff safety is taken care of by the employer. To encourage international shipping business participation, companies that established and operate business in Malaysia are granted double tax deduction. If we look closely at the tax initiatives, there is an exemption of individual income tax on local tourism spend to encourage local tourism. Table 6 presents specific economic initiatives for maritime sectors in the study.

Based on the economic situations of four maritime sectors and economic stimulus packages introduced by the government, the economic impacts during and post Covid-19 pandemic are reviewed. Almost all four sectors received negative impacts from the Covid-19 pandemic based on five attributes derived from the literature as summarised in Table 7. However, maritime tourism has suffered greatly during the pandemic (MCO – CMCO period), owing to the total closure of business operations. Shipping, on the other hand, is an essential service undergoing continuous operation during the outbreak despite the slow demand. Thus, the impact on the sector is less in comparison to the other three sectors, except for the case of poor seafarers' crew change management in many countries.

Table 3
Economic stimulus package towards business sector.

- Additional fund of RM4.5 billion to assist Small Medium Enterprises (SMEs), including micro-entrepreneurs.
- RM2 billion Special Relief Facility, to assist the cashflow of affected SMEs.
- Employers are allowed to defer, restructure and reschedule employer contributions to the Employee Provident Fund (EPF) for up to 6 months.
- Moratorium on loans repayment from TEKUN Nasional, Majlis Amanah Rakyat (MARA), as well as other cooperatives and government agencies providing financing facilities
- Social donations in collaboration with Islamic banking institutions and the State Islamic Religious Council will be channelled in the form of initial capital for micro-entrepreneurs using zakat funds and matched with microfinancing at affordable rates.
- RM50 billion guarantee scheme up to 80% of the loan amount for financing working capital requirements.
- Stamp duty exemption of 100% will be given on loan agreements arising from such restructuring and rescheduling of business loans.
- *Bank Simpanan Nasional* offers a RM200 million micro-credit scheme for companies in the tourism sector and other affected sectors at an interest rate of 4% where repayment of instalments begins after 6 months of disbursement of the loan.
- Malaysia Airport Holdings Berhad (MAHB) provides rebates on rental for premises at the airport as well as landing and parking charges.
- The government allocates RM500 million for; travel discount vouchers, tourism encouragement in Malaysia through matching grants, tourism promotion to stimulate the tourism sector.
- Relaxation of existing guidelines by the government on limiting the use of hotels to government events.
- In the event of job losses, the Employment Insurance System (EIS) fund will assist retrenched workers, with the fund amounting to RM1.1 billion.
- Provision of Human Resource Development Fund (HRDF) with a matching grant of RM100 million on a one to one basis. The fund will prioritise training for sectors affected by COVID-19.
- RM50 million to provide a subsidy towards financing short courses, particularly in digital skills. This will benefit 100,000 people.
- RM20 million to fund short courses conducted by the 13 state skills development centres (SSDC). The funding will focus on Technical and Vocational Education and Training (TVET) skills training. This will benefit more than 1600 trainees working with manufacturing companies.
- RM40 million grant towards helping small and medium enterprises involved in agriculture and food productions such as enabling fishermen to sell directly to consumers and other initiatives.
- Revising the limit of procurement to expedite the procurement process and increase business activities by enhancing the current procurement process.
- The government will promote private sector investments in innovation and new growth opportunities, by co-investing up to RM500 million through Government Linked Investment Companies (GLIC) alongside private investors in early and growth stage of Malaysian companies.
- RM1 billion for Food Security Fund through various assistance to farmers and fishermen, including agricultural inputs to increase domestic production.
- RM100 million for the development of infrastructure for food storage, food distribution, and crop integration programmes.
- RM100,000 to RM200,000 for viable farmers' associations and fishermen's associations. This is to develop agrofood projects that are capable of generating income within three to six months.
- Wage Subsidy Programme: to assist employers in retaining their workers where the government provides a monthly salary of RM600 to every employee for three months.
- Electricity Bill Discounts −15% discount on electricity bill for the tourism sector as well as a 2% discount for commercial, industrial, agricultural and household sectors in Peninsular Malaysia beginning April 1, 2020.

Source (Ministry of finance, 2020; Prime Minister Office, 2020).

Table 4
Stimulus package towards strengthening the economy.

- RM2 billion allocated to domestic investment through several small projects such as improving roads, upgrading schools, and upgrading tourism facilities benefiting contractors from G1 to G4 class.
- Implementation of all projects allocated in the 2020 Budget including East Coast Rail Link (ECRL), Mass Rapid Transit Line 2 (MRT2) and the National Fiberisation and Connectivity Plan (NFCP).
- Securities Commission and Bursa Malaysia will waive their listing fees for 12 months, for companies seeking a listing on the Leading Entrepreneur Accelerator Platform (LEAP) or Access, Certainty, Efficiency ACE Market.

Source (Ministry of finance, 2020; Prime Minister Office, 2020).

Table 5
Tax-related initiatives.

- Port operators will be given import duty and sales tax exemption on imported or locally purchased equipment and machinery directly used in port operation from April 1, 2020 to March 31, 2023.
- International shipping companies that established and operate business in Malaysia are given double tax deduction on pre-commencement expenditure for setting up regional offices in Malaysia.
- Exempt payment for HRDF levy across all sectors for six months beginning April 2020.
- Postponement of income tax instalment payments to all SMEs for three months beginning April 1, 2020.
- Tax deduction on equipment provided to employees (PPE only)
- Tax exemption of individual income tax on local tourism expenditure.

Source (Ministry of finance, 2020; Prime Minister Office, 2020).

Table 6
Specific measures to stimulate maritime sectors.

