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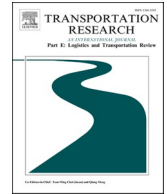
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Exploring a new development direction of the Belt and Road Initiative in the transitional period towards the post-COVID-19 era

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ABSTRACT

Since the outbreak of COVID-19, its impacts have been envisaged in multi-dimensional ways, including global supply chains, international logistics, and transportation. Owing to a series of virus variants since 2020, several Belt and Road Initiative (BRI) projects have been halted along the Belt and Road (B&R), and their implementation progress has been affected. In addition, China, which initiated the BRI in 2013, has been facing challenges which are caused by its economic, socio-demographic, and international political structural changes. Moreover, growing conflicts and tensions in international trade and politics, such as the war between Russia and Ukraine, China-US trade conflicts, foreign companies' reshoring the production lines from China, and diplomatic disputes between China and Australia, have been interwoven with the impacts of COVID-19 on the supply chains, international trade, and transportation in the world. Having considered the above, this study explores a new research-driven approach to reignite the BRI momentum in the transitional period towards the post-COVID-19 era from a Chinese economic perspective. In doing so, this paper proposes nine research agendas, such as the optimization network of transportation and logistics distribution centers (LDCs) along the B&R, priority development and performance of LDCs, greening the B&R with green shipping corridors, revisiting port devolution continuum, humanitarian logistics in association with COVID-19, security and risk analysis of China's energy supply chains, and export of the 6th Generation Ports (6GP) model with smart ports to major container ports along the port supply chains. Each research agenda is addressed with its motivation, significance, and applicable and representative methods.

1. Introduction

Since the outbreak of COVID-19, China has faced multiple challenges in the global supply chain and international transport, as well as structural changes in the production and consumption patterns. The former is highlighted by disruptions in production lines (e.g., automobile and electronics) and a sharp decline in international passenger flights and container ship capacities in global trade. The latter is characterized by a steady decline in economic growth in tandem with China's peculiar policy responses to the pandemic, increasing life expectancy and population aging, and rising labor costs because of the poor mobilization of human power caused by the COVID-19, both nationally and internationally. In addition, growing conflicts and tensions in international trade and politics, such as the war between Russia and Ukraine, China-US trade conflicts, foreign companies' reshoring the production lines from China, and diplomatic disputes between China and Australia, have been interwoven with the impacts of COVID-19 on the supply chains,

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international trade, and transportation in the world (Chowdhury et al., 2021; Notteboom et al., 2021). The above factors that China is facing now negatively influence existing and planned infrastructure investments in the participating countries along the Belt and Road (B&R). In such a circumstance, China should explore creative and strategic alternatives to mitigate the negative impacts of the above and maintain momentum in implementing the Belt and Road Initiative (BRI). This paper assumes that although China has declared no more domestic isolation and lock-downs since 7th December 2022 and announced the opening-up of cross-borders from 8th January 2023, the starting time of the post-COVID-19 is uncertain. Therefore, it uses the term “transitional period” in connotation with “towards the post-COVID-19 era”. Hence, the research agendas proposed in this paper could be applicable and worthwhile in a progressive manner towards the post-pandemic period.

A review of the extant literature shows that even though more than 11 special issues in international journals have been dedicated to the topics of the BRI¹ such areas as transport (shipping, port, air transport, and railway), logistics, and supply chain management (e.g., Lee et al., 2018, 2020; Wang et al., 2020), most papers have not dealt with revitalizing BRI projects along the B&R in the transitional period towards the post-COVID-19 era. The present study addresses this first research gap.

Although Lee et al. (2022a) provided an insightful research agenda, they did not provide a detailed approach background for each agenda. Moreover, their research did not achieve the anticipated significance and implications owing to the short period of empirical data since the outbreak of COVID-19. The world is still in a transitional period towards the post-COVID-19 era due to a series of virus variants. Therefore, one of the motivations for this study is to highlight research directions for the BRI during the “transitional period of the pandemic”.

The BRI covers a network of regional and international cooperation in the countries along the B&R connecting China to Asia, Europe, South America, and Africa. Therefore, BRI projects have inevitably suffered from the negative impacts of the pandemic, with some large-scale infrastructure projects temporarily on hold (Buckley, 2020; Zeng et al., 2021; Wang et al., 2022). The negative impacts of COVID-19 on the B&R region were analyzed, qualitatively and quantitatively, in terms of the global value chain, logistics performance, information development and services, and enterprise-scale (Cheong et al., 2022). In this paper, the BRI projects are more concerned with the transportation sector, focusing on shipping, port, and China Railway Express (CRE) along the B&R.

The negative impacts of COVID-19 on the BRI projects have been confirmed in several aspects. First, from the macro aspect of the negative impacts of the pandemic, the number of new contracting projects concluded by Chinese enterprises with the countries along the B&R decreased gradually by 8.7%, 5.2%, and 4.3% year-on-year from 2020 to 2022. (Ministry of Commerce of China, 2023). Second, COVID-19 has directly or indirectly affected global industries and supply chains, undermining their resilience and sustainability (Chowdhury et al., 2021). Third, container port congestion was caused by lock-downed ports, limited mobilization of port laborers, and disrupted land transport services (e.g., Alamouh et al., 2021; Cariou and Notteboom, 2022). Fourth, major shipping lines reduced their container ship capacity for the market, which caused an increase in sea freight rates and delayed cargo delivery (Yap et al., 2023). Finally, the lack of sharing information among land transport carriers, ports, shipping companies, logistics providers, shippers, and customs, immigration, and quarantine (CIQ) regarding COVID-19 also deteriorated the seamless cargo and ship movements (Kwon, 2020; Xu et al., 2021). This is a newly emerging port governance and management issue during COVID-19 (Notteboom and Haralambides, 2020).

Considering the negative impacts of COVID-19 on the BRI projects above, this paper aims to suggest research agendas to revitalize the momentum of the BRI in the context of transport, logistics, and supply chains. In addition, the port devolution continuum has been progressing from the perspective of port governance, privatization, and deregulation by decentralizing the decision-making, power, and responsibility of port management to local governments or port authorities (Brooks and Cullinane, 2007). Moreover, the outbreak of the COVID-19 pandemic, climate change with green shipping corridors (GSCs) initiated by the Clydebank Declaration in 2021, and the digitalization and decarbonization of the maritime industry (Green Shipping Challenges, 2022) could not be handled properly by local governments and port authorities because such issues require a legal mandatory system, centralized information network and substantial financial resources. The countries that participated in the BRI are facing such newly emerging issues. Therefore, this paper proposes research agendas to deal with such issues in the context of the BRI.

To fill up the research gaps associated with the research motivation, this study explores a new research-driven approach to regain the momentum in implementing the BRI projects in the transitional period towards the post-COVID-19 era from the Chinese economic perspective. In doing so, nine research agendas are proposed, referring to, among others, global supply chains, transportation focusing on shipping and railways, humanitarian logistics, regional economic development, port digitalization and decarbonization of the maritime industry in association with green shipping corridors. Each agenda is addressed with its research motivation, significance, and applicable and representative methods in a concise way.

