Journal of Engineering and Applied Sciences 13 (8): 2114-2119, 2018
ISSN: 1816-949X
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Intelligent Transportation System Architecture to Address Challenges of Traditional Shipping Operations (PELRA)

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Abstract: Less developed remote areas have few things in common, namely small scale economy and low connectivity. Those areas, particularly in Indonesia, rely very much upon the traditional shipping service provided by wooden ships, labeled as PELRA standing for Pelayaran Rakyat, meaning People's Shipping. The challenges of PELRA are huge and fundamental, namely outdated ships, old-fashioned business processes, no insurance coverage, low human resource qualifications and low productivity. As a low-cost shipping service provider, they are often the only connector of the above remote areas. Thus, they play a vital role of remote area's economy, especially, small islands in an archipelagic country. Conventional approaches to address PELRA'S challenges are usually in the following areas, i.e., improvement of port infrastructure and cargo handling performance or provision of nearly free port charges, fail. A breakthrough towards adopting Intelligent Transportation System (ITS) seems to be very promising. Its benefit cost ratio in the next 5 years shows that, the benefit of using ITS for PELRA goes far beyond its investment and operation costs.

Key words: Traditional shipping, remote areas, Intelligent Transportation Systems (ITS), shipping, service, cost

INTRODUCTION

On the other hand, areas and small islands located remotely from industrial centers on Java rely very much upon the shipping services provided by old-fashioned wooden ships (Fig. 1). This traditional shipping service, called Pelayaran Rakyat abbreviated as PELRA, meaning literally People's Shipping. PELRA's fleet are usually sail-assisted motor ships with a speed of 5-8 knots and maximum capacity of 500 GRT. The ships carry nearly everything, from bagged cargoes, drums, pipes, machineries till cars. The PELRA ships are often operated by masters and crew of limited qualifications (Sukirman). Furthermore, the number of ship of PELRA has decreased in count of 50% in the decade of 2000-2010.

The productivity of PELRA ships is low. For a carriage of breakbulk of 500 MT between two ports, its port time takes approximately 2-3 weeks with a round voyage of about 4-5 weeks. Some 90% of the port time belongs to idle time, namely waiting for cargoes (Ginting, 2009). A majority of ship operations is managed by a profit sharing system. After deducting the direct voyage costs from the freight, the owner and crew share this gross profit. From this remaining portion, the owner allocates it for fixed costs such as investment costs, maintenance and administration. In most cases, the owner acts as master and shipmanager at the same time. The fleet has been struggling to seize cargoes in line with their effort to regain the trust from shippers. Insurance companies are not willing to cover an insurance protection whilst few shippers demand an insurance coverage for their cargoes. PELRA'S business process and ship management still do not comply with modern and efficient shipping practices. Many documents are non-standardized which are prone for fraud. Furthermore, continuing containerization of breakbulk cargoes reduces

Fig. 1: PELRA ships at Kalimas Port

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the opportunity of PELRA to obtain cargoes as PELRA ships are more suitable for breakbulk cargoes carriage. These low productivity and traditional shipping practice make them far less competitive and less profitable compared to modern merchant ships.

Efforts to revive PELRA seems to be challenging. In order to reduce the operation cost of PELRA, the port authorities have been providing the berths for almost free of charge, some 25 US$ for a port stay of two weeks. Improving the cargo handling speed, streamlining the hinterland transport, enhancement of warehouse and open storage would not contribute to the PELRA productivity as 91% of port stay is in an idle status, i.e., waiting for cargoes which are viewed as non cargo handling activities (Ginting, 2009; Achmad, 2016).