Sectors	Measures
Shipping	• Double tax deduction for international shipping companies for setting up regional offices in Malaysia
Maritime tourism	• 15% discount on electricity bill for the tourism sector • Tax exemption of individual income tax on local tourism spend. • RM500 million for travel discount vouchers, tourism encouragement in Malaysia through matching grants, and tourism promotions • RM200 million microcredit scheme for companies in the tourism sector. • Relaxation of existing guidelines by the Government on limiting the use of hotels to government events
Fisheries	• RM1 billion for Food Security Fund through various assistance to farmers and fishermen • RM100,000 to RM200,000 to viable farmers' associations and fishermen's associations. This is to develop agrofood projects • RM40 million grant towards helping small and medium enterprises involved in agriculture and food production.
Oil and Gas	• No specific incentives to date

For the post-pandemic period (RMCO period onwards), the impact on the sectors that received more government incentives will be lessened, coupled with relaxation of control measures. This includes the reopening of eateries and local tourism attractions. Therefore, fisheries and maritime tourism are particularly expected to recover faster than other sectors. The shipping sector may take time to recover from the slow demand but the RMCO period allows most businesses to operate. This will contribute to the increase in import and export activities, hence improving shipping sector business. Meanwhile, the oil and gas sector may face significant economic impact post-pandemic due to low crude oil prices attributed to the low demand worldwide, as many countries are still grappling with the Covid-19 virus. Some economists predict that the oil and gas sector may experience slow recovery until 2024 (Barbosa et al., 2020). The decision of some major oil companies to transition towards renewable energy, combined with the pressure for greener energy may exacerbate the future of the oil and gas sector.

5. Potential strategies for a way forward

Although the control measure is needed to delay the contraction of the virus within the Malaysian community, the impact on the Malaysian economy shall not be undermined. Undeniably, the Covid-19 outbreak has been causing a huge impact on maritime communities in terms of business operation, financial, social impact (relating to employability) as well as global business. Despite negatively affecting the economy and the nation's wellbeing, the pandemic forces the industry to not only accelerate their capability in responding to disruptions, but also to devise better long-term strategies in dealing with uncertainties and adopt more sustainable operation.

For instance, the capability of shipping services to continue

Table 7
The impact of Covid-19 pandemic on maritime sectors.

Sectors	Product/service demand	Social impact	Financial impact	Business operation	Global business
Shipping	Exports: ↓ 25.5%, Imports: ↓ 30%,	300,000 seafarers trapped at sea globally.	15–60 million losses	Business as usual with strict SOP	Container ship: ↓13.77% Passenger ship: ↓42.77%
Maritime tourism	Not allowed during MCO - CMCO	Laid off: 2041 (3.6%), unpaid leave: 9773 (17%), pay cut: 5054 (9%).	60% losses	Total closure during MCO -CMCO	No international tourist due to closing of border
Fisheries	Low local and global demand	Fishermen income: ↓50% Job losses: 33%	Price of fish: ↓50–70%	Business as usual with strict SOP	Seafood imported to Singapore: ↓50%
Oil and gas	Local demand: ↓ 30%	Sapura Energy: 50% salary cut off for higher management, 800 staff lay off (20%)	No data	Business as usual with strict SOP	Oil prices: ↓ 30% BP: Cut off 15% staff worldwide (10,000)

providing undisputed transportation of foods and medical supplies is critical. Hence, the shipping sectors will need to become agile and resilient in adapting to this changing situation. They need to focus on erecting effective response strategies and execution plans so that they can recover quickly during disruptions and resume stronger than before. On the other hand, we can assume that the Covid-19 pandemic will be a tipping point for the application of remote technologies and automation in shipping. Autonomous port for instance, may be able to manage the crew change with limited contact, which reduces the possibility of virus contraction. The pandemic could be a significant driver in the adaption of new technologies, collaborative solutions and greater utilisation of space and resources (Schwerdtfeger, 2020). The innovation in the shipping system seems to be more sustainable, safe, efficient and reliable in minimizing pollution and maximizing energy efficiency.

For the oil and gas industry, Malaysia has to look into the option of energy transition which has been taken by major oil and gas players. The transition may not occur within a short period of time, thus requires early investment and technical knowledge to materialise it. This is very important as the oil and gas sector has long been a major economic contributor to Malaysia. The strategy for energy transition shall consider the large number of employees, which is currently around 40,000 involved in the sector. An effective capital management will enable smooth energy transition.

For fisheries sector, diversify the supply chain strategy including selling fish and seafood products through online platforms. This may help the sector to sustain through this period. Existing online platforms, such as Myfishman, provide commendable support to local fishermen (Harper, 2020). This platform recorded more demand during the pandemic as movement is limited. Having said that, the usage of online platform in the fisheries sector is still progressing as it currently supports the fishermen in the West Coast of Peninsular Malaysia. A comprehensive and wider coverage of online fisheries platforms is required to make this sector more sustainable. Other than that, a better post-harvest technology needs to be equipped to maintain the freshness of produce, should there be some delay in transportations for both local and global market.

Malaysia is now developing measures to build a more resilient tourism economy by preparing plans to support the sustainable recovery of tourism post Covid-19. The tourism sector suffered the most during the Covid-19 outbreak and requires a carefully planned strategy to mitigate it. Therefore, government support must be coordinated to ensure capacity building and productivity of the tourism key player. A lot of initiatives should be conducted by tourism players to encourage domestic tourism as this will be the only safest possible solution until the pandemic is ceased. Reshaping the industry towards a sustainable and innovative ecosystem will definitely benefit the tourism sector as well as local economies.

