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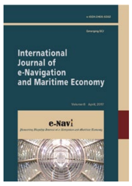

Original article

Challenge of Malaysia Port toward Shipping Revolution☆

Nurdiyana Athirah Bt Musa[a*], Loke Keng Bin[b]

[a*] Faculty of Maritime Studies, Universiti Malaysia Terengganu, nanadiyanaatie@gmail.com, Corresponding Author

[b] Faculty of Maritime Studies, Universiti Malaysia Terengganu, loke.k@umt.edu.my

Abstract

The shipping revolution was introduced due to development and improvement that occurred in the shipping industry. Until now, changes in the shipping industry are still ongoing to improve their services, especially by introducing mega ships to transport cargoes. Thence, the shipping revolution stimulates seaport to comply with the requirements for a new mega ship. Therefore, this study was conducted to determine the external environment factors that contribute to the challenge of Malaysia Port towards the shipping revolution. Firstly, the external environmental factors that challenge Malaysia Port towards shipping revolution are identified by using the PESTEL analysis; which are political, economic, social, technological, environmental, and legal factors. Then, these identified factors are ranked by using Analytic Hierarchy Process (AHP) to determine the priority external environment factors that contribute to the challenge of Malaysia Port towards shipping revolution. Data were collected by using pair wise comparison questionnaire which is qualitative method. The questionnaire consists two sections; there are demographic information and PESTEL factors. Thereafter, the data were analysed by AHP analysis. The results shown that the top three priority external environmental main factors that contribute to the challenge of Malaysia Port towards shipping revolution which are economic, technology and environment. Then, the top three sub factors are economic growth, digitalization and reduce emission. As a conclusion, these factors can influence the Malaysia Port towards shipping revolution and need priorities attention. Whereas the economic growth will monetary support shipping and port revolution, digitalization can reduce cost and increase efficiency, and reduce emission towards environmental friendly. Consequently, the findings will raising awareness and as a blueprint to government and port operators during development and expansion of harbour towards shipping revolution.

Keywords: Shipping Revolution, Seaport, PESTEL, AHP

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1. Introduction

According to the Smith (1982, p.13) in The Wealth Nation, shipping revolution is defined as shipping industry is a vast market compared to land transport that cannot cross the sea, the industry is changing naturally and there are changes to upgrade their services. Ever years the shipping industry always change or dynamically to improve their services. The shipping revolution has happened since the 1900s. The shipping industry changed in many dimensions, among them are technological change and innovation, changes in the structure of the industry and changes related to the geography of where the service is provided (Gaunaris, 2017, p.10).

The Triple E by Mearsk line was launched in mid-2013 that more economy of scale, energy efficient and environmentally improved. The transportation cost of this mega vessel 26% lower than current large vessels (Tran & Haasis, 2015, p.244). So, the construction of the mega vessel by shipbuilding industry provide more benefits to industries especially on transportation costs. The shipping revolution always happens in maritime transportation to improve their services and reduces the costs.

However, the shipping revolution burdens the port to comply with the requirements for the new mega vessel. The revolution of vessel size gives impact to the port, especially in the development and facilities to catch with their needs (Notteboom & Rodrigue, 2006, p.23).

Therefore, the objective of this paper is to identify the external environmental factors by using PESTEL analysis that contribute to the challenge of Malaysia Port towards shipping revolution and to determine priority dominant external environmental factors using AHP analysis.

2. Review Study

The shipping maritime is dynamic because it always changes to improve their services. To cope with the shipping revolution, PESTEL analysis is used to determine external environmental factors that influencing the seaport industry; which are Political, Economic, Social, Technological, Environmental, and Legal. Figure 1 shown the PESTEL factors and the each of the sub-factors. Each of sub-factors are determined through literature review and further verified by pilot study.