The National Logistic Systems (SISLOGNAS) envisions the integration of local ports and their connectedness to the global trade. Improvement of port capacity and performance has been undertaken, especially for container transport. The Indonesian National Single Window (INSW) implemented gradually from 2008 aims at simplifying administrative burden by single submission, single and synchronous processing of data and information and single decision making for customs clearance and release of cargoes (KK., 2016). This system in particular has been beneficial for modern shipping. PELRA shipping is not in position to benefit from it as their business practices do not comply with the modern shipping system. The INSW refers a promising implementation of the soft-infrastructure to address challenges in marine transportation which is supposed to apply also for PELRA. ICT could be viewed as a trigger for enhancing the performance of shipping which in turn this could enhance the trade. Investing in soft-infrastructure (ICT) is a promising instrument to enhance the transport capacity and performance, instead of investing in new ships or berths (Nugroho *et al*., 2017). The provision of information pipeline to enhance a supply chain visibility has proven to be able to enhance the security level (AC., 2014). This is an implementation of ICT to help improve the performance of a transportation system which is called Intelligent Transportation System (ITS). ITS aims at improving the productivity, efficiency, environment, security and safety of transport.

MATERIALS AND METHODS

PELRA at Kalimas Port: The Kalimas Port is located at the eastern part of the Tanjung Perak Port, in Surabaya. Tanjung Perak is the second largest port of Indonesia. The dynamic industrial activities of East Java make Tanjung Perak the most important port for eastern part of Indonesia. Most ships heading for eastern part of Indonesia are loaded fully at Tanjung Perak. In their return voyage, the ships are usually loaded with some 70% of the capacity. Whilst most of Tanjung Perak terminals are allocated for modern merchant shipping and equipped with advanced ICT systems, the Kalimas Port remains old-fashioned, characterized with less-well organized and low productive cargo handling facilities.

The process of shipment involves three types of flow namely goods, information and money. Interactions among shippers, shipping agents, port authority, stevedoring labour would determine the smoothness of a shipment process. This study focuses on the document processes starting from obtaining the shipping schedule until delivering the bill of lading (Fig. 2). A shipper would require in total 216 minutes to obtain a bill of lading for every shipment (Arizal, 2016). To conduct the above, it involves both typed and hand-written documents in mostly non-standardized forms. The process involves also non-textual information as a shipper should conduct a phone conversation with the shipping agent as the shipping schedule is not published for a wider public such as a publication in a shipping gazette or in a maritime portal.

The deficiencies of current process are that it takes a lot of efforts to obtain correct information and to produce documents timely. One of the most important documents, namely bill of lading, often appears in many forms which are prone for fraud. This document is important as this serves as a proof of ownership of the goods shipped.

The goal of the study is to contribute in enhancing the quality and performance of information processes. Having the above in place, it is expected that the information flow and efficiency improve in turn, the credibility of PELRA would improve as well. It is viewed as a part of efforts to regain the trust of shippers which is supposed to improve the PELRA'S position towards the shippers.

System architecture: Marine transport operations serving remote areas are challenging. Investing in ne vehicles and physical infrastructure are economically often unjustified. In spite of the limited ICT infrastructure, an implementation of ITS could be very promising (Cave, 2012). As an initial step of a planning process, a system architecture needs to be

