DETERMINING THE IMPORTANT FACTORS OF PORT DIGITALIZATION: THE EMPIRICAL CASES OF INDONESIAN PORTS

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ABSTRACT

Knowledge economy has been recently influencing various trading activities including the supply chain process on port operations. Ordering of port services, monitoring, controlling cargo handling and payment processes at a port including its continuous process at inland terminal are imperatively required by the port-users. This paper explores the effectiveness of implementing digitalization on operation and commercial process taking several main Indonesia ports that have been recently implementing their service digitalization at Tanjung Priok Port, Teluk Lamong multi-purpose terminal and Cigading Port. The qualitative and comparative approaches are applied in collecting responses from port-users as well as in comparing the requirements and expectations in implementing port digitalization. As the results, this study finds that the digitalization does provide better service performances in terms time and costs, including better performances, visibility of process and transparency of payments. Thus, the digitalization has a positive as well as negative effects not only due to the lower operational costs but also higher commercial effects both for port operators and users. However, internal platform of entities of port operators, shipping operators, forwarding agency and cargo owners should have a similar or standardized Information Communication Technology (ICT) platform in avoiding problem when interfacing data interactions

Keywords: Important determining factors, port digitalization, Indonesian ports

1. INTRODUCTION

In the digital economics, port is required to provide faster, better services and closer to the users of port using various information technology platforms in the form of digitalization (Kia et.al, 2000; Marianos et.al, 2007 in Talley, 2009). Starting from service ordering from shipping companies or agencies (for ship operations); assisting and controlling cargo handling operations companies by stevedoring companies (for cargo handling at berth) and further forwarding services (for inland and logistics services of cargoes). In the process of digitalizing port operation, Heilig et.al (2017) categories three generation of digital ports in terms of their procedures; initiated from paperless, followed by automated procedures and finally smart procedures. Further, Heilig and Voß (2016) find that there are six enabling technologies that have been applied to provide the digital services such as RFID, GPS/DGPS, RTLS, OCR, WSN, EDI, and mobile devices in five main service areas at a port: seaside operations, terminal operations, landside operations, yard operations and gate operations. However, various applications of port related digital services mainly focus on the benefit of port operators in providing faster and more transparent services for cargo owner and logistics operators, and rarely discuss the benefit of port users and in large scale for logistics service particularly on operational and commercial impact to port community members as port users (Kia et.al, 2000; Pallis and Lambrou, 2007; Vitic-Cetkovic, 2013; Xinyi et.al, 2016). Therefore, this

paper tries to explore the impact of port digitalization development in Indonesia initiated by port operators and port authority using several applications of online marine service at Tanjung Priok Port, semi-automatic port procedures at Teluk Lamong Terminal and online logistics services at Cigading Terminal. Further, the impact of port digitalization is measured to monitor how effective and efficient the implementation of port digitalization in the aspect of operational and commercial effects both for operators and port users.

The application of digital port services in Indonesia started in 2012 and was mostly driven by port authority and port users such as cargo owners, forwarding and shipping companies in containerized and dry bulk cargoes related operations. From two customer surveys of about 600 port users at Terminal Teluk Lamong (TTL, 2017) and Krakatau Bandar Samudera (KBS, 2017), it can be indicated that internally, port users have experienced three main benefits from current port digital services particularly on technical, commercial and service areas as can be seen in Figure 1.