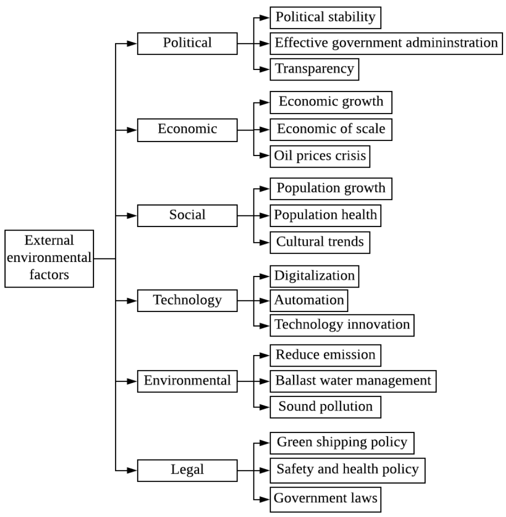

Figure 1: Research Variables and Framework

2.1 Political Factors

Political stability, transparency and an effective government administration are some pillars towards achieving credible improvement in policies and government institutions (Armstrong, 2005, p.2), by that the confidence to foster investment and drive economic growth increased. The country that has poor political government faced decrease the performance of the port and shipping unlike in the Southern African that spurred on maritime traffic growth (Ncube et al, 2011, p.8). The government as a key role to do the necessary investments in basic infrastructures to ensure a good accessibility by the land or sea (Notteboom & Rodrigue, 2005, p.300). The government will undertake development to improve port services especially in increasing the depth water at the port. Based on Turnet & Ernst (2015, p.2), Government and public institutions play a key role in transparency in the international trade arena by engaging in a broad range of official activities related to customs controls and trade. The advance transparency of port charges and services at the port give effect to the port users when selection of the port of calls.

2.2 Economic Factor

In the late 1800s, the rate of trade growth increased quite significantly and then again after the war in the mid-1900s (Gounaris, 2017, p.3). During economic growth, the use of ships keep increased due to the expanding trade and stable economy. For example, in 2014, Hamburg cargo trade was 100,000 million tonnes (Gaunaris, 2017, p.3). It because the shipping at that time more effective and reduce time at sea. The increasing of the ship size is explained by economies of scale (Sys et al, 2008, p.444). For instance, the deployment of Maersk Triple E-Class 18,000 TEU mega container ship in the Europe-Far Eastern route has represented to achieve economies of scale, energy efficiency and environment friendliness (Ha & Seo, 2017, p.57). The development of mega ship give more revenue to the ship owners due the size of ship that can carry more goods. Increasing the ship bunker fuel capacity can bring relatively significant benefits for shipping liners in terms of bunker fuel related cost savings (Yao et al, 2012, p.1165). This is a useful consideration in the deployment of ships or in the design of new ships, by slowing down the vessels and operating the vessels at economic speed less than 20 knots to reduce fuel consumption in ship (Du et al, 2011, p.1029). The concept of “economic of scale” for mega vessel can reduce the bunkering cost that gives burden to the ship owner when the oil price is too high than usual. When the oil price crisis, the ship had to reduce its speed to save on fuel consumption, but it could cause the ship to stay longer at sea.

2.3 Social Factor

Based on Zabel & Economics (2009, p.20), population growth leads to the creation of new technologies that can meet the needs of the population. Also, the population growth in china has boosted the country's economy due to the improvement in educational standards Chamon & Kremer (2009, p.21). Hence, there is a change in the shipping industry in terms of large vessel size and the use of new technology due to population and economic growth. Based on Eyring et al (2010, p.4755), the emissions produced by in-port ships can specifically affect climate (GHGs), regional air quality and ecosystems and public health for coastal community. This can affect the population health that living in the nearby port areas. For instance, the dengue fever was spread via sailing ship in 18th and 19th centuries when the shipping industry expanded, it happens due to the mosquito used the stored water on the ships as breeding sites in long voyages (Gubler, 2002, p.102). Next, globalization is one of cultural trends that happen in the industries (Seo & Buchanan-Oliver, 2015, p.90). This culture trends also can affect to the shipping industry when the technologies give more benefit to community and industries. The use of new technology is one of the trends in society or social has changed the shipping industry in the world especially in Japan.

2.4 Technological Factor

According to Alex (2018), by using the smart and big data processing is a key to make the port become more effective. The International Maritime Organization (IMO) was introduced the electronic data exchange from ship to ship and from land to ship (Fruth & Teuteberg, 2017, p.33). The introduction of the electronic system is to improve the efficiency, safety, and data security of navigation and communication at sea. The automation also give benefit to shipping and port industry which is reduce the workload and human error (Song et al, 2012, p.380). Based on Rebollo et al (2000, p.3) the gantry crane as an automatic system can minimise the aggregate delay cost when loading the goods into the ship. It can helps loading and unloading process become faster especially when the ship become bigger by using more than 2 gantry cranes. According to the Brooks et al (2016, p.780), by using the remote pilotage as new innovation at port it will give benefit to ports during ships want to berth.