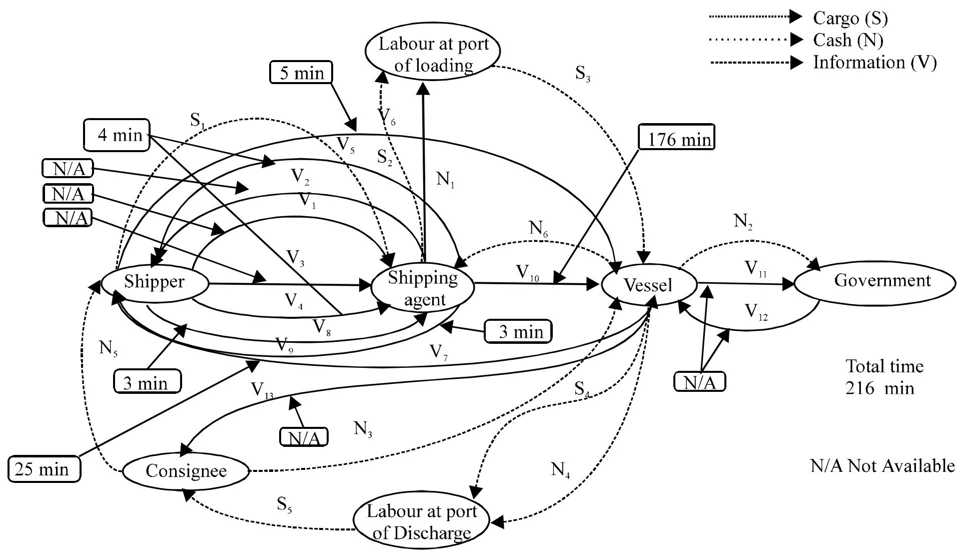

Fig. 2: Current physical architecture

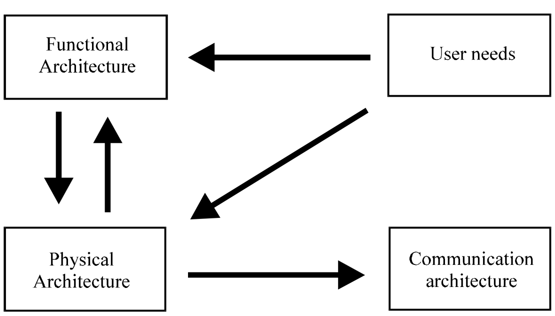

Fig. 3: System architecture

established. This is a strategic framework serving as a basis for choosing the design, deployment and investment decisions (IST., 2012). The system architecture covers the user requirements, organizational and technical aspects of the future ITS application (USDT., 2009; McQueen and McQueen, 1999; Toshiyuki, 2004).

The purpose of establishing a system architecture is to ensure effectiveness of the system when it is implemented. It is an instrument which is open to the public, to ensure the sustainability of the system by minimizing exclusivity or closeness. This could be articulated in the following situation when the system is broken and its provider does not exist any more, there is always another provider who could fix the broken system.

The architecture consists of four main elements, namely user requirements, logical, physical and communication architecture (Fig. 3). The user requirements describe the existing situations, its drawbacks and desired changes from the user's perspectives and user's capabilities. The logical architecture describes the processes or functions, flow of data, cargoes or ships and money. The physical architecture systematically reorganizes the functions or processes whenever possible in order to streamline the whole system. This physical architecture is drawn depending upon the chosen type of communication, transportation mode and institution, which is called layers. The description of the physical architecture serves as the main input for the implementation phase, namely delivering the services or packages. The service packages are manifested in the form of integrated software, hardware and communication infrastructure.

Three scenarios of solutions have been generated. One of them, i.e., scenaro 3 is illustrated in Fig. 4 and 5. Those scenarios are generated based on the degree of ICT usage on handling the information of a cargo shipment. Every scenario has distinct features namely size of hardware usage, size of processes to be handled by the system and in turn, its time and costs. The recommended scenario with the highest degree of ICT adoption, covers a web-based application with which a shipper could obtain schedule of shipment could enter the details of cargo shipment and could obtain information on the actual freight. Its corresponding mobile application for a smart phone or tablet is continuously synchronized to the server which enables shippers to access the App. from anywhere.