2. Major research directions for exploring a new momentum in the BRI

Lee et al. (2022a) defined a logistics distribution center (LDC) as “a facility that performs consolidation, warehousing, packaging, decomposition, and other logistics functions associated with the global or regional distribution of freight. They can also perform light

¹ Since the inception of the Belt and Road Initiative (BRI) in 2013, there have been more than 10 special issues of international journals in the fields of transport (shipping, port, air transport, railway), logistics, and supply chain management in the context of the BRI. Among them, this study focused on Transportation Research Part E (2017, 2018), Maritime Policy & Management (2018), Transport Reviews (2018), Journal of Transport Geography (2018), Transportation Research Part A (2020), International Journal of Logistics Management (2021), International Journal of Logistics Research and Applications (2021), and International Journal of Shipping and Transport Logistics (2022).

manufacturing activities, such as assembly and labelling. Their main purpose is to provide value-added services to global supply chains passing through the global freight network, and in doing so, to contribute to the regional and local economy through job creation and the lowering of logistics costs." (Lee et al., 2022a, p.25). The scope of the LDCs "focuses on containerized cargo flows and assembly and production lines associated with global supply chains. Major LDCs are usually located adjacent to first-tier seaports, airports, or dry ports having good connectivity and accessibility with maritime and inland transportation networks and regional markets." (Lee et al., 2022a, p.25). Two more LDCs (Djibouti and The Pacific) are added to the eight LDCs along the B&R by Lee et al. (2022a), who proposed the perspective of strategic and economic value for China, referring to China's overseas port supply chains (PSCs), CRE routes, and maritime connectivity. China's engagement in Djibouti in Northeast Africa is growing for three reasons. First, Djibouti is located in the Mander Strait between the Red Sea and the Indian Ocean and has become one of the most important trade routes connecting the Suez Canal. Second, since the inception of the BRI in 2013, the Chinese government has invested in the construction of several infrastructure projects in Djibouti, such as the State Grid, the Ethiopia-Djibouti Railway, the Doraleh Multi-purpose Port, and the Djibouti International Free Trade Zone (DIFTZ) (Belt and Road Portal, 2022). Third, the Djibouti Port is linked to the Djibouti Port railway terminal, which is currently in operation (National Development and Reform Commission, 2022). Consequently, the port serves as a gateway for landlocked countries in the northern part of the sub-Saharan region.

China's engagement is recently growing in the Pacific Islands. The Pacific region consists of many small and scattered islands. The total container port throughput of the Pacific increased from 1.2 million TEUs in 2010 to 1.4 million TEUs in 2019, with an annual growth of 1.6%. The Liner Shipping Connectivity Index (LSCI) of the region ranged from 1.7 to 14.3 from 2016 to 2022, which is relatively low compared to other ASEAN Member States (UNCTADstat, 2022). Despite that, the US, Japan, and colonial legacies are keen on the region owing to the geo-economic-political characteristics. China's engagement in the region has been proliferating under the BRI with a series of the country's leaders' visits over the last ten years. In addition, the United Nations Economic and Social Commission for Asia and Pacific (UNESCAP) has made efforts to improve maritime connectivity in the region and to deal with climate change in collaboration with the United Nations Conference on Trade and Development (UNCTAD) and the International Maritime Organization (IMO).

This section suggests major research topics, with their significance and applicable research methods in the transitional period towards the post-COVID-19 era to explore a new BRI momentum related to the ten global LDCs along the B&R. Table 1 lists nine research agendas proposed in this paper.

2.1. First research agenda: Forecasting the capacity of LDCs in association with international trade structure subject to the lower economic growth rates of the Chinese economy

A series of lockdowns in major cities and production lines in China during the COVID-19 pandemic caused China to decrease economic growth rates gradually in 2020–2022. In particular, production lines at electronics and automobile industries were disrupted by lack of their spare parts, limited mobility of the domestic workforce within China, and no entry visa issue for overseas technical and management staff. Moreover, growing conflicts and tensions in international trade and politics, such as the war between Russia and Ukraine, China-US trade conflicts, foreign companies' reshoring the production lines from China, and diplomatic disputes between China and Australia, have been interwoven with the impacts of COVID-19 on the supply chains, international trade, and transportation in the world. Consequently, the above factors in association with recent US decoupling policy against China and foreign companies'

Table 1
Summary of the proposed research agendas.

Agenda number	Research agenda
1	Forecasting the capacity of LDCs in association with international trade structure subject to the lower economic growth rates of the Chinese economy
2	Optimization of the transportation network among LDCs along the B&R
3	Development of a sea–rail combined transport network in association with an LDC in Northeast Asia
4	Priority and performance evaluation of the development of LDCs in association with BRI infrastructure investment along the B&R
5	Greening the B&R in association with port supply chains (PSCs), including green shipping corridors (GSCs) along the new Maritime Silk Road (MSR)
6	Revisit to port devolution continuum with the growing role of central governments in association with upgrading the 6th Generation Ports (6GP) model
7	Designing an integrated humanitarian logistics system, referring to the Chinese case
8	Security of global supply chains with a risk analysis of LDCs along the B&R, including China's energy and raw material supply chain
9	Export of smart ports (6GP) model to major container ports along the PSCs

reshoring policy from China have been influencing China's international trade and economic structure. *The first research agenda* is, therefore, to forecast international trade changes in volume between China and her major trading partners where LDCs and the BRI infrastructure investment have been made and then to adjust the capacity of the LDCs and further infrastructure investment in the region. In doing so, the cargo volume data in TEU is more important than the trade value data because the former is essential for considering the capacity of LDCs, transport connectivity, and fleet capacity².

2.2. Second research agenda: Optimization of the transportation network among LDCs along the B&R

The landlocked countries in the sub-Saharan region should use the neighboring ports and connecting roads between the ports and their inland region (Refer to Table 1 in Lee et al., 2022a). Generally, the port facilities in Africa are of poor quality except for a few ports, such as Durban and Cape Town in South Africa and Maputo in Tanzania. Therefore, the congestion problem at underdeveloped regional ports can be mitigated by deploying feeder vessels. China is a leading country with developed seaports, airports, highways, and railways in the sub-Saharan region in the context of the BRI. The China–Africa Research Initiative estimated that China invested approximately US\$153 billion in infrastructure projects in Africa from 2000 to 2019, some of which fall under the BRI. Such infrastructure developments improved connectivity between the seaports and the landlocked countries. Therefore, *the second research agenda* aims to optimize transportation networks between the seaport and landlocked countries and to utilize short-sea shipping (SSS) by revisiting the SSS literature (Kim et al., 2018). In addition, SSS can be combined with the concepts of GSCs, “Motorways of the Sea” and “Blue Highway” (Lee et al., 2010) to solve port congestions at underdeveloped ports and achieve the decarbonization of the corridors with low- and zero-carbon fuels. In particular, the SSS, in association with LDCs, can be applied to the Pacific region. Lee (2022b, 2022c) proposed a concept to regard the Pacific as “One Community” and then develop LDCs on the main islands in the region, which are connected to the rest of the region by SSS. This proposal will help the region lower the total transportation costs by reducing the number of multiple port callings by ships and increasing ships' turnaround time of ships from the origin to destination (O-D) and minimizing greenhouse gas (GHG) emissions at sea and ports in the Pacific region. The revisit to SSS aims to develop gateway ports associated with LDCs with assembling and warehousing functions (Lee et al., 2022a). This is interrelated to the research agenda of greening B&R and GSCs.

In June 2022, the G7 Summit led by the US launched the Partnership for Global Infrastructure Initiative (PGII) to raise US\$600 billion³ by 2027, which aims to close the infrastructure gap in developing countries, mainly focusing on African regions. In line with this, the US government stressed the strategic and economic value of the Sub-Saharan region in Africa, recognizing that the region played “a critical role in advancing global priorities to the benefit of Africans and Americans” and is regarded as “one of the world's fastest growing populations, largest free trade areas, most diverse ecosystems, and one of the largest regional voting groups in the United Nations.” (O'Brien, 2022, p.2). Therefore, *this second research agenda* is crucial for China to allocate financial resources to improve the investment efficiency of transport infrastructure in seaports, airports, railways, and roads/highways in Africa (Zhou et al., 2021) and the Pacific region, which are related to design productive economic and transport corridors in the BRI.