2.5 Environmental Factor

The operation of ships using common fuel that produces significant emission of nitrogen oxides (Åström et al, 2018, p.227). However, these emissions from ship can be reduced by up to 30% at a negative abatement cost per ton of CO_2 when replacing the existing fleet with larger vessels (Lindstad et al, 2012, p.390). Not only that, in the ballast water of ships, there are native species that were transported in many thousands of miles and then released into non-native waters (Walker et al, 2019, p.515). For example, Canada’s ballast water regulations require all ships entering the country to exchange their ballast water outside the EEZ in water 2000 m deep and 200 nautical miles from shore (Lo et al, 2012, p.299). This approach reduces the problem caused by native species in coastal water at Canada. Based on Papanicolopulu (2011, p.247), underwater noise pollution can significantly impact marine life even over long distances. The larger vessel has greater acoustic output especially at the propeller that give sound pollution to marine life.

2.6 Legal Factor

Green Shipping Policy has a positive influence on both the green ship and green supplier dimensions. The enlargement of vessel size on a loop is helpful in reducing the amount of CO2 emission (Lu et al, 2014, p.131). Next, The European Framework Directive on Safety and Health at Work, which introduces measures to encourage improvements in the safety and health of workers at work, applies to the working conditions in ports (Antão et al, 2016, p.269). So, with the safety and health policy, the risk of accidental occurrence in the workplace can be reduced. In the shipping revolution, the government is also involved in regulating and improving the laws and policies in accordance with the time passage in the shipping industry (Rosario, 2000, p.63). The local government has power to change their own policy that give benefit to them. For instance, SOLAS Convention by IMO can be a law if the country which is Malaysia ratified this Convention into the Merchant Shipping Ordinance (MSO).

Most of the previous studies described the issues in general basics and not focusing on the external environmental factors that affect the seaport expansion towards shipping revolution, especially they not emphasized on Malaysia seaport. Therefore, this study would like closing the gap and to stress on the external environmental factors that challenge Malaysia seaport towards shipping revolution

3. Methodology

Based on Kothari (2004, p.1), the research means an art of scientific investigation. So, the methodology will be use when conducting the research. Methodology means the dialogue of the underlying reasoning why that method was used for that research (Bryman & Alan, 2008, p.163). The methodology is important ensure that the finding is valid and accurate.

Kuantan Port is selected as a case study and ten respondents are the experts which are Head of Department from Kuantan Port that have experience more than 15 years. Table 1 shown the expert's background from Kuantan Port, in the state of Pahang. The experts are come from several departments that involve in port management and expansion program; which are research and development, commercial, traffic and marine service, new deep water terminal (civil), new deep water terminal (mechanical), marine services, health, safety and environment, governance, risk and compliance, free zone, and information technology departments. This study is using interview and pair wise comparison questionnaire to gain information and the questionnaire is determined from review study and verified by pilot test. Each of the main factors and sub-factors that formed the questionnaire are shown in Figure 1. After that, the data is analysed using AHP software. The results from the experts shown that they having different ideas due to different individual hold different beliefs and values, and it would formed different ideology. However, the result output from the AHP software shown the CR value (consistency ratio) is below 0.10. Salleh et.al. (2015, p.19) highlighted that if the CR value is 0.10 or less, is considered reasonable and acceptable. So, the result output is valid and reliability.

Table 1: Expert's background

No	Position	Years of Experience
1	Research and Development Manager	20 - 24 Years
2	Commercial Senior Manager	25 Year and above
3	Traffic and Marine Services Senior Manager	25 Year and above
4	New Deep Water Terminal Project Manager (Civil)	25 Year and above
5	Marine Services Manager	15 - 19 Years
6	Health, Safety and Environmentl Manager	20 - 24 Years
7	Governance, Risk, and Compliance Manager	25 Year and above
8	New Deep Water Terminal Project Manager (Mechanical)	25 Year and above
9	Free Zone Manager	20 - 24 Years
10	Information Technology Manager	15 - 19 Years

In this research, the analytical hierarchy process (AHP) method be used. The AHP analysis used to determine the important relative of each alternative in term of a criterions. According to Salleh et al (2015, p.18), to conduct the pair-wise comparison matrix, first step is to setup n criteria in the row and column of $n \times n$ matrix. Next, perform the pairwise comparison to all the criteria by using a ratio scale assessment.

Table 2 contains two parts which are described the numerical assessment together with the linguistic meaning of each number.