6. Conclusion

This study provides an overview of the Covid-19 scenario in Malaysia. Furthermore, this study examines the impact of the Covid-19 pandemic on four maritime sectors based on the review from January until end July 2020. Additionally, a post-pandemic situation was presented, which considered the current situation and the various economic stimulus packages introduced by the Malaysian government. Services sectors such as maritime tourism is the most affected, owing to the fact that it is considered a non-essential service, hence experiences total close down during the MCO until CMCO period. However, economic initiatives and domestic tourism may mediate the post-pandemic impacts. Based on the four sectors involved, shipping is considered less affected in comparison to other sectors, considering the high demands of PPE products and test kits during the pandemic. The oil and gas sector on the other hand, received no sector-specific incentives despite being the major economic contributor. Overall, the stimulus packages are expected to assist all the business sectors to sustain through this economic downturn. Apart from the government incentives, drastic changes are required in overall operation efficiencies for each sector to better respond to unprecedented situations. Malaysia's ability to contain the spread of the Covid-19 virus, through the introduction of the RMCO measure, provides an extra advantage to regain economic strength following the economic downturn during the MCO and CMCO period.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Article

The Sustainability of Cruise Tourism Onshore: The Impact of Crowding on Visitors' Satisfaction

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Abstract: The sustainability of cruise tourism has been questioned in relation to its negative effects on ports of call, among which crowding has recently become more pronounced. However, an understanding of how crowdedness influences cruise tourists' experience onshore is lacking. The study analyzed online reviews on onshore experiences in the main European ports of call through Leximancer, an automated text analytics software. The results revealed that the perceived destination crowding was not always negatively evaluated by tourists, but was also discussed as a factor adding up to the authenticity of the visit under certain circumstances. Nevertheless, the evidence indicates that only human crowding might be positively assessed, while the spatial crowdedness was always reported as detracting from the enjoyment of the visit. The analysis also showed that the crowding phenomenon was represented differently in the accounts of the low, average and high satisfaction cruise tourists' groups. The role of the guide, as well as the attractiveness of the sightseeing were identified as factors that can ameliorate the negative effect of crowding on the destination visit. The findings yield relevant implications for all actors involved in the cruise tourism activity, which should manage destination crowdedness in a more sustainably innovative way.

Keywords: sustainability; crowding; cruise tourism; Leximancer; satisfaction; innovation; port of call; eWOM

1. Introduction

The tourism sector plays a major role in the global economy, contributing to 10.4% of the Gross World Product and representing 1 out of every 10 jobs in 2017 [1]. One particular type of tourism that has witnessed a significant growth worldwide in the last decade, compared to other tourism products, is cruise tourism [2]. The surge in cruise tourism demand is especially pronounced in Europe, where the number of people purchasing a cruise holiday has increased from 4.05 million in 2007 to 6.96 million in 2017 [3].

This rapid growth should be grounded in the principles of sustainability, which implies that suppliers should not only be concerned about economic profits, but also embrace their social and environmental responsibilities [4]. A high number of cruise arrivals at ports of call may result in destination crowding [5]. Exploring how visitors perceive the crowds of tourists is essential, as it can deteriorate the quality of the destination experience, and negatively affect their post-visit behavior (i.e., recommend and revisit the port of call).

Although crowding has become a significant issue for the tourism industry [6,7], to date, there are few studies that have examined its effect on tourist experience [6–12], and no single study that has analyzed cruise tourists' perception of crowding at port of call destinations. Furthermore, previous crowding studies have mainly adopted quantitative methods, while qualitative approaches have been underutilized.

In view of the above, the purpose of this study is to explore cruise tourists' perceived crowding at the main European ports of call, and to examine its impact on destination visit satisfaction through the analysis of online reviews. This study therefore fills a major gap in the tourism literature on overcrowding by exploring the role of crowding perception in both, positively and negatively evaluated cruise destination experiences.

The remaining part of the paper is structured in four parts. It starts with sustainable destination tourism models, followed by examining the concept of tourism crowding. The forth section is concerned with the methodology of the study, addressing the advantages and weaknesses of using Leximancer. The fifth section analyses the results of the study, while the sixth provides the research conclusions. Finally, the last sections address the discussion of the results, the practical implications of the study, as well as the research limitations and the future research lines.

2. Sustainable Tourism

Achieving a sustainable tourism model has become a major challenge for travel destinations in Europe in recent years [13,14]. The steadily growing economic impact of tourism, together with the international debate on sustainable development, which pursues to make the economic interests of the sector compatible with the environmental and social constraints of the destination area, leads to a pressing need for a thorough reflection on tourism sustainability [11].

Numerous definitions of sustainable tourism have been proposed throughout the last decades, but most of them reflect the importance of a harmonious interaction between tourists and local communities [15]. Sustainable tourism can be defined as the development of tourism activities with a balance between the environmental, economic, and socio-cultural aspects, so as to ensure its long-term sustainability, according to the United Nations Environment Programme (UNEP) and World Tourism Organization (WTO) [16]. Sustainable tourism implies meeting the needs of the present tourists and destinations while providing opportunities for further development, preserving the world heritage, ecological integrity, biological diversity, and life-support system. The principles of sustainability can be applied to all types of tourism including mass-market tourism and the diverse niche or tourism products.

Sustainable tourism activities mainly include the environmental, economic, social and cultural aspects of development. A balance among these four pillars should be maintained to ensure the sustainability of the tourism sector in the short and long run [17]. To achieve sustainability, the negative effects of tourism activities on the environment, society and economy should be reduced.

The numerous interpretations of the notion of sustainable tourism hint at the differing approaches used by researchers, policy-makers and other stakeholders [18]. In this regard, researchers assert that different understandings of sustainable tourism are suited for different circumstances [15,19]. Hence, sustainable tourism should not be understood as a rigid framework, but as an 'adaptive paradigm which legitimizes a variety of approaches according to specific circumstances' [19].