2.3. Third research agenda: Development of a sea–rail combined transport network in association with an LDC in Northeast Asia

Of the proposed ten LDCs along the B&R (Lee, 2022a; Lee et al., 2022a; Lee, 2022b; Lee, 2022c), three LDCs are located along the Silk Road Economic Belt in association with the transport and economic corridors and CRE. An LDC in the “China, Mongolia, and Russia (CMR) Economic Corridor: Heilongjiang Silk Road Belt (CMR economic corridor) (Lee et al., 2018) has four sub-corridors in the CMR economic corridor, which are similar, as the economic corridor in the Greater Tumen Initiative (GTI, 2015) proposed by the United Nations Development Programme (UNDP) and the “Eurasia Initiative (EI)” by South Korea in 2013 (MOFA, 2015). This suggests that stakeholders in Northeast Asia, such as China, Mongolia, Russia, North Korea, South Korea, Japan, the UNDP, and the UNESCAP, have common interests in developing the transportation and logistics network in the region. In addition, North and South Korea have the same rail transportation system, which can be linked to the Trans-China Railway (TCR) and the Trans-Siberian Railway (TSR) without technical difficulties. Moreover, sea–rail cargoes from South Korea and Japan are transported by the TCR and the TSR to Central Asia and Europe. The Chinese government also launched sea–rail intermodal transport system connecting the railway with seaports and inland ports, which can alleviate the cumbersome, time-consuming, and expensive processes of cargo flows of imports and exports. *The third research agenda* aims to design a platform for collaboration among the regional stakeholders and to integrate the BRI into the existing initiatives above. In particular, container cargo from South Korea and Japan are transported to Chinese ports (e.g., Qingdao, Rizhao, and Lianyungang) and Russian ports (e.g., Vladivostok) by ship and then carried by the CRE or the TSR. This is a typical form of the sea–rail combined transport for South Korea and Japan and can be combined with the Chinese river-shipment transportation network in the context of the BRI. Therefore, *this third research agenda* requires a policy development approach and survey in tandem with data collection on cargo demand and obstacles in transportation and logistics.

² On the conversion model from trade value acquired by GTAP to trade volume in 20 equivalent units (TEU), see Lee et al. (2013) and Cheong and Suthiwartnarueput (2015).

³ US President Biden announced that the country will raise US\$200 billion for the PGII by 2027 through grants, federal financing, and leveraging private sector investments.

2.4. Fourth research agenda: Priority and performance evaluation of the development of LDCs in association with BRI infrastructure investment along the B&R

Most studies on Chinese overseas transport infrastructure investments in seaports and airport facilities, roads, highways, and railways, in association with international trade and transportation networks in the context of the BRI (Ng et al., 2018), have been based on the Chinese perspective, the so-called Chinese-centric viewpoint. Therefore, the existing literature has not reflected local/regional data to draw meaningful analyses and conclusions regarding the impacts of the BRI projects in the region. Hence, there are few reports on studies of the impacts of the BRI on regional economies, and joint research by scholars between China and the region. Therefore, China needs to highlight the contribution of the BRI to regional economies and global trade by conducting economic impact studies in collaboration with a global research network.⁴ *The fourth research agenda* is to evaluate the contributions of an LDC to the regional economy in terms of job creation, value-added creation, and linkage effects by applying the input–output model and the global trade analysis project (GTAP) (Chang et al., 2014; Lee et al., 2013).

Owing to the global going-out strategy, China's three major investors in the shipping, port, and construction sectors have contributed to establishing PSCs along the new MSR (Lee et al., 2022a; Chen et al., 2019). The PSCs have motivated China to develop the world terminal operating business through COSCO and China Merchant Ports⁵, which consequently have expanded their shipping networks along the new MSR. Some ports along PSCs in Africa play a key role as gateways connecting the landlocked countries in the region. Considering the above, it is necessary for China to investigate how to integrate PSCs in collaboration with stakeholders efficiently and maximize the synergy effect among them. In addition, port construction in Africa under China's port financing scheme⁶ showed low profitability over a long gestation period (Yang et al., 2020). Therefore, *the fourth research agenda* draws on the necessity of minimizing the negative aspects of port investment and attracts investors, considering the port-park-city (PPC) model (Yeung, 2009; Liu et al., 2020). In the PPC model, port construction, waterfront development, and transport connectivity investment between the port and city contribute to increasing the value-added of their port investment in a comprehensive way (Lee, 2022a; Lee et al., 2022a; Suthiwartnarueput et al., 2020; Lee, 2022b; Lee, 2022c).

Furthermore, China cannot develop the proposed LDCs along the B&R simultaneously. In other words, their developments should be prioritized. Therefore, *the fourth research agenda* also needs to evaluate the priority, performance, and importance of the proposed LDCs along the B&R. A matching model of logistics capability and demand, network scale, gravity, and efficiency should be considered. In doing so, hybrid multi-criteria decision-making (MCDM)/multi-attribute decision-making (MADM) methods can be applied in tandem with complex network theory and algorithm development (Lee et al., 2018; Wei and Lee, 2021; Zhang et al., 2020).

2.5. Fifth agenda: Greening the B&R in association with port supply chains (PSCs), including green shipping corridors (GSCs) along the new MSR

The fifth research agenda is concerned with greening the B&R in association with LDCs. In other words, it aims to estimate the reduction in gas emissions related to the proposed LDCs along the B&R. China is a leading country in global efforts to reduce gas emissions, aiming to achieve a zero-carbon economy by 2050 (ETC and RMI, 2019). SO_x, NO_x, and particulate matter (PM) are emitted from ships carrying China's import energy while they navigate along the coastlines and participate in port-related activities in China. The Clydebank Declaration at COP26 in Glasgow, UK in November 2021 declared to establish green shipping corridors (GSCs), which aim to develop zero-emission routes between two ports and more (Department for Transport., 2021). The GSCs were developed further by the COP27 in November 2022, which is closely related to the IMO's "Zero-Emission Shipping Mission⁷." The UNESCAP recommended implementing GSCs in the ESCAP region. As a reference case, the "Green Shipping Corridor Partnership" initiated by the Port of Los Angeles and the Port of Shanghai in January 2021 aimed to achieve the decarbonization of the maritime industry by 2030 in association with public sector entities⁸. The Port of Long Beach joined the Partnership in June 2022. The GSC Partnership is China's first mover in building GSC in the Asia-Pacific region to decarbonize cargo and ship flows. One of the peculiarities of the GSC Partnership is to form a public–private-partnership (PPP) where private companies operating in the route are competitors, but they collaborate to achieve the decarbonization of the maritime industry. In addition, Singapore and Rotterdam signed a memorandum of understanding to launch the world's longest corridor, the "Green and Digital Corridor" on August 2022 (MPA Maritime Port of Authority of Singapore, 2022). The top ten stakeholders participate in building GSCs (see Fig. 1). Therefore, *the fifth research agenda* is

⁴ The BRI–Global Research Network (BRI–GRN) has been launched by Zhejiang University in October 2021. More than 90 members from 35 countries along the B&R have joined in the network.

⁵ COSCO and China Merchant Ports are ranked on the 1st and 7th terminal operators in the world, respectively. Both world terminal operators (WTOs) handled 145.4 million TEUs in 2019, being 25.6% of the total 568.1 million TEUs handled by the top 10 WTOs.

⁶ China's overseas port investment and management patterns includes, among others, acquisition, joint venture, concession (long-term lease contract), build-operate-transfer (BOT) and public–private partnership (PPP). In addition, China's innovative port financing scheme is applied to ports in Africa, which is engineering procurement construction (EPC), finance (F), investment (I) (EPC+F+I) (Huo et al., 2019; Yang et al., 2020; Lee et al., 2022a).

⁷ On the details, see Resolution MEPC.304(72). [https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution%20MEPC.304\(72\).E.pdf](https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution%20MEPC.304(72).E.pdf) (Accessed 10 October 2022).

⁸ Xinde Maritime Network (2022); Shanghai Municipal Transportation Commission, 11 February 2022. <https://www.shanghai.gov.cn/nw31406/20220211/3bf0610dd58a4b05a993000693c1c00e.html> (Accessed 10 July 2022).

