OPTIMIZE PERFORMANCE DIMENSION FOR BERTHING ARRANGEMENT IN THAILAND MAIN PORT MODEL

Ronnakrit Settadalee[1], Tanan Kuntasa[2], Nitsakarn Piyanit[3], and Kittisak Makkawan[4]
[1,2,3]Faculty of Logistics, Burapha University, [4]Great Circle Shipping Agency Ltd

Received: June 13, 2020 / Revised: October 29, 2020 / Accepted: November 9, 2020

Abstract

Shipping ports are a vital component of the import-export economy, including the value-added utility of space at ports. This study applies the optimize performance dimension for berthing arrangement in Thailand main port model. To analyses the structural relationship between the loading factors and berthing arrangements of latent variables including ships, ship owners and shipping lines, the government sector, and customers, by 16 indicators of TEN SEM fit indexes for sample size as well as 160 samples. This study uses 190 samples for path analysis, structural equation modeling, and 2 validity tests (convergent validity and discriminant validity) were utilized. Moreover, loading validity and reliability loading were examined using Cronbach's Alpha of the ADANCO Program. The results revealed not only the effects of internal matters from terminal operators, but also from customers (0.439), the government sector (0.329), ships, ship owners and shipping lines (0.146). Latent variables were found to have directly affected berthing. In addition, the indicator results displayed priority guidelines for solutions to berthing problems as well as optimizing berthing performance.

Keywords: Berthing Performance, Berthing Arrangement, Terminal Operations, Port, Structural Equation Modeling

Introduction

The economic growth of Thailand depends on transportation to export goods to foreign countries with the major channel being by sea. Laem Chabang port replacing the Bangkok port which was limited to freight containers not exceeding 1.0 million TEUs since 1996. (Port Authority of Thailand, 2018) from 2014-2019 there were more than 6 million TEUs and increasing by 4 % every year. This effected the number of ships birthing at the port. This research intends to increase the effectiveness of the port from activities also at the port itself. To increase the ability for more ship berthing and reduce time operation by decreasing the time at the port, increasing the travel time, and reducing the fuel.

Corresponding Author
E-mail: ronnakrit@buu.ac.th

Research Objective

This research aims to distinguish berthing activities, a correlation of the indicator in Thailand's main port and making guidelines to achieve a higher level of port facility.

Literature Review

In the paper we selected the important topics concern berthing, port activities and including government and customer activities. The four; (ship owners, port, government parties and customer) parties have cooperated to take container throughput in Thailand's main port. The essential KPI's to measure port performance. For fulfilling these gaps in literature and operation processes in berthing arrangement. The testing model of service quality in maritime transport has six dimensions; resources, outcome, processes, management, image, and social responsibility to measure by 24 factors with internal and external process of service production and delivery (Thai, 2008: 493-518).

When a vessel is berthed is differential with an estimated time of berthing. Therefore, the time for cargo operation is decreasing from the schedule. The Port operators adjust their instruments for solving buffer time problems. The way for optimal solutions in a Robust Berth Scheduling Algorithm (RBSA) shows performance and service levels of formulation (Xu, Chen, & Quan, 2012: 123-140).

Almost all terminals maintain a policy of first come first serve for berth arrangement. Shipping and Ship company to command to master for full speed to berth as soon as possible. In this case it takes taken more fuel consumption per ship approach to port. The hybrid simulation-optimization represents the performance allocation of terminal resources and the basic principles of planning activities at the terminal (Alvarez, Longva, & Engebrethsen, 2010: 327-346).

When the vessel arrived at boarding ground to schedule to come alongside due to berth congestion and the previous vessel is operating cargoes in loading/unloading process (Salido, Rodriguez-Molins, & Barber., 2011: 435-451). The container stacking arranged by the port of discharge, voyage, and weight type of the container. The vessel comes alongside with a first come first serve policy the container location must be relocated to adjust the stowage plan. The buffer time of container movement is the main partial problem to attend berth period.

Port services are supported customer, shipping lines and cargo owners' demand. The berth arrangement initial activity to respond servicer (Yeo, Thai, & Roh, 2015: 437-447). Port operator measure customer satisfaction by port service quality (resource, outcomes, process, management, image, and social responsibility) to make decision and control port operation work plan (Marlow & Casaca, 2003: 189-202).

Port service is double derived demand. The leanness and agility in port expect to decrease total minimize cost and solve bottle neck problem associated with delays and wastes time. The port performance divided 2 indictors: financial, operation indicator.

The performance is better form good linker to port such as "the concept of lean port network" need more modes to transportation shift cargo from place to place and control time to container stack in yard/warehouse areas.

