An Empirical Analysis on Container Vessels Enlargement: Exploring Causal Factors from the Perspective of Malaysian Maritime Trade System

Jagan Jeevan, Masha Menhat, Diana Anuar

Abstract: The capacity of container carrier has been evolved since 1956 from 500 TEUs until more than 21,000 TEUs via Ultra Large Container Ship (ULCS). Large vessels benefited the customers from the perspectives economies of scale at sea, but terminal operators and seaport authorities are pushed into potential diseconomies of scale because they must make significant investments such as equipment and nautical accessibility. To react with the current situation, a research was carried out to investigate the main factors that contribute to the containership size enlargement which become a significant parameter for seaport competitiveness. Self-administrated and online survey has been conducted at 3 main seaports including Port Klang Authority, West Port Malaysia and Port of Tanjung Pelepas which consisting of 37 participants. To achieve main objectives of this paper, Exploratory Factors Analysis (EFA) has been employed. The outcome shows that factors that causing vessels enlargement in Malaysian maritime system are including shipping operations, seaport and shipping integrations, cost effectiveness and technological advancement.

***Index Terms*: Keywords: Container Vessel; Vessel Enlargement; Malaysian Seaports.**

I. INTRODUCTION

In the middle of 1950's a container revolution has been initiated by Malcom McLean who was the mastermind behind the design of first containership. Finally, in 1956 a steamship vessel called *Ideal X* make first voyage in the Atlantic Ocean from New Jersey to Houston, Texas (Pinder, 2016).The evolution of the containerization is not meet the end whereas the existence of modern containership known as *Gateway City* with capacity of 226 containers has been introduced to the ocean. Then, in 1968 and 1969, American Lancer (capacity of 1210 TEUs) and Encounter Bay (capacity of 1530 TEUs) were among the first purpose-built cellular ships. Then Handy ships (capacity of 2000 TEUs) also included at the end of the 1960s. That was the main reason why those years are catogorised as a 'trial and error' years due to the most container ship developed. A new chapter started in 1970's where the era of Panamax where increasing as well as the capacity of these container vessels are also increasing simultaneously. The capacity of sub-panamax ships are between 2000–2999 TEUs and Panamax are between 3000–4500 TEUs (Tran and Haasis, 2015).

The significant increase in demand has resulted a dramatic uprising in vessel size up to 8000 TEUs in 2000s (Tran and Haasis, 2015). The size of this vessel has grown up to 19,000 TEUs in 2016. Monios (2017) argue that the evolution of container vessels size is continually increasing and no signs of stopping. This because the ability to gain significant profit the traders willing to explore to transport a huge volume of containers to gain economies of scale and economies of scope respectively. The trend of ship size enlargement is not stopping at the physical capacity building. However, the enlargement of ship size also happened via alliances between several shipping companies which has navigated a new trend of ship size enlargement This recently-strengthened vessel-sharing alliances is for purpose filling ship capacity and therefore, many shipping lines has indicated their interested to involve in this promising business strategy. This strategy usually reached between various partners within a shipping consortium who agree to operate a liner service along a specified route using a specified number of vessels (Pinder, 2016). This strategy allows ocean carriers to reduce the operational costs and increase efficiency by splitting up the available slots for containers (Hacegaba, 2014). Further Notteboom *et al.* (2017) added that consolidation and alliance formation enable a small number of large shipping groups offering joint services on key trade routes for a significant collective benefits.

In this digital century, shipping industries are familiar about trend of ship size enlargement. In addition to that, industry players began to explore to core reason of this scenario. The growing demand for maritime container transportation is exceeding the capacity of vessels. Therefore, the introduction of mega vessels and strategic ship alliances are immediately required for fuel-efficiency This because the advantages of a 20,000 TEU vessel is that the CO^2 emissions generated by transporting each container are 50% lower than a ship that carries 8000 TEUs

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(Notteboom *et al.* 2017).