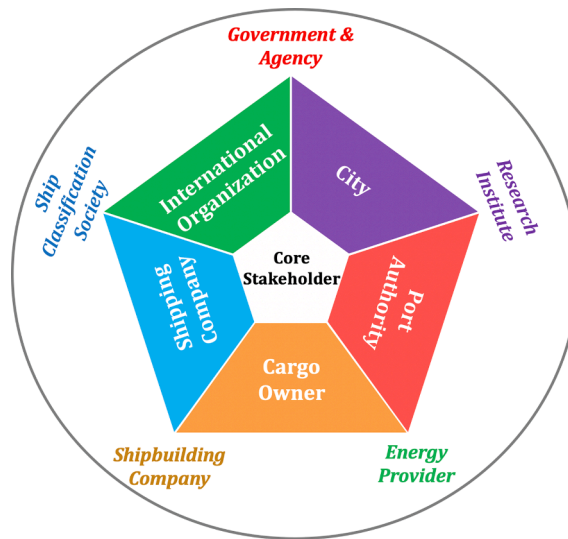


Fig. 1. Major stakeholder groups of the green shipping corridor Source: Lee (2022).

related to China’s leadership in the global climate change issue in proactively launching more GSCs along the new MSR, including the iron ore, cruise, and LNG sectors. GSCs will be a focal issue that leads China to collaborate among the public and private stakeholders (Fig. 1) to promote port digitalization and decarbonization of international shipping routes based on international guidelines, including the IMO.

2.6. Sixth research agenda: Revisit to port devolution continuum with the growing role of central governments in association with upgrading the 6th Generation Ports (6GP) model

Fig. 2 presents a path of the port devolution continuum that reflects the recent impacts of COVID-19, digitalization, and decarbonization (CDD), based on traditional port devolution factors such as port privatization, governance, and deregulation (Lee, 2020; Lee, 2022b; Song et al., 2022). Devolution continuum has been following a series of processes of control level of central government, consultation under government corporation, commercial partnership and privatization (see Fig. 1.2 in Brooks and Cullinane, 2007, p.6). Such typology of devolution can be applied to port sector. Lee (2022b) argued that the path of port devolution continuum has been changing from a local government or port authority to a central government owing to recent developments, such as CDD (Fig. 2). The CDD cannot be fully tackled by local government or the port authority itself because support from considerably more resources and an information-sharing network in tandem with a legal mandatory system is required, but it cannot be borne by the local government or the port authority. In particular, the outbreak of COVID-19 has disrupted port services at major ports around the world. Accordingly, those services cannot be handled properly by local governments or port authorities.

GSCs are being developed in collaboration with C40 Cities and ports. Considering the port devolution continuum gaining the

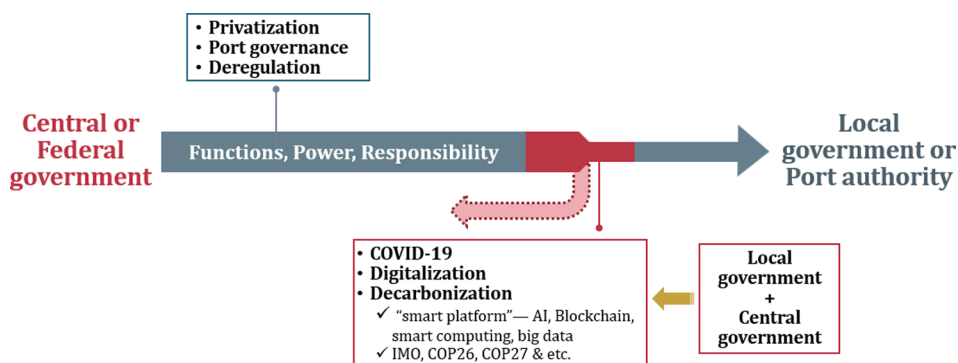


Fig. 2. Port Devolution Continuum gaining the central government’s intervention Source: ©Lee, P.T.-W. and Song, Z-Y (2022).

central government's intervention owing to CDD, local and central/federal governments are driven to collaborate with port authorities to implement GSC efficiently. Therefore, *the sixth research agenda* aims to revisit the existing port devolution theory, analyzing the impact of CDD on port devolution in tandem with the role of central governments. This agenda is interrelated to the new port level, the so-called "Smart Port" as 6GP (Song et al., 2022), which has evolved from a "Dynamic Customer-Centric Port Community (5GP) (Lee and Lam, 2016). The 6GP model adds new features, dimensions, and factors to the X-axis and Y-axis, including three major components, i.e., "Smart port technology platform", "Resilient system", and "Governance for smart port system". The Smart Port (6GP) is supported by three pillars: "economies of flow, connection, and fusion technology (Lee and Lee, 2016)", "smart port/city (i.e., smart community)", and "governance of smart platform". The newly proposed 6GP will help provide port authorities and developers with insights into the port development direction. In addition, the 6GP is proposed to generate a creative value of ports in association with digital fusion technologies. *Digitalization* helps minimize the negative impacts of COVID-19, promote decarbonization of the maritime industry, and keep improving the sustainability in the port/city area.

Most LDCs along the new MSR are adjacent to major container ports. Some also have a function of free trade zone, of which various types were developed in China's major ports. Seven of the top ten container ports in the world are located in China. China is one of the leading countries to develop innovative technology in container yards and cargo handling. Since the 9/11 terrorist attack, a series of regulations on container cargo movements in ports have been issued by US governments (e.g., C-TPAT, 2001⁹; SAFE Port Act¹⁰, 2006) and international organizations (e.g., ISPS Code amendment to the SOLAS Convention, 2002¹¹). They caused a deterioration in port efficiency and significantly increased logistics costs worldwide. Similarly, COVID-19 has driven China to control customs, immigration, and quarantine (CIQ) processes for cargo and seafarers on ships calling at Chinese ports. In addition, China implemented a peculiar prevention policy for COVID-19, known as "dynamic zero-COVID" (*dongtaiqingling* in Chinese pinyin) policy (People's Daily, 2022) in association with makeshift hospitals (*fanganqiyuan*) by 7th December 2022. In other words, China followed interventionism by the central government, unlike neoliberalism in Western countries. Like the above regulations preventing terrorist attacks, CIQ control requires human-made processes, which may impede port efficiency, particularly in terms of time and cost. *The sixth research agenda* also covers designing an integrated system of an LDC comprising a hybrid method of an automated information system (AIS), blockchain, port entry system, and single window system (see Lee and Lam, 2015; UNESCAP, 2018) to improve the efficiency of ports where the LDCs are located.

2.7. Seventh research agenda: Designing an integrated humanitarian logistics system, referring to the Chinese case

In 2022, China implemented a social experiment to prevent COVID-19 by completely locking down the two big cities according to the "dynamic zero-COVID" policy of 2021, i.e., Xi'an and Shanghai, with a population of 13 and 25 million, respectively, leaving aside several cities with population in the millions. A series of PCR tests were performed for such large population in two days. Local governments converted existing buildings (e.g., the National Exhibition and Convention Center in Shanghai¹²) into makeshift hospitals. They built temporary container buildings as quarantine camps according to the order of the Chinese central government. As far as the prevention and control of COVID-19 are concerned, the system of Chinese local governments, under the guidance of the Chinese Center for Disease Control and Prevention (China CDCP), was equipped to implement the "dynamic zero-COVID" policy. China's interventionism can link and control governmental and non-governmental organizations and lock-down areas. However, some technical problems in providing residents with food, emergency medical services, and life-saving related logistics (Choi, 2021), which belong to a type of humanitarian logistics, were disclosed while the policy was being implemented. For example, the Shanghai City Government acknowledged that the cold food supply chain management (CFSCM) system for perishable products did not work properly in the city.¹³ The CFSCM is a set of supply chain practices aimed at preserving the appropriate atmosphere for perishable food products and defying microbial spoilage (Qian et al., 2022; Shashi et al., 2018). Although the Chinese government declared to stop domestic isolation and lock-down measures on 7th December 2022 and to lift the cross-borders from 8th January 2023, the above failure cases still motivate the authors to propose *the seventh research agenda*, i.e., to develop an integrated humanitarian logistics system in collaboration with stakeholders, such as the China CDCP, local governments, community systems, and logistics providers for the possible future cases. *This seventh research agenda* is unique and applicable to establishing China's centralized humanitarian logistics distribution system in collaboration with private and public stakeholders, applying well-developed fusion technology in China. In addition, the agenda stimulates a feasible study for two reasons. First, China has well-organized large databases, which are available, unlike the countries under a neo-liberal policy for disease control. Second, China's IT systems are well established in locating

⁹ The Customs–Trade Partnership Against Terrorism (C-TPAT) regulates, among others, the 24-hour Rule to say that the information of container cargo bounding for US ports is required 24 hours before they are loaded onto vessels at foreign seaports.