The UNCTAD has categorized port model and nowadays after 1980s. Port model become in third generation. Type of port changed with cargoes from break bulk and dry/liquid bulk cargo to bulk and unitized containerized cargo. Organization bodies close relationship between port and nearby city growth (Beresford et al., 2004: 93-107).

The handling equipment decreased manpower transformation port driven by technology. The WORKPORT schematic model from 1960s-2000s in EU Port have many dimensions changed. For example, cargo support processes and information provision information technology and communication network are complexity and more utility in port activities.

The container terminal development in China. The large economy country become the main seaborne trade in the word. The elements were supported from huge funds driven by central government (Cullinane et al., 2004: 55-75).

In 1978 startup state enterprise shipping company and initial container port development in mainland. The first service via ad hoc container because the demand less amount when compare in the present. The huge demand was taken until China become to the member of the World Trade Organization. The cargo many types of export to the many destinations around the world. The importance result growing containerizes of cargoes through the port sector. The construction of new container ports designed capacity over throughput. The government encourage coastal container transportation policy to support mainland port.

Nowadays the world economy deserves from transportation. The Sea transportation is the top service mode to support material and finished goods distribute around the world. Ports are door to receive and sending cargo through the customer (Song & Panayides, 2008: 73-87).

The information and communication technologies have relationship with working factors. The terminal performance able to support the vessel berthing arrangement and encourage the competitiveness factors for customer satisfactory such as price, quality, reliability, responsiveness.

Port service activities cooperated with parties. The factors challenged port service relationship door to door transport chain (Frémont, 2010).

The sea transport chain in shipping freight from origin point to destination point have more connection nodes and more procedure to transfer. The parties are exporter to importer compound with forwarding agent, shipping agent, freight services (customs broker, port forwarding agent), vessel services (port authority, provisionary, cargo handler, pilot, boatman, towage). The lean cost and time to cooperate are the advantage to competitive in the market.

The government sectors supported installation port because the infrastructure almost port in the word received financial aid for construction from municipality or central government (Cullinane & Song, 2002: 55-75).

Therefore, the port is the capital-intensive industry. The ones were driven berth arrangement activities. The Vessel Traffic Service monitor and control ships in traffic separation scheme including arrange vessel sequence to berth. Port controls support the pilot to advice characteristics of canal for alongside. During berthing situation Port authority operate mooring activities by mooring gang and provide basic consumption to support vessel. The hygiene department check quarantine in crews and passenger.

From the berthing arrangement is relationship with other parties. The driven activities connecting with varies dimension. The method for testing correlation by Path analysis to analyze path and testing multi-independent variables to describe dependent in studies case constrain all independent variables relationship and correlation with dependent variable or independent variable are not constrain (Akintunde, 2012: 9-15).

The condition to use path analysis. The variables must be linear correlation and same direction from independent variable to dependent variable also correlation in rational. The data is normal distribution and equivalent variance. The sample group has big sampling size (Bedeian & Armenakis, 1981: 417-424).

There is a declaration requirement for every container needed to pass the referring to related research studies and operational area exploration, including interviewing associated people in port arrangement activities. It was found that the working performance impacted the berth arrangement efficiency, which did not meet the provided berth schedule. This result could affect many working parts; however, the cause of the mentioned problem also was generated from other working units. In addition to berth arrangement dimensional analysis and data collection from works, it could differentiate the dimensional elements and berth arrangement activities of Laem Chabang Port, container port, as follows.

Elements of Berth Arrangement and Activities

1. Ships, Ship owners, and Shipping Lines

1.1 Estimate Time of Arrival: ETA Given that most container vessel often arrives at Laem Chabang port as it is routine services liner, informing time of arrival is an important priority. This, moreover, can impact the berth arrangement planning and related people's preparation such as container preparation and container stowage at the port. Besides, there are also pilot equipment preparation and vessel pilotage planning. Transporters, furthermore, must prepare for the loading and unloading container (Meijer, 2017).

1.2 Number of Loading and Unloading Container of a Voyage There are several types of containers arrived at Laem Chabang port. For instance, import containers, export container, and transshipment containers are regarded the main types. However, not only the number of loaded containers from the other port before unloading at Laem Chabang port or loaded containers from Laem Chabang port to others but also the transshipment containers of each voyage are quested to be arranged appropriately with the berth window period (Martin et al., 1988: 429-440).

1.3 Container Stowage Plan is managed by following the data prediction of shipping liner agent. The responsibilities for planning are under the center planner of shipping liner. On the other hand, the numbers of containers are predicted from shipping liner agent of each port to plan the vessels route appropriately with the berth period. The predicted containers, sometime, do not match the real numbers. This is the cause to make an impact on the working system.

