



The symbiotic relationship between seaports and dry ports: An analysis of the ambidextrous functionalities of freight nodes and implications on regional development

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ABSTRACT

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The revolution in maritime trade has caused some changes in maritime subdivisions which create an unavoidable bonding or relationship between seaports and dry ports. The seaport will facilitate and support the dry port activities, while the dry port provides a competitive advantage to the seaport. Owing to the continuous turbulence in the maritime trade, the composition of the cooperation between the seaport and dry ports needs to be emphasised to ensure that the productivity, efficiency and connectivity between foreland, seaports and hinterland remain attractive among different players throughout the freight supply chain. Hence, this research was conducted to analyse the symbiotic relationship between seaports and dry ports as well as exploring how this reciprocal collaboration may contribute to regional development. This paper employed a qualitative methodology to meet the aim of the proposed objectives. Data collection was conducted through interviews with professional personnel from seaports, dry ports and government agencies. The findings show that there is a significant relationship between seaports and dry ports, especially towards competitive advantages, circular economy and sustainable development. The results indicate that seaports improve productivity, enhance the continuity of cargo, increasing the efficiency in freight mobility and boosting the capacity of dry ports. In comparison, dry ports relieve congestion, enhance the efficiency of the transportation system, boost operational efficiency and engender the container rotation at seaports. This ambidextrous functionality in both nodes needs to be specified and groomed to improve socio-economic activity as well as infrastructure development in this coastal region.

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1. Introduction.

The networking between seaports and various players in the maritime industry is crucial due to the interdependencies of seaports on every section in the supply chain to maintain the quality of their services for competitiveness. The dry port has become the main component in the freight supply chain to determine seaport competitiveness. In Malaysia, the dry port is crucial to ensure the continuity of container volume to seaports and this volume is expected to increase while the current capacity in each seaport will be exceeded by the support from

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this intermodal terminal (Jeevan et al., 2020a). The dry port significant to meet the need for economies of scale and might influence the uncertainty of global commerce, swift globalisation changes and regionalisation priorities, particularly from the Asian economic community.

The vicissitudes of the seaport and the trends in international trade enforce the importance of regional trade. The symbiotic relationship between the major seaports and dry ports needs to be developed to ensure the competitiveness of these trade nodes. However, in some countries, this symbiotic relationship in between seaports and dry ports does not exist (Roso et al., 2015). This condition reduces significant integration between these nodes to achieve comprehensive benefits to seaports, inland components as well as initiating regional trade development. Owing to these limitations, this paper explores the symbiotic advantages that can be sustained if these two major nodes collaborate in the freight chain and evaluates the implication of this symbiotic relationship on regional development.

From the seaport perspectives, several strategies need to be taken by this node when involving regional development (Sakalayan et al., 2016). The ability of seaports to initiate regional development has been proven by their capacity for developing supply chain efficiency, collaborating with regional organisations for regional growth, playing a proactive role in the regional innovation system, and being pro-active in the ports' environmental and social responsibility. These have become the primary pieces of evidence that seaports can be utilised as an effective medium for regional development.

2. Seaports and dry ports as freight nodes.

According to Roa et al. (2013), the seaport is controlled by a multidimensional system that combines economic activity, infrastructure, geographical space and trade. The seaport has been managed by an organisational model that generates public and privately-owned convergence needs. It is a known fact that the seaport is changing radically, particularly in terms of organisation and structure that follows an international environment. Over the past 4 decades, the seaport has become primarily used for the sea-land trade of a geographical region where ships and goods are received. The seaport is an important channel in the supply chain for the entry of products, commodities and passengers to a country between sea transport and land transport. It also serves as a component for freight distribution and acts as a gate for international trade (United Nations, 2013).

Owing to the growth in international trade and operational pressure, seaports have to develop effective strategies to increase their capacity so that they remain competitive. However, as noted by Jeevan et al. (2018), if the seaport fails to increase its capacity due to congestion, there would be a consequence of long turnaround times not only for vessels but also for containers. This situation will affect the attractiveness of seaports in every region and country. Therefore, an immediate solution by expanding the network inland as well as developing a prolific integration between seaports and dry ports is urgently required. Hence, the concept of seaport regionalisation needs to be ex-

plored, understood and utilised to gain a collective advantage for seaports, dry ports and regional growth.

Dry ports are logistic centres for straightening out the movement of containers without any constraint with custom inspections within inbound or outbound activities throughout seaports (Andersson & Roso, 2016). Dry ports provide a platform for seaports in preventing heavy truck traffic or congestion at the seaport gateway. This not only benefits the seaport but the client as well by reducing the waiting time of fleets and there is a huge relief on congestion at the berth or terminal. The multi-modal transport network is supported by the dry ports which has become the backbone of economic activities of local enterprise by facilitating their exports and imports of raw materials, semi-manufactured products and finished goods, and distributing them directly to the customer.