Reducing the negative tourism effects by boosting the tourism benefits into the right direction is the greatest challenge of sustainable tourism [17,20]. For instance, a profitable and ecologically sustainable industry can provide satisfying experiences for visitors, as well as improve residents' life quality [21].

There is, nevertheless, some ambiguity. Past research maintains that mass tourism is the opposite of sustainability [15,22,23]. "When sustainable tourism has been applied to the industry, more emphasis has been given to tourism's effects upon the environment and economy, rather than to factors related to its effect on communities" [24].

The seasonality associated with tourism activity presents a number of negative impacts that could affect the sustainability of destinations, which go beyond the economic costs, but encompass social and environmental aspects [14]. High visitor concentrations at certain times of the year imply that some destinations suffer stronger impacts [25]. Martín et al. [26] classified them as follows: Environmental (natural resources overuse and massive waste generation), socio-cultural (loss of

residents' quality of life and tourist dissatisfaction) and economic (unstable employment, decreased competitiveness, and profitability difficulties in the long run). One of the strategies employed to reduce these impacts is to spread the flow of tourists more evenly across the year, so as to obtain a more balanced demand distribution. Hence, tourism crowding management is essential in terms of controlling and redistributing the number of tourists, aiming at ameliorating perceived crowding. Controlling for perceived crowding is crucial not only for a sustainable destination development, but also for achieving tourist satisfaction [27].

3. Tourism Crowding

Early studies define a situation as crowded when the presence of others results in interference with one's comfort [28]. Crowding produces stimulus overload, occurring when there is inappropriate or unpleasant contact with other individuals [29]. Furthermore, crowding can be viewed as a situation in which the presence of other people restricts individual's range of choices or hinders one's ability to pursue goals and perform certain activities [30,31]. In this sense, crowding is associated with the notion of carrying capacity [32]. If an overload of the carrying capacity is the starting point of an unsustainable destination model, crowding clearly has a negative effect on it. Crowdedness, therefore, implies exceeding the maximum number of people that can visit a destination simultaneously, leading to externalities in the physical, economic, and socio-cultural environment and diminishing visitors' satisfaction [11,33]. Crowding, thus, refers to a certain level of destination saturation [33].

In the tourism domain, the perception of crowdedness has been analyzed in urban areas [7,8,11,34,35]; festivals [9], tourist attractions [36,37], cruise ships [38] and outdoor settings such as natural parks [6, 10,39–42], or mountains [12]. The existing research shows mixed results on the effect of crowding on behavioral outcomes.

A review of the literature reveals that tourists' perception of crowding depends on a wide range of factors: (i) Personal characteristics (e.g., motivations, expectations, previous experience, nationality, length of stay) [6,11,33,37,43,44]; economic factors (income and expenditure) [11,33,37]; the characteristics of other tourists encountered (i.e., behavior, interaction with others and similarity) [11,44–46]; as well as the situational variables of the environment (i.e., quality of the facilities, number of tourists, destination design, availability of resources and places of contact) [11,33,37,46–48].

In regards to crowding consequences, past research suggests that crowding perception affects the quality of the experience, as well as tourists' affective response and satisfaction [6,9,11,12,49,50]. Research investigating the relationship between crowding perception and satisfaction has yielded mixed findings. There are studies demonstrating a significant negative effect of crowding on tourist satisfaction [12,51]. Some researchers, though, report a weak [52,53], or even a non-significant correlation between the two variables [6]. Interestingly, evidence for the positive association between crowding and tourist satisfaction has also been found, [8,54], particularly when visitors look for hedonic experiences [54], when the level of crowding does not exceed the expectations or when the perception of crowdedness is relatively low [8,55]. In this regard, it can be concluded that a crowding perception is not always negative, but can even contribute to tourist's experience and satisfaction [7,9,11,56].

Crowding in tourism studies has usually been measured with a single question [11,57]. However, this approach fails to reflect the cognitive and physiological states inherent to crowding perception [6]. Crowding is posited as a multidimensional construct, comprising two dimensions: Human (i.e., full of people) and spatial (i.e., restricted movement) [9,58]. Both types of crowding may influence customers' behaviors either positively or negatively [7,58] Recently, Li et al. [6] proposed three dimensions to assess crowding: Neutral, personal and social, reflecting not only the perception of a physical constraint, but also the conflict of interests with other tourists at the destination, and internal conflicts among tourists resulting from that interaction. There are several theoretical approaches that can guide the interpretation of the online reviews describing the "good crowding" effect: The Manning theory, the social motivation theory, the social identity theory and the flow theory. Several theoretical perspectives

guide the study of the negative side of crowding: Social interference, stimulus overload and traffic flow theory [9,10].

To the best of the authors' knowledge, there is currently only one study that uses a qualitative approach to inquire crowding [7], while exploratory research is much needed to expand on its relation to destination sustainability.

In recent years, the concept of crowding has frequently been associated with cruise tourism [59,60]. While cruise ship arrivals bring economic benefits to the destinations, the negative impacts of this economic activity, such as congestion and overcrowding of ports of call, the sea contamination and the excessive use of resources should also be considered [61,62]. Previous studies indicate that, in general, the aforementioned factors affect residents' quality of life, as well as tourist satisfaction [61] and even deteriorate their destination experience and the sustainability of the tourism model [63]. Research to date has not yet explored the perception of crowding of cruise tourists and how it influences their satisfaction with the port of call experience.

4. Methodology

4.1. Information Source and Data Collection

To explore cruise tourists' perception of crowding, the study analyzed online reviews on European ports of call published on the leading cruise website cruisecritic.com. Data from cruisecritic.com have previously been used to assess various cruise-related topics such as passengers' cruise ship satisfaction and evaluation of shore excursions [64–66]. Leveraging available online information for advancing cruise tourism research has been suggested as a research line by Papathanassis [67].