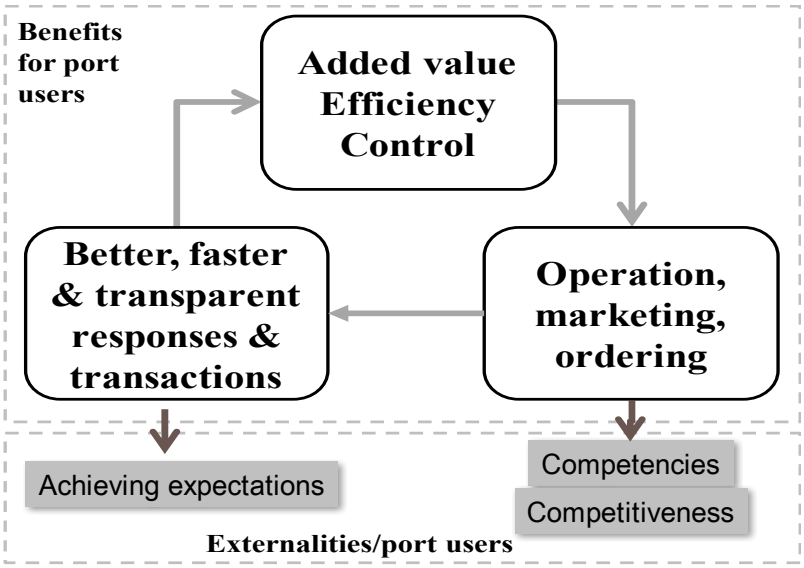


Figure 1. Three major outcomes of port digital services in Indonesia

There are three major technical performances of digital services provided by port operators that has been experienced by the users i.e. better or simpler in the handling process of administrative related activities, faster (less time required by cargo owners coming to port due to ICT or mobile devices) and transparent services in various operational responses while ordering and fulfilling transactions. Other meaning, there is less face-face related meeting that had been bureaucratically implemented before. The port users also commented that digital services may result higher added value (several services may be substituted by ICT application rather than manual activities), better in efficiency (level of costs may be reduced) and jointly control the process of services (participation of users in monitoring and evaluating the whole process and its performance outcomes). In the service area, the port customers mainly pointed out three major related services that port digital services have been provided. These are operational related (for ship, cargo, and passenger if required from service), marketing related services/information (tariff, scheduling, the availability of berth, yard and storage/shed), and lastly the ordering services for ships and cargoes including ordering facilities or equipment related to various services.

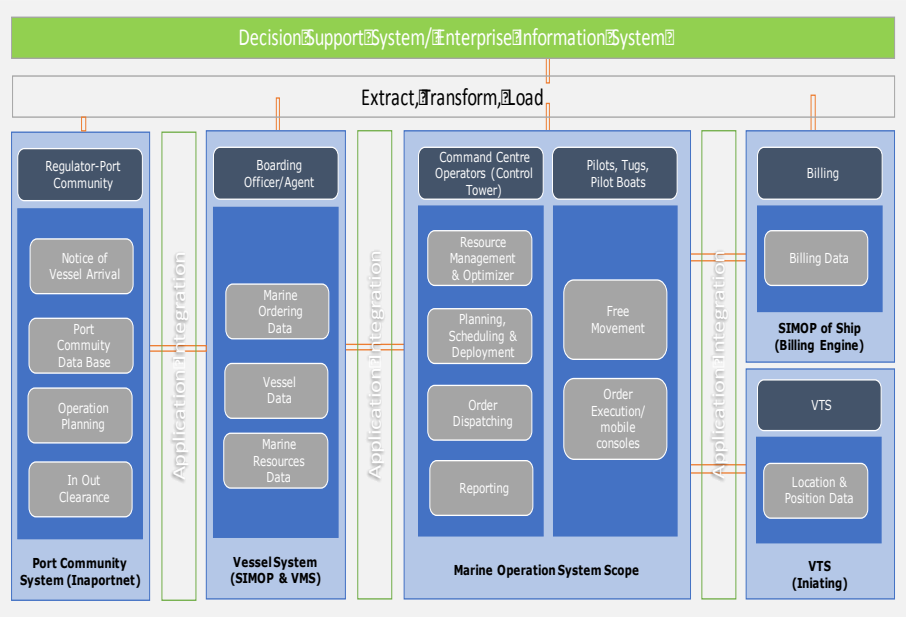
Externally from the perspective of port users, they experienced that digital services have been partially oriented to achieve their expectations, as they also indicated there are certain online or digital services which were not required in the process of port services. Further, it is a fact that ports providing digital services to their customers, may have better competencies and competitiveness or more preferable by port users in the port and shipping market.

2. EXISTING PORT DIGITAL SERVICES IN INDONESIA

Three cases that are provided in this paper may represent the development of port digital service in Indonesia during the last five years (2015-2019). First case is the online marine service at Tanjung Priok Port which is initiated by Port Authority of Tanjung Priok in Jakarta. The second case is the implementation of semi-automatic multipurpose terminal of Teluk Lamong handling containerized and dry bulk cargoes in Gresik-East Java which is now the most advanced terminal in Indonesia. Finally, the third case is the logistics services of a dry bulk terminal of Krakatau Bandar Samudera, Cigading West Java. These three locations have been implementing port digital services to their users.

