December 17 (Vol. 1) (Issue. 1)

Available online at www.jarims.aibma.net

JOURNAL OF ADVANCED RESEARCH IN BUSINESS, MARKETING, AND SUPPLY CHAIN MANAGEMENT

Journal homepage: www.jarims.aibma.net

# *Qualitative Research on the Impact of Information and Communication Technology on Penang Port Sdn. Bhd.*

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ARTICLE INFO

*Article history:*
Received in revised form 20 October 17
Accepted 1 December 2017

**Keywords:**
information communication and technology (ICT), level of ICT usage, security system, container management, smart-rail system and port performance.

ABSTRACT

The use of (ICT) in logistics has been advocated to enhance the performance of the logistics sector especially in the seaports. A huge number of researches showed the importance of using RBV in analyzing performance. RBV however has been adopted in accordance to address the implication of IT on performance for many years, and the latest findings on "IT-performance" relationship is very unclear to make a conclusion. Therefore, further study on application of this theory in the ICT-performance relationship in port industry. This study seeks to examine the impact of ICT implementation on Penang Port Sdn. Bhd. (PPSB) performance. This research is exploratory in nature and the data was collected through a series of interviews. The result from this study shows that there are impact on the ICT usage, container management and Smart-Rail system on port performance. However, this study indicates that port security system does not give an impact towards achieving overall port performance. This study found that technology resources raise internal and external capabilities, which in turn affect port performance. Port resources positively affect organizational efficiency through its impact on internal capabilities thus directly impact the port performance. The results of this study provide direction for investing and managing organizational it resources to achieve competiveness.



## 1. INTRODUCTION

The growing needs for freight transport logistics industry to improve their services come with the vital prerequisites in the use of information communication and technology (ICT). It is highly recognized that the use of Information and Communication Technology (ICT) in logistics has been advocated as a way to enhance the performance of the logistics sector (Feng and Yuan, 2006). As ports are known for facing multi-faceted challenges such as security including cargo theft; robbery; extortion; trafficking of people, drugs, stolen goods, weapons, or money; as well as vessel hijacking, a port should have an advanced ICT system in order to reduce and mitigate these risks. The incidents of cargo theft in Asia is increasing rapidly; with Malaysia and the Philippines having the highest

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http://dx.doi.org/10.1018/j.jarims.2017.10.017

number of cases (FreightWatch International Global Assessment, 2011). Cargo related incidents could impact a firm's performance, and cause tangible as well as intangible damage to an organization (Securitex, 2008).

In previous and recent literature on port studies, ICT is considered as one of the main factors that give a significant impact on a port's performance. ICT could enhance a port's competitiveness and increase its efficiency through the Port Community System by having ICT systems connected to each member (Carlan, Sys and Vanelslander, 2016). All members of the maritime supply chain are connected by means of efficient exchange of information. Due to the growth of ICT, many firms have adopted its application in their business processes to enhance operational excellence. This is a trend that is particularly popular amongst the logistics firms (Cooper & Schindler, 2013).

Nevertheless, the impact of ICT on companies has amplified the difficulties in measuring performance, as it is particularly hard to identify the specific contribution of ICT in generating superior company's performance (Kenneth & Laudon, 2007). The evaluation of the impact of the technology on port users is still unclear. This cloudy atmosphere therefore provides a fertile ground for the researchers to examine the effects of information technology on logistic firm's performance (Wilson, Iravo, Tirimba and Ombui, 2015).

There have been a number of port studies that discussed the implication of ICT on port's performances. Chow et al. (1994) argued that it is difficult to define performance for the researcher in all management fields due to the different goals and objectives. The success of an organization in achieving its goals is normally evaluated based on the performance. Key performance indicators of a port are evaluated using throughput and the TEU. Slack et al., (2007) highlighted the difficulties in comparing the performance of the ports using throughput, which is mainly due to the different container handling types at the terminal.