Reviews on shore experiences in the key European ports of call (in terms of cruise passengers) were collected by means of a web crawler in December 2018. According to CLIA Europe [3], the following ten ports of call received the largest number of cruise tourists in the period 2013–2017: Marseille (France), Tenerife (Spain), Naples (Italy), Valletta (Malta), Dubrovnik (Croatia), Mykonos (Greece), Istanbul (Turkey), Côte d'Azur, Corfu (Greece) and Santorini (Greece). Overall, 2202 reviews were collected of which the opinions on the shore experience in Naples, Santorini, Marseille and Dubrovnik were most numerous.

Together with the text body of the review, the satisfaction rating of the experience and the date of the visit, information on author's review experience (number or published reviews) and cruise ship brand was also gathered. Unfortunately, data on reviewers' gender, origin or age was not available and therefore, the sociodemographic profile of the reviewers could not be established.

4.2. Data Analysis

The automated text-mining software Leximancer was used to analyze the content of the reviews. Leximancer is a "relatively new method for transforming lexical co-occurrence information from natural language into semantic patterns in an unsupervised manner" [68]. The software is based on semantic and relational algorithms, which first "learn" categories of concepts from the text corpus, code the text segments accordingly and finally, analyze the relationships among the concepts.

The obtained results are presented by means of colorful maps depicting underlying themes (groups of concepts), concept frequency and connectedness. Each theme is represented by a circle containing several interrelated concepts, and the relative importance of each theme is indicated by its size and brightness (i.e., the bigger and brighter the circle, the more important the identified theme). The distance between themes and concepts on the map depicts the degree of relatedness among them, with closely situated concepts co-occurring more frequently in the corpus. Apart from the initial exploratory map generated by Leximancer, the data can be profiled per categories of interest (e.g., gender, year of posting, ratings of satisfaction).

When compared to other qualitative research instruments such as NVivo and Atlas.TI, Leximancer offers a number of advantages [69]. First of all, unlike other qualitative tools, this software does not require any previously established code categories. Due to the automated concept extraction in Leximancer, a quicker identification of concepts is possible, which results in time saving. Furthermore, reaching intercoder agreement is not an issue with Leximancer, as the software uses its own algorithm based on lexical co-ocurrence to conduct the content analysis. Also, because minimum researcher intervention is needed in mining the text corpus, the researcher bias is reduced, and the results are mode reliable. Whilst Leximancer offers the above mentioned advantages, it also has some limitations. For example, the software is not able to identify the style or tone of voice of the textual statements. Another weakness of Leximancer is that, even though the software performs automatic content analysis, the researchers still need to read the text passages to make sense of the words that the algorithm has determined as concepts or themes to understand their meaning in a context.

Leximancer has been used to assess corporate sustainability [70], analyze the concept of entrepreneurial ecosystem [71] and explore the sustainable supply chain management trends [72], among others.

The performed data analysis includes two stages: (i) A general overview of the themes underlying cruise tourists' onshore experience narratives describing crowding and (ii) an analysis of different satisfaction rating groups' perceptions of crowding. Firstly, out of the collected 2202 reviews from cruisecritic.com, only those comments containing the word "crowd" or its derivatives (e.g., crowds, crowded, crowding) were used as data input for the automated thematic content analysis performed by Leximancer. Visualizing the most frequent concepts and topics contained in cruisers' narratives about their destination visit helps understand the context and the significance of the crowding perception in the general experience. It should be noted that although the software automatically defines a list of concepts not all of them provide meaningful information, and the researcher has to review them carefully [73].

Initially, Leximancer identified 45 concepts, but we had to remove some of them, as they were either name-like concepts (i.e., destination or sightseeing attractions names such as Santorini and Pompeii) or were too generic verbs and adverbs (e.g., take, down) and thus were not providing any insight on the analyzed information. The final concept list was composed of 34 concepts. In a second stage, reviews' satisfaction scores were chosen as mapping concepts, which produced a new view of the map with satisfaction categories correlated with certain concepts and themes.

5. Results

5.1. Representation of Crowding in the Overall Cruise Tourists' Onshore Experience

Once the concept list was adjusted, a map showing the most relevant themes and concepts representing cruise tourists' overall experience onshore was produced (see Figure 1).

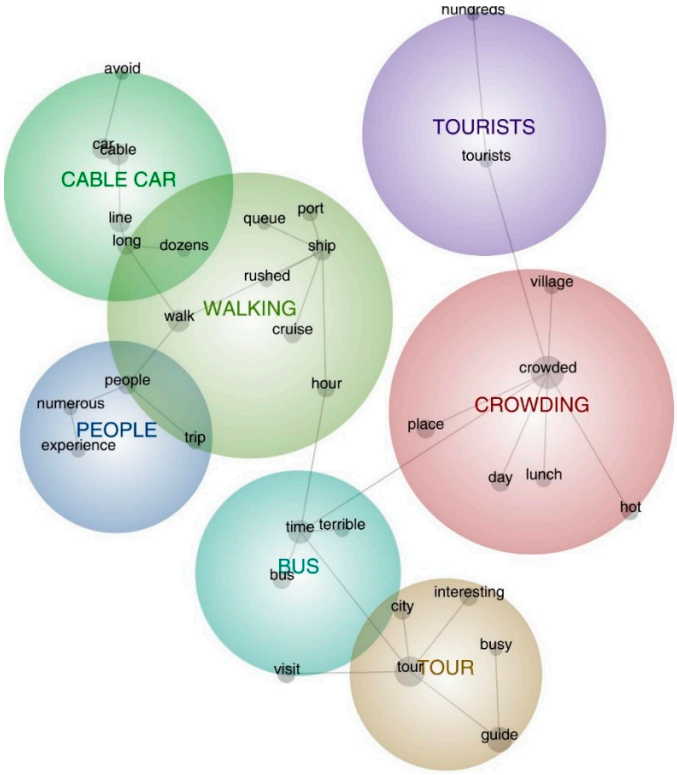

Figure 1. Overall concept map representing cruise tourists' onshore experience.