Despite providing a huge benefit to the traders and environment, the introduction of these mega vessels generating significant implications to seaport by introducing new requirements on seaports, impacting land-side operations and stressing the whole logistics chain of containers. Ports invest large sums upgrading their facilities and competing to receive vessel calls but handling such demand spikes is difficult. Large container drops can result in inefficient crane utilization, as the numerous large cranes required to service large ships are not all required between calls; furthermore, such numbers of containers cannot always be moved in and out of the port in a smooth manner. It has been estimated that a 19,000 TEU vessel dropping 8800 TEU in a single call will necessitate 14,000 container moves, 53 trains (carrying 90 containers each), 96 TEU barges and 2640 trucks (Grey, 2015). In addition to that, terminal operators and seaport authorities are pushed into making significant investments in equipment and nautical accessibility in view of reducing or eliminating potential diseconomies of scale of such large units in seaport (Notteboom *et al.*, 2017).

Vessels enlargement has indicated to provide significant benefits to the trades and conversely providing massive stress to the seaport operators. Based on these statements, this paper will analyse the factor contribute to the vessel enlargement from the perspective of Malaysian trading system. This is important to identify to root-cause of this issue to provide appropriate policy and recommendation strategies to ensure the vessels enlargement provide prolific benefits to all players who involved in the container transportation chain. The legend of this paper is organised as follows. Section 2 reveals the methodological application employed in this paper. Section 3 reviews the literature on the factors that affecting vessel enlargement and Section 4 indicates the result and discussion of this paper. Finally, Section 5 concludes the paper.

II. METHODOLOGICAL APPLICATION

This study employing Exploratory Factor Analysis (EFA) by utilising SPSS Version 22 software to execute the data analysis procedure. In this paper, a mixture of descriptive and inferential statistical analysis was used by exploratory factor analysis (EFA). EFA is exploratory in nature and it investigates the main dimensions to generate a concept, theory or model from a large set of items (Williams et al. 2010). In this paper, EFA was applied to validate and explore the relationship among the factors that influence vessel enlargement from the perspective of Malaysian trade system. The objective of this paper was to evaluate these factors and construct a brief description of the data structure. Both approaches are important to define newly developing features or dimensions of the factors that underline the set of items (Tabachnick and Fidell 2007).

Exploratory factor analysis is a multi-step process, a complex procedure with few absolute guidelines and many options (Costello and Osborne, 2005). Further, the broad purpose of factor analysis is to summarize data so that relationships and patterns can be easily interpreted (Yong and Pearce, 2013). Hence the main aim employing EFA in any research is to determine the minimum number of common factors required to adequately reproduce the item correlation matrix (Izquierdo et al. 2014). Moreover, Yong and Pearce (2013) argue that the importance of EFA is to help researcher to reduce a large datasets that consist of several variables by observing 'groups' of variables. In this paper, the factor that influence the vessel enlargement will be classified accordingly based on the view from Malaysian seaports. Fig. 1 presents the vessel enlargement model. It consists of list of factors (x_1-x_{16}) and expected group of factors (factor 1-4) after EFA analysis.

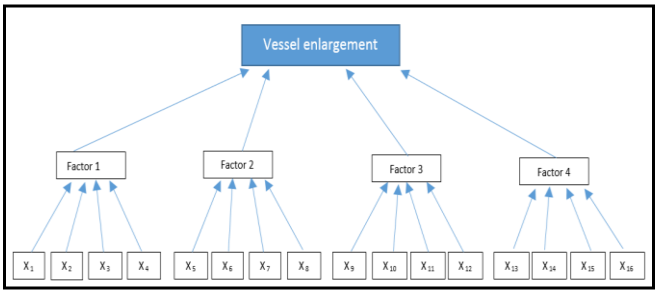

Fig. 1: Conceptual framework for EFA of vessel enlargement factors

A. Sample Profile

Table I presents the general characteristics of the sample representative, whom are expertise in shipping industry. There are total 37 respondents from 2 seaport operators and one seaport authority. Total response rate for Port Tanjung Pelepas is 59.5%, West Port Malaysia (27 %) and Port Klang Authority (13.5%). In organization type, it was found that plenty of respondents are from terminal operator (89.2 %) and port authority, 8.1%. The participant is mostly from higher is senior group (40.5 %) while middle and junior group managers are 29.7% each.

