



PORT-CITY INTEGRATION TOWARDS SUSTAINABLE PORT-CITY ECOSYSTEM CONSIDERING INDUSTRY 4.0: A CASE STUDY OF ISKANDAR, MALAYSIA

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ABSTRACT: Port cities have played a focal role in each of the previous Industrial Revolutions as a kind of special economic region with inner inevitable connection. The shift to a new era i.e. Industrial Revolution 4.0 (IR4.0) has brought significant changes in the development policies and integration between port and city but the impending changes has yet to receive enough attention from the industry players. IR4.0 is based on data and due to the speed at which it unfolds and affects the way people move, work and communicate, it is embraced differently from the previous big leaps in history. Therefore, expertise and researchers has been trying to identify a road map to move towards port-city integration considering IR 4.0. To this end, this study highlights the various plans that a port can employ to modernize physical and virtual infrastructures to improve their readiness for IR4.0. In the context of port-city, IR4.0 creates a new level of integration underpinned by enhanced network connectivity and real-time interconnection of all components in the ecosystem where all relevant data and information can be accessed immediately in the cloud enabling the most efficient coordination of activities. This study in particular aims to look into the road map that charts the journey of Port of Tanjung Pelepas (PTP) in Iskandar Johor, Malaysia in IR4.0 era while identifying opportunities and challenges towards port-city implementation from sustainability viewpoints. To this end, different parties from the private and public sectors have been interviewed and data were collected from key players who have been actively engaged in IR4.0 strategies in port-city integration and development. This study has identified that enhanced mobility of cargo and sustainability adoption will be the core competencies of future ports which can be achieved by implementing appropriate IR4.0 strategies.



INTRODUCTION

Port city is the node in global commodity flows. It is open to the outside world and often the primary test field of new economic development model. Since last fifty years ago, the relations between ports and cities have been studied by experts from different perspectives which shows that port-city integration is a multifaceted concept. Since the role of port on global economic development has become increasingly strong, especially after globalization and containerization, the changing functions of port have made the relationship between port and urban economy much closer. The current dominant logic to integrate port and city mainly focuses on economic impacts of port cluster on local urban economy such as direct, indirect and induced impact while the consequences of inner interactions between port and city such as environmental and social issues have been ignored.

However, over the last decade, there has been continuous pressure for organizations to focus on the sustainability and accountability of a company's performance beyond the border of financial issues. There have been requests to focus more on environmental and social issues by the government, stakeholders and shareholders [1]. Moreover, changes from one era to the next, happen when mega trends converge at the same time. There are some disruptive technologies such as artificial intelligence (AI), robotics, internet of thing (IoT), autonomous vehicle and 3D printing that are about to hit the maritime industry which leads to a new technological era now known as the fourth industrial revolution (IR 4.0). These new technologies not only improve customer satisfaction and transport efficiency, but also improve the sustainability and social commitment of industries. Sustainable development has been defined as “development that meet the needs of the present without compromising the ability of future generation to meet their own needs (World Commission on Environment and Development, 1987). Different definitions and perceptions of sustainability have been used by researchers and practitioners. Among sustainability definitions, Triple Bottom Line (TBL) has led to a significant increase in economic efficiency due to the theoretical concept of TBL, which consists of the social issue and corporate sustainability [2]. Moving towards sustainable port is also a social challenge that requires international and national law, urban planning and transport and smart communication tools.

The future of sustainable port is a concept that consider not only the number of jobs and in particular the economical aspect, but also the environmental and social aspects of port operations and port development. Therefore, development of sustainable port-city integration is necessary to compete with rivals and to get more market share in new business ecosystem. This study aims to highlight the necessary infrastructures to implement sustainable port-city integration considering IR 4.0. To this end, the Port of Tanjung Pelapas is chosen as case study to find out the road map to transform port-city integration into sustainable port-city ecosystem complying with Industry 4.0. In consequence, parties that play key role to implement such a transformation have been interviewed to chart the road map towards having sustainable port-city ecosystem.