However, the complexity of the seaport environment has created challenges in offering competitive services to customers. The study done by Notteboom and Winkelmanns (2001) found that growing vessel sizes, demands for logistic services at seaports and the involvement of great diversity in the industry and the community of players have contributed to the complexity of the seaport environment. Fortunately, the competitiveness will be increased if they have a dry port to function as an interface for the entire seaport community. An effective strategy for enhancing container seaport competitiveness is having a dry port that performs as an interface between seaports and their various stakeholders. It has been recommended by Roso et al. (2013) that the dry ports have the potential to serve as an extended hinterland for seaports to fulfil customer needs.

This study aims to critically discuss some of the prominent ideas in the contribution finding of the dry port and seaport to further investigate the relationship between them. The symbiotic relationship can be utilised as an ambidextrous strategy from both of these trade nodes to enhance seaport and dry port competitiveness as well as generating an effective procedure for regional development in this region. The remainder of this paper is organised as follows. Section 2 discusses the concept of symbiosis, followed by the current symbiotic relationship between seaports and dry ports. Section 3 describes the methodological structure and unit of analysis of the paper. Section 4 explains the result and discussion of the paper which comprises the contributions of seaport towards the dry port and vice-versa. Additionally, Section 5 proposes forms of cooperation between seaports and dry ports as well as providing a fundamental requirement for a successful symbiotic association between the seaports and dry ports and discussing the implication of this symbiotic relationship on regional development. Section 6 concludes the paper.

2.1. Concept of symbiosis and the trend in maritime logistics: previous research.

Scientifically, symbiosis is defined as the term for closely related organisms. Most organisms engage in symbiotic relationships because the interactions benefit both species (Sarah, 2013). Nevertheless, from the industrial perspective, industrial symbiosis is a subfield for industrial ecology, including different sectors in a specific productive approach to resource trade,

power trade and services (Lombardi & Laybourn, 2012). Subsequently, businesses improve their production efficiency by reducing the volume of main material used and waste disposed at the landfill (Fraccascia & Yazan, 2018). Industrial symbiosis is also recognised as an important activity for the promotion of the circular economy and sustainable development since it can boost the production process's technological efficiency as long as industrial symbiosis relationships between companies remain active for a longer period (Fraccascia, 2019). However, this symbiotic relationship remains vague between the seaports and dry ports. Although from the managerial perspective many views can be derived, not much has been done from the academic view especially in the Malaysian context. Hence this paper has been initiated to reduce the lacuna in the ambidextrous relationship between seaports and dry ports as well as the implication on regional growth.

Technological advancement is one of the key indicators for seaport competitive advantage. This occurs for both shipping and seaport operations, containerisation, and changes in manufacturing and multimodal transportation. However, according to Pallis and Vaggelas (2005), competitiveness will be achieved when the seaports are responsive to a high level of differentiation to the port users' demand compared with other seaports. This can improve the technological efficiency of manufacturing processes if the symbiosis or relationship between seaports and dry ports remain active over a long period. Roso et al. (2015) stated that in dry port operations' perspective, the level of port competitive efficiency can be achieved by having a transport infrastructure planning, appropriate planning and efficient operation of container movement to seaports, competition with other transport nodes, location, as well as high infrastructure pressures on the city that impacts on the role of dry port operations.

Most of the dry ports deal with a noteworthy volume of containers for seaports and intend to go as local multi-purpose hubs interfacing with terminals. It is important to encourage the growth of freight along the supply chain and upgrade the intensity of seaports to grow the seaport organisations to inland districts (Roso et al., 2015). Notwithstanding, the presence of such contrasts can be a wellspring of administration roles by initiating cooperation to boost seaport intensity. This volume additionally makes a convincing case for seaport coordinated effort around the current difficulties looked at by seaport-overseeing bodies, including hinterland advancement and the economic progress towards more eco-accommodating vehicle modes while keeping up and having the upper hand in the seaport competitiveness (Haezendonck & Verbeke, 2020).

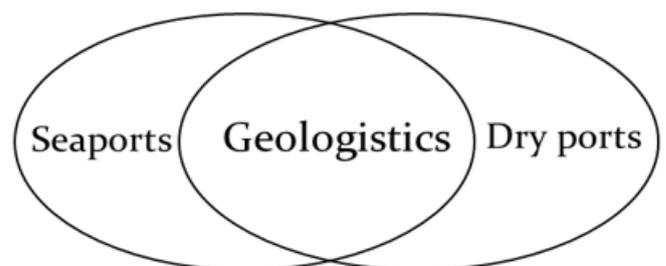
The implementation of a dry port in a seaport's immediate hinterland could facilitate the seaport to stabilize the pressure from overusing the terminal capacity through upgrading the landside integration of the seaport via high capacity transport. The execution of the dry port in the seaport's immediate hinterland could encourage the seaport in expanding its terminal limit inland and implementing the concept of regionalisation in the seaport system. In the process to carry forward the seaport services to another location, the concept of sustainable development needs to be absorbed by seaports and dry ports to achieve an environmentally friendly business nature which ben-

efits their clients and foster proactive environmental strategies for future sustainability (Kovacs et al., 2008).