Table 2: The ratio of pair-wise comparison

Numerical assessment	Linguistic meaning	Numerical assessment	Linguistic meaning
1	Equally important	1	Equally unimportant
3	A little important	1/3	A little unimportant
5	Important	1/5	Unimportant
7	Very important	1/7	Very unimportant
9	Extremely important	1/9	Extremely unimportant
2, 4, 6, 8	Intermediate values of important	½, ¼, 1/6, 1/8	Intermediate values of unimportant

Sources: Salleh et al, 2015, p.18

The qualified judgements on pairs of attribute Ai and Aj are represented by $n \times n$ matrix A as shown in equation (1).

$$A = (aij) = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ \frac{1}{a_{12}} & 1 & \dots & a_{2n} \\ \vdots & \vdots & \dots & \vdots \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & \dots & 1 \end{bmatrix} \quad (1)$$

Where I, j = 1, 2, 3, …, n and each aij is the relative importance of attribute ai to attributes aj.

For a matrix of order n × (n – 1) / 2 comparisons are required. According to Salleh (2015, p.19), the weight vector indicates the priority of each element in the pair-wise comparison matrix in term of its overall contribution to the decision-making process. Such a weight value can be calculated using equation (2).

$wk= 1n\, \Sigma(nj=1akj\Sigma aijni=1)$ $(k = 1, 2, 3, \dots, n)$ (2)

Where aij stands for the entry of row i and column j in a comparison matrix of order n.

The weight values obtained in the pair-wise comparison matrix are checked for consistency purpose using a consistency ratio (CR). The CR value is computed using the following equations (Saaty, 1990, p.260; Salleh et al, 2015, p.19).

$$CR = \frac{CI}{RI} \quad (3)$$

$$CR = \frac{\lambda max - n}{n - I} \quad (4)$$

$$\lambda max = \frac{\sum_{k=l}^{n} \frac{\sum_{k=l}^{n} w_k a_{jk}}{w_j}}{n} \quad (5)$$

Where n is the number of items being compared, λmax stands for maximum weight value of the n × n comparison matrix, *RI* stands for average random index (*RI*) in Table 3 and *CI* stands for consistency index.

Table 3: RI values

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Source: Salleh et al, 2015, p.19

CR is designed in such a way that a value greater than 0.10 indicates an inconsistency in pair-wise comparison. If CR is 0.10 or less, the consistency of the pair-wise comparisons is considered reasonable (Saaty, 1980, p.30; Salleh et al, 2015, p.19).

4. Result

4.1 Main factors

Geometric mean (GM) can be calculated as follow:

$$GMIJ=[eij1,eij2,eij3\dots eijk]1k$$

The formula are represents as follows:

- k is the number of experts
- $eijk$ Stand for the experts opinion for relative importance of the *i* criterion to the criterion.

From the result, the calculation to determine the importance between each criteria:

GM value between political factor and economic factor:
GMIJ =
[(0.2000)x(0.2000)x(0.5000)x(0.6000)x(0.7000)x(0.7000)x(0.9000)x(0.9000)x(0.9000)x (0.9000)]1/10
=0.1743

GM value between economic and social factor:
GMIJ=
[(9)x(9)x(9)x(9)x(9)x(8)x(8)x(8)x(2)x(2)]1/10
=6.4306

GM value between economic and technological factors:

GMIJ=[(5)x(5)x(5)x(4)x(3)x(3)x(2)x(2)x(1)]1/10=3.1291

Matrix A in this test case is main criteria of the external environmental factors that contribute to the challenge of

Malaysia Port towards shipping revolution and the calculation as shown below:

$$Matrix\ A = \begin{bmatrix} 1 & 0.1743 & 0.6475 & 0.3209 & 0.4097 & 0.6012 \\ 5.7363 & 1 & 6.4306 & 3.1291 & 3.6019 & 3.4154 \\ 1.5443 & 0.1555 & 1 & 0.2106 & 0.3321 & 0.3845 \\ 3.1164 & 0.3196 & 4.7488 & 1 & 2.4495 & 2.1946 \\ 2.4407 & 0.2776 & 3.0109 & 0.4082 & 1 & 1.9663 \\ 1.6632 & 0.2928 & 2.6011 & 0.4557 & 0.5086 & 1 \end{bmatrix}$$

Based on Matrix A, formula 2 are used to calculate the weight for main criteria and it will be demonstrated as follow:

$$w_k = \frac{1}{n}\sum_{j=1}^{n}\left(\frac{a_{kj}}{\sum_{i=1}^{n} a_{ij}}\right) \quad (k = 1, 2, 3, \ldots, n)$$

Table 4: Weight of main factors.