1.4 Ship's Structure, Ship gear, gearless to berth the vessels at Laem Chabang port, there are some conditions for the general cargo vessels to make it meet suitable function. Feeder ship is requested to load commodity instead. It is designed to install handling equipment which is an obstacle for the shore cranes. Therefore, this is the reason why the working time is extended (Podesta, 1979).

1.5 Vessel berthing Duration and Goods Preparation. It is consisted of gangways preparation to provide comfort to the stevedore aboard (Martin et al., 1988: 429-440).

This procedure is to make the port meet The International Ship and Port Facility Security: ISPS code; furthermore, the immigration process and public health process are also included (Debnath, Chin, & Haque, 2011: 645-655).

However, all the mentioned processes above have resulted in the delay before the start of work.

2. Government

2.1 Traffic Congestion in the Vessel Traffic Separation Scheme Every vessel is requested to inform the Vessel Traffic Service Centre to notify district coordinates for knowing the vessel movement (Debnath, Chin, & Haque, 2011: 645-655).

It is, sometimes, required the informing six hours and one hour in advance prior to an arrival at the piloted district. According to the berth arrangement, there is Laem Chabang channel management during the berthing and unberthing time. For the safety conditions, the vessels are requested to anchor to wait for the berth at the port. In this focal point, it wastes more berthing time, and it affects all work systems.

2.2 Traffic Congestion in the Vessel in Port Zone There is channel management at the Laem Chabang port for the safety. It, sometimes, causes the delay of berthing and unberthing vessel. Even though the vessel has been finished its process, it needs to wait for the channel management to unberth. Meanwhile, the outside vessels are drifted to berth. This is the reason why time extension is caused and has an impact on the berth window period.

2.3 Pilot Officer and Mooring Gang Responsibilities It is extremely necessary to have an expertise from the pilot officer and mooring gang when needed to fasten and loosen the ship lines during the vessel berth and unberth. According to the traffic congestion, which means there are a lot of vessels in and out at the port, and insufficient number of specialists, it is another reason why time extension is caused in vessel berthing.

2.4 Verified Gross Mass: VGM Regarding the bending and capsizing of the MOL Company, it is the cause of increasing restriction in VGM. The gross mass clarification is required to declare by the verification at the first door prior to an arrival at the port zone, then it is requested to specify shipping particular documents and cargo permit documents. Whereas, in some cases, the gross mass numbers in the document are unmatched to the verified numbers. These causes' containers are unable to get in to wait for the loading. In case of the unresolved gross mass numbers, there will not be loading to the vessels, and data entering the system. Additionally, prior to unberth, there will always be the final stowage plan confirmation; therefore, it will spend more time for the verification.

2.5 Containers X-ray Verifications. According to time limitation and physical factors of containers, x-ray verifications have been applied to meet the conditions. The verifications are specified by the customs department's profile system and risk profile, green and red. In some cases, staffs are unable to verify all the containers within a limited time. Therefore, containers will be left at the x-ray ground to wait for verifications. It causes the delay of loading and unloading on the vessel.

2.6 Loading and Unloading DG Container There is only one dangerous warehouse entrepreneur at the Laem Chabang port whose services are provided for every port operator in this zone (Vinitkamtorn, 2010). During rush hour, it often faces with the support insufficiency and traffic congestion. Thus, it has impacts on switching the working queue, affected not only loading and unloading plan but also the working period extension.

3. Terminal Operator

3.1 Handling Equipment Readiness This is an important equipment for containers loading and unloading from the apron to container yard, consisted of ships to shore cranes and RTG (Rubber Tired Gantry Crane). Ships to shore cranes are for loading onto truck head and transferring to the container yard; meanwhile, RTG are for containers arrangement in the container yard (Imai et al., 2006: 373-389).

3.2 Stacking Container in Yard as Laem Chabang Port is the original port in Thailand, there will always be an arrival of import and export containers and some transshipment containers as usual. Therefore, the arrangement is required to allocate the containers along with the vessel capabilities appropriately. Nevertheless, there is also a container transporter entrepreneur at the port whose job to transport containers in and out. This causes the traffic congestion in the container yard and impacts the cargo operations.

3.3 Initial and Final Stowage Confirmations After completing the containers stowage confirmations, the information will be sent to the Centre Planner to verify the shipping line. During this process, there is no ship stability information (Wilson & Roach, 1999: 403-418).

The importance of ship stability information is to check if the vessels are appropriate for the seaworthiness or not. This information will be received when the vessel berth at the port, after containers verification aboard. Therefore, it is needed to extend time for this process. Then, it can run through the next procedure.

3.4 Domestics Container and Rail Transfer Management. There are different ways to transfer containers to the Laem Chabang Port, including by road, domestics lighter, and rail (Zhao, Yang, & Haralambides, 2019: 11-25).