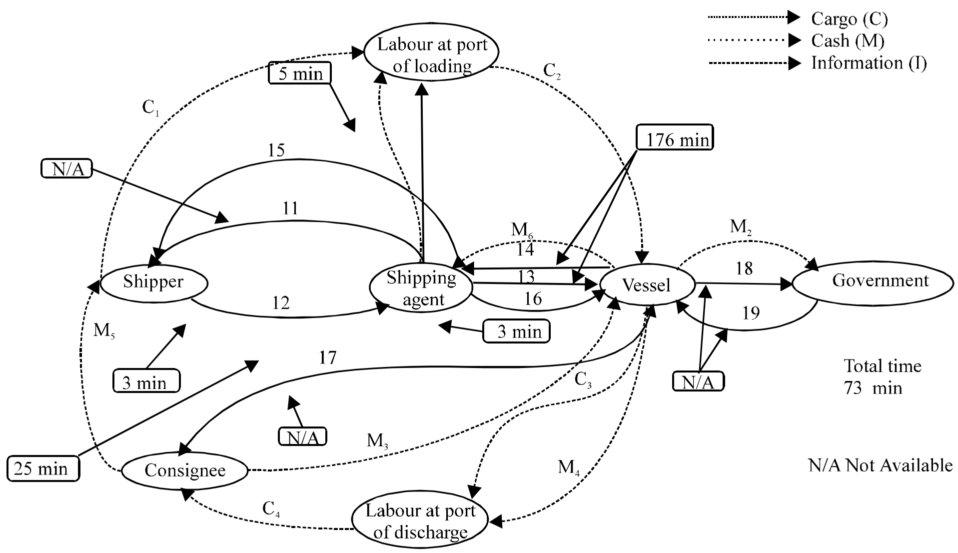

Fig. 4: New physical architecture (scenario 3)

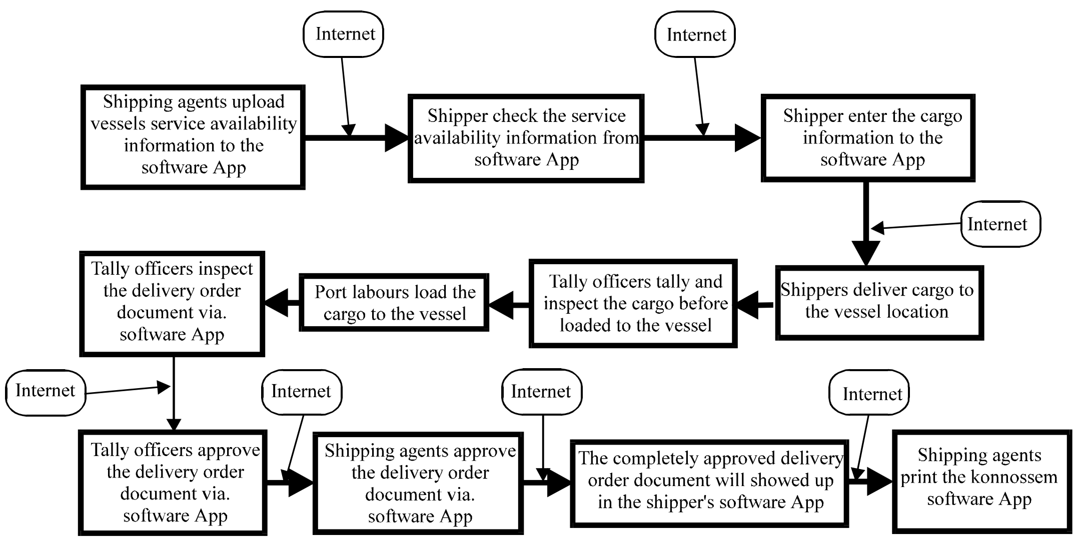

Fig. 5: Communication architecture

RESULTS AND DISCUSSION

In completing a system architecture an evaluation is to be made to assess, whether the initiative or project is feasible. The feasibility of an investment is often associated with economic evaluation such Internal Rate of Return (IRR), Net Present Value (NPV and Payback Period (PBP). In ITS implementation many investments are not intended to deliver profit. Rather, it is intended to deliver benefits, to the society at large such as better performance and productivity. In this particular initiative, the running of an ITS system for PELRA itself is cannot be viewed as a business venture, rather than a social venture at least in the short run. Nevertheless, a common approach seems to converge with the idea for assessing the feasibility of an ITS initiative is using the Cost-Benefit Analysis (CBA) (Boardman, 2006; MT., 2008).