2.1 Digitalization for marine services at Tanjung Perak Port

This program is established by the management of Tanjung Priok port as the biggest port in Indonesia to ease the process of ordering marine services. Digital marine services is an end to end IT based integrated system that connected port authority, port administrator and customer using a single dashboard. This system is integration of many applications among other Inaportnet, vessel management system, simop and marine operating system (MOS). Inaportnet is an aplication managed by Minister of Transportation Republic of Indonesia that provide dashboard of registration of the port community and administration regarding vessel service on the port area ie. notice of vessel arrival, stevedoring booking system and other administration issue handled by port authority and port administrator.



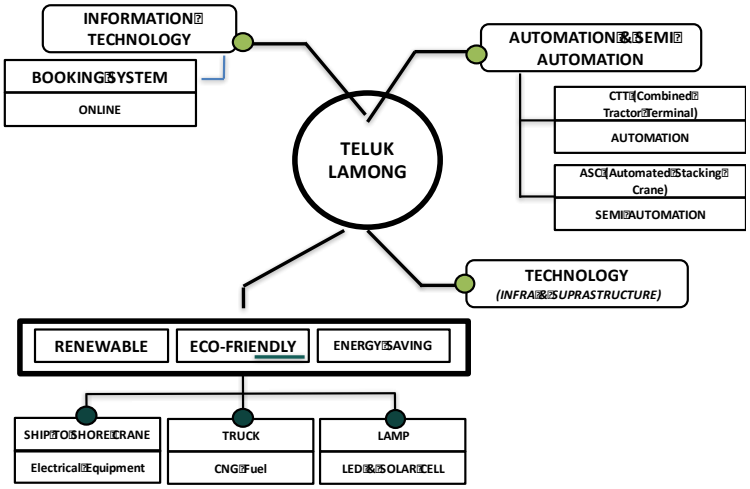
Source: Tanjung Priok Port (2018)

Figure 2. Digital of port marine services Architecture of Tanjung Priok Port

Vessel Management System (VMS) is an application provided by port operator that covers the administration process of requisition of the marine services on the port. This system replaces face to face interaction among port operator, customers and port administration. This application specificaly provide the facility of booking port marine service i.e Pilot and harbour tug. Port Management Information System in Indonesia provide data base of transaction between port and its customer. The customer (ship agent and ship owner) and their vessel will indentify unique code to simplify the data. Further, MOS is a solution of dispatch order management of port marine service resources. When the port administrator has issued the permit of vessel to moving in or out the port, this system will automatically suggest the viable resource and directly send the job order to respective resource at once as approved by executive planner.

2.2 Semi-automatic operation at Terminal of Teluk Lamong (TTL)

Terminal of Teluk Lamong is one of major multi-purpose terminal in Indonesia that has been implementing the application of semi-automatic particularly on containers traffic for the service booking, stevedoring, stacking operations and renewable energy consuming for lamp arrangement, ship to shore crane and internal truck operations. In relation to cargo handling equipment, TTL applies combined tractor terminal (CTT) for automated operation and automated stacking crane which is still on semi-automated operation. ICT facility is also installed for service and transaction booking for various customers. The detailed digital services provided by TTL is shown in Figure 2. Due to its semi-automated technology applied in the operations of TTL may generate more competitive tariff with lower operational expenses but higher performance in container and stacking handling compared to other not only regionally but also nationally (TTL, 2018).