It is calculated more than 50% of the containers transported by domestics lighter; however, there is no certainty in berth arrangement for domestic lighter at Laem Chabang Port. Therefore, the terminal operators managed berthing by keep the loaded container vessels wait until things have been done. This occurs the same in case of transferring by rail.

4. Customers (Shipper, Transporter Entrepreneur, Forwarder, and Customs Broker)

4.1 Closing Time-Free Time To transport containers to the destination, sometime, there is an arrival of transferring containers in a cut-off time (Gambardella & Rizzoli, 2000).

Closing time extension is caused at the port. Furthermore, it impacts on number of containers which do not match with the liner prediction, and also impacts on containers, which are unable to arrive in time of vessel unberthing. In term of inbound recognition duration, if there is more provided time, it will cause the container congestion. To plan and manage involved equipment in that area for the containers, it is congested. Meanwhile, it affects the vessel operations.

4.2 Customs Clearance Procedure Therefore, it takes more time, and needs more space for the declaration of both inbound and outbound containers. Inbound containers will be used the equipment in the port to move them, so this affects equipment utilizing plan for outbound container (Zhao, Yang, & Haralambides, 2019: 11-25).

Moreover, it must wait for the completed procedure before being able to load. On the other hand, in case of some containers fail the verification, there will be shut-out container. This affects goods and services plan.

4.3 Road Containers Transportation and Transport Channel Readiness There are three types of provided transportations, including by road, sea, and rail. Transporting by road is the core channel to transfer containers at Leam Chabang Port. Thus, there are numerous trucks affected to the traffic in the Port, which does not respond in accordance with cargo operations. Meanwhile, transporting by sea is also congested as well. Some liners transfer containers from different ports in Bangkok to transit at Laem Chabang Port. Hence, there are utilized lighters berth at the port. The vessels needing to berth must wait for berthing of lighters. However, there is a reduction in equipment operations of transporting by rail to adjust the working form between cargoes and rails. It could increase the working hours of port operations from that reduction.

4.4 Goods and Containers Readiness

Normally, shipments procedure is often started with booking the container and voyage of cargo owner. There will be duration predictions for shipments. Sometime, when it meets the due, the preparation can be finished in closing time. Therefore, the containers are not loaded, causing inaccurate predictions, and affecting port operations.

Methodology

Regarding the studied dimensions affected to berth arrangements, researchers are interested in ratio and relationship of each dimension. The importance levels could be elaborated by the following four parties.

To increase the effective of the port operation. Reducing the time in port effect the circular of ships. The ship berthing operation not only concerned by terminal operator but also agencies, ship, ship owner and customers. As a result, finding the equality of the activities and the relationship between each party by creating structure that describe the importance and order of problem solving inside of ship berthing in Laem Chabang Port.

The Sample an increase in berthing arrangement efficiency. The acquisition of variables through in-depth interviews and literature review and consistency verified by 4 experts are key importance (Port Managers and Port Instructors) as the samples for data collection, including ship companies, entrepreneurs, sailors, government officials involving in berthing arrangement activities, port operator, and users, was found that there were 71.2% of operator level as well as 25.2% of an executive level, and others 3.6%. Furthermore, working experience between 1- 5 years was about 58% while 5-10 years was at 15.3% as well as over 10 years was 23.7% and others 3%.

However, data collection from the sample group by TEN SEM fit indexes of sample sizes was received from all 190 questionnaires, according to the specified conditions and all examined 190 sets of data (Fan et al., 1999: 56-83).

The Survey measures

Table 1 The Dimensions of Vessel Berthing Arrangement Model

Items	Indicators	Measurement
Terminal Operator (TOE)	1. Handling equipment readiness (TOE1) 2. Stacking container in yard (TOE2) 3. Initial and final stowage confirmation (TOE3) 4. Domestic container and rail transfer management (TOE4)	Imai et al., 2006: 373-389 Walda, 1970 Wilson et al., 1999: 403-418 Zhao, Yang, & Haralambides: 11-25
Ship, Ship Owners, and Shipping Lines (SHO)	1. Estimate time of arrival: ETA (SHO1) 2. Number of loading and unloading containers of a voyage (SHO2) 3. Container stowage planning (SHO3) 4. Ship's structure, ship gear, gearless (SHO4) 5. Vessel berthing duration and goods preparation (SHO5)	Meijer, 2017 Martin et al., 1988: 429-440 Podesta, 1979 Martin et al., 1988: 429-440
Government Agencies (GOV)	1. Traffic congestion in the vessel traffic separation scheme (GOV1) 2. Traffic congestion in the vessel in port zone (GOV2) 3. Pilot officer and mooring gang responsibilities (GOV3) 4. Verified gross mass: VGM (GOV4) 5. Containers x-ray verifications (GOV5) 6. Loading and unloading DG container (GOV6)	Debnath, Chin, & Haque, 2011: 645-655 Debnath, Chin, & Haque, 2011: 645-655 Vinitkamtorn, 2010
Customers (Shipper, Transporter Entrepreneur, Forwarder, and Custom Broker) (CUS)	1. Closing time-free time (CUS1) 2. Customs clearance (CUS2) 3. Road containers transportation and transport channel readiness (CUS3) 4. Goods and containers readiness (CUS4)	Gambardella & Rizzoli, 2000 Zhao, Yang, & Haralambides: 11-25