The circular economy refers to a waste management system which contributes to minimum emission. According to Gallo et al. (2020), the circular economy is focusing on utilising waste as resources to minimise greenhouse emission (GHG). In the seaport sector, the application of circular economy is based on industrial symbiosis, urban symbiosis and city-territorial symbiosis (Hazendock & Berghe, 2020). Industrial symbiosis refers to a business-focused approach to promote sustainability (Salamone et al., 2020), while urban symbiosis indicates the relationship between seaports and city and inland ports to minimise the waste and maximise re-use for economic activity and protecting the urban environment. Finally, city-territorial symbiosis shows an integration between seaports and wider hinterland areas for regional freight movement and contributing to reverse logistics (Hazendock & Berghe, 2020).

The aforementioned contents indicate that the symbiotic relationship may generate three main advantages including competitive advantages, reduction in GHG or deriving the benefits from the circular economy and sustainable economy. However, in the context of the symbiotic association between the seaports and dry ports, these three general benefits can be translated into a concept of geologistics. As an outcome of industrial symbiosis, these three elements have given significant consideration to motivate the symbiotic relationship to gain an ambidextrous functionality between them. In this paper, the same outcome will be derived to analyse the relationship between the seaports and dry ports. However, a term called geologistics has been utilised to relabel the three elements that are generated through this symbiotic relationship. This is because geologistics are defined as being a broad term used to characterise the process of concentrating all knowledge to utilise the available resources for the welfare of mankind (Sachaklian, 2012). Competitive advantage, circular economy and sustainable development are taken into consideration for creating a good life for mankind. Hence, the concept of geologistics in this paper refers to the utilisation of in-situ resources to enhance the efficiency in the logistics system to gain competitive advantages, minimum emission and sustainable development.

Figure 1: The symbiosis concept in the relationship between the seaport and dry port.



Source: Authors.

2.2. The current symbiotic relationship between seaports and dry ports.

According to Jeevan et al. (2018), a collaborative relationship should be established between dry ports and seaports to ensure dry ports are involved in the smooth management of container freight, thus benefiting customers. The efficiency of dry ports is influenced by the rivalry in similar functions between seaports and dry ports. Seaports, for instance, plan to benefit from precedence by delaying the transport of containers from seaports to dry ports. Thus, the dry-port operator cannot compete and deliver containers to the supplier at the time promised, but a collaborative relationship between the seaport and dry port may prevent this.

During the last few decades, the seaport industry has continued to change as global trade, external markets and consumption have increased. These factors have resulted in seaports becoming more competitive, active and sustainable. Because of the changes, seaports are required to manage and monitor their performance to achieve organisational performance. The dry ports need to assist seaports in their performance management and monitoring. Nowadays, dry ports have been put forward as essential links for efficient global freight transport and corridor development (Witte et al., 2014). The increasing volume in container traffic and demand for seaport services have resulted in this node expanding its capacity as well as the functionality of services. This reflects an increase in container freight transport. Nonetheless, due to the limited supply of land for seaport enlargement, congestion has increased, especially at major container seaports.

Seaports strive to increase freight traffic through dry ports to reduce congestion and boost competitiveness. The priority is to enhance the productivity of seaport operations. According to Wan et al. (2014), the inland extension of the seaport due to the growing number of inland ports or dry ports is essential to support the productivity of seaports and to ensure they remain attractive among their competitors worldwide. Dry ports have significantly developed to become important anchors to improve seaport profitability, reduce congestion in seaports, increase terminal capacity in seaports and enhance seaport inland interconnections (Roso et al., 2013). Dry ports assist and enhance seaports' capability and performance such as enhancing the multimodal connectivity that is related to hinterland delivery (Ngoc et al., 2011).

According to Roso et al. (2013), the increase in freight flow in every seaport would contribute to congestion in seaports, leading to considerable increases in container residential times and eventual delays. Thus, seaports can relieve their limits in space by using dry ports for logistic purposes and providing customs clearance and other value-added facilities (Roso et al., 2013). In New Zealand, Wiri Inland Port contributes to the management of late containers moved from the seaport which also reduces the charges for seaport demurrage (Frost, 2010). According to Jeevan et al. (2018), dry ports assist container seaports by providing space for laden containers and empty containers and providing more spaces at seaports. Dry ports assist seaports by enhancing the capacity of the seaport, boost-

ing the seaport's competitiveness, increasing the efficiency of the seaport and reducing the demurrage charges at the seaport.