B. Preliminary Analysis of Data

1) Validity of the result

Kumar et al. (2013) stated that validity is the extent to which a test measures represent on what want to measure. According to Hair et al. (2006) regarding measures of intercorrelation, the researcher must ensure that the data matrix has enough correlations to justify the application of factor analysis. The Kaiser-Mayer-Olkin (KMO) measure of sampling adequacy (MSA) and Bartlett's Test of Sphericit are parts of main method in testing the appropriateness of factor analysis (Kumar et al.2013). According to (Kumar, Talib and Ramayah, 2013) KMO: sizeable sampling adequacy is (>.8) great, (>.7) acceptable, (.6) mediocre, (<.5) unacceptable, while significant for Bartlett's Test is ($p < 0.01$). KMO MSA value should always above 0.50 before proceeding with factor analysis while the Bartlett's Test is sig. lower than 0.05 (Hair et al., 2006). The outcome in this paper is aligned with the requirements as proposed.

There are several criteria need to be considered for determining number of factors and items including in Eigenvalue with total variance, factor loading, and communality of each item. Eigenvalue is a measure of

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how much variance is explained by each factor (Kumar, Talib and Ramayah, 2013; Hair et al., 2006). The percentage of variance is based on a specified cumulative percentage of total variance extracted by successive factors (Hair et al., 2006). Both combination methods explaining total dimension of scale is extract with total variance percentage. The criteria used for selecting measurement items eigenvalue (>1.0) (Hair et al., 2010 cited in Kim, Kang and Dinwoodie, 2016). Number of factors to meet a specified percentage of variance explained, usually 60% or higher (Hair et al., 2006).

Table I: Demographic profile of respondents

Demographic Variable	**Description**	**Frequency**	**Percentage (%)**
	Port Klang Authority	5	13.5
Seaports	West Port Malaysia	10	27.0
	PTP	22	59.5
	Port Authority	3	8.1
Type of organisation	Terminal Operator	33	89.2
	Others	1	2.7
	Human Capital Management	2	5.4
	Marine	15	40.5
Department	Operation	9	24.3
	Port Planning	1	2.7
	Training & Development	10	27.0
	Junior	11	29.7
Job position	Middle	11	29.7
	Senior	15	40.5
	Less than 5 years	8	21.6
Working experience	5-10 years	6	16.2
	11 - 20 years	16	43.2
	Over 20 years	7	18.9

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2) Reliability Analysis

The reliability of measure is an indication of the stability and consistency in which the instrument measure the concept (Kumar, Talib and Ramayah, 2013). Internal consistency of measures is indicative of the homogeneity of items measuring the construct (Kumar, Talib and Ramayah, 2013). Internal reliability refers to whether those items are internally consistent or whether the items that constitute the scale are measuring a single concept (Hair et al., 2006). Cronbach's Coefficient Alpha is the most popular indicator of internal consistency and was utilised in this study to evaluate the reliabilities of measurement scales (Hair et al, 2006). Cronbach's Alpha >0.70 for all extracted factors indicates constructs which are internally consistent and valid (Hair et al., 2010). The coefficient values more than 0.7 are considered acceptable however for exploratory studies alpha value of 0.6 and above are also accepted (Ken 2011). In this paper, the alpha values are between 0.6 and 0.9 which indicates optimum level of reliability of the outcome.

III. FACTORS OF VESSEL ENLARGEMENT IN GLOBAL MARITIME TRADE

In general, there are three phases involved in the enlargement of container ship which including technology advancement, economies of scale in ship size and evolution of containerisation (Cullinane and Khanna 2000). Nowadays, firms are seeking for better development of containership where main criteria included both economies of scale and technology. However, contradiction in this phenomenon discovers that the use of larger container ships implies that economies of ship size are enjoyed at sea and diseconomies of ship size are suffered in seaport. Most of the firms believed that as the ship size increases, the ship costs at sea per tonne or TEU decrease" and inclusive total time spent on the voyage for ship efficiency (Cullinane and Khanna, 2000).