METHODOLOGY

Moving towards sustainable port-city ecosystem needs multifaceted strategy which encompasses different aspects of IR 4.0. This study has focused on four main factors that need to be considered in order to implement sustainable port-city ecosystem approach such as, cloud and Internet of Things (IoT), urban transportation, environmental management and social contributions. These four factors are known as pillars of the approach. To identify what strategies have been employed by authorities to



implement sustainable port-city ecosystem, different parties from the private and public sectors have been interviewed and data were collected from key players who have been actively engaged in IR4.0 strategies in port-city integration and development.

PORT-CITY INTEGRATION TOWARDS SUSTAINABLE PORT-CITY ECOSYSTEM

IR 4.0 is going to reshape the role of port in global supply chain and the future of seaports is undergoing prominent changes. In fact, IR 4.0 is a multifaceted phenomenon that can bring new and unique opportunities and also threats to global businesses. In order to benefit from opportunities and reduce the level of risks, ports have to prepare themselves to be able to incorporate IR 4.0. However, moving towards IR 4.0 is also a challenge that entails international law, urban planning, transport and infrastructures. On the other side, due to the pressure from government and stakeholder to implement sustainability concept in all business activities, port authorities need to integrate not only environment-friendly methods of port activities and operations, but social aspects of port operations should also be considered. To this end, sustainability of port considering IR 4.0 will be the backbone of development strategies and plans. To indicate how a port-city integration can move toward sustainable port-city ecosystem while complying with IR 4.0 and sustainability concept, Port of Tanjung Pelepas (PTP), Johor was chosen as a case study to explore its roadmap towards sustainable port-city ecosystem.

According to the United Nations Conference on Trade and Development (UNCTAD), Malaysia is among the top-ten best connected economies in 2019 [3]. Moreover, Malaysia is the fourth best connected economy among Asian countries, a position in which PTP can benefit from. PTP is located at the confluence of the main east-west shipping lanes. Best known as Malaysian’s most advanced container terminal, PTP is offering Shipping Lines minimal deviation time of 45 minutes [4]. According to the official PTP’s website, it has 14 linear berths totaling 5.04 km. The terminal is equipped with 58 Super Post Panamax cranes, 16 of which have a 24-boc outreach catering for next generation of Triple-E size vessels. On the 18th August 2018, PTP became the first port in the world to depart a vessel with a final load over 19000 TEUs. Figure 1 shows the total throughput of PTP in the period of 2014-2019.

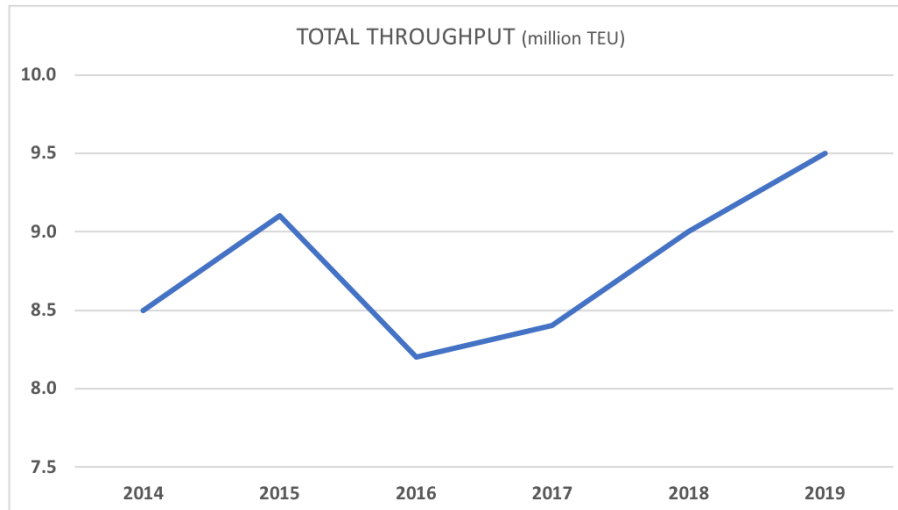


Figure 1: PTP container throughput (million TEUs) (Source: Authors)

Roadmap towards sustainable port-city ecosystem

The main aim in port-city integration is to strengthen relationship between port and urban economy while environment and social aspects of such a combination have been ignored or have not received enough attention. IR 4.0 will take what was started in the second generation of port with the adoption of computer and automation and enhance it with smart and autonomous systems fueled by data and machine learning. By incorporating IR 4.0 into port-city integration, we would be able to integrate port and city whereby both sides can benefit from each other economically while each side is responsible to mitigate the negative influence on the other side including social and environmental impacts. In fact, sustainable port-city ecosystem is the ultimate solution to integrating port and city which supports the coexistence model of port-city. Therefore, to be among leading ports of a region and global, port authorities should invest huge amount of money to craft and implement their roadmap to leverage their potential through incorporation of sustainability in port-city ecosystem considering IR 4.0 requirements.