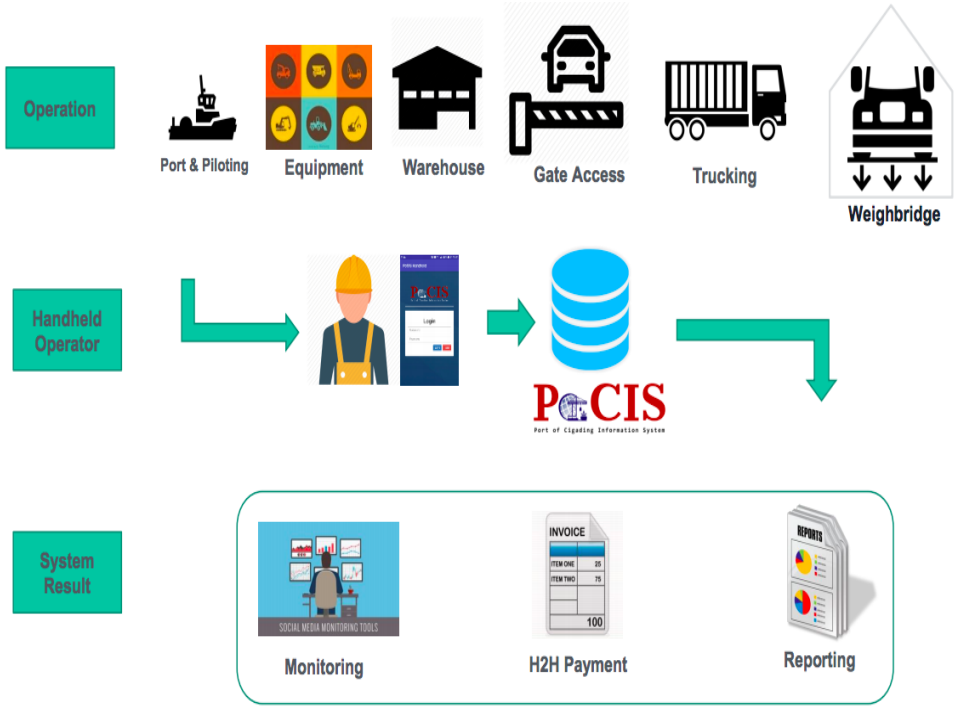
Source: TTL (2018)

Figure 3. Multipurpose digital terminal service of Teluk Lamong .

The digital service offered by TTL, almost reached at about one million TEUs given several similar competitor of container terminal surrounding to TTL. The terminal started growing progressively as TTL may provide simpler service, better and faster in performance and also transparent in transaction. Al of these deliver commercial certainty of containerized cargo owner not only coming surrounding the terminal but also in national and international scale.

2.3 Logistics service based on dry bulk cargoes at Cigading terminal

Cigading terminal known as Krakatau Bandar Samudera (KBS) is a major dry-bulk based terminal in Indonesia that has been providing integrated port and digital services using Port of Cigading Information System (PoCIS) combined with the strategy of port-centric logistics mainly for iron-ore and steel product including food and feed based cargoes for local and national scale of cargo and ship handling, storing, packaging, transporting and distributing raw, semi-finished and finished products (as seen in Figure 3). For customs related supporting services, KBS has also been implementing services as a dry-port and custom-clearance related operations including logistics center providing better and faster services based on ICT for ordering, importing-exporting, custom clearing, distributing and transporting. The uniqueness of PoCIS by customers is not only the specific application for dry bulk related cargoes and operations but also reliable data security that has been provided in which customers are also actively participating in controlling and monitoring their operational processes (KBS, 2018b). Further, the digital service of PoCIS may also deliver better added value services wth faster, simpler and more transparent business process.



Source: KBS (2018a)

Figure 4. PoCIS of Cigading Terminal (KBS).

3. LITERATURE REVIEW OF DETERMINING FACTORS

There are about 30 possible variables that have been listed in seven literature discussing determining factors in implementing port digitalization such as Kia et.al (2000), Marianos et.al (2007), Lamborou et.al (2008), Cepolina and Ghiara (2013), Carlan et.al (2016), Xinyi et.al (2016) and Heilig and Voß (2016). These literature may be divided into two main related categories i.e operational and commercial as listed in Table 1 below.

Table 1. Literature analysis of determining factors on operational and commercial aspects