Tran and Haasis (2015) argue that cost saving is an important driving force to deploy bigger ships to provide minimum cost estimation in correspondence with different operating speeds and handling rates. Furthermore, the vital advantage is Twenty Equivalent Unit (TEU) as standardised measurement unit of capacity which allow costs can be disaggregated on a "per TEU" basis and many costs are incurred on this basis (Cullinane and Khanna, 2000).This because, the operation of container mega-ship is expected to benefit from the economies of scale achieved in the maritime segment of the trip (Imai *et al.*2006).On the other hand, the theory of optimum ship size which proposed by Kendall (1972) emphasises to minimise total transport costs during the voyage. Hub-and-spoke network required a cost minimisation model which can be derived from optimisation of

larger vessels to gain economies of scale and minimum terminal costs (Kidson *et al.*, 2015). Meng et al. (2017) indicates that economies of scale which applied on a larger container vessel able to reduce unit costs, thus influencing shipping liners tending to use larger sized container vessels. It is important to maintain the cost operation at the lower level to retain the cost of cargo at competitive level especially in hinterland.

A Malacca-max ship could carry 18,000 TEUs with cost saving of 16% over an 8000 TEUs. These dimensions are restricted by operational conditions of Malacca Strait and Suez Canal, which are the two key strategic positions on the East–West route. While, the Panama canal is the most important connection between West Coast North America and Europe, Far East and East Coast North America (Tran and Haasis, 2015). In result, the benefit of physical geography condition for maritime sea route, and hub and spoke network, give opportunity to firm built large containership size with greater TEU capacity.

During the era of Sub-Panamax era diesel engine was installed with large powered steam turbines for producing high speed ship. The container ship capable transporting 4354 TEUs and expand service voyage round the world. However, large amount of ballast water is required to maintain the stability, which resulted in lower DWT carrying capacity and higher fuel consumption (Watanabe 2000). Hence, new container ships have been developed with the same capacity, cheaper investment cost (about 5%), and less fuel consumption due to less or no ballast (Ham, 2005). Also designated the ship with wide beam for better stability, more flexible, easier, faster stowage of containers, and smaller heeling motion associated with loading and discharging (Fossey, 1994; Kai and Dan, 1997; Lloyd's Shipping Economist, 1996; Ryle, 1993; Tozer, 2003 cited in Tran and Haasis, 2015).

Table II: Factors that affecting vessel size enlargement

Factors that Affecting Vessels Size Enlargement	**Reference(s)**
• **Cost saving of bigger ships (such as capital cost, operational cost)**	(Tran and Haasis, 2015)
• **Per TEU as measurement unit (such in term of capacity and cost basis incurred)**	(Cullinane and Khanna, 2000)
• **Minimise cost trade-off between ship** • **Minimise total cost of terminal**	(Kidson et al., 2015)
• **Scale economies on segment of trip (service network, time sailing)**	(Imai et al., 2006)
• **Reduce unit cost influence liner shipping use bigger ship**	(Meng, Weng and Suyi, 2017); cited Cullinane and Khanna (2000) & (Tran and Haasis, 2015)
• **Formation of shipping liner alliance**	(Notteboom et al., 2017)
• **Evolution containerization**	(Hayuth, 1987) cited in (Cullinane and Khanna, 2000)
• **Increase capacity of ship carry container**	(Notteboom et al., 2017; Tran and Haasis, 2015)
• **Produce high speed ship** • **Save or reduce fuel consumption** • **Better stability of Ship** • **Easier and faster stowage of container**	(Tran and Haasis, 2015)
• **Change multi-port calling to hub and spoke network**	(Imai et al., 2006)
• **Change in the design of canal and strait**	(Andrés and Piniella, 2017; Tran and Haasis, 2015)
• **Country as hub trade (such: china and the republic of Korea in East Asia, Singapore and Malaysia in Southeast Asia)**	(Hoffmann, Wilmsmeier and Lun, 2017)
• **Canal and strait linking maritime-hub and sea route**	(Andrés and Piniella, 2017)
• **Bunker prices constantly fluctuate** • **Strict emission standards regulation**	(Notteboom and Vernimmen, 2009)
• **Improving vessel efficiency, reduce emission, and cost effective**	(Corbett, Wang and Winebrake, 2009)
• **Alternative technology on ship to reduce emission and bunker cost**	(Notteboom and Vernimmen, 2009; (Psaraftis and Kontovas, 2010)