¹⁰ Container cargo that enters US seaports from all over the world ports should be scanned by "The Security and Accountability for Every (SAFE) Port Act", so-called "Port Security Bill", which was signed by President G. Bush on October 13, 2006.

¹¹ This stands for International Ship and Port Security (ISPS) code and is equivalent to C-TPAT in US in 2001.

¹² "Shanghai's largest makeshift hospital for COVID-19 put into use" (Source: China People's Daily Online, 9 April 2022) <https://en.people.cn/n3/2022/0410/c90000-10081926.html> (in English. Accessed 9 May 2022). According to the press conference on the prevention and control of the COVID-19 in Shanghai held on April 9, 2022, Shanghai has built more than 100 makeshift hospitals with more than 160,000 beds. (Source: China News Service, 9 April 2022) <https://www.chinanews.com.cn/sh/2022/04-09/9724062.shtml> (in Chinese. Accessed 9 May 2022).

¹³ Shanghai police reported that the residents in Meilong town had received deteriorate pork meat" (in Chinese) (Source: China People's Daily Online, 19 April 2022) <https://society.people.com.cn/n1/2022/0419/c1008-32402771.html> (Accessed 9 May 2022).

and estimating the demand sources in lockdown cities. The model is supposed to be correlated with the CFSCM and emergency food and relief-service distribution model (e.g., Sheu, 2014), referring to empirical cases in Shanghai and Xi'an.

2.8. Eighth research agenda: Security of global supply chains with a risk analysis of LDCs along the B&R, including China's energy and raw material supply chain

China imports coal, natural gas, liquefied natural gas (LNG), and crude oil. They are related to so-called "energy security supply chains"¹⁴. China is also a major player in exporting manufacturing goods to the world. Therefore, China faces challenges worldwide, such as supply chain autonomy, security, and control (Lee et al., 2022a,b). This is a focal issue in securing safe choke points in intermodal transportation and global supply chains connected to LDCs along the B&R (see Figure 3 in Lee et al., 2022a, p.28). International politics and maritime laws handle sea-lane security, maritime trade, and sea lanes of communications (SLOCs) (Rimmer and Lee, 2007). These circumstances lead to the eighth research agenda. This agenda is to mitigate the risks of Chinese vessels passing through choke points along the B&R and to search for alternative routes to secure energy supply chains and transportation networks for China. Both issues are critical to the sustainability of China's economy. China needs to design an energy supply chain resilient to any disruptions (Jabbarzadeh et al., 2016) and seek alternatives in tandem with transport/economic corridors in the BRI if energy carriers and container ships are impeded by the interdiction of the Suez Canal and the Malacca and Singapore Straits *en route* to and from Chinese ports. A recent diplomatic conflict between China and Australia has led Chinese importers of iron and ore¹⁵ to diversify their import countries from Australia to Brazil and West Africa, employing 400,000 deadweight tons (DWT) ships, so-called *Chinamax* ship type, to lower the transport unit costs.¹⁶ As of October 2022, China can accommodate up to 400,000 DWT carriers at 13 berths of 10 ports along the coastline, including Tangshan Port, Tianjin Port, Lianyungang Port, and Ningbo-Zhoushan Port¹⁷.

Several disruptions in global supply chains have been caused by ship accidents in the Suez Canal, COVID-19, terrorist attacks, and natural disasters. Therefore, it is necessary for stakeholders in the logistics and transportation industries to prepare contingency plans against any impedance to cargo movements and transportation services along the B&R. In other words, this eighth research agenda aims to secure sustainable supply chains among the LDCs, along the B&R, against impediments in global supply chains and transportation networks from the Chinese perspective. It is worth drawing a question: What would the consequences to China be if the global transport network and supply chains, in tandem with the proposed LDCs along the B&R, were restricted or prevented? The eighth research agenda can be extended to include a risk analysis of transport/economic corridors, including the Polar Silk Road, i.e., Arctic shipping routes, by applying the Bayesian method.

2.9. Ninth research agenda: Export of smart ports (6GP) model to major container ports along the PSCs

The ninth research agenda proposed by this paper is to export the technology of smart ports (6GP) model to major container ports along the PSCs, referring to the comparative study of smart port development between China and Europe. Song and Lee (2022) compared the direction and considered factors in developing and constructing smart ports between China and Europe, considering the cases of the Shanghai Port and the Qingdao Port in China, the Rotterdam Port in the Netherlands, and the Hamburg Port in Germany. The findings show similarities and differences in smart port development between China and Europe, giving the following policy implications. First, the differences between the two regions can be attributed to the differences in port development policy, i.e., the European Continental Doctrine and Asian Port Doctrine (Lee and Flynn, 2011). The high growth of container ports in China is ascribed to the latter, in which the central government plays a key role in constructing the port infrastructure (Lee and Lam, 2017). The Asian Port Doctrine, led by the top-down method, has been applied for developing smart ports in China. In contrast, smart port developments in Europe have been led by port authorities in collaboration with local governments, which means the European Continental Doctrine. Second, the smart port development direction of the two European cases is more concerned with the environment and logistics in tandem with urban port cities. In opposition to the previous, Chinese smart ports are oriented towards improving port efficiency by applying high technologies to cargo handling and container yard design in tandem with implementing port integration without a close port/city interface in smartization. Accordingly, two questions can be raised. Which doctrine or devolution direction of smart ports is more suitable and efficient for major container ports along the PSCs? How will digitalization and decarbonization be integrated to achieve smart ports?

¹⁴ Note the US's position of energy supply chain and transportation for China's reference. "Failure to meet increasing energy demand with increased energy supplies, and vulnerability to disruptions from natural or malevolent causes, could threaten our nation's economic prosperity, alter the way we live our lives, and threaten our national security." (Source: Secretary of Energy Spencer Abraham, 20 March 2003).

¹⁵ China's iron ore imports in 2021 from Australia and Brazil are 694 million metric tons (mmt), being 61.7% of all imported iron ore and 238 mmt being 21.1% of all imported iron ore, respectively. The iron and ore imported from Australia and Brazil together accounted for 82.8% of China's total imports of iron ore.

¹⁶ The *Chinamax* ship size is 24 m draft, 65 m beam, and 360 m length. It is similar to the *Valemax* ship type in Brazil with a capacity ranging from 380,000 to 400,000 dwt.

¹⁷ The top four ports handled iron ore 580.5 mmt in 2021, accounting for 80% of the total 756.3 mmt handled at all Chinese iron ore ports.

3. Discussions and concluding remarks

This paper has proposed nine research agendas to revitalize the momentum of the BRI in the context of transport, logistics, global supply chains, and climate changes in association with green shipping corridors (GSCs). The focus of the agendas is to help stakeholders revitalize BRI projects in association with LDCs along the B&R in the transitional period towards the post-COVID-19 era. The agendas have been developed from the perspective of Chinese stakeholders facing socio-economic and demographic structural changes and the international trade conflicts between China and the US. Furthermore, the agendas contribute to exploring a new development direction and momentum of the BRI in the coming post-COVID-19 era. The proposed nine research agendas are also mostly concerned with the following: forecasting the capacity of LDCs, the economic impacts of the BRI and LDCs on the regional economies, the optimization development of transport and LDCs network, the performance of BRI projects with LDC from the perspective of their viability, greening the B&R in association with the very recent development of the green shipping corridors, humanitarian logistics referring to Chinese cases; security and risk analysis of China's energy supply chain; revisiting the port devolution theory considering COVID-19, digitalization and decarbonization (CDD), which have recently influenced the path of the port devolution. The nine research agendas in this paper have been expanded and crystalized from Lee et al. (2020) and Lee et al. (2022a), concisely highlighting key methods related to the nine research agendas¹⁸.