Study on berthing arrangement structure. It was applied to the Likert Scale configuration questionnaire with 4 latent variables: 1) Ships, ship owners, and shipping lines, 2) Government agencies 3) Terminal operator 4) Customers (Shipper, Transporter Entrepreneur, Forwarder, and Custom Broker). Furthermore, it utilized 19 indicators for Structural Equation Model: SEM Analysis as well as Goodness of Model Fit Assessment, and Path Analysis. In addition, there were 2 types of validity which were convergent validity, measured by loading unit with statistical significance greater, and discriminant validity, measured by AVE > 0.5 (Fornell & Larcker, 1981)

While reliability was measured by Cronbach's Alpha (Joseph Jr et al., 2010) and Construct reliability > 0.7. The processing SEM structural equations was completed by ADANCO program.

Results

Verification of the suitability of the model structure. The relative structure of the berthing arrangement relies on the Standardized Root Mean Square Residual (SRMR) about 0.0888. The model was appropriate since the SRMR that makes the model suitable is less than 0.1 (Hooper, Coughlan, & Mullen, 2008).

Table 2 Ship, Ship owners, and Shipping Lines (SHO), Government Agencies (GOV), Terminal Operator (TOE), Customer (CUS).

	$Loading_a$	AVE_b	Dijkstra-Henseler's rho $(\rho_A)_e$	Jöreskog's rho $(\rho_c)_f$	Cronbach's alpha$(\alpha)_d$
SHO		0.5292	0.7133	0.8177	0.7044
SHO1	0.7246				
SHO2	0.7251				
SHO3	0.7793				
SHO5	0.6772				
GOV		0.5390	0.7346	0.8199	0.7039
GOV1	0.5234				
GOV4	0.8033				
GOV5	0.8300				
GOV6	0.7403				
TEO		0.6609	0.8334	0.8862	0.8289
TEO1	0.7678				
TEO2	0.8339				
TEO3	0.8445				
TEO4	0.8033				
CUS		0.7016	0.8623	0.9038	0.8580
CUS1	0.7916				
CUS2	0.8707				
CUS3	0.8613				
CUS4	0.8244				

Items removed: Indicator items are below 0.5 SHO4, AVE < 0.5, GOV2 GOV3

a. All item Loading > 0.5 indicator Reliability (Hooper, Coughlan, & Mullen, 2008: 53-60)
b. All Average Variance Extract (AVE) > 0.5 as indicates Convergent Reliability (Gambardella & Rizzoli, 2000; Hulland, 1999: 195-204)
c. All Composite reliability (CR) > 0.7 indicates Internal Consistency (Bagozzi & Yi, 1988: 74-94)
d. All Cronbach's alpha > 0.7 indicates Indicator Reliability (Gefen et al., 2000: 7)
e. Dijkstra-Henseler's rho (ρA) > 0.7 indicates Indicator Reliability (Henseler et al., 2016)
f. Jöreskog's rho (ρc) > 0.7 indicates Indicator Reliability (Henseler et al., 2016)

Model test found that there are some indicators showing a loading value less than 0.5, which is the structure of a ship with a crane that hinders product operations (SHO4) and the average variable extraction (AVE). Port traffic congestion (GOV2) and in and out of ships (GOV3) affect the AVE value less than 0.5, but both values are close to 0.5. Therefore, it was excluded from the consideration of the berth structure. From the indicators and latent characters as shown in Table 2, the model criteria were described the relationship of the berthing arrangement structure.

Table 3 Discriminant Validity: Fornell-Larcker Criterion

Construct	SHO	GOV	TEO	CUS
SHO	0.5292			
GOV	0.1714	0.5390		
TEO	0.2326	0.3640	0.6609	
CUS	0.2068	0.2363	0.4435	0.7016

Squared correlations, AVE in the diagonal.

Discriminant Validity was differentiated by the standard of each construct from the AVE of each latent variable greater than the correlation between the latent variable (Fornell & Larcker, 1981).

The test showed that the SHO GOV TEO CUS's AVE was greater than the correlation between the variables. Therefore, the model has the discriminant validity along with the standard.