The map includes 34 concepts, clustered in seven themes: "crowding", "tour", "walking", "bus", "cable car", "people" and "tourists". The most relevant theme is "crowding", encompassing concepts such as "place", "village" and "hot". The concepts in this theme mainly refer to the physical spaces where crowding was mostly perceived. Some of the comments representing this theme include the following:

"10,000 people on Santorini (4 ships). Uncomfortably crowded."

"You need to get to Oia village early as it has tiny streets and gets very crowded with tourists."

"We took the 8:30 am shuttle, as we wanted to walk the walls before it got crowded and hot and it worked out well."

"The village of Oia is beautiful, but very crowded and overly commercialized."

"Tour" emerged as the second most mentioned theme in cruise tourists' narratives about their onshore stay. This theme is associated with the concepts of "guide", "city" and "interesting", and is highly connected with the "bus" theme, as most cruise passengers visit ports of call on bus tours. "Bus", in turn, includes the adjective "terrible", indicating the satisfaction with the transport service, and the concept of "time", denoting the excessive amount of time spent inside the bus instead of sightseeing.

Below are some typical comments illustrating the above concepts and themes:

"I wished that we could have spent more time with our wonderful and interesting guide, Italio, at Pompeii."

"Tour guide was great, very very crowded on a bank holiday."

"It was nice to see the ruins, but the trip back was difficult because they were not prepared for the trip back and we got into a bus full of people, it was terrible."

"Visited Oia and Santo winery, could have spent a bit more time in Oia, the winery visit was very crowded with lots of buses there at the same time."

"I found that this excursion spent much time bussing us to different levels of the island."

Another theme refers to "walking", and represents the third most relevant topic identified in cruise tourists' narratives about their onshore experience. The theme includes concepts such as "port", "ship" and "queue" and reveals that walking distances and difficulties in moving around the port of call are important aspects for cruise passengers.

The following review excerpts express the aforementioned ideas:

"Hard to walk around with so many people on the narrow streets."

"We had to queue for the cable car for an hour but it was worth it as the walk down was very difficult and slippery."

"To get back to the ship we recommend walking the donkey trail in Fira to the harbour—it is 20 minutes."

Further themes emerging from the narratives are "cable car" and "people". Regarding the topic of "cable car", reviewers most frequently mentioned the concepts "line" and "long" and "dozens". The "people" theme is associated with "numerous", "experience" and "trip".

Some typical comments include the following:

"To get back to the ship we recommend walking the donkey trail in Fira to the harbor—it is 20 minutes (smelly) but worth avoiding the queues for the cable car which can take up to an hour."

"The place is beautiful but very crowded. And the line ups for the cable car were crazy."

"The city is lovely, but there were so many people it was hard to walk."

The last dominant theme is about other "tourists", which have been frequently defined as "hundreds". A representative comment of this theme is the one above:

"It was impossible to walk around with all the tour buses unloading hundreds of tourists."

The results reveal that, at an overall level, cruise tourists experiment the sensation of crowding strolling at the port of call, during the bus transfers and at the attraction sites. The queues and waiting time add up to the negative experience onshore, as tourists perceive it as a wasted time. However, those tourists who had a guided tour seem to be more satisfied with their onshore visit, thanks to guides' efforts to avoid the congested sites and routes.

5.2. Representation of the Crowding Perception by Different Satisfaction Groups

This section provides an account of how the perception of crowding was represented in reviews from different satisfaction groups. Satisfaction levels (ratings 1 to 5) were used as mapping concepts, which resulted in five themes: "crowded", "tour", "cable car", "cruise" and "trip" (see Figure 2).

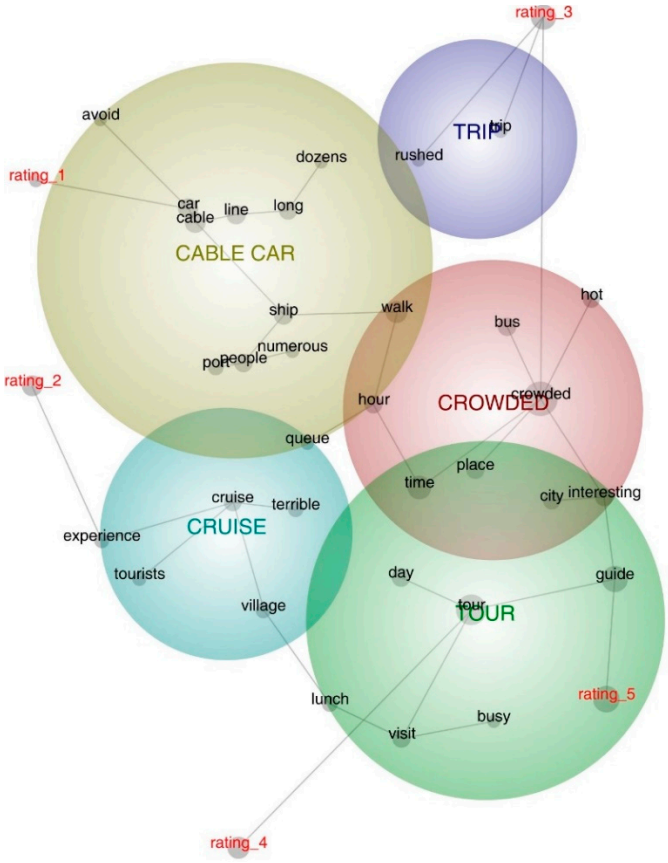

Figure 2. Representations of the onshore experience: different satisfaction groups.