EFFECTS	Kia et.al (2000)	Lamborou et.al (2008)	Marianos et.al (2007)	Cepolina & Ghiara (2013)	Carlan et.al (2016)	Xinyi et.al (2016)	Heilig & Voss (2016)	Total
OPERATIONAL								
1. Reduce access cost	*	*	*	*	*	*		**6**
2. Reduce cost of communication		*	*	*	*	*	*	**6**
3. Decrease rate of operational errors	*		*	*		*	*	5
4. Reduce data inconsistency	*			*			*	3
5. Increase operational performance	*	*	*	*		*	*	**6**
6. Avoid operational risks by early warning						*	*	2
7. Simplify ship declaration		*	*			*		2
8. Provide navigation assistance (tug+ilot)		*	*	*	*		*	5
9. Provide data security	*		*	*	*	*	*	**6**
10. Reduce accidents and incidents		*	*				*	2
11. Assist the route planning			*	*			*	3
12. Electrical and Internet failures							*	1
13. Better tracing and tracking	*	*	*	*		*	*	**6**
14. Enchance the function of GIS		*	*	*		*	*	5
15. Better dangerous good management	*	*	*	*				4
COMMERCIAL								
1. Less illegal transaction	*	*					*	3
2. Reduce labour quantity							*	1
3. Faster custom clearance service		*		*	*	*	*	5
4. Assist logistics services	*	*		*	*	*		5
5. Support cargo distribution		*	*	*	*	*	*	**6**
6. Provide business intelligent		*				*	*	3
7. Help to draft commercial contract		*						1
8. Provide plaform for collaboration		*		*		*	*	4
9. Less beraucratic procedures	*	*	*	*	*		*	6
10. Promote coordination among entities	*	*	*	*	*	*	*	**7**
11. Assist tariff prediction			*			*	*	3
12. Lower operational expenses	*	*	*	*	*			5
13. Require higher capital expenses		*					*	1
14. Faster booking service	*	*	*	*	*	*	*	**7**
15. Complex claim handling		*	*					2

In operational aspect, the factors of reduce access costs, reduce cost of communication, increase operational performance, obligation to provide data security, and better tracing and tracking are dominantly stated as important effects of applying port digital services both for port operators and port users. Further, for the commercial aspect, the factors of support cargo distribution, less bureaucratic procedures, promote coordination among entities and faster booking service are significant parameters of commercial effects that have been experienced in the implementation of port digital services.

From those major items stated in the literature, it may be identified that port digital services are preferable in favor to port users in terms of costs, better service provision and assist them to coordinate with other partners or entities in the port community system providing and supporting their business. However, to achieve the sustainability of this business platform, data security and simple procedures are fully required to maintain the benefit of the digital port services.

4. THE ANALYSIS OF DETERMINING FACTORS

4.1 Data collection and its survey instruments

In order to validate the requirements from the literature above in Indonesia, there are about 500 respondents of port users (shipping operators, cargo owners and forwarders) in February 2018 till March 2019 have been included in face to face, online and telephone customer surveys supported by systematic questionnaires exploring operational and commercial factors in implementing port digital service. In addition, the consequences and outcomes of services in comparing traditional and non-digital services at three sampled terminals/ports locations.

4.2 Results of survey data and its results

From customer survey of TTL (2018-2019), Tanjung Priok (2018) and KBS (2017), it has been indicated six main areas as major concerns of port users in relation to port digital services such as employment, cost related, transaction, ordering, operational and marketing as seen in Table 1. The positive effects of port digital services are mainly due to simplification, faster services, less time to process, relatively faster operational performance, easier ordering and transaction, faceless and enhance visibility of customers in participating of service provision (TTL, 2018). These factors create efficiency and less resources allocated particularly time, energy, and costs. In opposite, the negative effects of the application of port digital services are the reduction of employment, the risk of electricity disturbances and internet connection instabilities, cyber-crime/attacks, difficulties to repair/maintain the semi-automated equipment, higher investment, require high skilled operators and relatively higher operating costs (if none or less reliable manual back-up).

Table 2. Major concerns and negative issues of digital port services**.**
Source: TTL (2018-2019); Tanjung Perak (2018); KBS (2018)

Area	Major concerns	Negative issues
Employment	Lower labor-costs	Lower employment
	Less in quantity	High skilled requirement
Costs related	Lower OPEX	Higher CAPEX
	Less time allocated	Additional new ICT staff
	Less meeting/faceless	
Transaction	Faster/simpler	Currencies level
Ordering	Faster and simpler	
Operational	Better performance	Instability of internet
	Better visibility	Cyber-crime/ attracts
	Transparent	Electrical failure
	Joined monitoring	Difficulty in repair
	Faster in process	Incompatible platform
	Closed customers	Reliable manual back-up
Marketing	Better intimacy	Complex claim handling

Further, in the implementation of digital port services in Indonesia taken the case of marine service of Tanjung Priok, it reported that positive benefit may be available both for port operators and users considering factors of transaction, safety, visibility, service and data reliability. Customer is now able to have a transaction of port marine service at any locations they may access and order and at any time using the IOT concept, including none face to face transaction, quick response and easy control a transaction.