3. Methodological frame and unit of analysis.

To meet the aim of this paper, interviews were employed to gather information about the symbiotic relationship between the seaport and dry port in Malaysia as well as their implication on Malaysian regional development. Convenience sampling has been utilised to select the participants to participate in the interview session. Convenience sampling aims to identify the potential participants who are available and ready to be involved in the interview session (Klassen et al., 2012). This sampling frame is proposed by locating potential respondents who meet the required criteria and selecting them on a first-come-first-served basis until the sample size proportion is full (Robinson, 2014).

A total of twenty (20) potential participants from higher management positions with adequate knowledge of seaport and dry port operations throughout the regions were selected. The participants consisted of five (5) key players each from Malaysian dry ports, seaport authorities, seaport operators and government agencies, respectively. A method of content processing was used to analyse the gathered data. The content analysis is a systematic interpretation that is not limited to the author or the user of a whole body of text, images and symbolic matters. According to Madzli et al. (2020), content analysis is a research technique used to analyse and interpret documents, media or tangible objects such as historical work of the collected data or knowledge to draw a valid conclusion.

4. Results and discussions.

The number of participants was reduced due to the Covid-19 pandemic and only fifteen (??) surveys were completed since some of the selected interviewees could not commit themselves (see Table 1). Each interview session took about 90 to 210 minutes on average. In section 1 of the questionnaire, the participants were asked about their perspective and opinion about the contribution of the seaport towards the dry port. In section 2, the participants were asked about their perspective on the contribution of the dry port towards the seaport. In the final section, the participants were asked about the implication of this symbiotic relationship on Malaysian regional development. The discussions were based on categories or topics developed based on the research objective through a data analysis process.

4.1. The contributions of the seaport towards the dry port.

Based on the responses from the participants, the contribution of the seaport towards the dry port was analysed and consequently, four themes have been derived. Specifically, all the participants agreed that the contribution of the seaport towards the dry port boosted the productivity of dry ports. "*The standardisation of operations procedure, scheduling of the cargo and the harmonisation of the communication between the seaport and dry port increase the productivity of this inland node*". These

participants also emphasised that a seaport should have a dry port or inland terminal as an alternative for the maritime port to face uncertain situations. For example, during the pandemic, dry ports can perform as humanitarian terminals to accommodate, repack and supply necessary cargo to and from inland.

Table 1: Demographic profiles of participants and interview session durations.

No	Identity code	Participant	Years of experience	Date of interview	Time of interview	Duration of interview
1.	P ₁	Seaport operator	15	26 Nov 2020	0930-1100	90 minutes
2.	P ₂	Maritime department	11	10 Nov 2020	1000-1230	150 minutes
3.	P ₃	Ministry of Transport Malaysia (MOT)	6	27 Nov 2020	1400-1630	150 minutes
4.	P ₄	Seaport authority	8	28 Nov 2020	1115-1330	165 minutes
5.	P ₅	Seaport operator	10	25 Oct 2020	0830-1045	135 minutes
6.	P ₆	Seaport authority	12	2 Nov 2020	0900-1130	150 minutes
7.	P ₇	Seaport operator	19	20 Nov 2020	0830-1045	135 minutes
8.	P ₈	Seaport operator	14	22 Nov 2020	0830-1145	195 minutes
9.	P ₉	Dry port	10	23 Nov 2020	1115-1300	135 minutes
10.	P ₁₀	Seaport operator	12	27 Oct 2020	0900-1130	150 minutes
11.	P ₁₁	Malaysian railway	21	7 Nov 2020	0900-1230	210 minutes
12.	P ₁₂	Seaport authority	7	9 Nov 2020	1115-1300	135 minutes
13.	P ₁₃	Dry port	10	11 Nov 2020	1100-1300	120 minutes
14.	P ₁₄	Seaport authority	14	26 Nov 2020	1400-1600	120 minutes
15.	P ₁₅	Dry port	13	21 Nov 2020	1600-1830	150 minutes

Source: Authors.

Seaports assist dry ports to provide the continuity of cargo to this specific terminal (P₃, P₄ & P₁₅). They mentioned that “this contribution of seaports to dry ports ensure these terminal remain sustainable by receiving continues cargo from foreland”. By this approach, the awareness of the functionalities of dry ports will be exposed to new and potential clients. The DPA Maritime (2018) stated that a seaport is a point of entry and exit for different cargo. Improved capacity for cargo accommodation, seaport channels and berths have been built to handle these ships and facilities for freight handling. This raises freight loading and unloading time that allows the dry port to become more competitive and leads to foreign trade. “In addition to that, seaport provides or initiates connectivity via road or railway to reach a dry port or inland port. This assists dry port to manage the transportation of freight from seaport to dry port and vice versa as requested by customers” (P₁, P₃, P₄ & P₁₃). This is evident in an argument by Jeevan (2018) stating that a collaborative relationship should be established between dry ports and seaports to improve the performance of dry ports for smooth management of freight transportation which will benefit customers in the end.

