

## **A PRELIMINARY STUDY ON PORT OF HARBOUR EXPANSION EVALUATION: LUMUT PORT CASE STUDY**

W.M Dahalan<sup>1</sup>, I.A. Abu Bakar<sup>2</sup>, Anis F.G<sup>3</sup>, N.A.Qursyah<sup>2</sup>, F. A. Nordin<sup>2</sup>

<sup>1</sup>*Marine Electrical & Engineering Section, Universiti Kuala Lumpur, Malaysian Institute of Marine Engineering, Technology Lumut, 32200, Perak, Malaysia*

<sup>2</sup>*Maritime Management Section, Universiti Kuala Lumpur, Malaysian Institute of Marine Engineering, Technology Lumut, 32200, Perak, Malaysia*

<sup>3</sup>*Faculty of Information Technology and Communication, Universiti Teknikal Malaysia Melaka, Jalan Hang Tuah Jaya, 76100, Durian Tunggal, Melaka*

*Corresponding author: wardiah@unikl.edu.my*

### **ABSTRACT**

Port expansion is needed because every day, the number of customers will increase; this is very important to make sure the capacity of the Port can cover the increasing number of customers and to make sure they get better service which is minimal turnaround time and eliminate the working downtime in the Port. This study has been isolated into two, where this target demonstrates the factor of the port expansion and formulate the expansion algorithm. This is because customers like faster service so that they can run their business smoothly. Marine terminal operation can be enhanced by the new range of new support services that can be more beneficial to the Port itself. All related factors are highlighted by previous research work. This research was conducted through a systematic literature review of journal articles on the factor of the port expansion and their implementation limitations. This research comes out with the new formulation for the expansion algorithm for the Lumut Port expansion. In this research, the questionnaire is used to collect the information, and the result is very encouraging. Further, the data were analyzed using SPSS statistical software to confirm the results. The study provided recommendations based on these results for the future implications for academicians and practitioners.

**Keywords:** *Factor of port expansion, Formulation expansion algorithm, Lumut Port expansion, Harbour expansion*

### **INTRODUCTION**

This research is conducted to study the factor that can influent the port expansion and to formulate a new formula that can prove the need to enlarge the port area. This study will be on the Lumut Port, which is in Perak. Port area need to be enlarged because every day the number of customers, the amount of the import and export product and the size of the ship will always increase. This is

very important to make sure that the port area can cover all the customer needs to make sure their customer is satisfied with their services. The expansion of the Lumut Port in Kampung Acheh is expected to be completed before 2020 at the cost of RM200 million.

Lumut Port Industrial Park gives arrive space to warehousing or transshipment and is on offer for nearby and remote financial specialists who can add to the throughput of the Port by [1]. The second Lumut Port which is being built in Kampung Acheh, Sitiawan, here, is expected to be completed within two years. The new Port to be operated by Lumut Maritime Terminal Sdn Bhd was situated on an 80ha site near the Raja Permaisuri Bainun Bridge, in Sitiawan, near the first Port. [2] The type of cargo handling in Lumut Port is breakbulk Cargo, dry bulk Cargo, and liquid bulk Cargo, The Lumut Port, can be improved by the presence of container port development. This is important because most of the Cargo is shipped by container, which is 60% of the other Cargo. The development of the new Port will also allow for improved port efficiency and hence the ability to achieve these volumes of container handling [3].

Port is no longer a single entity but a component of the overall supply chain and its operations have implications for all those associated with the transport of Cargo and the movement of goods. Thus, port operations are now an integral part of supply chain management. Cargo handling, storage, and associated services are now the criteria by which ports are assessed and classified in terms of customer service [4].

Nowadays, the size of the ship has become larger to make sure the maximum load can be transported. This can save costs in terms of seafarer wages, fuel consumption, and port service. The depth of Port plays the role with the welcomed of the ship. The dragging process was needed to make sure the ship could berth at the Port. [5] The locational is inelastic for the port expansion and port facilities. The scale of infrastructural projects also depends on the economic and environmental sequences [6]. Planning for infrastructure essentially constitutes establishing of an optimal capacity at the appropriate time and place by looking into the future and related forecasts. The type of capacity investment (expansion or internal efficiency improvement alternatives) is a major concern. Another important and related aspect concerns the optimal utilization of the facilities being added [7].