Moreover, there is a need to understand the complexity of ICT that could lead to the superior performance of a port in comparison to others. According to the RBV theory, each firm is characterized by its own unique collection of resources of core competencies. Theory built on the RBV postulates; ICT can improve productivity but cannot improve the profit of a firm. ICT does not directly affect a port's performance due to the fact that ICT can be easily duplicated by other firms, and because of that, it is not considered as a competitive advantage.

ICT expenditures will not have direct impacts on a firm's profit as proposed by RBV theorists. However, the combination of expenditure on ICT with the expenditure of other resources can jointly have an effect on its profits. The model of the ICT Business Value from the RBV perspective was developed by Melville et al (2004), where it is stated that ICT is combined with other organizational resources and is deployed within business processes to enhance the business process performance, which as a result contributes to organizational performance. Hence, this paper is developed under the RBV approach to evaluate the effect of ICT towards a port's performance. A literature review about the Resource-based view is presented with a special highlight on the impact of ICT in a port's performance.

## 2. LITERATURE REVIEW

### 2.1 Terms and concepts

There are few important terms and concepts needs to be highlighted in this study. They are namely; Resourced Based View (RBV), Information technology and communication (ICT), and port performance.  The RBV theory define firm resources as " all assets, capabilities, organisational process, firm attributes, information, knowledge, etc. controlled by a firm (Barney, 1991) and proposes that a firm has a competitive advantage when it create a successful strategy based on firm resources that cannot be duplicated by a current competitors. Another concept proposed by RBV scholars are "dynamic capability" which argued that firm could achieve competitive advantage when they have ability to integrate, build and configure internal and external competences to address rapidly changing environment (Teece, 1997).

Winter (2003) have examined the basic idea of firm capabilities while Helfat and Peteraf (2003) present the idea of capability lifecycles, which helps to explain the evolution of capabilities over time. The dynamic of the RBV to the firm competitiveness provides a framework for our analysis of the development of PPSB's Port. A huge number of research shows the importance of using RBV in analysing performance. RBV however has been adopted in accordance to address the implication of IT on performance for many years, and the latest findings on "IT-performance" relationship is very unclear to make a conclusion. Therefore, further study on application of this theory in the ICT-performance relationship research is needed.

### 2.2 Information Technology and Communication and Port Performance

New IT and complementary investments can lead to innovations and this associated with growth in turnover. In other words, firm that innovate their system are more likely to grow in the future (Seddon, 2005). With the assistance or aids of ICT, a number of countries have displayed an impressive economic growth. Prior research concerning global economic growth and ICT have shown that the contribution of ICT to economic growth as being very remarkable for economy development during the periods 1990-1995 and 1996-2000 (Bowersox, 2009). The huge economic benefits from ICT are typically observed within countries possessing high levels of ICT diffusion. Data from the Organization for Economic Cooperation and Development (OECD) have shown that New Zealand, the United States, Australia, Canada, the Netherlands and the Nordic countries are amongst those with the highest rates of diffusion of ICT (Bowersox, 2009).

One of the ICT advancements in port operation is the port security systems. They have been proposed for tracking trucks and trailers, as well as fleet and cargos. These security systems typically include a GPS tracking device, a clock, a door sensor, and a memory device for recording times and dates. In some applications, both the sensor data and the tracking data may be transmitted back to a centralized trucking manager. A cargo security system, can be referred to as a system to protect cargo in all stages of the manufacturing, shipping and transporting processes (Hintsa et al., 2009). As the cargos and containers are of the main sources of security concerns in the supply chain, the security system is needed to ensure the security of the shipment right to its final destination. Common security issues such as cargo theft, piracy, pilferage and hijacking cause great disturbance in the supply chain (Ekwall, 2009).

Moreover, according to Boile et al., (2014) one of the important criteria that technology solutions need to provide in all links of the supply chain for a successful overall performance is security. In the case of port industry, a port must improve its visibility across the supply chain thus this could reduce the number security issues. Based on a report published by the European Commission (2007), improving supply chain security can reduce theft and loss due to delay.