Table 4 Discriminant Validity: Heterotrait-Monotrait Ratio of Correlations (HTMT)

Construct	SHO	GOV	TEO	CUS
SHO				
GOV	0.6047			
TEO	0.6210	0.7821		
CUS	0.5893	0.6489	0.7818	

The reliability of The Heterotrait-Monotrait Ratio of Correlations (HTMT) model is less than 1 and significant (Henseler et al., 2016).

The test of the berthing arrangement structure is less than 1; therefore, its accuracy of discriminant validity meets the standard.

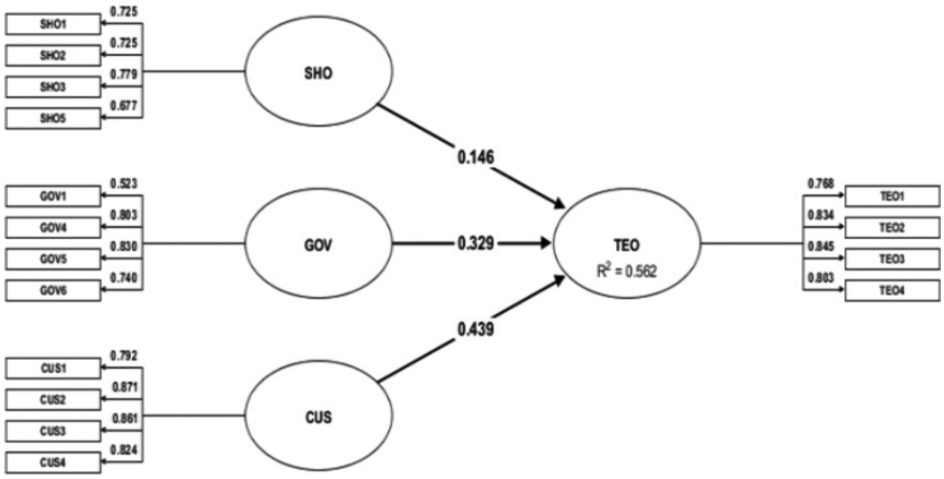

Figure 1 Berthing Arrangement in Thailand Main Port Model

Goodness of Fit

Structure considered by confidence of reliability validity of loading between the latent variables and the statistical value (R^2 = 0.562) Moreover, social science research divided R^2 into 3 levels consisting of 0.25 (Weak), 0.50 (Moderate), and 0.75 (Substantial) as well as f^2 from Figure 1 and Table 5, it was applied to one data analyzes which influenced on 3 paths with loading values of 0.146-0.439. Its value ranges from 0.0363-0.3024, and the impact value between the latent variable 0.0363-0.3024 (Cohen, 1992).

From requiring 0.02 as a small, 0.15 as a medium and 0.35 as a large, it is found that the activity of the port influenced by the ship, ship owner, and shipping line are small and the government agencies, customers (carriers, carriers, transport agents) are medium. It was measured from Path coefficient (Beta) and path coefficient or the direct impact of the route analysis (Hooper, Coughlan, & Mullen, 2008: 53-60).

However, there is a positive relationship between the management of a berth.

Table 5 Effect Overview

Effect	Beta	Total effect	Cohen's f^2
SHO -> TEO	0.1462	0.1462	0.0363
GOV -> TEO	0.3292	0.3292	0.1772
CUS -> TEO	0.4395	0.4395	0.3024

Discussion and Conclusion

Accessing the safety factor of ship berthing operation Hsu (2015: 576-588) ship berthing operation for safety from Human factors, Machinery, Port management and Port facility. The research represents the port safety activities and effectiveness of ship berthing with the length set at port and improve the ship berthing activities.

To expand the overall work effectives of the port. It needs to be considered together with the agency and the activities concern with increasing the effectives of ship berthing management from upstream to downstream by consider the terminal operator to be the center.

Berthing Arrangement

It was found that the activities in the Terminal operator itself were influenced as follows: Initial and final stowage confirmations (0.845), Stacking Container in Yard (0.834), Domestics Container and Rail Transfer Management (0.803), Handling Equipment Readiness (0.768). The proportions from the route analysis and influence with the terminal operator can be sorted in the following order: Customers (0.439) The proportion of the loading of the activities are Customs clearance (0.870), Road containers transportation and Transport channel readiness (0.861), Goods and containers readiness (0.824), Closing Time-Free Time (0.791), Government agencies (0.329), Meanwhile, the Proportion of the loading of activities are Containers x-ray verifications (0.830), Verified Gross Mass: VGM (0.803), Loading and unloading DG container (0.740), traffic congestion in the vessel traffic separation scheme (0.523). Finally, ships, ship owners, and shipping lines (0.146), the proportion of the loading of activities are Number of loading and unloading containers of a voyage (0.779), Container stowage planning (0.725), Vessel berthing duration and Goods preparation (0.724), Estimate time of arrival: ETA (0.677).