The seaport also contributes to the efficiency in freight mobility in the dry port (P₁, P₂, P₃, P₅, P₆ & P₇). Based on the respondents, “seaport assists dry ports to manage freight movement by having a significant interaction and strong cooperation between them. Information sharing through communication is crucial for all port management”. According to Jeevan et al. (2020a), significant communication between ports allows these

nodes to provide their customers and stakeholders with reliable and productive services.

The third element of the contribution of the seaport towards the dry port is the seaport can help the dry port to enhance its capacity. Based on the data, all of the respondents agreed that seaports can enhance the capacity of dry ports. *This capacity is highly related to space, services and infrastructure ability. This condition is crucial to cater the demand from hinterland of dry ports and also to gain confidence from their clients.* Besides, based on the respondents’ responses, the seaport can support the dry port by providing customs clearance and other supplementary value-adding activities which cannot be provided inland. Some of the respondents explained that the seaport still needs a dry port as its representative in various locations inland.

4.2. The contributions of the dry port towards the seaport.

Based on the responses from the participants, the contributions of seaports towards dry ports were analysed and consequently, five themes were identified. According to (P₁, P₂, P₃ & P₆), “the contribution of dry port toward seaport allowed seaport in relieving congestion and enhancing seaport’s competitiveness”. According to (P₅, P₆ & P₇), “the dry port can enhance the seaport’s competitiveness by utilising and maximizing the train capacity in carrying cargo from the seaport to the dry port. The dry port also assists the seaport in providing all the logistics facilities and services available at the seaport to interior strategic location which is essentially an extension of the seaport”. Some of the respondents (P₁₀, P₁₁ & P₁₃) stated that “dry port helped in providing capacity and space due to the capacity in most of the Malaysian seaports have reached an optimum level” (see Table 2). Roso et al. (2013) stated that dry ports have evolved significantly to become influential in improving the profitability of seaports, helping to ease congestion at seaports, growing terminal capacity at seaports and enhancing inland connectivity at seaports.

Table 2: Container throughput and seaport capacity of Malaysian seaports in 2018.

Port	Container volume (TEUs)	Seaport capacity (TEUs)	Utilisation rate (%)
*Port Klang	12.3million	17.6 million	70%
*PTP	8.9million	12.5 million	71%
*Penang	1.5million	2 million	75%
*Johor Port	0. 900million	1.2 million	75%
Kuantan Port	0.149million	0. 600million	25%

TEUs: Twenty-foot Equivalent Units

*Approaching optimum level of utilisation rate

Source: Jeevan et al. (2020b).

Some of the respondents (P₅, P₁₂ & P₁₄) stated that “dry port can develop an efficient transportation system that can utilise the train facilities as the main carrier for cargo from the seaport. The dry port initiating and managing intermodal transportation from dry port to a seaport. This is because the dry port can act as a freight coordinator to ensure that users enjoy a one-pack service package that includes road transport from dry port to premises or vice versa”. Reservation via the

dry port can assist the seaport to manage the late-transfer containers for shipping, documentation clearances especially for customs, brokerage as well as freight forwarding. Further, the expansion of vessel size in the current maritime trend, the immediate freight removal from seaports and instant arrival of cargo for rapid uploading procedure cannot be done by a single entity and requires a comprehensive freight transportation system (Jeevan & Roso, et al., 2019). Hence, the availability of this inland terminal with sufficient transport facilities will additionally become a supporting capacity for seaports.

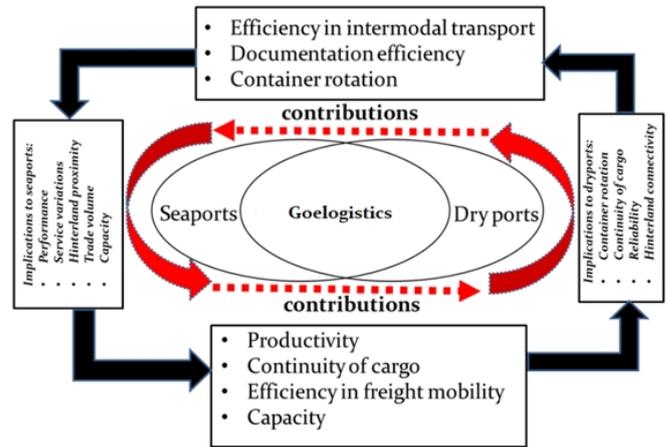
Besides that, the dry port assists and enhances the efficiency of the seaport when importers and exporters clear all the import duties and customs duties of their goods at the dry port (P2, P7 & P15). The dry port can replace the seaport in managing the client to clear all the taxes at the dry port. This can help the seaport to maintain efficiency and effectiveness. The dry port assists the seaport to manage the delayed containers and enhances the effectiveness in container rotation (P8 & P9). For example, the Covid-19 pandemic caused most of the containers to be stranded in the Intra-Asia Trade zone which caused blank sailing and eventually increasing the carrier surcharges. At this point, dry ports can contribute to re-rotate the containers from the point of destination to point of origin through these specific inland nodes. According to Frost (2010), some dry ports assist seaports to manage the delayed containers that were moved from seaports or inland and improving the rotation of the containers in the seaport system. Figure 2 summarises the symbiotic relationship that occurs between these two major nodes in Malaysia.

