Chapter 1

Setting the scene on maritime transport and regional sustainability

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1 Introduction

This book addresses the contemporary development and connections between maritime transport and regional sustainability, including its geography, planning, economics, management, policy and regulations, governance, and organizational behaviors. It introduces how the maritime sector tackles challenges posed by climate change so as to achieve regional sustainability in selected areas around the world, including the Arctic. Through undertaking deep analysis on different types of transport from diversified angles and perspectives, including case studies from both the developed world and the emerging economies, it enables readers to understand the major issues and challenges that planners, policymakers, managers, and researchers face, and enables them to develop the ability of applying theoretical knowledge into practice. Hence, the first major audience includes all researchers and postgraduate (both research and professional) students. It will inspire them to generate original, innovative ideas for further research in sustainable transport and regional systems. The second audience consists of senior policymakers and industrial practitioners. It will equip them with comprehensive knowledge and understanding regarding contemporary developments in maritime transport in the context of regional sustainability.

A key feature of this book is that it closely knits maritime transport with its regional surroundings. Although many previous works address the importance of sustainability in (maritime) transport, they mainly focus on how maritime transport, as an "operational system," can achieve well-defined sustainability (e.g., carbon emission targets). Few works directly address how maritime transport affects the well-being and functioning of surrounding regions. This leaves

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a major gap where researchers, policymakers, and industrial practitioners, in many cases, only treat transport as a field of operational interest rather than considering the role played by (maritime) transport in a regional system. In fact, the impacts of transport on surrounding regions have become only more important in recent years, especially with a number of strong governmental incentives to invest and commit in ports and other maritime transport facilities. For example, the *Silk Road Economic Belt and the 21st Century Maritime Silk Road* (hereinafter referred to as the "Belt & Road Initiatives," or BRI), launched by the Chinese government in 2013, aims "to promote the connectivity of Asian, European, and African continents and their adjacent seas, establish and strengthen partnerships among the countries along the BRI, set up omni-dimensional, multitiered and composite connectivity networks, and realize diversified, independent, balanced, and sustainable development in these countries." Indeed, as things stand, the Chinese government is also seriously considering the possibility of applying some of its BRI philosophies and perspectives to the Arctic area (e.g., the Canadian Arctic) through the "Polar Silk Road" initiatives and, rather peculiarly, declares China as a "Near-Arctic State" (PRC Government, 2018). Although the outcomes of such an initiative remain to be seen, it is without doubt extremely important to study in more detail how maritime transport can contribute to the sustainability of regions.

Through close collaboration between reputed scholars, researchers, and practitioners from diversified backgrounds, this book identifies the commonalities that contribute to the coherent transport–regional relationship—how operations, planning, and management impact on sustainable regional governance and establish a strong theoretical framework for this purpose. This is going to pose substantial interest to researchers, policymakers, and practitioners involved in any aspect of the transport, environmental, and planning sectors (e.g., port authorities, airport managers, planners, etc.). Readers can understand the major trends related to the topic, develop effective approaches and skills so as to address diversified challenges in transport and sustainable regional planning, and for researchers, inspire new ideas on research in transport and regional studies and planning. Hence, we believe that this book offers a unique perspective. Through collating the most updated information and research outcomes, especially original research conducted by contributors, the volume serves as an efficient channel in facilitating the transference of the latest original knowledge to researchers and practitioners, bridging the gap between academic knowledge and professional practice. It is a quality companion and a solid platform for further research, planning, and the development of appropriate policies and effective practice.

Also, this book is a major output of the *International Workshop on Climate Change Adaptation Planning for Ports, Transport Infrastructures, and the Arctic* (CCAPPTIA conference), held in Winnipeg, Manitoba, Canada, on 3–4 May 2018 and the *Yangtze River Research and Innovation Belt* (Y-RIB), held in Zhoushan, China, on 2–5 December 2018. Bringing together leading experts

and stakeholders from academia, government, industry, and interest groups, CCAPPTIA and Y-RIB aim to consolidate and coordinate global research and development activities that understand the current decision-making process in climate adaptation planning, identify attributes that catalyze collaboration between ports and other transport infrastructures, including those in the Arctic and countries/regions along BRI, in sustainable planning, identify ways that can facilitate the transfer of adaptation strategies and solutions to regions under different geographical and cultural contexts, and assess strategy and policy implementation under the context of climate adaptation planning. All the editors and many contributors attended and contributed to CCAPPTIA conference and/or Y-RIB. Such initiatives have directly contributed to the establishment of the *International Forum on Climate Change Adaptation Planning for Ports, Transport Infrastructures, and the Arctic* (ccapptia.com) in 2019.

The rest of the chapter is structured as follows: Section 2 briefly describes the contents of this book, while Section 3 provides some insight for further research and collaborations.