To achieve this aim, PTP, has already developed its roadmap to implement sustainable port-city ecosystem considering IR 4.0 to enhance its strong position in east-west shipping lanes and also to get more market share by creating new added-value services to the users. To find out how PTP is moving towards sustainable port-city ecosystem, PTP’s R&D manager and other authorities such as Iskandar Regional Development Authority (IRDA), have been interviewed. In general, PTP has been focusing on different infrastructures and technologies.

Cloud

Cloud and the edge of computing is going to transform how port and city has been integrated so far. These technologies have the potential to improve services provided by port and city, port users satisfaction, increase productivity, reduce port operation cost and improve safety while enable port



authorities to incorporate sustainability concept in port-city integration by reducing environmental and social negative impacts. Therefore, PTP and other stakeholders have been trying to provide and built the necessary infrastructures. According to the PTP CEO’s statement, they have setup Terminal Wide Wireless Broadband Mobile Network that support and connects operational devices in order to benefit from the future of Internet of Things (IoT) for Smart Port transformation. Furthermore, to fully embrace the benefits of IoT and also to lay the foundation for IR 4.0, Telekom Malaysia Berhad (TM) and Huawei Company have recently signed a memorandum of Understanding (MoU) to collaborate in accelerating 5G communication in Malaysia. In this regard, TM has begun a live 5G transmission in Langkawi on the 5th December 2019. This is expected to be the first deployment of 5G Standalone (SA) network in Malaysia which is crucial to fast track 5G implementation in the country. This deployment allows TM to test new 5G features and to evaluate the best way to extend nationwide 5G infrastructure.

It has been highlighted by experts that digital and smart infrastructures are the core component of building a smart and dynamic ecosystem whereby port and city can empower each other while they attempt to mitigate social and environmental issues. To achieve this objective, the business solutions arm of TM which is called TM One, has officially launched the Iskandar Puteri Data Center (IPDC) by investing up to USD 73 million dollar, located at Nusajaya, Malaysia. This Data Center is one of two major facilities planned by the TM Group to meet anticipated growth in data and hosting requirements, which is one of the core infrastructures towards having port-city ecosystem. The Data Center as regional hub, is designated to provide services such as cloud services, end-to-end managed information, communication and technology and high-speed broadband connectivity to cater for customers in Malaysia and the ASEAN region.

Urban transportation

Connectivity and accessibility of a port to other nodes such as seaport, inland port or industrial parks plays crucial role to provide better services to the users. In fact, to achieve highest level of port accessibility, an unblock integrated transportation system around the port should be established in the city in a way to be merged with port facilities in a most effective way to support port-city ecosystem. Therefore, not only hinterland transportation has to be developed effectively, the urban transportation also should be well connected to the hinterland transportation in order to minimize manual handling and maximize efficiency of handling cargo. To this end, IRDA has prepared the Iskandar Malaysia transportation blueprint which has been endorsed by the Malaysian Ministry of Transportation [5]. According to the transportation blueprint, the main aim is to benefit from strategic location of Iskandar Malaysia, and the strategy is to improve the region’s logistics and supply chain capacity and prepare the region to be ready for global competitions.

To improve the integration of port and city transportation and logistics infrastructures, IRDA has built highway connecting the Senai airport to the PTP (Figure 2). Furthermore, a new Free Trade Zones (FTZ) has been established namely Nusajaya FTZ and also another two new FTZ will be developed namely Seelong FTZ and Ulu Tiram FTZ by 2025. To improve connectivity of the ports and FTZs, two Integrated Logistics Centers (ILC) have been developed as Nusajaya ILC and Kota Masai ILC in 2015, and another two ILCs are going to be developed as Seelong ILC and Ulu Tiram ILC by 2025.