During the interview sessions, most of the participants from seaports (P1, P5, P7, P8 & P10) argued that seaports are not dependent on dry ports for operational efficiency, profit enhancement or as the seaports' representatives in different locations inland. In contrast, these dry ports are dependent on the seaports to meet their operational purposes. This situation indicates that the readiness of seaports to collaborate with dry ports is not at a mature level but remains at the infant stage. Trade instability, exposure to the global pandemic, rapid advancement in technological applications, new and trendy marketing approaches, skyrocketing demand from clients, competition with inter-regional and intra-regional seaports and others are valid justifications for why these two entities need to cooperative rather than being competitive.

5. Proposing forms of cooperation between seaports and dry ports.

According to Jeevan et al. (2020a), insufficient resources and inconsistency in global market trend have become the main influencing factors for cooperation among maritime nodes in this country. Hence, these factors correspondingly become the motivation for seaports and dry ports to cooperate and achieve a competitive advantage in the maritime trade. For example, lack of ability to serve the clients, the limited scope of the market, new participant threats, port user bargaining power, competitive intensity and sustainable development are some of the factors which fall under the scope of insufficient resources. Besides,

Figure 2: Summary of a symbiotic relationship between the seaport and dry port.



Source: Authors.

inconsistency in global market trend refers to an environmental factor, uncertain international business environment, competition among existing competitors and barriers to entry to new markets. Hence, these factors have become the main motivation for substantial cooperation between these two nodes of the country.

Therefore, to initiate the cooperation between seaports and dry ports in this country, several aspects need to be considered which include co-adjutant (mutual agreement), public-private partnership (PPP) and alliances as shown in Table 3. These partnership strategies have been experimented with among seaports, especially in this country. Hence, it is possible to generalise these current cooperation policies which have been used solely among seaports to be mutually implemented for seaports and dry ports.

Firstly, the cooperation between seaports and dry ports can be started through the co-adjutant procedure. Through this policy, coepetition, cooperation agreements, complementary cooperation, exchange of knowledge and institutional cooperation are required to initiate the cooperation between seaports and dry ports. Initial research (Jeevan et al. 2020a) shows that some seaports from China such as Port of Dalian, Jiangsu Taicang Port, Port of Haikou City, Fujian Fuzhou Port, Guangzhou Port, Beibuwan Port, Ningbo Port and Qingdao Port have become sister seaports to Port Klang. As sister seaports, they are willing to share resources for seaport research, training, apprenticeship, exchange of information, technical assistance, traffic development and service establishment. In this context, a similar approach can be replicated, whereby the seaports become mentors to dry ports for achieving the abovementioned objectives.

Table 3: Motivation for cooperation and types of cooperation between seaports and dry ports.

The motivation for cooperation between seaports and dry ports	Motivation
Insufficient resources	Lack of ability to serve the clients, the limited scope of the market, new participant threats, port user bargaining power, competitive intensity and sustainable development.
Inconsistent global market trend	An environmental factor, uncertain international business environment, competition among existing competitors and barriers to entry to new markets.
Form of cooperation between seaports and dry ports	Approache
Co-adjutant (mutual agreement).	Coopetition, cooperation agreements, complementary cooperation, exchange of knowledge and institutional cooperation.
Public-Private Partnership	Cooperating with port authority, commercial cooperation, industrial cooperation, joint investment, and agreement for an exchange of services.
Alliances	Joint lobby, horizontal integration, cross participation, and strategic alliances.

Source: Authors.

Secondly is about Public-Private Partnership (PPP). According to Ismail (2013), PPP is the most widely used mechanism by the government to relocate a certain portion of responsibilities to private parties in providing public services effectively. Initial research indicates that cooperating with the port authority, commercial cooperation, industrial cooperation, joint investment, and agreement for an exchange of services are some of the strategies to implement PPP among seaports. In this case, similar approaches can be implemented as a catalyst for the cooperation between seaports and dry ports. Assimilating dry ports in seaport authority, involving dry ports in seaport cooperation plan, investment plan as well as agreement for an exchange of services through PPP will be a significant modus operandi for enhancing the cooperative trends in a vertical direction.