Another ICT system that could increase the efficiency in port operation is the Smart Rail System. It is based on the model of the Global Positioning System (DGPS) which facilitates the operation of the Rubber Tire Gantry (RTG) cranes in the container terminal. Leading technology also facilitates automatic steering of the RTGs as they traverse the area on the way to the next location. Each RTG is equipped with a DGPS antenna and given the correct signal from a base station located at the top of the crane. This method ensures accuracy within 20mm.

The Smart Rail System consists of rubber-tyred gantry cranes which are fitted with the Smart-Rail area (advanced automated steering system and position determination satellite-guided) which could virtually eliminate human error through the use of the Differential Global Positioning System. This system could avoid the misplacing of containers as well as reduce the waiting time for loading clearance. The Smart Rail uses the Global Positioning System (GPS) that enable the RTGs to auto steer along invisible rails. This frees the driver to concentrate on the course as soon as possible between the lift, as well as the lifting and lowering of containers. The Smart Rail reduces the down-time spent searching for misplaced of container as well as increase efficiency and productivity.

### 2.2.1 Port Performance

'Performance' is generally understood as an industry jargon for assessing the success of an organisation in achieving some level of strategic goals (Feng et al., 2013). Logistics performance can be defined as the extent to which a firm's goals are achieved (Bonney, 2014). Port performance criteria are often found as determinants of a port's performance, or factors influencing a port's performances (Tongzon and Heng, 2005). Port performance is multi-dimensional and there is no adequate measure for performance (Bonney, 2014). As highlighted previously, port performance can be measured by service quality, port throughput, seaside accessibility, landside connectivity, storage facilities and capacity, cargo dwell time, port efficiency, technology, transaction processes, cost, ships' turnaround time, and the variety of services provided (Haezendonck et al., 2011). These factors can be grouped into three categories or measures: port productivity, port efficiency and service quality.

Productivity and efficiency are the two main concepts of economic performance (Liu, 2010). Generally, the concept of productivity is defined as a ratio of the volume measure of output, to the volume measure of input used (Coelli, 2005). Port operators and authorities can only control the resources within the port. Therefore, port productivity consists only of the productivity of seaside and terminal operations. However, the productivity of landside includes the productivity of land transport, which is not under the control of the port.

For a container port, the popular port performance indicator is based on the total number of TEU. TEU or twenty -foot equivalent units is a standard unit to describe the ability of a cargo ship, and this is the measure of containerized cargo, which is equal to one standard 8 ft. (width) x 20 ft. (length) x 8.5 ft. (height) container (approximately 39 m3) (Talley, 2009). Meanwhile, port performance measurement can also be made based on the type of the port. For a single port, the port performance is not only measured in term of its technical efficiency (whether the port is technically efficient), but also on whether it is effective in providing throughput. Effectiveness is concerned with the way a port use its existing sources, and provides throughput services to its users.

As mentioned by Langen et al. (2007), even though there are many indictors for measuring port performance, throughput volume is the common indicator to measure port performance for many ports in the world. However, there is a limitation in using the throughput volume as a port performance measurement, which is the fact that the growth of the throughput volume is mainly explained by international trade flows, and not by the port performance. The throughput volume does not tell much about the economic impact of a port. It is therefore very difficult to compare port performance strictly by throughput due to the different operation and different cargo services offered by each port (Slack, 2007).

## 3. METHODOLOGY

### 3.1 Research Design and Instrument

The study was carried out qualitatively. This study used survey research as a method in studying impacts of ICT on port performance. Descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals (Orodho, 2003). In this study, a semi-structured interview methodology has been chosen. This type of interview resembles a normal conversation, but is guided by the set of questions that have been prepared before commencing the interview session. The main aim is to know more on the respondent's experience in real life (Kvale and Brinkmann, 2008).