• **Applying slow steaming (or called speed reduction)**	(Corbett, Wang and Winebrake, 2009); Corbett, Wang and Winebrake, 2009)

According to Corbett et. al (2009) containerships are among the largest maritime emitters of CO2 because aim for speed that is compounded by the fact that fuel consumption is a non-linear function of speed. Following legislation by the European Commission, the first Sulphur Emission Control Area (SECA) came into force on the 22th November 2006 in the Baltic. The next SECA became effective in August 2007 in the North Sea area (European Commission (Psaraftis and Kontovas, 2010). The primary effect of this EU legislation is to reduce to 1.5% the maximum sulphur content of marine bunker fuel oil consumed within the SECA. In addition, legislation and environmental considerations are causing consumption of High Sulphur Fuel Oil (HSFO) on land to decline (Notteboom and Vernimmen, 2009). Predicated on this issue, Andrés and Piniella (2017) emphasise that ultra large container vessels (ULCV) guarantee efficiency on energy (reducing CO2 emissions by half), economy (generating economies of scale) and the environment (fewer atmospheric emissions). In addition, the unit transportation cost is 26% lower than current large ships in service, and CO2 emission per container can be reduced by more than 50% as compared to the industry average on the Asia–Europe route.

Notteboom and Vernimmen, (2009) indicate that the bunker market is extremely price sensitive, also bunker prices constantly fluctuate due to market force and the cost of crude oil. So, increase in the bunker oil price has an upward effect on costs. Further, emphasize on environmental anxiety has resulted in strict emission standards in some parts of the world and more regions are expected to follow such policy. These changes are significant and will have considerable financial and operating implications for the oil refining and marine industries. Table II summarises related factors that influence vessel size enlargement in the global maritime trade environment.

IV. RESULT AND DISCUSSION

A. Contributing Factors of Containership Size Enlargement: Malaysian Perspectives

Sixteen indicators have been identified as contributing factors for vessels size enlargement in Malaysia maritime trade. The outcome of EFA interpreted the dimension scale of items into five factors (see Table III). Inter-correlation items for contributing factors were assessed, KMO measure of sampling adequacy is 0.706 which indicates variables acceptable and Bartlett's test was significant for all variables. The outcome of EFA analysis derives 4 major factors that contribute to the vessel enlargement from the perspective of Malaysian seaport operators and authority. The first component is shipping operations consisting of 7 items with loading value between 0.688 – 0.882. The second component is classified as seaport and shipping integration consisting of 3 items with loading value between 0.571-0.780. Thirdly will be cost effectiveness consisting of 3 items with loading value is between 0.696 - 0.787. Fourth factor that influence vessel enlargement is technological advancement consisting of 3 items with loading value between 0.615 – 0.721.

1) Shipping Operations

From the perspective of fleet size, Malaysian shipping is currently ranked at 3rd place in the Asian region and 24th in the world. In addition to that, most of the specialised trade are dominated by the foreign vessels compared to local (MOT, 2016). Owing not significant reputation in the shipping industry, Malaysian Ministry of Transportation has proposed Malaysian Shipping Master Plan 2017-2022 to improve the performance of shipping industry in this region. The main aim of this plan is to enhance Malaysia maritime transport/shipping service sector's market share by participating in selected market of domestic regional and global maritime transport/shipping services. In conjunction to this aim, shipping industry aims to increase the volume of Malaysian vessels by 20% in global shipping, enhancing number of Malaysian vessels by 30% in Intra-ASEAN Trade Shipping. All these aims proposed in Malaysian master plan will be a motivation for the vessel enlargement in this specific region. Furthermore, container overcapacity of Malaysian tonnage due to cargo imbalances moving between Peninsular Malaysia, Sabah and Sarawak is another justification on why Malaysia is keen on mega vessels operation. Larger vessel is required to transport container evenly to west and east Malaysia to avoid the issue of overcapacity. Hence, the transformation of seaports from multi-port calling to hub and spoke network playing a crucial role for the mega vessel demand (0.882). The demand of this mega vessels directly will generate speed reduction (0.861) and produce a substantial cost reduction during the operation (0.848).