Thirdly, alliances specify the goals and scope of cooperation. Joint lobby, horizontal integration, cross participation, and strategic alliances are the main components in the alliances. In general, alliances can be achieved when the two seaports consent to share assets to accomplish similar objectives. Therefore, a similar approach can be taken to enhance the alliance between seaports and dry ports. For example, the implementation of an e-port community exchange platform to share information database, human resource training and development programs for seaport personnel, best practices in seaports and logistics industry, mutual promotion efforts to support seaports in both country and seaport terminal investment, operations and development are some of the examples that can be implemented between seaports and dry ports in this country. Table 3 summarises the outcome of the motivation for seaport and dry port cooperation and types of cooperation that can be executed between these maritime nodes.

5.1. Requirements for an effective symbiotic relationship between seaports and dry ports.

Initial findings show that the symbiotic relationship between the seaport and dry ports is possible and cooperation between them also can be implemented due to the existing policy that has been executed in the Malaysian seaport system (see Figure 2 and Table 3). Although the exploration of the possibilities

for a symbiotic relationship between these critical nodes and the types of cooperation that can be initiated to boost this symbiotic association has been done, the basic requirements that these nodes must have to kick start the proposed association are still uncertain.

During the interview session, all participants have agreed that three main components are required to initiate the symbiotic cooperation between seaports and dry ports which including operational infrastructure, human factor requirement, capital infrastructure and policy development. *They argue that seaports and dry ports need to complement each other in term of the policy, capital, infrastructure, human factor and operational requirements by sharing the resources in each entity to achieve the ultimate goal in the trading business.*

Firstly, seaports and dry ports have to initiate this cooperation through an operational infrastructure consisting of primary conditions, important conditions, differentiating conditions and miscellaneous conditions (*all respondents*). From the view of the primary condition, seaports and dry ports have to prepare basic infrastructure such as container yard, customs, rail access truck, rail siding, express clearance lane, immigration and quarantine office (see Table 4). Then, key components such as weighbridge, truck parking bay, internal roads, cargo consolidation yard, external and internal road accessibility, and stacker cranes need to be prepared. Other than that, bonded and non-bonded warehouse, stuffing and unstuffing yards, empty container and repair yards and clearance agent’s office, as well as police station, fire station security office and cafeteria, are categorised as differentiating and miscellaneous conditions that need to be prepared by these two freight nodes to gain substantial benefits from the proposed symbiotic associations (Jeevan et al., 2020a).

Besides infrastructure, the human factor has become another component that seaports and dry ports need to complement each other to be a success in the symbiotic alliance. For example, warehouse staff, yard staff and safety as well security staff have been proposed by the respondents (P1, P3, P5, P6, P8 & P9). Based on these three categories, they suggested that bonded and non-bonded, container yard, stuffing and unstuffing, consolidation, container repairs, physical check officers, express clearance lane officers, truck parking bay managers and stacker crane operators, customs officers, immigration and quarantine officers, security officers, police officers and fire fighting officers need to be placed in both nodes to ensure an effective operation (Gujar, 2011).

Thirdly, (P5, P6 & P7) suggested that capital requirements need to be enforced in seaports and dry ports. For example, spatial necessities (land area and warehouses), legal necessities (customs office, immigration and quarantine office) and accessibility necessities (rail siding, rail access tracks, weighbridge, yards, internal roads) need to be developed as main prerequisites for a glorious association between seaports and dry ports (Budi et al., 2019).

Table 4: Fundamental requirements for an effective symbiotic relationship between the seaports and dry ports and the implication on regional development.

Symbiosis in operational infrastructure		Implication on regional development
Primary conditions	Container yard, customs, rail access truck, rail siding, express clearance lane, immigration & quarantine office.	Infrastructure development
Important conditions	Weighbridge, truck parking bay, internal roads, cargo consolidation yard, external and internal road accessibility, and stacker cranes	
Differentiating conditions	Bonded and non-bonded warehouse, stuffing and unstuffing yards, empty container and repair yards and clearance agent's office	
Miscellaneous conditions	Police station, fire station security office and cafeteria.	
Symbiosis in human factor requirement		
Warehouse staff	Bonded and non-bonded	Socio-economic development
Yard staff	Container yard, stuffing and un-stuffing, consolidation, container repairs, physical check officers, express clearance lane officers, truck parking bay managers and stacker crane operators.	
Safety and security staff	Customs officers, immigration and quarantine officers, security officers, police officers and fire fighting officers	
Symbiosis in capital infrastructure		
Spatial necessities	Land area and warehouses	Infrastructure development
Legal necessities	Customs office, immigration and quarantine office	
Accessibility necessities	Rail siding, rail access tracks, weighbridge, yards and internal roads	
Symbiosis in policy development		
Investment policy	Public-Private Partnership (PPP)	Socio-economic and infrastructure development
Transport infrastructure policy	Highways, railway gauges, traffic lanes and thick pavements for heavy motor vehicles to optimise distribution processes	
Seaport policy	Intermodal infrastructure and seaport-hinterland connectivity	
Multimodal transport policy	Facility for modal shift and split	
Inland port policy	Connecting inland players and seaports	

Source: Authors.