The underlying foundation of CBA is quantifying and incurring all non numerical items (qualitative, intangible and external factors) and then combining them with numerical items such as investment and operational costs (Table 1). A Benefit-Cost Ratio (BCR) represents an evaluation result where BCR of over 1.0 showing that the project is beneficial. The BCR is calculated for a period of 5 years. From three scenarios, scenario 3 shows its

Table 1: Summary of scenarios

Steps	Current system	Codes	Scenario 3	Code
1	Shipper delivers cargoes to shipping	S_1	Shipper delivers cargoes to ship's berth location	C_1
2	Shipper brings cargoes from shipping	S_2	Port labours load cargoes onto ship	C_2
3	Port labours load the cargoes on to	S_3	Ship departs	C_3
4	Ship departs	S_4	Port labours discharge cargoes to truck	C_4
5	Port labours discharge the coagoes	S_5	Pelra pays port labour at port of loading	M_1
6	Pelra pays port labour at port of loading	N_1	Ship pays port clearance	M_2
7	Ship pays port clearance	N_2	Cosignee receive cargoes	M_3
8	Consignee receives cargoes	N_3	Ship pays port labour in destination port	M_4
9	Ship pays port labour at port of discharge	N_4	Consignee pays shipper	M_5
10	Consignee pays costs and freight to shipper	N_5	Shipowner shares profit to shipping agent	M_6
11	Ship's owner shares the profit to the shipping agent	N_6	Shipping agent upload vessels service availability information using software App.	11
12	Shipper request availability of ship via. Phone or SMS	V_1	Shipper send order request by entering the cargo information to the software App.	12
13	Pelra gives information on ship availability	V_2	Shipping agent issues the order via. Software App.	13
	via. Phone or SMS	V_3	Tally orders the cargoes and the order and approving via. Software App	14
14	Shipper requests the service	V_4	Shipping agent approves checked order via. Software App.	15
15	The shipper creates the delivery order and sends to the	V_5	Shipping agent issues e-konossement via. Software App. and upload it. It will be synchronized in the server	16
	shipping agent with the cargoes	V_6	Consignee receives e-bill-oflading via. Software App.	17
16	Shipping agents issues shipping instruction	V_7	Shippowner prints bill od lading and uses it for arranging the issuance of port clearance	18
17	Shipping gives order to tally	V_8	Harbour master issues port clearance	19
18	Tally checks cargoes and shipping order	V_9	-	-
19	Shipper sends the checked order to shipping agent	V_{10}	-	-
20	Shipping agent stamps the order	V_{11}	-	-
21	Shipping agent issues bill of lading with wordprocessor	V_{12}	-	-
22	Shipowner uses bill of lading for arranging the	V_{13}	-	-
	issuance of port clearance	V_{14}	-	-
23	Harbour master issues the port clearance	V_{15}	-	-

No. of processes; 23; 19; Durration (min); 216; 77; Cost (IDR); N/A; 837,900,000; Benefit (IDR); N/A; 11,592,174,089; Benefit cost ratio; N/A; 13.83

highest BCR value of 13.83, its processing time is reduced from 216 min per shipment to 72 min and 23 processes are cut by 4 processes to 19 processes. All the aforementioned three indicators show a converging conclusion that the project is feasible.

CONCLUSION

The usage of Intelligent Transportation Systems (ITS) has been very useful for many sectors. Modern merchant shipping has benefited a lot from it. On the other hand, the traditional shipping has a low affinity to the modern technologies. They are continuously struggling with fundamental and serious challenges to survive. As ICT has become more and more affordable, ITS should be viewed as a window of opportunity to help the traditional shipping survive or even revive. A case study on streamlining of the information processes of cargo shipment has shown a favorable result. Its benefit is far beyond the costs incurred.

ACKNOWLEDGEMENTS

We express our sincere gratitude to the Associations of Traditional Shipping Companies (DPD and DPC PELRA) in East Java, Surabaya and Gresik for their strong co-operation which have made the research run well.

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