2 Description of different chapters

The 17 chapters in this volume are divided into five major subsections, namely "theoretical settings," "adapting to climate change impacts," "improving environmental performance," "opening up the Arctic seas," and "other key issues."

2.1 Theoretical settings (Chapter 2)

In Chapter 2, Monios reviews different institutions and players in the environmental governance of shipping and ports. From the International Maritime Organization (IMO) to national policy to local planning ordinances, a variety of regulations and planning regimes interact to govern this complex global sector. Yet the existence of overlapping jurisdictions and the reluctance to invest leads to certain challenges being under-addressed, ranging from carbon emissions at sea and in ports, to noise and congestion in port regions to climate change adaptation. By revealing the scale conflicts and the relative power plays in this multifaceted governance regime, this chapter identifies current institutional weaknesses where action is needed by policymakers. The conclusion is that, while maritime policy is polycentric with a strong global component, national policies for dealing with climate change adaptation can be expected to play an increasing role in the evolution of maritime transport and trade in the coming decades.

2.2 Adapting to climate change impacts (Chapters 3–6)

In Chapter 3, Burroughs and Becker study storm resilience and sustainability at the port of Providence, Rhode Island, United States. Sustainability trajectories

provide a means to consider social capacity to guide interactions between nature, in this case hurricanes, and society. In Providence, port stakeholders viewed a visualization of the impacts of historical hurricane intensity on a slightly shifted path that resulted in an estimated water level of 6.4 m above NAVD 88. Port business representatives observed projected water elevation with respect to specific business facilities. Results from surveys and interviews of 15 businesses show that meeting, training, planning, and data back-up were common proactive measures; many had back-up generators; but few had flood and wind proofed buildings, elevated properties, or electrical systems. In Providence, port businesses have taken initial actions along the trajectory but lack the port-wide coordination of effective stakeholder actions that marks a robust sustainability trajectory.

In Chapter 4, Randrianarisoa, K. Wang, and Zhang review economic modeling works on port adaptation. They focus on summarizing the modeling approaches and the major factors considered in such works. Specifically, they compare how disaster uncertainty and port market structure have been incorporated in these models, in terms of similarities and differences. The findings are then reconciled and compared. There are several findings that are robust across the modeling frameworks, thus offering useful policy and managerial implications. Meanwhile, there are some distinct findings, driven largely by the specific model setups and assumptions. Possible explanations are provided so as to better understand such variations. Finally, based on the existing modeling work, it proposes several promising avenues for future modeling research.

In Chapter 5, G. Wang studies sustainability cruising and its supply chain. The cruise industry is made up of the interconnection of various stakeholders in the maritime space. Their interdependence displays the need for cooperation in order to increase industry adaptability and flexibility. The growth of the industry has shown the need for a reliable value chain within the cruise sector. It identifies sustainable practices in order to improve the efficiency and reliability of the cruise network. Under this domain, it identifies sustainable practices and vulnerabilities from different stakeholders within the cruise industry. Sustainability of cruise practices can be observed from the perspectives of cruise ports, cruise liner companies, and the cruise supply chain in a maritime cluster. These practices are essential for the long-run sustainability and development of the cruise industry. Finally, it offers a holistic viewpoint of industry sustainability from multiple stakeholders as well as an incentive reliability framework. It is designed to offer a potential focus for policy improvement.

In Chapter 6, T. Wang, Qu, Yang, and Ng study the adaptation experience of United Kingdom's road and rail systems in managing the risks posed by climate change. In particular, they explore the current and potential issues in climate adaptation planning through in-depth investigation of four cases in the United Kingdom. Although considerable adaptation measures and actions have been implemented at both the national and regional levels, the road and rail systems still confront diverse challenges. They include insufficient scientific data, aging

infrastructure, unclear planning horizon, and unspecialized climate risk management. Through combining the analysis of the relevant literature, local reports, news, and interviews with domain transport experts, it offers a broad view of adaptation planning of roads and railways in the United Kingdom and useful insight in creating an integrated inland transport adaptation system. An analysis of road and rail adaptation measures to climate change does not only benefit the stated sectors by cross-reference but also generates new solutions in terms of using one system to enhance the resilience of the other when climate risks occur.

2.3 Improving environmental performance (Chapters 7 and 8)

In Chapter 7, Gonzalez-Aregall and Bergqvist examine port-based strategies that improve environmental performance and promote sustainable solutions for combating climate change in the context of large urban areas. Focusing on Barcelona, the investigation analyzes past and present hinterland initiatives that could successfully facilitate the city's and its port's growth and resilience. The geographically sensitive location of the port of Barcelona along the Mediterranean Sea results in high volume of freight and cruise passenger traffic. It presents an interesting case in addressing the sustainability challenges associated with freight transport paths and urban areas.