Figure 2 indicates that the five satisfaction groups viewed the crowding experience differently during their onshore stay. This is inferred by the fact that some concepts and themes are more closely associated with particular rating groups, suggesting that the content of the narratives differed significantly.

The narratives of the reviewers that rated their port of call experience the highest (i.e., 5 points) are linked with the concepts "guide", "interesting" and "city", while the sense of crowding was not always reported as a negative one. Typical reviews include:

> *"Our tour guide (looked just like Jeremy Renner) was exceptional! He was able to show us the most interesting parts of the city in just 3 hours [. . .] No one spoke English, it was very retro, the soccer games were on, the crowd was lively and what a great day in Dubrovnik!"*

> *"'Private Custom Tour Santorini.' Dimitris our private tour guide and driver exceeded our expectations! Dimitris took us to some wonderful places that bus tours simply can't navigate."*

> *"Fabulous guide made all the difference in bringing the ruins to life and knowing the tricks of avoiding the crowds."*

> *"This included guided walking tour was again very interesting. We mixed and mingled with the crowds of Italian speaking people while being guided very well by our English speaking tour guide."*

> *"Not enough time to explore this beautiful place. Our excellent tour guide got us into palace before all the crowds."*

> *"Only had a short time there but thanks to an excellent guide saw a lot (and away from the crowds too)."*

"Tour" is the concept most frequently discussed by those tourists who evaluated their shore experience with 4 out of 5 points (i.e., very good). Other concepts related to a 4-rating experience include "lunch", places to "visit" and "busy". Some reviewers declared that they would have rated their onshore visit with 5 points if it had not been for the overcrowding.

Below are some comments pertaining to this satisfaction group:

"Naples itself is a big busy city, so not sure I would've wanted to spend much time there. We did an NCL small-group tour to the Amalfi coast where we visited Positano, then Sorrento for lunch, then a guided tour of Pompeii. It was a great tour—but I'm giving it 4 stars instead of 5 because of the traffic on the Amalfi coast and the unfortunate overcrowding in Positano and Sorrento."

"Great place to visit and great tour, but lots and lots of tourists! Wish I knew the answer to these overcrowded tourist hotspots."

"We were able to spend enough time at the Blue Mosque and Topkapi palace, although its museums were more crowded than any I have ever seen. We had time for lunch and an hour in the Grand Bazaar on our own. It was enough. I would have been totally lost if I had tried to go on my own so I am satisfied with the excursion."

The reviews of those cruise tourists who reported that their onshore experience was of "average" quality (i.e., 3 rating points), were most frequently associated with the concepts of "crowded", "rushed" and "trip". In this case, the perception of crowding had a relevant negative impact on the visit, even though reviewers admitted that it was an "interesting trip". The following comments show the aforementioned ideas:

"The tour itself felt a bit rushed—I'd have preferred a transfer only rather than the guided tour as there was a lot to see, but shuffling along in a group in the crowds made for slow progress."

"It was very crowded and we couldn't always see what the guide was trying to show us."

"An otherwise interesting trip to a reasonably interesting place (with decent history) somewhat overshadowed by the large delay getting out thanks to dozens of coaches crowding a road barely wide enough for one."

The group of reviewers who rated their onshore experience with only two rating stars, thus indicating a relatively poor level of satisfaction, complained about the "terrible" "experience" they had due to the large amount of "tourists". Some typical comments include the following:

"But this experience on a day with 4 ships in port was anything but magical due to massive crowding and the awful options to get back to port."

"The crowds in Ola were terrible and things got dangerous in narrow streets we had to pass through."

"We went to Oia Village, so crowded and hot. It was impossible to walk around with all the tour buses unloading hundreds of tourists."

Lastly, the comments of those cruise tourists who were least satisfied with the onshore experience (rating = 1) were strongly linked with the "cable car" theme. The "long" "lines", the "numerous" "people" and the large distances they had to "walk" from the cruise "ship" until the places of interest were mentioned as the main causes of dissatisfaction.

Below are some review excerpts that illustrate the negative contribution of crowding on the onshore experience:

"1 hour in Amalfi, where we were constantly in fear of being run down by autos whizzing through narrow, overcrowded streets. Highly disappointing."

"Extremely crowded, cruise description was not even close to what was described. Spent over half the allotted time on a bus or in line to get onto the cable cars to get back to the ship."

"Very long wait for the cable car!!! Very disappointing."

In summary, while crowding was perceived by all satisfaction groups, its impact on the onshore experience differed significantly. The findings can be interpreted in the following way: The negative effect of crowding was ameliorated by the tour guide, the attractive sightseeing and the gastronomy of the places visited. In contrast, the spatial crowding and the lack of the aforementioned elements in the onshore visit are suggested as the reasons underlying the low levels of satisfaction.

6. Conclusions

The aim of the study was to assess how cruise tourists perceive and describe the crowding phenomenon as part of their onshore experience. The research confirms the widely acknowledged tourists' negative reactions towards crowding at attraction sites. Nevertheless, evidence of good crowding perception was also found. The analysis identified that the different satisfaction groups showed a varying degree of sensitivity toward crowding. The results reveal that those tourists, who rated their onshore experience as very good, reported perceptions of human crowding. While the encountered tourist congestion was also emphasized by the lower satisfaction groups, the highly satisfied cruise tourists showed crowding tolerance and even described it as "good crowding" [7]. This was especially the case when the interaction with the crowd adds to the experience (e.g., immersion in a crowd of locals speaking a different language added to the authenticity of the travel experience, rather than ruin it).