To increase the efficiency of the berthing arrangement is not only to focus on the importance of the factors occurring in the port, to work more efficiently, the priority must be given to solving problems according to the research priorities. As a result, The management of port allocation. The information from the relevant department has been missing. This effect the operation of the port. The research has described the impact and the problem-solving priorities, for example, the expected number of containers do not correlate with reality this effect the space preparation and the lifting tool. This causes the ineffective in space management and the congestion of the traffic and the ship management as well.

Suggestion

According to some indicators having been excluded from the berthing arrangement structure equation, it included ship gear, gearless (GOV3) due to the ability of the ship to shore crane capable of lifting and crossing the ship's structure. However, most of the newer ships that berth at Laem Chabang Port are vessels without tools. On the other hand, for traffic congestion in the vessel in port zone: (GOV2), Pilot officer and Mooring gang responsibilities (GOV3) were disregarded from the structural equation since the AVE value is less than 0.5, yet the value is similar. Nevertheless, in the next study, to clarify the port operation guidelines, only two factors should be defined to deepen the study framework for further benefits. Many KPI's have been used to indicate the effectiveness of the operation in the port. One of them is ship birthing beside the port and the clients, the government (the relevant department) The investment in the port uses a lot of budgets. Government decided to invest in the port and been concession and mange by the private sector. For the expansion in Macroeconomic the government must support enough officers and promote the operation of the port to reduce the complexity and increase the traffic both by land and sea. When the ship birthing faster and less time spenting in the port. this will affect more containers traffic and the economic growth in the country.

Acknowledgement

The research would like to thank the research funding supported by the Faculty of Logistics, Burapha University. Port Authority of Thailand, Laem Chabang Port, Harbor Department, Shipping Company, Sailor and Research Team.

References

Akintunde, A. (2012). Path Analysis Step by Step Using Excel. *Journal of Technical Science and Technologies, 1*(1), 9-15.

Alvarez, J. F., Longva, T., & Engebrethsen, E. S. (2010). A Methodology to Assess Vessel Berthing and Speed Optimization Policies. *Maritime Economics & Logistics, 12*(4), 327-346.

Bagozzi, R. P. & Yi, Y. (1988). On the Evaluation of Structural Equation Models. *Journal of the Academy of Marketing Science, 16*(1), 74-94.

Bedeian, A. G. & Armenakis, A. A. (1981). A Path-Analytic Study of The Consequences of Role Conflict and Ambiguity. *Academy of Management Journal, 24*(2), 417-424.

Beresford, A. K. C., Gardner, B. M., Pettit, S. J., Naniopoulos, A., & Wooldridge, C. F. (2004). The UNCTAD and WORKPORT Models of Port Development: Evolution or Revolution? *Maritime Policy & Management, 31*(2), 93-107.

Cohen, J. (1992). Statistical Power Analysis. *Current Directions in Psychological Science, 1*(3), 98-101.

Cullinane, K., Fei, W. T., & Cullinane, S. (2004). Container Terminal Development in Mainland China and Its Impact on the Competitiveness of the Port of Hong Kong. *Transport Reviews, 24*(1), 33-56.

Cullinane, K. & Song, D.-W. (2002). Port Privatization Policy and Practice. *Transport Reviews, 22*(1), 55-75.

Debnath, A. K., Chin, H. C., & Haque, M. M. (2011). Modelling Port Water Collision Risk Using Traffic Conflicts. *The Journal of Navigation, 64*(4), 645-655.

Fan, X., Thompson, B., & Wang, L. (1999). Effects of Sample Size, Estimation Methods, and Model Specification on Structural Equation Modeling Fit Indexes. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 56-83.

Fornell, C. & Larcker, D. F. (1981). *Structural Equation Models with Unobservable Variable and Measurement Error: Algebra and Statistics* (Research Report). Ann Arbor, MI: The University of Michigan.

Frémont, A. (2010). *Empirical Evidence for Integration and Disintegration of Maritime Shipping, Port, and Logistics Activities* (Research Report). Paris: Organization for Economic Co-Operation and Development.

Gambardella, L. M. & Rizzoli, A. E. (2000). The Role of Simulation and Optimization in Intermodal Container Terminals. *European Simulation Symposium,* (9), 107-116.

Gefen, D., Straub, D., & Boudreau, M. C. (2000). Structural Equation Modeling and Regression: Guidelines for Research Practice. *Communications of the Association for Information Systems, 4*(1), 7.