Usually, before the ship berth, the ship needs to anchor to wait for the tern. This will increase the time lost waiting. This problem can be reduced by 11 the expansion of the Lumut Port. This is because the vessel, which is waiting, at the Penang Port and the West Port can go to the Lumut Port for discharge the Cargo. Port time has a significant impact on efficient ship operation. A reduction in port time due, for example, to a reduction of waiting time through just in time arrival and department, to the improvement of berth productivity and to the signification of the administration process, led not only to a reduction in operating cost but also to an improvement in the level of environmental performance in the shipping industry [8].

## **METHODOLOGY**

The area of this research is around Lumut Port. It gives the reader the whole outline of the research process and summary in the research. It contains important details such as problem statement, research objectives, some literature review and methodology researcher wants to use. Deriving the related formula from literature review and more focus on reading and collecting the information on the research that already done other researcher that related to this research for their references. The literature review is more to the port expansion. The total of literature reviews that had been collected is 80 but only few of them can be used to complete this project. The resource of literature review come from multiple sources such as journal, article, books and other resources that be related to this research. There are two types of methods usually used for research, which are primary data and secondary data. The process of preparing and collecting data from the distributed questionnaire to the respondent.

The main reason for data collection is to obtain information from the respondent on how they react to the questionnaire given. In this study, the researcher collects primary data by using the quantitative analysis method through a survey questionnaire. A researcher collected the primary data with the specific method for the study of expansion evaluation in Lumut Port. SPSS is used for analyzing the data, a total of two variables factor taken into consideration, which is an internal factor and external factor. Data was entered into the SPSS, and then the data were analyzed by using descriptive statistics. Descriptive statistics is usually used to measure the means of factors or variables in the research. The researcher used a Morgan table as a sample size estimation to get the right number of respondents. The questionnaire was divided into five sections, which is, section A, section B.1, section B.2, and section C.

The first section is section A which covers all demographic information such as Gender, Age, Job Scope, and the Working Experian. Section B is divided into two which is sections B.1 and B.2, which is about the port productivity and the expansion plan. Lastly is section C which has 11 section and each section have five more questions. The question covers the Capacity of Port, Connectivity in Port between Department, Development of container Port, Port Improvement, Risk Assessment, Increasing in Economy, Turn Round in Port, Port Working Downtime, Increase the Wharf Length, Safety and Quality Control in Port and Productivity of Port. The question is closed-ended consist Likert scale question that requires the respondent to provide their opinion, thought and comments based on the option that is provided.

## **RESULT AND DISCUSSION**

The findings are the researcher got from the questionnaire compatible with the objectives of the study. Overall, respondents give agree and strongly agree about the factor of expansion in the Lumut Port. From this view, it shows that all objective of the research have been met. Even though the Lumut Port has a lot of workers, which is 256 people, only 30 of them are capable and get permission to answer the questionnaire. This is because they are not among the Management or Administration Department. Most of the person who answers the questionnaire are male, and the majority of them is more than 40 years old. The majority of their Working Experian also is more

than 40 years and come from Management Department. There are 11 factors of the port expansion, and not all factor is applied in improvise modeling algorithm as shown in Table 1. This is because some of the factor standard deviations shows a positive result and some of the factors are not included in the operation system of the loading and unloading process from ship to shore and shore to ship.

Table 1: Factor of Lumut Port Expansion Model

Factor	Standard Deviation	Description
Capacity of Port	0.6874	Need to be enlarge
Connectivity in Port between Departments.	0.6262	To have collaboration between department
Development of container port.	0.713	This cannot be applied in Lumut Port Because there is less demand for the Container Port.
Port Improvement	0.553	To make sure that Lumut Port will improve in every side from time to time.
Risk Assessment	0.4372	Need to be assess avoid loss
Increasing in Economy	0.3668	Increase the GDP
Turn Round in Port	0.6474	To make sure no down time in Lumut Port
Port Working Downtime	0.6432	To make sure Lumut Port become productive
Increase the Wharf Length	0.7032	To make sure that big ship can berth
Safety and Quality Control in Port	0.5682	To maintain and improve the safety.
Productivity of Port	0.639	The productivity become more efficient

### 3.1 The improvised algorithm

The priority  $P_i$  is an important factor affecting the port efficiency, so  $P_i$  is added into the standard model as well as the section  $k$  as in equation 4.0, 4.1 and 4.2.