Another interesting finding related to the crowding perception reported by the highly satisfied cruise tourists is the role of the tour guide in mitigating the negative congestion effects by providing space orientation to avoid the crowds. It should also be noted that the guide's contribution to the positive evaluation of the onshore experience was also due to his/her knowledge about the destination, which was also frequently reported by the reviewers. Thus, it might be inferred that informative tour guides with good storytelling and planning skills can compensate, to a certain extent, for the negative effect of the sensation of crowding on the overall tourist experience.

The guided tour was also the most relevant concept representing the narratives of the reviewers who rated their onshore experience with 4 points. While this group of tourists reported having perceived human crowding, aspects of the visit such as the lunch they had, and the interesting attraction sites (e.g., cathedrals, heritage sites, etc.) helped to offset the negative crowding impressions. However, some tourists pertaining to this group admitted that the crowding has detracted from their onshore experience, which they would have otherwise rated as excellent.

The tourists who reported an average onshore experience were more sensitive to the crowding, which had "ruined" the interesting visit to the ports of call. In this case, the reviewers described both, human and spatial crowding, i.e., not only congestion of people was encountered, but also difficulties in moving freely at the destination. This group of visitors acknowledged the tourist appeal of the visited ports of call, but this was, apparently, not enough to remedy the inconveniences caused by crowdedness.

As for the impressions shared by the unsatisfied group of tourists, they were almost exclusively focused on the crowding issue, pointing out that the encountered crowdedness (both human and spatial) has superseded the attractive sightseeing as the core of the onshore visit.

7. Discussion

Overall, the findings suggest that cruise tourists perceive human and spatial crowding, which might not only be negative in nature, but also positive, in terms of augmenting the authenticity of the travel experience. While the evidence shows that the perception of crowding in general diminishes tourist satisfaction (and thus is in line with past research (e.g., [6]), differences have been observed in

the specific impact of human and spatial crowdedness. Unlike spatial crowding, which has only been reported as an impediment for enjoying the visit, human crowdedness has sometimes been considered as "good crowding", adding up to the local experience. Thus, an interesting finding emerging from this research is that crowding can have not only negative, but also positive consequences on tourist experience and satisfaction [7,9,11,34,56].

Another noteworthy finding is the role of the guide in attenuating the negative impact of crowding on the port of call visit by avoiding the crowds of tourists in space and time. This result is in line with existing studies emphasizing that a reasonable level of crowding makes the perception of congestion and lack of space more bearable [8].

Several online reviews described the "good crowding" effect, which can be interpreted in the light of different theoretical perspectives. For some of the cruise tourists, being part of the crowd has contributed to a greater enjoyment of the visit, as the multitude of tourists is indicative of the importance and attractiveness of the port of call destination (the Manning theory). In the case of those cruise tourists who have chosen a guided tour as the visit format, being part of a group of tourists who share the same interests, has contributed to a greater extent of socialization, and a more satisfying experience (social motivation and social identity theory). Furthermore, some tourists declared being so engaged in the visit and delighted by the tour, that the crowd around them has gone almost unnoticed (flow theory).

Similarly, the evidence of the negative side of crowding can also be explained through existing theories. For example, some tourists described the crowding as a circumstance that was impossible to manage and prevented them from satisfying their sightseeing needs (social interference theory). Others reported excessive undesired social interactions (stimulus overload theory), which restricted their mobility (spatial crowding) and made the traffic flow uncontrollable (traffic flow theory) [9].

8. Practical Implications

The findings yield important practical implications for all the organizations involved in the management of cruise tourists' flows (i.e., DMOs, cruise ship companies, guided tour businesses, etc.). It is strongly recommended to create strategies to more efficiently manage the traffic of tourists in a way that reduces spatial crowdedness, which will, in turn, increase the satisfaction with the visit. However, while local tourism authorities should be responsible for distributing tourists' flows in the destination, the cruise industry can also contribute to reduce the crowdedness in ports of call by considering the cruise traffic when planning the itineraries, and not the fuel cost mainly [74].

The positive effects of crowding should also be leveraged by informing those tourists, who seek to immerse into the local ambience, about the places where residents usually gather. DMOs are also advised to encourage the purchase of guided tours, as the results of the study emphasize their mitigating effect on tourists' crowding perception. One way to achieve this is through more affordable prices of cruise excursions and local company's guided tours.

In summary, all organizations involved in cruise tourism management have to adopt sustainable innovation practices in order to avoid the negative consequences of human and spatial crowding. In reaching this purpose, coordination among the different actors involved in cruise tourism is essential to secure the sustainability of this economic activity.

9. Limitations and Future Research

Finally, some research limitations have to be acknowledged. The study has analyzed crowding perceptions in the main European cruise ports of call, which makes these findings less generalizable to the rest of cruise regions. Hence, future studies could compare crowding perceptions across various cruise regions (e.g., the Caribbean, Asia-Pacific). Also, the study is limited by the analysis of reviews written in English, authored by predominantly English-speaking cruise tourists such as US and UK citizens. A further study could collect reviews written in other languages and check if the results still hold. Assessing the cross-cultural crowding perceptions could provide interesting findings. A

third limitation lies in the use of one single source of data- cruisecritic.com. While this is the most relevant online platform for cruise-related information, other sources such as Tripadvisor or cruise blogs can be used to extend the validity of the results by increasing the sample size. Although the current study is based on a relatively limited sample of cruise tourists, the findings suggest the key role of tour guides in tackling tourists' negative crowding impressions. In this regard, further research is required in order to determine the mechanism through which guides cope with crowding, and thus are able to significantly enhance visitors' experience onshore. A natural progression of this piece of work is to include the perception of crowding in tourist behavior structural models, and thus assess its relationship with antecedent and outcome constructs.

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