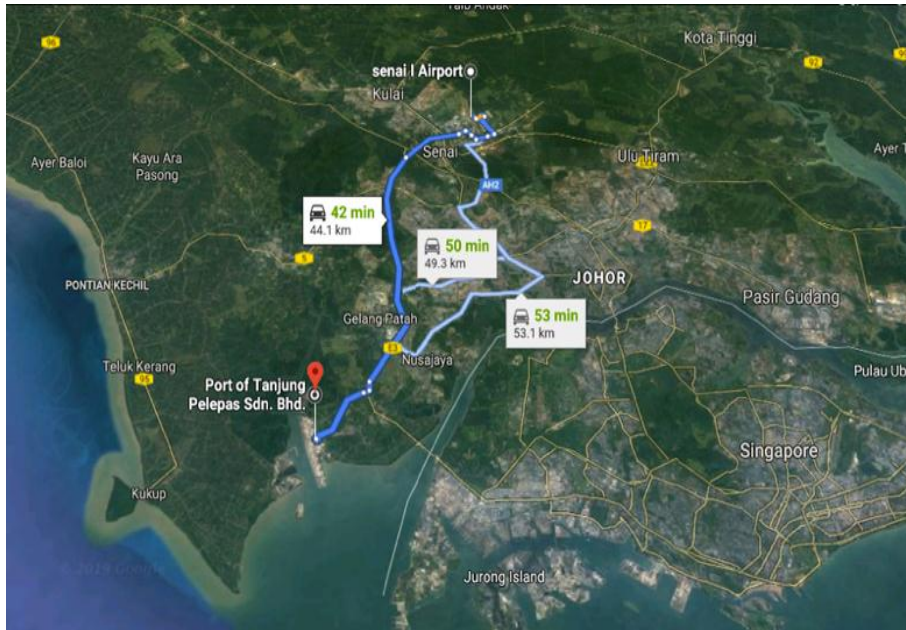


Figure 2: Senai Airport to PTP (Source: Google Map)

Moreover, to benefit from multimodal transportation, PTP is linked to Johor Port in Pasir Gudang, Johor through two different routes namely Lebuhraya Sultan Iskandar (EDL) and Senai-Desaru Expressway (Figure 3 & 4). To enhance multimodal transportation network and provide different transportation modes, a 71 km-long single-track railway has been built from PTP to Johor Port. Currently, upgrading this single railway to a double track is under progress to allow for smooth movement of cargo between these ports.

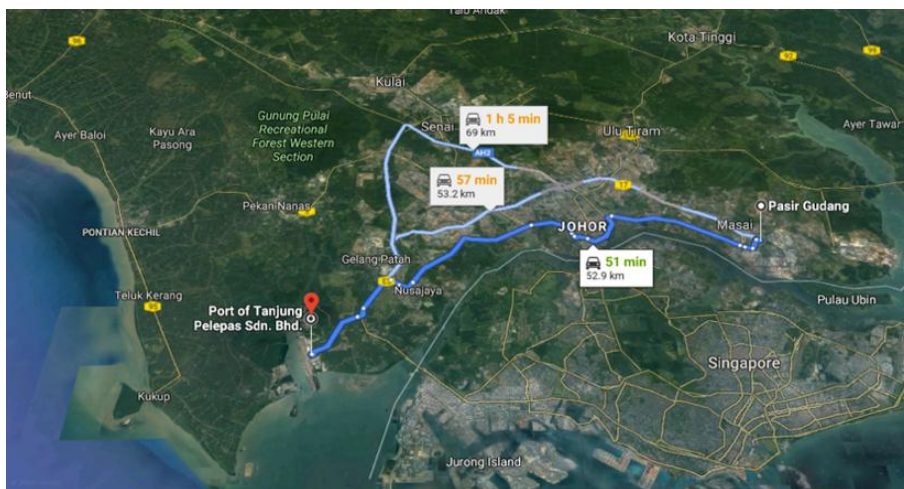


Figure 3: PTP to Pasir Gudang via Lebuhraya Sultan Iskandar (EDL) (Source: Google Map)