The major significance of the proposed nine research agendas can be categorized into three groups. The first group is concerned with improving the synergy effects of China's overseas investment in infrastructure in transportation sectors (seaports, airports, railways, and highways/roads) by combining port supply chains (PSCs) along the new MSR with the LDCs. At the beginning of the BRI, each stakeholder (e.g., port constructor, highway constructor, and railway constructor) focused on each own construction for the profit from each construction. Hence, China's stakeholders and foreign direct investors in the regional manufacturing industry should build up a platform to share business information and to maximize intraregional connectivity between sea transport and land transport (e.g., sub-Saharan region). Chinese direct investors and the regional economy can benefit from the platform. Forecasting of cargo flows between China, and the region is related to the capacity of ports and LDCs. This research outcome may give meaningful insight into the optimization of the transportation network in association with LDCs in the region. This comprehensive approach makes China's BRI project viable in preventing inefficiency in the stakeholders' resources.

The second research agenda group focuses on greening the B&R in collaboration with the GSCs, which the Clydebank Declaration initiated at COP 26 in November 2021 (US Department of State, 2022). As of December 2022, 17 GSCs were launched under the memorandum of understanding and accouchements at the COP27 in November 2022. Some of the GSCs are overlapped with the new MSR. In addition, as shown in Fig. 1, ten stakeholders have joined in building and implementing GSCs to decarbonize the maritime industry, developing zero-emission shipping and green energy for ships. In addition, the BRI can provide new momentum to green the new MSR in the context of GSCs, by collaborating with the countries along the B&R.

It is worth noting that the GSCs have a variety of names, such as green digital corridor, green and digital shipping corridor¹⁹, and green corridors. The term "digital" in the GSCs implies that the stakeholders joining the green shipping corridors apply digitalization for the seamless movement of ships and cargos (Yap et al., 2023) and for collecting data on the decarbonization of ships and green energy on the corridor. The Chinese GSC Partnership with the US can be connected to the "Green and Digital Corridor" between Singapore and Rotterdam and the "Green Digital and Shipping Corridor" between Singapore and Los Angeles so that the "Green Shipping Network" can establish the Europe-Asia-Pacific, by integrating Shanghai into the above GSCs. In this regard, China's high technology has the potential to develop GSCs along the new MSR. The CDD influence the path of port devolution continuum which implies the transferring processes of function, power, and responsibility of port management from central governments to local governments or port authorities. This is because the CDD factors cannot be handled by local government and a port authority owing to the lack of information, financial resources, and legal mandatory system. Therefore, the central government's intervention has been growing to deal with the CDD. In particular, the negative impacts of COVID-19 on shipping, port, and global supply chains have driven central governments to step in dealing with CDD. Consequently, the path of port devolution continuum has begun to turn back to its centralized direction because of the growing role of the central government, as shown in Fig. 2.

The third research agenda group is concerned with China's policy approaching the design and implementation of BRI projects in the transitional period towards the post-COVID-19 era. More than 95 countries along the B&R joined the BRI projects in 2013–2020. Despite the explicit contribution of infrastructure investment to the regional economies, the projects were criticized by some scholars in the disciplines of international relations and journalism without solid ground evidence and logical development. The majority of critical views are related to the "debt-trap", which is a controversial topic²⁰. This paper argues that such criticism has been caused partly by Chinese stakeholders' misunderstanding of cultural differences and their non-proactive measures to build up two-way communication and disseminate the mutual benefits of the projects. In particular, such two-way communication should be established in advance before starting the projects and during the projects between Chinese stakeholders and local ones, including regional academic circles. Generally, political opposition parties in a country tend to develop their own arguments or allegations against their ruling party without sound analysis of the economic and social value of BRI projects for their economy. One of the best practices to overcome such delicate conflicts is to publicly share the economic impact studies of the projects with the two parties and academics

¹⁸ This paper has not included innovative modelling and quantitative method because Lee et al. (2020, pp.538–539) has already addressed the methods applied for the BRI studies.

¹⁹ Singapore and Rotterdam used "Green and Digital Corridor" and Singapore and Los Angeles named "Green and Digital Shipping Corridor".

²⁰ On the controversial arguments, see Brautigam (2020), Singh (2020), and Lai et al. (2020).

and to disseminate such correct information of the projects to opinion leaders and people in the country. Therefore, an imminent research agenda is to study the economic and social value of BRI projects for the country and/or region, such as job creation, increase of value-added, human power training, transfer of technology and knowledge, backward- and forward-linkage effects, and transport connectivity. In addition, the agenda is to highlight China's new leading role in developing regional economies by implementing the BRI projects and recognizing the strategic and economic value of the LDCs along the B&R.

The PGII launched by G7 Summit explicitly showed that it aims to provide "an alternative to China's BRI" and "to compete with the BRI", as discussed in the second research agenda (Komminoth, 2022). Therefore, Chinese leadership should be different from the colonial period in the 19th and 20th centuries. Consequently, China may not only mitigate the negative and biased image of the BRI in the region, but also revitalize the momentum of implementing BRI projects in the transitional period towards the post-pandemic era.

CRedit authorship contribution statement

Paul Tae-Woo Lee: Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Zhaoyu Song:** Data curation, Investigation, Visualization, Writing – review & editing.

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.

Data availability

This paper has not articulated the detailed methodology of the nine research agendas partly because it has focused on highlighting focal research topics, which may draw the momentum of the BRI in the transitional period towards the post-COVID-19 era and partly because the methodology applicable to the agendas is variable subject to the researchers' preference and empirical data availability.

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References

- Alamouh, A.S., Ballini, F., Ölçer, A.I., 2021. Ports, maritime transport, and industry: the immediate impact of COVID-19 and the way forward. *Marit. Technol. Res.* 4, 250092.
- Belt and Road Portal, 2022a. Ethiopia-Djibouti railway starts vehicle shipment. <https://eng.yidaiyilu.gov.cn/qwyw/rdxw/271173.htm> (Accessed 6th January 2023).
- Belt and Road Portal, 2022b. Djibouti enhances regional logistics hub position through robust cooperation with China. <https://eng.yidaiyilu.gov.cn/chinaafrica/business/292292.htm> (Accessed 6th January 2023).
- Brautigam, D., 2020. A critical look at Chinese 'debt-trap diplomacy': the rise of a meme. *Area Dev. Policy* 5 (1), 1–14.
- Brooks, M.R., Cullinane, K. (Eds.), 2007. *Devolution, port governance and port performance*. Research in transportation economics, 17. Elsevier, UK, Oxford.
- Buckley, P.J., 2020. China's Belt and Road Initiative and the COVID-19 crisis. *J. Int. Bus. Policy* 3, 311–314.
- Cariou, P., Notteboom, T., 2022. Implications of COVID-19 on the US container port distribution system: import cargo routing by Walmart and Nike. *Int. J. Log. Res. Appl.* 1–20 <https://doi.org/10.1080/13675567.2022.2088708>.
- Chang, Y.T., Shin, S.H., Lee, P.-T.-W., 2014. Economic impact of port sectors on South African economy: an input–output analysis. *Transp. Policy* 35, 333–340.
- Chen, J., Fei, Y., Lee, P.T.-W., Tao, X., 2019. Overseas Port Investment Policy for China's Central and Local Governments in the Belt and Road Initiative. *J. Contemp. China* 28 (116), 196–215.
- Cheong, I., Suthiwartnarueput, K., 2015. ASEAN's initiatives for regional economic integration and the implications for maritime logistics reforms. *Int. J. Logist. Manag.* 26 (3), 479–493.
- Cheong, I., Yoo, J.H., Hong, K., Lee, P.T.-W., 2022. Impact of the COVID-19 pandemic on global value chain and implications for the Belt and Road Initiative. *Int. J. Ship. Transport Logist.* 14 (4), 371–394.
- China News Service, 2023. ASEAN annual goods enter the western region of China along the new land-sea corridor in the west (in Chinese). <https://www.chinanews.com/cj/2023/01-06/9929520.shtml> (Accessed 6th January 2023).
- Choi, T.M., 2021. Risk analysis in logistics systems: a research agenda during and after the COVID-19 pandemic. *Transport. Res. Part E: Logist. Transport. Rev.* 145, 102190 <https://doi.org/10.1016/j.tre.2020.102190>.
- Chowdhury, P., Paul, S.K., Kaisar, S., Maktadir, M.A., 2021. COVID-19 pandemic related supply chain studies: a systematic review. *Transport. Res. Part E: Logist. Transport. Rev.* 148, 102271.
- ETC and RMI (Energy Transitions Commissions and Rocky Mountain Institute), 2019. *China 2050: A Fully Developed Rich Zero-carbon Economy*. Accessed 7th May 2022. <https://www.energy-transitions.org/publications/china-2050-a-fully-developed-rich-zero-carbon-economy/>.
- Department for Transport, UK, 2021 & 2022. COP 26: Clydebank Declaration for green shipping corridors. Policy paper. <https://www.gov.uk/government/publications/cop-26-clydebank-declaration-for-green-shipping-corridors> (Accessed 11th October 2022).
- Green Shipping Challenge, 2022. Green Shipping Challenge at COP27. <https://greenshippingchallenge.org/cop27/#announcements>. Accessed 21 November 2022.
- Greater Tumen Initiative (GTI), 2015. Rajin-Khasan Railway and Port Study Project: Preliminary Forecast on Transport Volumes and Shipping Costs at Pacific End of Tumen Transport Corridor. Accessed 10th March 2016. <http://www.tumenprogramme.org/?info-18-115.html>.