Following that, the research has been conducted using semi-structured interviews with the managers and executives working in PPSB. They are representatives from four departments which include the Operation Division, the

Technical Services Division, the Security and the IT Division. However most of the respondents are from the Technical Service Division, the IT Division and the Operation Division. These three divisions are the main departments in PPSB which are highly dependent on IT equipment in their terminal handling, port handling, international cargo, warehousing, transportation and custom clearance, making them eligible candidates to provide the necessary information for the study.

All information that gathered through the interviews then transcribed with note insertion where appropriate. The MAXQDA was extensively used for data analysis. All information and notes were coded and labelled according to particular participant code. After the transcription, data cleaning was carried out by deleting non-essential words. For the analysis, all comments were checked for their common categories or themes across the entries for each question. Once a consensus has been achieved on the best categories for organizing the data then each category was assigned with a number or letter that best fits the entry of each sheet. Following that, the entries were grouped according to the assigned categories. In the occasion where an entry did not fit any of the category, a re-categorizing was made, or additional category was introduced.

## 4. FINDINGS

### 4.1 Demographic

A total of eight respondents have agreed to participate in this research, comprising of a Senior Manager and a Senior Operation Manager from the Operation Department who have 13-35 years of working experience in the field, making up 37.5 percent of the respondents. While the other six, which make up 62.5 percent of the respondents, include executives from the vessel planning unit, dangerous cargo, quality and performance, port security officer, technical officer and the service department officer.

### 4.2 The Impact of IT Usage on Port Performance

**Table 1: IT Usage and Port Performance**

| | |
|---|---|
| **Impact 1**<br><br>**(Increase Productivity In Port Operation )** | • enhance port performance by increasing in productivity and decreasing in time consuming<br>• save cost precisely to the reduction of resources<br>• increase from 32 to 34 shipping lines<br>• joint sailing frequency of 31 weekly vessels that call at 60 ports |
| **Impact 2**<br><br>**(Increase Efficiency In Billing And Financial Report)** | • More efficient in term of producing port performance report from monthly to weekly report.<br>• Easily access to the data from the various departments.<br>• Financial report more accurate and time-consuming.<br>• Improve proper billing system |

The first objective of this study is to examine the impact of IT usage on port performance. From the interviews, all of the respondents are highly dependent on the system in order to ease their daily operation that could assist them in achieving significant impact on the port productivity. The PPSB is using the PELCON III system in their port operation. This system includes the Ship Planning Module, the Berth Planning Module, the Yard Planning Module, the Operation Resource Planning Module, and the Operation Cargo Module.

In general, there are two main impacts of ICT towards the overall port performance. The first impact is based on the increase of productivity and efficiency in port operation, and the second impact is based on the increase efficiency in billing and financial report. In terms of the impact on the level of ICT usage within the port in respect to the port productivity, most of the respondents agreed that the level of ICT usage within the port has a direct impact on the efficiency of the operations. This is evident when the PPSB has successfully added their shipping lines, and made a joint frequency of 31 weekly vessels that call at 60 ports. This system increased the number of shipping line from 32 to 34 shipping lines in 2016.

Another advantage of using the ICT in the port operation is through the ability to communicate and access data from various department. This has increased the overall efficiency in term of producing the port performance report. All port performance report are released on weekly and monthly basis. From the findings, it was found that ICT has improved the accuracy of the reports as well as improved the port billing system. However, there is a need to upgrade this system as it is still in the medium range. Based on all the evidence, most of the respondents agreed that the level of ICT usage within the port has a direct impact on the overall port performance.