Main	Political	Economic	Social	Technological	Environmental	Legal
weight	0.0575	0.427	0.0552	0.2196	0.1379	0.1028

After that, Consistency Ratio (CR) of pair-wise comparisons will be calculated by using formula 3 to 5. Based on the formula 5, it will be used λmax to calculate as to lead the RI and CR.

A=(1×0.0575)+(0.1743×0.4270)+(0.6475×0.0552)+(0.3209×0.2196)+(0.4097×0.1379)+(0.6012×0.1028)= 0.3564

B=(5.7363×0.0575)+(1×0.4270)+(6.4306×0.0552)+ 3.1291×0.2196)+(3.6019×0.1379)+(3.4154×0.1028)= 2.6467

C=(1.5443×0.0575)+(0.1555×0.4270)+(1×0.0552)+(0.2106×0.2196)+(0.3321×0.1379)+(0.3845×0.1028)= 0.3419

D=(3.1164×0.0575)+(0.3196×0.4270)+(4.7488×0.0552)+(1×0.2196)+(2.4495×0.1379)+(2.1946×0.1028)= 1.3607

E=(2.4407×0.0575)+(0.2776×0.4270)+(3.0109×0.0552)+(0.4082×0.2196)+(1×0.1379)+(1.9663×0.1028)= 0.8547

F=(1.6632×0.0575)+(0.2928×0.4270)+(2.6011×0.0552)+(0.4557×0.2196)+(0.5086×0.1379)+(1×0.1028)= 0.6372

$$\lambda_{max} = \frac{\left(\frac{0.3564}{0.0575}\right)+\left(\frac{2.6467}{0.4270}\right)+\left(\frac{0.3419}{0.0552}\right)+\left(\frac{1.3607}{0.2196}\right)+\left(\frac{0.8547}{0.1379}\right)+\left(\frac{0.6372}{0.1028}\right)}{6}$$

$$= \frac{6.1971}{6}$$

$$=1.0328$$

$$CI = \frac{1.0328-6}{6-1} = 0.9934$$

$$CR = \frac{CI}{RI} = \frac{0.9934}{1.24} = 0.0316$$

According to Saaty (1980, p.30), if CR value is maintained at 0.1 or less than 0.1, the judgement on the data analysis is considered acceptable. Therefore, the results are considered acceptable.

The results for weight and CR are stated in table 5. The initial results shown that economic (0.4270) is the first priority criteria and following by technology (0.2196), environmental (0.1379), legal (0.1028), political (0.0582), and social (0.0552).

Table 5: Ranks for main factor.

Ranks	Criterion	Weight	CR
1	Economic	0.427	0.0316
2	Technological	0.2196	
3	Environmental	0.1379	
4	Legal	0.1028	
5	Political	0.0582	
6	Social	0.0552	

4.2 Sub factors

To get the value for weight of each factor, formula 1 and 2 should be calculated separately as show in table 3. By using formula 3, 4 and 5, the CR should be calculated separately according to their factors. The results for weight and CR are stated in table 6.

Table 6: Ranks for sub factors

No.	Variables	Weight	CR
1	Economic growth	0.6020	0.0191
2	Digitalization	0.5446	0.0349
3	Reduce emission	0.4841	0.0065
4	Population growth	0.4730	0.0307
5	Local government laws	0.3780	0.0004
6	Political stability	0.3800	0.0022
7	Safety and health policy	0.3707	0.0004
8	Ballast water management	0.3319	0.0065
9	Transparency	0.3386	0.0022
10	Effective government	0.2814	0.0022
11	Economic of scale	0.2862	0.0191
12	Population health	0.2774	0.0307
13	Green shipping policy	0.2513	0.0004
14	Cultural trends	0.2495	0.0307
15	Automation	0.2385	0.0349
16	Technology innovation	0.2169	0.0349
17	Sound pollution	0.1840	0.0065
18	Oil prices crisis	0.1118	0.0191

According to table 6, the top 3 sub factors of external environmental factors that contribute to the challenge of Kuantan Port towards shipping revolution are economic growth (0.6020), digitalization (0.5446) and reduce emission (0.4841). The last priority factor is oil prices crisis (0.1118) in economic factors that may not be give big effect in the shipping revolution and challenge to the port.

5. Discussion

5.1 Three priority external environmental factors for main factors

Firstly, the economic factor is highest compared with other factors. According to the Rodrigue & Schulman (2013, p.241), when economic growth the port can expand the market opportunity on both national and international markets. Thus, the economic factor which is economic growth can help the port to gain more revenue due to increasing number of trade occurred at port.