The aim of this master plan indicates that Malaysian shipping industry will improve the maturity level of required technology, data security and boosting the expansion in basic infrastructure. Before this, these are some of significant issue arose in the seaport system which preventing Malaysian seaport move towards the 4th industrial revolution. These components need to be improved to prepare Malaysian seaport systems towards IR4.0 and become competitive in the global market. Compatibility of shipping industry with new policy become the core reason of Malaysian shipping industry heading towards 4th industrial revolution which including the preparedness to accommodate mega vessels. Therefore, alternative technology on ship to reduce the emission and bunker cost can be expected during the execution of IR4.0 (0.835).

Besides that, the preparation of Malaysian towards belt and road strategy will be a main reason for this nation to be involve in the mega vessel operations. Maritime Silk Road that proposed under OBOR strategy are including Malaysia as one of the 65 participated countries that can make this strategy successful. It is because Malaysia plays an important role in Maritime Silk Road due to strategic location that connecting coastal China to the Mediterranean via Singapore and Malaysia, Hindi Ocean, Arabian Sea and Straits of Hormuz. Major projects that will be constructed under OBOR strategy in Malaysia are including East Coast Rail Link

(ECRL), Malaysia-China Kuantan Industrial Park (MCKIP) in Pahang, Malacca Gateway National Maritime Park, and Iskandar Malaysia development in Johor. The existence of this global network via belt and road strategy, formation of shipping alliances (0.722) and changes of canal strait design eg. Thai Canal (0.704) will be a motivation for vessel enlargement in this region. In that case, the capacity to handle mega vessels need to be established in Malaysian trade system (0.688) to move align with the current trend in trade system especially in this region.

2) Seaport and Shipping Integration

The mega vessels need to be introduced immediately in the Malaysian water to reduce follow the strict emission and standard regulation (0.780). The transportation cost transportation cost is 26% lower than current large ships in service, and CO2 emission per container can be reduced by more than 50% as compared to the industry average on the Asia–Europe route (Tran and Haasis, 2015). Moreover, South East Asia is a hub trade region in this region (0.771). The hub trade including China, Republic of Korea, Singapore and Malaysia are critical hub trade to the regions. For example, Singapore and Thailand are located closely to Malaysia. Therefore, the hub trade network is very important to disseminate the cargo via multimodal network.

Environmental anxiety has resulted in strict emission standards in some parts of the world and more regions are expected to follow such policy" (Notteboom and Vernimmen, 2009). The bunker market is extremely price sensitive due to market forces and the cost of crude oil (Notteboom and Vernimmen, 2009). According to UNCTAD report, the best-connected countries in 2016 are China and the Republic of Korea in East Asia, while Singapore and Malaysia have the highest Liner Shipping Connectivity Index (LSCI) (most active in trade) in Southeast Asia; Sri Lanka and India in South Asia; Morocco, Egypt and South Africa in Africa; and Panama and Colombia in Latin America and the Caribbean (Hoffmann et al., 2017). Triple E specialise in the route that passes through the Suez Canal, linking maritime hubs in Northern Europe, the Mediterranean and Asia (Andrés and Piniella, 2017). Apart from improving vessel efficiency and reducing emissions, there are plenty of technology-based approaches including propeller re-design, anti-fouling measures for hulls, and improved engine operations achieve targets more cost-effectively (0.710). Then, due to the continuous increase in ship size, changes occur in the service networks from a multi-port-calling to a hub-and-spoke.

3) Cost Effectiveness

Kidson et al. (2015) indicate that cost effectiveness is achieved through minimising total transport costs. Further, cost effectiveness refers to minimising cost trade-off between ships to reduce operational overall operational cost (0.787). Diesel engine was installed with large powered steam turbines for producing high speed ship (Tran and Haasis, 2015). Larger container vessel able to reduce unit costs, influencing shipping liners tending to use larger sized container vessels (0.763). In addition to this, the reduction of liner shipping in important to influence liner shipping to utilise larger vessels (0.696).