- Jabbarzadeh, A., Fahimnia, B., Sheu, J.B., Moghadam, H.S., 2016. Designing a supply chain resilient to major disruptions and supply/demand interruptions. *Transp. Res. B Methodol.* 94, 121–149.
- Kim, H.-J., Lam, J.S.L.L., Lee, P.-T.-W., 2018. Analysis of liner shipping networks and transshipment flows of potential hub ports in sub-Saharan Africa. *Transp. Policy* 69, 193–206.
- Komminoth, L., 2022. G7's \$600bn global infrastructure initiative targets Africa. *African Business*, 27th June 2022. <https://african.business/2022/06/trade-investment/g7s-600bn-global-infrastructure-initiative-targets-africa/> (Accessed 28th December 2022).
- Kwon, O.K., 2020. How is the COVID-19 pandemic affecting global supply chains, logistics, and transportation? *J. Int. Logist. Trade* 18 (3), 1–5.
- Lai, K.P.-Y., Lin, S., Sidaway, J.D., 2020. Financing the Belt and Road Initiative (BRI): research agendas beyond the “debt-trap” discourse. *Eurasian Geogr. Econ.* 61 (2), 109–124.
- Lee, P.-T.-W., Flynn, M., 2011. Charting a new paradigm of container hub port development policy: the Asian doctrine. *Transp. Rev.* 31 (6), 791–806.
- Lee, P.-T.-W., Lam, J.S.L., 2017. A review of port devolution and governance models with compound eyes approach. *Transp. Rev.* 37 (4), 507–520.
- Lee, P.-T.-W., 2022a. Sustainable Maritime and Port Connectivity for Resilient and Efficient Supply Chains in the Aftermath of COVID-19 (Phase I) (2021-TD-003). UNCTAD, Bangkok, Thailand.
- Lee, P.-T.-W., Hu, Z.-H., Lee, S.-J., Choi, K.-S., Shin, S.-H., 2018a. Research trends and agenda on the Belt and Road (B&R) initiative with a focus on maritime transport. *Marit. Policy Manag.* 45 (3), 282–300.
- Lee, P.-T.-W., Zhang, Q., Suthiwartnarueput, K., Zhang, D., Yang, Z., 2020a. Research trends in Belt and Road Initiative studies on logistics, supply chains, and transportation sector. *Int. J. Log. Res. Appl.* 23 (6), 525–543.
- Lee, P.-T.-W., Hu, K.-C., Chen, T., 2010. External costs of domestic container transportation: short-sea shipping versus trucking in Taiwan. *Transp. Rev.* 35 (3), 315–335.
- Lee, P.-T.-W., Lee, T.-C., Yang, T.-H., 2013. Korea-ASEAN free trade agreement: the implications on seaborne trade volume and maritime Logistics policy development in Korea. *J. Int. Logist. Trade* 11 (1), 43–65.
- Lee, P.T.-W., 2016. China's growing engagement in emerging maritime logistics market in Africa. In: Lee, P.T.-W., Cullinane, K. (Eds.), 2016. *Dynamic Shipping and Port Developments in the Globalized Economy. vol. 1: Applying Theory to Practice in Maritime Logistics*. England: Palgrave MacMillan, pp. 39–68.
- Lee, P.T.-W., 2020. The 6th Generation Ports and Smart Ports. Working Paper No. 2020-01, Maritime Logistics and Free Trade Islands Research Center, Ocean College, Zhejiang University, Zhoushan, China, 20pp.
- Lee, P.T.-W., 2022b. Green Shipping Corridor Strategy in Asia Pacific Region. United Nations Economic and Social Commission for Asia (UNESCAP) and The Pacific and SPC, SPREP, IMO, UNCTAD, Workshop on Sustainable and Resilient port development to support Sustainable Maritime Connectivity in the Pacific, Suva, Fiji, 6-7 December 2022.
- Lee, P.T.-W., 2022c. Regional strategies to enhance sustainable port development: the Perspective of the Pacific Region. United Nations Economic and Social Commission for Asia (UNESCAP) and The Pacific and SPC, SPREP, IMO, UNCTAD Workshop on Sustainable and Resilient port development to support Sustainable Maritime Connectivity in the Pacific, Fiji, 6-7 December 2022.
- Lee, P.-T.-W., Hu, Z.-H., Lee, S., Feng, X., Notteboom, T., 2022a. Strategic locations for logistics distribution centers along the Belt and Road: explorative analysis and research agenda. *Transp. Policy* 116, 24–47.
- Lee, P.-T.-W., Lam, J.S.L., 2015. Container port competition and competitiveness analysis: asian major ports. In: Lee, C.Y., Lee, Meng, Q. (Eds.), *Handbook of Ocean Container Transport Logistics: Making Global Supply Chain Effective*, International Series in Operations Research & Management Science, vol. 220. Springer, New York, pp. 97–136.
- Lee, P.T.-W., Lam, J.S.L., 2016. Developing the fifth generation ports model. In: Lee, P.T.-W., Cullinane, K., (Eds.), 2016. *Dynamic Shipping and Port Developments in the Globalized Economy. Vol. 2: Emerging Trends in Ports*. England: Palgrave MacMillan, pp.186-210.
- Lee, P.-T.-W., Lam, J.S.L., Lin, C.-W., Hu, K.-C., Cheong, I.K., 2018b. Developing the fifth generation port concept model: an empirical test. *Int. J. Logist. Manag.* 29 (3), 1098–1120.
- Lee, P.T.-W., Lee, T.-C., 2016. New concepts of economies of flow, connection, and fusion in maritime logistics. In: Lee, P.T.-W., Cullinane, K. (Eds.), 2016. *Dynamic Shipping and Port Developments in the Globalized Economy. Applying Theory to Practice in Maritime Logistics, vol. 1*. Palgrave MacMillan, England, pp.198–218.
- Lee, P.-T.-W., Suthiwartnarueput, K., Li, K.X., Ge, Y.-E., 2020b. Impacts of the belt and road initiative on global supply chains and international logistics. *Int. J. Logist. Manag.* 31 (4), 725–727.
- Lim, S.W., Suthiwartnarueput, K., Abareshi, A., Lee, P.-T.-W., Duval, Y., 2017. Key factors in developing transit trade corridors in Northeast Asia. *J. Korea Trade* 21 (3), 191–207.
- Liu, Z., Schindler, S., Liu, W., 2020. Demystifying Chinese overseas investment in infrastructure: port development, the Belt and Road Initiative and regional development. *J. Transp. Geogr.* 87 (2020), 102812 <https://doi.org/10.1016/j.jtrangeo.2020.102812>.
- Ministry of Commerce of China, 2023. China's Investment Cooperation with BRI Participating Countries, a series of data between 2021-2022. <http://hzs.mofcom.gov.cn/article/date/202301/20230103378055.shtml> (Accessed 9th January 2023).
- MOFA (Ministry of Foreign Affairs), Republic of Korea, 2015. Eurasia Initiatives. Republic of Korea, Seoul. http://www.mofa.go.kr/ENG/image/common/title/res/0707_eurasia_bro.pdf (Accessed 25th February 2016).
- Ng, A.K.Y., Jiang, C.M., Li, X.Y., O'Connor, K., Lee, P.-T.-W., 2018. A conceptual overview on government initiatives and the transformation of transport and regional systems. *J. Transp. Geogr.* 71, 199–203.
- Notteboom, T., Pallis, A., Rodrigue, J.-P., 2021. Disruptions and resilience in global container shipping and ports: COVID-19 pandemic vs. 2008–2009 financial crisis. *Marit. Econ. Logist.* 23 (2), 179–210.
- Notteboom, T.E., Haralambides, H.E., 2020. Port management and governance in a post-COVID-19 era: quo vadis? *Marit. Econom. Logist.* 22, 329–352.
- MPA (Maritime Port of Authority) of Singapore, 2022. Maritime and Port Authority of Singapore and Port of Rotterdam to establish world's longest Green and Digital Corridor for efficient and sustainable shipping. <https://www.mpa.gov.sg/media-centre/details/maritime-and-ports-authority-of-singapore-and-port-of-rotterdam-to-establish-world-s-longest-green-and-digital-corridor-for-efficient-and-sustainable-shipment> (Accessed 27th December 2022).
- NDRC (National Development and Reform Commission), China, 2022. The joint construction of the “Belt and Road” has made solid achievements. (in Chinese) https://www.ndrc.gov.cn/wsdwhzf/202205/t20220527_1325885.html?code=&state=123 (Accessed 6th January 2023).
- O'Brien, J., 2022. United States and Africa: Building strong partnerships. Baker McKenzie, 8th December 2022. <https://insightplus.bakermckenzie.com/bm/banking-finance/1/united-states-and-africa-building-strong-partnerships> (Accessed 5th January 2023).
- People's Daily, 2022. Why China stands firm on dynamic zero-COVID policy. 1st May 2022. <http://en.people.cn/n3/2022/0501/c90000-10091493.html> (Accessed 4th May 2022).
- Qian, J., Yu, Q., Jiang, L., Yang, H., Wu, W., 2022. Food cold chain management improvement: a conjoint analysis on COVID-19 and food cold chain systems. *Food Control* 137, 108940. <https://doi.org/10.1016/j.foodcont.2022.108940>.
- Rimmer, P.J., Lee, P.T.-W., 2007. Repercussions of impeding shipping in the Malacca and Singapore Straits. *J. Int. Logist. Trade* 5 (1), 7–26.
- Shashi, S., Cerchione, R., Singh, R., Centobelli, P., Shabani, A., 2018. Food cold chain management: from a structured literature review to a conceptual framework and research agenda. *Int. J. Logist. Manag.* 29 (3), 792–821.
- Sheu, J.B., 2014. Post-disaster relief-service centralized logistics distribution with survivor resilience maximization. *Transp. Res. B* 68, 288–314.
- Singh, A., 2020. The myth of ‘debt-trap diplomacy’ and realities of Chinese development finance. *Third World Q.* <https://doi.org/10.1080/01436597.2020.1807318>.
- Song, Z.-Y., Lee, P.T.-W., 2022. A comparative study on port devolution towards smart ports between China and Europe, in: *Proceedings of Academic Seminar on Multimodality of River Shipping and Ocean Shipping, Ningbo, China, 29–30 October 2022*.
- Song, Z.-Y., Lee, P.T.-W., Lin, C.-W and Chen, J., 2022. Developing a conceptual model of the 6th generation ports and smart ports, in: *Proceedings of IAME Conference, Busan, Republic of Korea, 14–16 September 2022*.