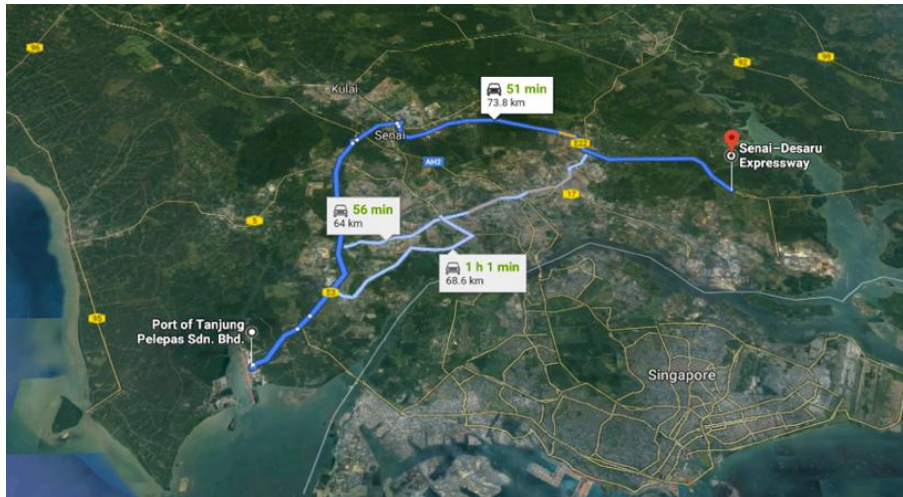


Figure 4: PTP to Pasir Gudang via Desaru-express-way (Source: Google Map)

Another game changer of Iskandar, Johor economy is Gemas-Johor Bahru electrified double-tracking project (Figure 5). This project costs USD 2.1 billion and according to the Transport Minister’s statement, it is ahead of schedule and is expected to be completed by October 2021. This railway will enhance the movement of cargo from Thailand to Johor and can play important role to export cargo from northern part of Malaysia to overseas through east-west shipping lane. On top of all these mega projects and developments, in order to enhance the movement of commuter, Johor Bahru-Singapore Rapid Transit System (RTS) has been planned and is estimated to cost USD 961 million. RTS will connect Woodlands North MRT/RTS station to the Malaysia terminus located at Bukit Chagar RTS station.

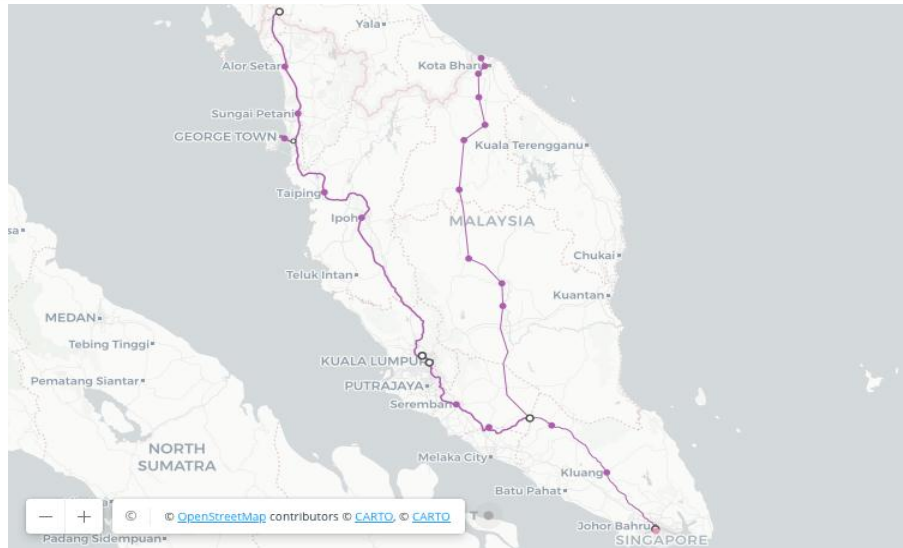


Figure 5: Gemas-Johor Bahru electrified double-tracking project (Source: Google Map)