On the other hand, intermodal connectivity in each seaport needs to be utilised for cost effectiveness (Roso and Lumsden 2010). The linkages between these two nodes need to be improved to provide significant benefits to seaports and their users. Some of the dry ports in Malaysia including in northern region, central region and southern region utilising road network compared to rail. In that case, the railway network needs to be improved to reduce the stress on road facilities as well as increasing the connectivity from seaports to the hinterland. This progress is highly anticipated by seaports to cater the larger vessels. This because an even development on both networks may reducing congestion issues at seaports, especially at Port Klang, PTP and Penang Port, and to gain cost and time benefits during container transportation to and from the seaport.

Table III: Factor Analysis Result Contribute Factor to Containership Enlargement

No.	Factors	Items	Factor Loading Value	Cronbach Alpha
1	Shipping operations	Change multi-port calling to hub and spoke network	0.882	0.930
		Applying slow steaming (or called speed reduction)	0.861	
		Cost saving of bigger ships (such as capital cost, operational cost)	0.848	
		Alternative technology on ship to reduce emission and bunker cost	0.835	
		Formation of shipping liner alliance	0.722	
		Change in the design of canal and strait	0.704	
		Increase capacity of ship carry container	0.688	
2	Port and shipping integration	Strict emission standards regulation	0.780	0.782
		Country as hub trade (such: china and the republic of Korea in East Asia, Singapore and Malaysia in Southeast Asia)	0.771	
		Improving vessel efficiency	0.710	
3	Cost effectiveness	Minimise cost trade-off between ship	0.787	0.704
		Produce high speed ship	0.763	

4	Technological advancement	Reduce unit cost influence liner shipping use bigger ship	0.696	0.684
		Easier and faster stowage of container	0.721	
		Better stability of ship	0.704	
		Evolution containerization	0.615	
Notes:	Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy: .706 Bartlett's Test Sig: .000 Total Variance (%): 69.889			

4) Technological Advancement

Mega vessels are designed with wide beam for better stability, more flexible, easier, faster stowage of containers. Therefore, it is easier for faster stowage of containers (0.721). Although the transloading activities in the seaports cause significant issues, the assimilation of artificial intelligence and autonomous vehicle could make it even faster. Larger vessels own better stability and ease the transloading as well as transhipment activities at seaports (0.704). Hence, the transloading and transhipment activities can be executed as fast as possible. In that case, the duration of ships at seaport will be reduced significantly which eventually will enhance the reputation of seaports among the users (Jeevan et. al 2018). In addition to that, the evolution of containerisation has produced as the contributing factors for containership enlargement (0.615). As Monios (2017) indicated that the trend of containerisation has no end. Therefore, every single nodes and shipping lines must be prepared to overcome the process of container shipping enlargement.

V. CONCLUSION AND IMPLICATION

The outcome of this study indicates that shipping operation and its current scenario, application of cost-effective operation, technological advancement as well as standardised measurement unit are important factors that contribute to ship enlargement in the current maritime business. It is evident by the enormous development in the shipping sectors, which provides significant implications on Malaysian trade as well as regional economic progress. Conversely, the ship size enlargement will be a stepping stone towards era of digitalisation in shipping sector. This because research has proven that productivity of crane in seaports keeps reducing if the vessel size is increasing. Therefore, application of automated cranes especially for trans-loading activities will be emphasised to ensure enlargement of fleet size is interconnected with crane productivity.

Although shipping industry facing dramatic changes from time to time, it is causing significant 'stress' to seaports in this specific region. In other words, seaport operations need to be aligned with the progress of shipping dimension to ensure the competitiveness of theses nodes are improved and preserved. If seaports in this region unable to comply with these changes, most probably the performance and the attractiveness of seaports might be affected and neighbouring seaports including Singapore, Indonesia, Thailand will outpace the competitiveness of Malaysian seaports. In that case, the seaports development needs to be aligned with current trend, which is almost impossible with the status of seaports. Since seaport operations are rigid and time consuming to adapt with the current trend and changes, external components are required to assist these key nodes. For example, the assimilation of dry ports in the seaport system to adapt with the current changes in the shipping size is essential. In addition, the agility of dry ports will be a perfect complementary component for seaport to be aligned with the current trend especially on the evaluation in fleet size. Therefore, the application of dry ports in the seaport system to assimilate with global ship size amplification is worth to be explored.

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