In Chapter 8, Wilmsmeier discusses the relevance of climate adaption and mitigation for the Colombian port system. It discusses the identified threats and general adaptation and mitigation needs in the national port climate change action plan. Colombia's climate action plan, or *Intended Nationally Determined Contribution* (INDC), includes the goal to reduce its greenhouse gas (GHG) emissions by 20% by 2030, as compared to a projected business-as-usual scenario. The INDC document stresses that climate action is fundamentally a developmental issue. Thus, innovative and strong development in the various sectors of the economy will support efforts to reach this goal. In addition, this chapter focuses on the mitigation efforts by presenting results for current baseline measures for implementing and monitoring mitigation solutions in the port sector.

2.4 Opening up the Arctic seas (Chapters 9–13)

In Chapter 9, M. Zhang, D. Zhang, C. Zhang, and Cao analyze the navigational risk factors of Arctic shipping. Typical navigational risks in the ice-covered waters in the Arctic area, such as a ship stuck in ice and collision accidents (e.g., ice-ship and ship-icebreaker collisions), are identified and estimated, which are defined as three typical accident scenarios in Arctic ice-covered waters. In this chapter, models of stuck ships and collision accidents are developed and analyzed to identify and classify the factors influencing these risks. It first identifies navigational risk factors using the HFACS-based ship collision risk analysis model, and the test mining approach based on accident reports and scientific literature. After then, the "fault tree" approach is used to analyze the fundamental

risk factors that contribute to three typical accident scenarios. Finally, it presents the findings of a qualitative analysis carried out to analyze navigational risk factors, in the context of three typical accident scenarios. The navigational risk factors in different scenarios are proposed by comparative analysis. Finally, it concludes by providing theoretical guidance for ice navigation in risk control and safety management.

In Chapter 10, Afenyo, Khan, and Ng review risk assessment techniques which are both static and dynamic in nature. It explores the challenges to implementing these techniques in the Arctic scenario, especially for shipping. A potential scenario is used to illustrate how these tools are used. The tier IV fugacity approach is employed in combination with the Monte Carlo simulation technique to model the fate and transport of oil spill. This tracks where the oil goes after the spill. To address data limitation, variability, and uncertainty issue further, the Bayesian approach through influence diagrams and the Object-oriented Bayesian Network (OOBN) are used. The results illustrate that the tools available are capable of addressing the problems of oil spill risk assessment.

In Chapter 11, Messner considers the potential consequences from air emissions associated with the increased shipping activity in the arctic with a specific focus on black carbon (BC) particle emissions. Environmental impacts from increased shipping through the Arctic will occur from BC emissions from fuel oil combustion. In addition to impacts on local health from haze, research efforts indicate that increased BC emissions from fuel oil combustion from shipping could have a noticeable local warming effect—warming from the dual effects of BC solar radiation absorption and albedo reduction from deposition on snow and ice. In this case, IMO requirements to lower sulfur content in vessel fuels by 2020 should reduce health impacts relative to local haze. However, considerable uncertainty remains on how BC emissions will be reduced and thus on how to reduce the overall impacts of increased shipping on the climate in the Arctic area. It argues that future policy changes will need to consider include improved particulate controls, cleaner fuels, and improved engine technologies in Arctic-going vessels.

In Chapter 12, Saeed and Ng analyze the potential opportunities and challenges associated with the opening of the Arctic seas for Norway. Climate change in the Arctic is opening up access to sea routes of the Arctic region and this could boost trade and, consequently, may result in a sharp increase in shipping traffic in Norway. Specifically, northern Norway would become a focal point for port- and shipping-related activities. However, these opportunities can only be fully utilized if the stakeholders involved can manage the challenges of the opening of the Arctic seas. Like opportunities, challenges also cover a range of spheres, including environmental pollution, ecological damage, and geopolitical risks associated with new resources and trade opportunities. With the help of relevant documents, case studies, and in-depth interviews, it identifies opportunities and challenges related to the opening of the Arctic seas and discusses measures that could be taken to minimize the risks.

In Chapter 13, Lin, Ng, and Afenyo discuss what Arctic shipping could mean for communities in the Arctic area. The opportunities that climate change presents for shipping in the Arctic are well-documented. However, the "landside" of Arctic shipping is often overlooked. Their analysis is supported by an in-depth case study of the town of Churchill located in northern Manitoba, Canada. It focuses on the damaged railway incident (that took place in 2017) that disrupted Churchill's vital links between the northern communities and other parts of Canada. It highlights the need for infrastructural investments in these regions so as to open up the Canadian Arctic area and get ready for the opportunities that Arctic shipping can potentially bring to northern Canadian. Finally, it generates useful information on how transport disruption influences the social sustainability of remote communities and thus affects intermodal transport development in the Arctic.