- Suthiwartnarueput, K., Lee, P.-T.-W., Lin, C.-W., Visamitanan, K., Yang, Z., Ng, A.K.Y., 2020. A trial to generalise evaluation of key driving factors of port-city waterfront development. *Int. J. Ship. Transport Logist.* 12 (3), 174–196.
- UNESCAP, 2018. Single window for trade facilitation: regional best practices and future development. Bangkok, Thailand. <https://repository.unescap.org/handle/20.500.12870/825> (Accessed 4th April 2022).
- US Department of State, 2022. U.S. announcements under the green shipping challenge at COP27. <https://www.state.gov/green-shipping-corridors-framework/> (Accessed 9th November 2022).
- Wang, J., Wei, H., Yan, X., Zhang, M., Han, X., 2022a. Review and perspective for resources and environmental information development and service along the economic corridors of the “Belt and Road” initiative. *J. Geo-Inform. Sci.* 1019–1033.
- UNCTADstat, 2022. Liner shipping connectivity index quarterly data. <https://unctadstat.unctad.org/wds/TableView/tableView.aspx?ReportId=92> (Accessed 6th January 2023).
- Wang, X., Liu, Z., Yan, R., Wang, H., Zhang, M., 2022b. Quantitative analysis of the impact of COVID-19 on ship visiting behaviors to ports—a framework and a case study. *Ocean Coast. Manag.* 230, 106377.
- Wang, X., Wong, Y.D., Li, K.X., Yuen, K.F., 2020. Transport research under belt and road initiative: current trends and future research agenda. *Transportmetrica A* 17 (4), 357–379.
- Wei, H., Lee, P.-T.-W., 2021. Designing a coordinated horizontal alliance system for china’s inland ports with china railway express platforms along the silk road economic belt. *Transport. Res. Part E: Logist. Transport. Rev.* 147, 102238 <https://doi.org/10.1016/j.tre.2021.102238>.
- Xinde Maritime Network, 2022. Why is Shanghai-Los Angeles the first Green Shipping Corridor? (in Chinese). <https://new.qq.com/rain/a/20220208A08CF400.html> (Accessed 24th December 2022).
- Xu, L., Yang, S., Chen, J., Shi, J., 2021. The effect of COVID-19 pandemic on port performance: evidence from China. *Ocean Coast. Manag.* 209, 105660.
- Yang, Z., He, Y., Zhu, H., Notteboom, T., 2020. China’s investment in African ports: spatial distribution, entry modes and investor profile. *Res. Transp. Bus. Manag.* 37, 100571.
- Yap, W.Y., Hsieh, C.-H., Lee, P.-T.-W., 2023. Shipping connectivity data analytics: implications for maritime policy. *Transp. Policy* 132, 112–127.
- Yeung, H.W., 2009. Regional development and the competitive dynamics of global production networks: an East Asian perspective. *Reg. Stud.* 43 (3), 325–351.
- Zeng, P.W., Bouey, P.J., Dossani, D.R., Wang, D.H., Li, P.G., 2021. The Belt and Road Initiative and disease control amid the COVID-19 pandemic. *J. Travel Med.* 28 (4), taab034.
- Zhang, X., Zhang, V., Lee, P.-T.-W., 2020. Importance rankings of nodes in the China Railway Express network under the Belt and Road Initiative. *Transp. Res. A* 139, 134–147.
- Zhou, Y., Kundu, T., Goh, M., Sheu, J.-B., 2021. Multimodal transportation network centrality analysis for Belt and Road Initiative. *Transport. Res. Part E: Logist. Transport. Rev.* 149, 102292 <https://doi.org/10.1016/j.tre.2021.102292>.