Hair, J. F., Black, W. C., Basin, B. J., Anderson, R. E., & Tatham, R. (2010). *Multivariate Data Analysis:* Upper Saddle River, New Jersey: Pearson Education.

Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS Path Modeling in New Technology Research: Updated Guidelines. *Industrial Management & Data Systems, 116*(1), 2-20.

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural Equation Modelling: Guidelines for Determining Model Fit. *Electronic Journal of Business Research Methods, 6*(1), 53-60.

Hsu. W. K. K. (2015). Assessing the Safety Factors of Ship Berthing Operations. *The Journal of Navigation, 68*(3), 576-588.

Hulland, J. (1999). Use of Partial Least Squares (PLS) in Strategic Management Research: A Review of Four Recent Studies. *Strategic Management Journal, 20*(2), 195-204.

Imai, A., Sasaki, K., Nishimura, E., & Papadimitriou, S. (2006). *Multi-objective* Simultaneous Stowage and Load Planning for a Container Ship with Container Rehandle in Yard Stacks. *European Journal of Operational Research, 171*(2), 373-389.

Marlow, P. B. & Casaca, A. C. P. (2003). Measuring Lean Ports Performance. *International Journal of Transport Management, 1*(4), 189-202.

Martin Jr, G. L., Randhawa, S. U., & McDowell, E. D. (1988). Computerized Container-Ship Load Planning: A Methodology and Evaluation. *Computers & Industrial Engineering, 14*(4), 429-440.

Meijer, R. (2017). *ETA prediction: Predicting the ETA of a Container Vessel Based on Route Identification Using AIS Data.* Master's Thesis, Delft University of Technology.

Podesta, S. (1979). *U.S. Patent No. 4,158,416.* Washington, DC: U.S. Patent and Trademark Office.

Port Authority of Thailand. (2018). *The Annually Statistic Report in 2018*. Retrieved August 15, 2019, from http://www.port.co.th/cs/internet/internet/%E0%B8%AA%E0%B8%96%E0%B8%B4%E0%B8%95%E0%B8%B4%E0%B8%A3%E0%B8%B2%E0%B8%A2%E0%B8%9B%E0%B8%B5.html?page_locale=en_US

Salido, M. A., Rodriguez-Molins, M., & Barber, F. (2011). Integrated Intelligent Techniques for Remarshaling and Berthing in Maritime Terminals. *Advanced Engineering Informatics, 25*(3), 435-451.

Song, D.-W. & Panayides, P. M. (2008). Global Supply Chain and Port/Terminal: Integration and Competitiveness. *Maritime Policy & Management, 35*(1), 73-87.

Thai, V. V. (2008). Service Quality in Maritime Transport: Conceptual Model and Empirical Evidence. *Asia Pacific Journal of Marketing and Logistics, 20*(4), 493-518.

Vinitkamtorn, P. (2010). Operators' Competency in Dangerous Goods Cargo Management through Seaport. Master's Thesis, Chulalongkorn University. [in Thai]

Walda, F. (1970). *U.S. Patent No. 3,550,796.* Washington, DC: U.S. Patent and Trademark Office.

Wilson, I. D. & Roach, P. A. (1999). Principles of Combinatorial Optimization Applied to Container-Ship Stowage Planning. *Journal of Heuristics, 5*(4), 403-418.

Xu, Y., Chen, Q., & Quan, X. (2012). Robust Berth Scheduling with Uncertain Vessel Delay and Handling Time. *Annals of Operations Research, 192*(1), 123-140.

Yeo, G. T., Thai, V. V., & Roh, S. Y. (2015). An Analysis of Port Service Quality and Customer Satisfaction: The Case of Korean Container Ports. *The Asian Journal of Shipping and Logistics, 31*(4), 437-447.

Zhao, Y., Yang, Z., & Haralambides, H. (2019). Optimizing the Transport of Export Containers Along China's Coronary Artery: The Yangtze River. *Journal of Transport Geography, 77*, 11-25.

Name and Surname: Ronnakrit Settadalee

Highest Education: Master of Economics, Chiang Mai University

Affiliation: Faculty of Logistics, Burapha University

Field of Expertise: Port Economics and Port Operation

Name and Surname: Tanan Kuntasa

Highest Education: Master of Science, Burapha University

Affiliation: Faculty of Logistics, Burapha University

Field of Expertise: Maritime transport, Nautical science, and Shipping

Name and Surname: Nitsakarn Piyanit

Highest Education: Master of Political Science, Burapha University

Affiliation: Faculty of Logistics, Burapha University

Field of Expertise: Public Policy and Public Administration.

Name and Surname: Kittisak Makkawan

Highest Education: Bachelor of Science, Burapha University

Affiliation: Great Circle Shipping Agency Ltd

Field of Expertise: Navigation and Maritime Logistics.