### 4.3 The Impact of Security System on Port Performance

**Table 2: Security System and Port Performance**

| | |
|---|---|
| **Indirect Impact 1**<br><br>**(Cargo Tracking)** | • Easily to trace the dangerous goods /suspicious cargo through the custom tracking system indirectly impact to the port<br><br>• Track and trace unidentified cargo and contribute to the efficiency of the security in terms of handling entry and exit gate at the port territory. |
| **Indirect Impact 2**<br><br>**(Assessment of Port Productivity)** | • The productivity of bulk handling cargo can be access through this system.<br>• ICT contribute to the efficiency of security implementation. |

The second objective of the study is to examine the effect of the security system on performance. Before the emergence of the ICT, all procedures including the 'track and trace' of cargos were done manually. With the help of the security system, it is now possible for ports to track all cargos, handle security related documents efficiently through a smooth and smart data system. This has also contributed to a lasting impact on the security for both the port entry and the exit gate.

From the interviews, as mentioned by the PPSB Dangerous Goods Executive, the security system has no direct effect on the performance of port. However, there are certain aspects that proved the security system has improved the port performance. There are also some procedures before commencing the operation of dangerous cargo in the terminal. The Ship Shore Safety Checklist (SSSCL) signed by the Port representative (Safety), the vessel representative (Vessel Chief Officer) and the cargo owner representative (Un-loading Master) is a mandatory document for liquid bulk dangerous cargo vessel based on the IMO regulation. The regulation is needed to ensure that the cargos are secured. From this system, the duty officer can easily trace any suspicious cargo through the custom tracking system. In addition, the duty officer can capture the productivity and measure the efficiency of bulk cargo terminal in handling dangerous goods. This system is needed to ease the operation of dangerous goods. Apart from the Port Pilot, the Port Police Officer and the Operation Staff in this department, the cargo owner as well as the forwarding agent are also given the access into this system. By using this system, the movement and the information of cargos, data, productivity and efficiency of the port operation can be accessed by all the parties involved. With that, this system will indirectly contribute to the efficiency of the port operation and indirectly improve the overall port performance.

## 4.4 The Impact of Container Management System on Port Performance

The third objective of this research is to examine the effect of container management system towards the port performance. The PPSB has officially launched its latest container terminal management system on the 1st September 2006 (APA Malaysia 2008). It consists of a Planning module, a Gate system, an operation resource management for the deployment of manpower and equipment known as the Operation Control Module (OCM), for live operation and monitoring, the Marine Module and the Invoicing or Billing Module. These are operated based on the new version of system which is known as the PELKON III.

From the interviews, most of the respondents agreed that the container management system directly affects the performance of the port. Before the introduction of this new version, most of the respondents said that they were having difficulties with the previous system. However, after the upgrading of the PELKON II to the PELKON III, there are significant improvements in term of productivity in the daily operation. Among the improvements is the increase of port efficiency in the working environment through the minimization of the amount of equipment 'idle time', as well as through the maximization of the sea and land side productivity.

From the study, it was found that the Container Management System has the highest impact to the overall port performance. As mentioned by the Quayside Operation Manager from the Operation Division, this new system could reduce vessel delays, missing containers and the time for processing document. In 2015, the rail turnaround time of container terminal has reduced from 2.7 hours to 2 hours, and the gate turnaround time reduces to 19 minutes from 27 minutes. Based on that, the Vessel Operation Manager agreed that this system could also increase the productivity at the container terminal as this system could increase the growth of the TEU from year to year.

*"…These system will definitely affect performance of port. Talking about performance measurement of the port are basically come from productivity, smooth flow of operation and accurate data and inventor. Other than that, fast turn- around the landside and quayside operation. For container operation, the data or location can easily been traced in the system. From 2013 to 2015 the growth of TEU is 2.8 percent on average…"*