Some possible abnormalities on the administration process would be responded by system with a facility of popying up message to customer contact. In addition, customer is also able to undertake tracking and tracing the execution process of vessel handling easily. Vessels that would like to cal lat Tanjung Priok will be assissSted with the viable resources complying with the regulation. Further, All marine resources can be monitored giving port users will get service guarantee in which their vessel will deliver as agreed Service Request Time (SRT). In relation to this, once the service is compppleted, the data directly sent to billing engine wherein data transaction

will be back up and provide customer able to see how many transaction has been executed. All of those progress creates higher ship movement with lower level of insufficient movement of 2,2 %per year (as seen in Figure 30), and then consequently may safe fuel cost at about 85.000 US dollar per year per ship or in total for annual pilot and tug service cost of about 110.000 US dollar.

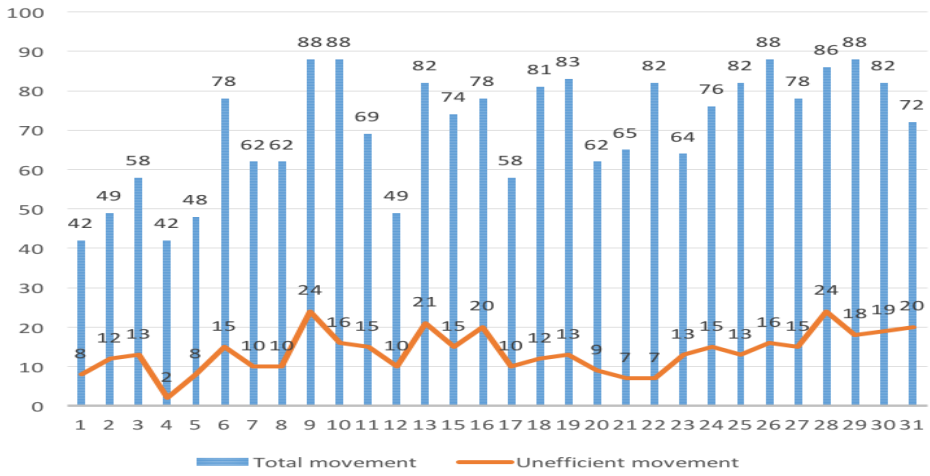


Figure. 3. Operational impact of higher ship movement efficiency of one-month sampling after applying digital operation for marine service ordering in Tanjung Priok Port

From the customer survey (2017-2018) at Tanjung Priok, TTL and KBS it is also identified four key of recurring operational problems found by related entities particularly on the application of digital port services for ship, cargo and logistics operations as listed in Table 3. Those four issues are harmonization of ICT platform; the need of big data facility; legal and operational coordination either for government agencies or public-private entities in the port and shipping services; and reliable manual back-up in case failures or disturbances occur due various potential risk factors. These four issues also discussed in Marianos et.al (2007) and Tijan (20090 for harmonization and reliable back-up; Carlan et.al (2016) and Xinyi et.al (2016) for coordination and big data.

Table 3. Summarized results for positive and negative effects of digital port services
Source:, TTL (2018); Tanjung Perak (2018); KBS (2017)

Issues	Applications
Harmonization	Standard of ICT platform needs to be established in having effective interface among entities
Big Data	The support of big data should be available to accommodate interaction and storing of data
Coordination	Government agencies require to synchronize rules/regulation
	Also coordination among entities: shipping companies, stevedoring, forwarding, transporters, and financial institutions

Reliable manual-back up	When internet connection is failure then manual back-up should be reserved and implemented

5. CONCLUSION

Digital port service has been changing traditional business platform of port operators and port users. In Indonesia, the requirement of port users has driven the availability of various derived digital service for better and faster performance, transparent response and transaction and further delivering to port users more added value benefit, efficiency and control in the provision of port services. In addition, the literature also indicate that port digital services are preferable in favor to port users in terms of costs, better service provision and assisting them to coordinate with other partners or entities in the port community system providing and supporting their business. These determining factors however should be supported by the sustainability efforts of this business platform such as harmonization of ICT platform, the provision of big data, data security facility and simple procedures for manual back-up to preserve the benefit of digital port services.

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