The priority model:

$$P_i = \alpha V_i \text{ customer} + \beta V_i \text{ cargo} + \gamma V_i \text{ trade} \quad (4.0)$$

Were

$\alpha$ ,  $\beta$  and  $\gamma$  are the coefficients

$V_i$  Customers

$V_i$  Cargo

$V_i$  Trade are the weight factor.

$$Y = \min \sum_{i=0}^{V_n} \sum_{j=0}^{B_n} \left( T_{si} - T_{fi} - T_{di} + \frac{W_{si}}{B_{vj}} \right) X_{ijk} \times P_i \quad (4.1)$$

(4.2)

$$Y = \min \sum_{i=0}^{V_n} \sum_{j=0}^{B_n} \left( T_{si} - T_{fi} - \frac{T_{di}}{K_i} \right) P_i + \left( \frac{W_{si}}{B_{vj}} \right) X_{ijk}$$

The model uses several decision variables to obtain the berth assignment of vessel to section along the quay as well as berth order of vessel at each section as in equation 4.3, 4.4, 4.5, 4.6 and 4.7.

$$\min(\max(T_{ei})), i \in V \quad (4.3)$$

$$\max(T_{ei}) \geq T_{si} - T_{fi} - T_{di} + \frac{W_{si}}{B_{vj}} \quad (4.4)$$

$$\left( T_{si} - T_{fi} - T_{di} + \frac{W_{si}}{B_{vj}} \right) - \left( T_{si+1} - T_{fi+1} - T_{di+1} + \frac{W_{si+1}}{B_{vj+1}} \right) \geq 0 \quad (4.5)$$

$$\sum (dk - Di)lk \geq 0 \quad (4.6)$$

$$\sum_k \left( lk - \sum_{i, i \neq i} Li, Di, Wi \right) lki \geq 0 \quad (4.7)$$

Where:

- $W_{si}$  : outturn for vessel  $i$
- $T_{fi}$  : is arrival time
- $T_{si}$  : job start time
- $T_{wi}$  : waiting time for vessel  $i$
- $B_{vj}$  : job velocity for berth  $j$
- $X_{ijk}$  : job sequence time  $k$  for vessel  $i$  berth  $j$
- $T_{di}$  : Total job downtime in berth  $j$
- $j$  :  $|\dots|N|$  vessel berth at port
- $D_i$  : draft of vessel  $i$
- $L_i$  : length of vessel  $i$
- $W_i$  : set of cargo type ( $s$ )
- $dk$  : draft of section  $k$
- $lk$  : length of section  $k$

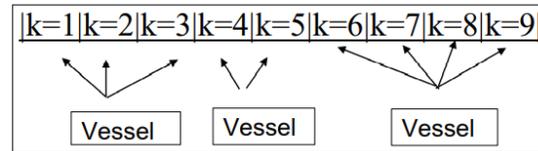


Figure 1: A new expansion schematic represents a bulk port terminal

The vessel shown in Figure 1, need to only berth within 5 hours, or the Port will be a loss because the port charges will decrease while Table 2 indicates of the berthing hours.

Table 2: Indicates of the berthing hours

Time range	Status
< 5 hours	Congested
Within 10 hours	Mild congested
Above 20 hours	Congested free

## CONCLUSION

This research is held in the Lumut Port area where the objective is to identify the factor of the port expansion and to formulate the expansion algorithm. Both of these objectives are achieved due to this research producing the questionnaire from the factor of the port expansion and improvise of the algorithm. This will help Lumut Port to take action and make a decision for the port expansion in in the port area. This expansion will help Lumut Port to improve their service and productivity due to the increasing number of customers. This activity also will encourage the new customer to use the service provided in Lumut Port. Lumut Port also will attract the big vessel to come and berth at their Port.

This will give working opportunities to the citizen and will increase the economy. The port expansion problem relies on the berth utilization rate. The type of Cargo on vessel and equipment installed such as a conveyor. This research work proposed of the hybrid bulk port terminal for Lumut Port. The model explicitly takes into account. The cargo type on the vessel by introducing the port section factor. In the bulk context, the proposed model is making robust to account for unseen downtime operation which owing to uncertainties.

Therefore, is modeled with some degree of variable information. As the model indicates of higher denoted time, it is indicating that the expansion plan is now required even though hybrid concept implemented. Under conclusion remark for improvement for the future project. This new model is proposed to have the sensitivity test of the result to different input parameters. This is needed because the more sensitivity the more accurate. Sensitivity is important because it can reduce the loss or risk that might been happened in the future. The congested value represents the congested scenario when it indicates. Future these proposed model will be evaluated and been test in the next project. This is because this research is just improvising the previous model. Any test is not done yet with this improvement of the algorithm.

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