Then, technological factor is the second higher of external environmental factors that contribute to the challenge of Malaysia Port towards shipping revolution. By having technology, it can help the industries to reduce the cost of operation and delay. According to the Yassien (2019), the technology can increase the productivity and efficiency in their services. So, they can save a lot of time and money by using technology.

Lastly, the environmental factor is in third position compared other main factors. The port and shipping lines must take action to reduce pollution to support the green and environmental friendly to the environmental. The port and terminal operator replace the facilities and equipment such as diesel energy for the quay crane with electrically driven models to reduce emission and pollution (Zhu, et al, 2002, p.4326). So, the environment will become greener and environmental friendly.

5.2 Three priority external environmental factors for sub factors

5.2.1 Economic growth

In the economic factors, economy growth is the important thing that give effect to the Malaysia Port due to the shipping revolution. According to the Xu et al (2015, p.3), rapid economic growth of emerging countries in the last two decades such as China, India and South Africa had prompted shipping carriers to adjust their container deployment worldwide for better coverage of their service networks and higher revenues. During economic growth, the industries in a good condition so it can help the port to do investment and development. Because of the shipping revolution, the port needs development new terminal that can receive the mega vessel to their port. The New Deep Water Terminal (NDWT) port that already develop at one of Malaysia Port which is Kuantan Port can be as example. After port expansion project finish, the port can handle the bigger ships up to 150,000 DWT Bulk carrier or 18,000 TEU Container ship (Kuantan Port Consortium, 2014). The port expansion will reduce the delay during economic growth because the demand of the ship is high especially for export and import activities.

5.2.2 Digitalization

Digitalization is one of technology sub factor and second higher of sub factor compare with another sub factor. In the maritime industry, The International Maritime Organization (IMO) supports the introduction of electronic data exchange, to improve the efficiency, safety, and data security of navigation and communication from ship to ship and from land to ship (Berg & Hauer, 2015). By using it, it can help the industry to become green or zero-pollution and efficiency. The Malaysia Port also using this technology to improve their operation and use it to communicate with other port user. Also, the artificial intelligence will allow an increase in the efficiency of ship operation. Malaysia Port also have this technology in their system and operation. Hence, Malaysia Port agree by using technology the operation become more efficient and reduce the accident at the port.

5.2.3 Reduce emission

Lastly, the environmental factor is the third higher for main factor. According to some IMO predictions, by lowering ships' speed, it would reduce emissions and save fuel (Prpic-orsic & Faltinsen, 2012, p.5). Nowadays, reduce emission is very important in the world especially in port and shipping industry. In the port industry, the green port and economic friendly is very popular topic for nowadays. One of Malaysia Port which is Kuantan Port also want to apply the concept green port and economic friendly in their operation. According to the Prpic-orsic & Faltinsen (2012, p.6), through vessel route planning for increased transport efficiency is the potential for reduced emissions. Kuantan Port also reduce emission in their operation by using green technology. Because the environment is very important, and it need to protect not to harm it.

6. Conclusion

Nowadays, the ship is an important transportation for waterway transport. The shipping industry is dynamic because it always changes, and it name as shipping revolution. Thus, the shipping revolution give challenge to the seaport to cope with their needs. In conclusion, the top 3 external environmental main factors that contribute to the challenge of Malaysia Port towards shipping revolution are economic (0.4270), technology (0.2196) and environment (0.1379). The subsequence main factors are legal (0.1028), political (0.0582) and social (0.0552). Meanwhile, for the top 3 external environmental sub-factors are economic growth (0.6020), digitalization (0.5446) and reduce emission (0.4730). The subsequence sub-factors are population growth (0.4730), local government laws (0.3780), political stability (0.3800), safety and health policy (0.3707), ballast water management (0.3319), transparency (0.3386), effective government administration (0.2814), economic of scale (0.2862), population health (0.2774), green shipping policy (0.2513), cultural trends (0.2495), automation (0.2385), technology innovation (0.2169), sound pollution (0.1840), and oil price crisis (0.1118). The weightage of economic (0.4270) is much higher than other main factors, it is due to shipping and seaport revolution are need monetary support. The weightage of sub-factors for economic growth is 0.6020, this is further defined that monetary is playing crucial role in revolution. Consequently, the study will raising awareness and as a blueprint to government and port operators during development and expansion of harbour towards shipping revolution.

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