**Table 3: Container Management System and Port Performance**

| | |
|---|---|
| **Impact 1** | • Create an efficient working environment<br>• Optimize equipment and resource utilization |
| **Impact 2** | • Minimizing the amount of equipment idle time |
| **Impact 3** | • Reduce document processing and invoicing time |
| **Impact 4** | • Reduced cost of doing business, greater transparency through readily available information |
| **Impact 5** | • Fast issuance of bills, expedited operations |
| **Impact 6** | • Real-time, on-line information |
| **Impact 7** | • Reduced human intervention thereby minimising human errors. |
| **Impact 8** | • Reduced rail turnaround time to 2 hours from 2.7 hours |
| **Impact 9** | • Reduce gate turnaround time reduces from 27 minutes to 19 minutes in 2015 |
| **Impact 10** | • Maximizing sea and land side productivity. From 2013 to 2015 the growth of TEU is 2.8 percent on average |

### 4.5 The Impact of Smart-Rail System on Port Performance

Currently, the PPSB is equipped with 13 Quay Gantry Cranes (QGCs). Out of these 13, 7 consist of post Panamax QGCs. The berth capacity is currently at 2 million TEUs per annum. 8 Rail Mounted Gantry (RMG) cranes service the 2,244 Ground Slots (GS) belonging to the export decks located on the wharf itself for faster and efficient loading operations. On the landside, the North Butterworth Container Terminal (NBCT) is equipped with 32 Rubber-Tyred Gantry (RTGs) of which 10 units are of the e-RTGs (Electrified). A fleet of 60 Prime Movers and 124 trailers further expedite container operations at the NBCT as well as utilizing the Reach Stacker for empty container movements. The Smart-Rail system is based on the differential global positioning system (DGPS) in which when the RTG operator activates the automated steering, moving the crane along a pre-determined path. This enables the exact position of the RTG to be calculated to the accuracy of 10 centimetres. By automating the steering, the Smart-Rail technology enables the driver to travel at a maximum speed between the lifts, and to fully concentrate on picking up or setting down containers. The net result is a faster and safer operation.

**Table 4: Smart Rail System and Port Performance (Rubber-Tyred gantry cranes (RTGs) and Rail Mounted Gantry Cranes RMG**

| | |
|---|---|
| **Impact 1** | • travel at a maximum speed between lifts and to concentrate fully on picking up or setting down containers. The net result is faster and safer operations |
| **Impact 2** | • linked to the yard management system and eliminates the need for drivers to type in location parameters manually in order for the containers to be stacked |
| **Impact 3** | • ports and terminals to keep their turnaround times, for both vessels and trucks, down to an absolute minimum |
| **Impact 4** | • 8 Rail Mounted Gantry Cranes RMG<br>- improved handling rates averaging 27 crane moves per hour compared to 18 moves per hour in early 2014<br>- improved productivity levels by more than 30 percent |

This system also has the ability to be linked to the yard management system and eliminates the need for drivers to type in the location parameters manually in order for the containers to be stacked. The Smart-Rail has the ability to verify a container's position automatically, regardless of whether the container is being stacked for the first time or has arrived by ship or by truck, or is being shuffled as the crane looks for a particular box. In real terms, the Smart-Rail enables ports and terminals to keep their turnaround times, for both vessels and trucks, down to an absolute minimum.

From the interviews, it can be concluded that the Smart rail System has improved PPSB's productivity through its handling rates from 18 moves per hour to 25 moves per crane. As for now, PPSB is at an average of 27 crane moves per hour as compared to 18 moves per hour in the early 2014. However, respondents can only quantify the improvement expenditure or estimate its overall contribution based on the operational performance and not much on the financial performance.

## 5. DISCUSSION

This research aims to examine the impact of ICT on port performance for PPSB. Revisiting the objectives of the study, this study attempts to seek answers for a number of research objectives. (1) To examine the impact of IT usage on port performance (2) To determine the impact of Security System on port performance (3) To examine the impact of Container Management System on port performance (4) To identify the impact of the Smart-Rail System on port performance. Based on the findings of this study, the main objectives have been achieved, in which the impacts of ICT on the PPSB have also been established.