5.2. Implication of ambidextrous functionalities of freight nodes on regional development.

During the interview sessions, the respondents were asked about the main influencing factors that trigger regional development from the symbiotic relationship between seaports and dry ports. Firstly, (P1, P2, P3, P4 & P12) agreed that these freight nodes managed to enhance the opportunity for economic investment and initiating employability. They mentioned that “job opportunities, socio-economy growth, transportation system, infrastructure facilities and a better standard of living are the main reason for an opportunity for economic investment and these advantages can be derived if these two major freight nodes are cooperating instead of competing”. They also added that the combination of these two nodes may encourage resource utilisation and overcome current issues in the Malaysian labour market such as limited job opportunities, limited placement and insufficient professional human capital for economic growth. Furthermore, the cooperation between these two freight nodes integrates inland and coastal maritime activities by developing a regional centric logistics plan.

As an implication, most of the participants argued that this effective “combo” of freight nodes may enhance infrastructure and socio-economic development especially in the north and east coast of peninsular Malaysia. For example, (P1, P4, P5, P8, P11 & P12) emphasised that infrastructure development will be seen from the perspective of the standard of living of the community around seaports and dry ports, increasing the utilisation of seaports and dry ports and increasing hinterland development and road-rail connectivity. From a socio-economic perspective, (P2, P6, P7, P9 & P10) declared that the ambidextrous plan between the seaports and dry ports encourages trade growth, development of export-driven industries, increased transport infrastructure, boosts local producers, attracts inward investments and improves the standard of community life. Nevertheless, the

absence of a symbiotic relationship between the seaports and dry ports may reduce the trade efficiency in this country compared with other countries which have a very substantial relationship between these nodes (Bergqvist & Monios, 2021). This situation may affect the pace of regional development in this maritime nation. For example, the absence of a symbiotic relationship between the seaports and dry ports in operational, human factor, capital and policy development may prevent infrastructure and socio-economic development which eventually discourages the emergence of a geologistics application from the cooperation of seaports and dry ports. The relationship between them may utilise in-situ resources to enhance the efficiency in the logistics system to gain competitive advantages, emission reduction and sustainable development.

Conclusion and implications.

A symbiotic relationship is a healthy relationship between seaports and dry ports for sharing their advantages or benefits. This symbiosis relationship has led seaports and dry ports to enjoy competitive advantages, promote the circular economy and for sustainable development. The result from the interview sessions indicates that seaports are contributing in terms of productivity, cargo continuity, efficiency in freight mobility and enhancing the capacity of the dry ports. In contrast, the dry ports are providing efficiency in the intermodal transport, document efficiency and assisting seaports in the container rotation process. The existence of the symbiotic relationship between seaports and dry ports needs to be explored further due to the requirements of this unpredictable environment especially in the maritime trade. For example, during the Covid-19 pandemic, these nodes were unable to perform independently to cater to the need of each region. Therefore, cooperation from seaports and dry ports are required to ensure the sustainability of these entities. To ensure a successful symbiotic association between seaports and dry ports, fundamental requirements need to be emphasised.

Operational infrastructure, human factor requirement and capital infrastructure and policy development need to be considered. Seaports and dry ports need to be prepared in terms of operation, human factor and capital development to retain the sustainability of a symbiotic cooperation between them. Further, a clear policy is required to bring seaports and dry ports together and benefit the region collectively. Currently, the seaport policy and infrastructure policy are the main policies to be referred to regarding these two entities. Therefore, a new policy especially on inland ports needs to be introduced to infuse the functionalities, objectives, roles and mission of these two nodes under a single roof. From the regional development perspective, this symbiotic relationship is happening to boost economic investment and initiating higher employability in this country. As a result, infrastructure and socio-economic development are considered lucrative outcomes from this cooperation.

In a nutshell, the symbiotic relation between the seaport and the dry port explores all connections between the seaport and the dry port. The future outlook indicates that the volume of containers will continue to increase and eventually affecting the

capacity of seaports as well as dry ports. To overcome these circumstances, seaports and dry ports need to be linked to offer a long-term solution for these nodes by remaining competitive in global markets as well as achieving the necessity of geologistics between seaports and dry ports.

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