Environmental Blueprint

IRDA as the single authority for coordinating the implementation and approval of development programs within Iskandar, Malaysia, has prepared an Environmental Planning Blueprint (EPB) for Iskandar Malaysia [6]. EPB aims to achieve variety of objectives including; achieving sustainable forms of development and land use, preserving and protect the biodiversity of Iskandar Malaysia, protecting all environmentally sensitive areas, promoting and enhancing air quality. Moreover, Johor Port Authority (JPA) has developed green port policy which covers water management, fuel quality of ships in ports, energy saving and environmental initiatives to reduce the environmental issues caused by port operations. Apart from EPB which has been prepared by IRDA and also JPA's green port policy, PTP has been taking steps to become a green port and be more environmental-friendly. PTP was awarded green port/terminal of the year due to its collective efforts in reducing ecological and energy footprint based on its sustainable and environmentally friendly business model, at the 4th Global Ports Forum held in Dubai, United Arab Emirates (UAE) in 2018. PTP has been using new advance marine system such as Vessel Traffic Monitoring and Information System (VTMIS) and Marine Resource Management System (MRMS) to improve environment and further strengthen the safety and security of vessel navigation within the PTP terminal.

On the top of all plans, policies and actions taken by PTP towards becoming a green port, PTP has identified opportunities created by IR4.0 to improve sustainability incorporation across the entire port operations. IoT, as an enabling technology will drive an increase in port operation efficiency and help port authority to better measure climate impacts of entire port operations. For example, Big Data analytics positively influences operations by affecting two factors, speed and maintenance. Although ships have optimum speed, it has been trying to optimize fuel consumption by determining optimum speed to minimize fuel consumption. However, various factors such as engine wear and maintenance affect the engine performance and as a result, it is difficult to operate a vessel at its optimum speed.



Ship owners can benefit from Big Data by determining the optimum speed for fuel consumption, taking into consideration factors such as bunker cost, freight rates and schedules. Furthermore, to minimize maintenance cost, decisions are taken based on schedule rather than on actual vessel performance.

Moreover, to operate more accurately in the port, voyage managers and port agents need estimated time of arrival (ETA) and cargo information. Real-time data would be sent by tracking vessels using dashboards instead of relying on notes, email or phone call to make more effective and accurate decisions about terminal and berth allocation, cargo handling and route tracking. Effective and accurate decisions can reduce fuel consumption and decrease environmental issues. Therefore, a real-time Big Data analysis performance monitoring and optimization solution enables vessels to reduce fuel consumption and ports to reduce environmental impacts of port activities by providing accurate information on current operations and on potential operational changes.

Employment and social contributions

IRDA has been trying to implement sustainability concept to develop Iskandar Malaysia in order to achieve three core objectives: wealth generation, wealth sharing and resource optimization. PTP as an engine of region economy, has created over 6,000 jobs over 20 years. It has always been giving back to the society not only by creating direct and indirect jobs but also by improving the environment and general lifestyle of its local community. In this regard, PTP has been conducting different programs such as GRP at some schools located in its local community to clean and renew the school compound. PTP Chief Executive Officer, Marco Neelsen stated that “PTP is ever committed in giving back to the community and strengthening the sense of solidarity among its staff and local people through the spirit of volunteerism. He also mentioned that PTP is also championing social causes by investing money and resources into taking care of the community and environment.

CONCLUSIONS

A sustainable integration of port-city is the key to develop port and urban economy. Every port authority should attempt to incorporate sustainability in port-city ecosystem whereby all stockholders are attempting to mitigate environmental issues and bring more benefits to society. As it is highlighted by experts, digital supply chain push port-city integration into a dynamic ecosystem whereby speed, reliability and transparency will be the core competencies. Meanwhile IR 4.0 enables port authorities to increase the level of sustainability in port-city ecosystem. In sustainable port-city ecosystem, the main objectives will be how to minimize manual handling so the cargo flows smoothly from one part of the system to another and how to implement sustainability criteria in a very cost effective way. To this end, PTP has been trying to rewrite its actions plan to prepare itself for full implementation of IR4.0 in order to benefit from emerging technologies and increase the credibility of PTP by incorporating sustainability into the port-city ecosystem. To enhance mobility of goods and passengers, local government and PTP have been investing billion dollars to provide hard infrastructure such as urban transportation, road and rail networks, and also soft infrastructure such as cloud and 5G. PTP is pursuing its aim to become leading container port in South East Asia by providing new technologies and facilities and also by investing in human capital development to employ well-trained employees.



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