Based on the discussion on the first objective of this study, it is evident that the level of ICT usage affect port performance. ICT is an important means for the exchange and transfer of information within the port, as the port is a setting for various activities and operations that need to be handled by the employee on a daily basis. This findings support the assertion by Kia et al. (2000), highlighting the importance of ICT, in facilitating the exchange of information in commercial transactions among enterprises and individuals, as well as enhancing growth and profitability and the proper use of ICT can help port to achieve superior performance.

Furthermore, ICT also can reduce time consumption and cut the cost of documentation. This is in line with the findings by Gordon et al. (2005) in his study on PSA which emphasized on the importance of ICT in reducing time and cost, and thus contributing to a highly efficient port operation. It is necessary to make a bigger investment in ICT in order to enhance operational efficiency and an overall firm's performance (Cooper et al., 2013).

Based on research second research objective, it was found that Security System does not directly impact port performance. However the Security System has a direct impact on port efficiency, thus indirectly affect port performance. These findings supported an earlier study conducted by Boile and Sdoukopoulos (2014) which argued that security is an important criteria in order to achieve a successful overall performance.

From the third research findings, it has been established that container management system directly affect the performance of the port. Without this system, problems will easily occur whereby it can affect the operation which eventually contribute to the performance. The research on the effect of characteristics of the container terminal to the port performance by Felicio, Caldeirinha and Dionísio (2015) has confirmed the influence of port and terminal characteristics on container terminal performance. Performance is measured in terms of efficiency, activity and customer satisfaction.

The results of the findings have also shown a significant improvement in port efficiency and productivity, while lessening the process of documentation thereby minimizing human errors. Productivity is improved by the reduction of gate and rail turnaround time. However, container terminal system does not directly improve the port profit. This findings support the study by Kenneth (2012), where he argued that the RBV theory believes that ICT can improve productivity, but not the profit of the firm, as ICT can be easily duplicated by other companies and therefore, is not a source of competitive advantage.

From the last findings of this study, there are a number of implications of the use of Smart-Rail on port performance. The

Smart-Rail improves the maximum travel speed between the lifts, resulting in a faster and safer operation. This system also increases port turnaround times for both vessels and trucks. Overall, this system could improve the productivity level by more than 30 percent.

As a conclusion, the results of the study confirm the research model as a wider, more holistic approach of ICT impacts on port performance. The existence of ICT also help to boost port performance both directly and indirectly. The results demonstrate that the port tangible resource, the ICT supported the RBV model by contributing and having implications on port performance.

## CONCLUSION

There are a number of recommendations that could be useful for future study. First and foremost, it is hoped that this study can provide the ideas and become a guideline in conducting research regarding this topic. This study suggests that future studies can proceed with the ongoing studies of the use of ICT in ports, taking into account the different perspectives of the diversity of the system and the ports involved in port industry.

The paper contributes to the increasing reading materials on the theoretical and empirical understanding of how IT resources affect port performance. The framework has been presented to explore the relationship among resource, and performance. The RBV theory was used to test the impact of ICT on port performance. It was found that technology resources increase internal and external capabilities, which in turn affect port performance. Port resources positively affect organizational efficiency through its impact on internal capabilities. However, in order to utilize the ICT, the port authority should develop their existing ICT technical and managerial skills, which subsequently will contribute to a successful design of the implementation of the various operation and ICT system at the port.

In this case, the significance of ICT is highlighted in which it can be utilized to expand port capacity without adding more investment in plants and equipment of the physical space. Port technology helps firms to utilize asset more effectively. The results of this study provide direction for investing and managing organizational ICT resources to enhance their performance. Managers can contribute to enhancing firm performance through transferring ICT resources to firm's capabilities. This study points to a better use of the RBV model in future research on ICT and firm performance.

With the right move, improvement in utilizing the assets and core competency of the PPSB, will help it to sustain in the market, and place it amongst the rapidly developing ports. The PPSB managers should recognized that they are unlikely to be able to gain competitive advantage from one resources, or random set of resources. Success is more likely to come from a group of resources that interact with each other (Gordon et al. 2005).

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