2.5 Other key issues (Chapters 14–18)

In Chapter 14, Lau and Sun investigate the responsibility of cruise tourism in China. Traditionally, the cruise market has been dominated by the North American and European regions. Since the 1990s, cruise passengers have increasingly begun to search unexpected cultures, attractive cruising destinations, exotic experience, and interesting shore excursions. In this case, China is becoming an attractive, emerging market. However, existing research mainly focuses on how cruises bring positive economic impacts to regions and port cities, while the negative impacts remain largely overlooked, including China. Understanding such a framework of responsible cruise tourism, including nonprofit organizations, governments, cruise passengers, local communities, and cruise liners, is proposed. It strives to increase the awareness of researchers, policymakers, and practitioners to the responsibility and sustainability of cruise tourism in the long term.

In Chapter 15, Jiang, Ng, and Li conduct an in-depth case study on the development of high-speed rail (HSR) in China. There have been considerable efforts by many governments to engage remote or peripheral regions within national or continental networks. Indeed, they often play hugely significant, and sometimes decisive, roles in the evolution and development of transport and regional systems. However, hitherto, the impacts of such initiatives on transport and regional systems are under-researched. The chapter first reviews the Chinese HSR's network development, where it analyzes the impacts of government initiatives on transport infrastructure and regional accessibility. Next, it investigates the Chinese HSR by projecting its future development and discusses its potential impacts on spatial distribution of employment and population, intermodal network, HSR freight, and long-distance HSR services. At the national level, they argue that government initiatives may pose positive impacts on transport and regional systems. However, at the international level, such impacts may be more limited.

In Chapter 16, Lee and Chen look at the "connect" or "be connected" strategy in the context of the BRI with a focus on the Korean peninsula. There are three ways to connect Korea to Europe, i.e., existing south-west bound maritime routes, railway by Trans-China Railway and Trans-Siberian Railway, and the "Polar Silk Road." Although China has not explicitly mentioned Korea in its BRI documents, recently, the Chinese government has been persuading the Korean government to join it. In particular, as dialogues between North and South Koreas have been progressing, despite its uncertainty, the Korean Peninsula is likely to be connected to the Eurasian train system. Having considered such circumstance, it is worthwhile to investigate the impacts of the BRI in connecting Korea to Europe. It aims to overview China's BRI and overseas port development strategy and explore some key points to make connectivity between the Korean peninsula and Europe efficient in the context of the BRI, drawing its implications for logistics providers and transport carriers.

In Chapter 17, Ge, Du, Z. Wang, and Zhou compare the competitiveness of existing and potential corridors for freight transport between the Indian Ocean region and China in the BRI context. A multiobjective programming model is proposed to allocate cargoes to each corridor in which four objectives, such as minimum transport cost, minimum energy consumption, minimum greenhouse emissions and highest safety, are balanced. The proposed model gives the optimal cargo volume allocation over the four corridors of interest, which has been shown numerically to vary as the priority of each objective varies. Subsequently, the rate of the return on investments in the three potential corridors is analyzed.

In Chapter 18, Mishra, Kumar, and Appadoo propose the "Mehar method" for solving unbalanced generalized interval-valued trapezoidal fuzzy number transportation problems. Hitherto, there is an existing method that transforms an unbalanced generalized interval-valued trapezoidal fuzzy number transportation problem (IVTrFNTP) into a balanced generalized IVTrFNTP and the methods in solving the latter problem. However, the authors show that, when applying the existing method in transforming an unbalanced generalized IVTrFNTP into a balanced generalized IVTrFNTP, the obtained dummy supply and/or dummy demand is not a generalized interval-valued trapezoidal fuzzy number (IVTrFN), and thus it is not valid. Understanding such, a new method (the "Mehar method") is proposed in this chapter so as to transform an unbalanced generalized IVTrFNTP into a balanced generalized IVTrFNTP. The validity of this new method is also discussed.

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3 Looking to the future

"Maritime transport and regional sustainability" is a huge topic and, admittedly, it is not possible for one book or research project to cover it fully. Having said so, we believe that the contents of this book give a general, comprehensive coverage of the topic and offer a good platform for future research. Following on from the topics already covered in this volume, we can identify several critical issues that require further investigation:

- How should climate change adaptation and resilience be implemented?
- Should climate change adaptation and resilience be quantified? If so, how should this be done?
- There is a clear imbalance of research between different aspects of Arctic shipping, in terms of both geographical/regional (e.g., Russia vs. Canada) and sectoral (e.g., marine side vs. landside). What should be done to address such gaps?
- What are the impacts of rapid infrastructural development on regional societies and economies, such as the BRI initiatives, the Greater Bay Area in southern China, and the isolated Arctic areas? How can relevant socioeconomic factors be studied?

Each of these questions involves many issues regarding methodological approach and data availability, as well as political, economic, and regulatory issues regarding implementation of possible solutions. As the editors, we hope (and believe) that this volume will act as the "gateway" in opening the door for more valuable research on these related topics.

Reference

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