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Who are the Beneficiaries and Stakeholders of Blockchain Commercialization in the Shipping Industry?

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Abstract : *In the field of logistics, the maritime shipping industry plays a critical role as the backbone of global trade activities. Nevertheless, previous studies on the commercialization and benefits of blockchain technology are limited in the field of marine logistics. Thus, the purpose of this study was to predict the benefit for each group involved in marine logistics when blockchain technology is applied. As such, 21 factors of benefits were selected for seven major logistics groups (financial institutions, freight forwarders, inland transportation, ocean carriers, port operators, port-related government authorities, and shippers) to study the benefit expected for each through the commercialization of blockchain technology. Based on the results, a different benefit level is expected for each group when blockchain technology is used. In order, ocean carriers (0.155), inland transportation (0.150), financial institutions (0.153), port operators (0.145), freight forwarders (0.142), port-related government authorities (0.129), and shippers (0.126) were found to benefit most from the use of blockchain technology. This study has industrial implications in that it presents the benefits expected when blockchain technology is realized and used in marine logistics by groups involved in logistics transactions.*

Key words : *Blockchain Technology, Commercialization, Marine Logistics, Beneficiaries, Stakeholders*

1. Introduction

Blockchain, a distributed database of records as well as a decentralized and secure ledger of transactions, has become popularized since it is able to validate transactions over a peer-to-peer network without the use of a third party. All transaction data is kept in the form of a ledger, which can be updated by inserting new blocks of transactions to maintain the data's unity. This technology shows the potential of aiding the evolution of existing business processes in the financial, healthcare, agricultural, and governmental fields. Blockchain technology has been used in many sectors, such as the food industry (Yiannas, 2018) and the education sector (Chen et al., 2018).

In addition, blockchain technology can provide many advantages in the field of logistics. For instance, Tian (2016) demonstrated an agri-food supply chain system using blockchain and radio-frequency identification (RFID). This system can increase the safety and quality of agri-food products by gathering and managing trusted information across the entire supply chain. Casado-Vara et al.(2018) presented a system based on blockchain that uses smart contracts and a multi-agent to speed up distribution times and enhance security management. Moreover, South Korea's Hyundai Merchant Marine (HMM) managed to use blockchain for cargo delivery, real-time operation, and shipment booking during a pilot voyage on 4 September 2017 (HMM, 2017).

In the field of logistics, the maritime shipping industry plays a critical role as the backbone of global trade activities. Many stakeholders including ports/terminals, ocean carriers, government authorities, freight forwarders, and financial services are involved in this industry. Nonetheless, our understanding of systematizing these parties in the commercialization of a blockchain, as well as the influence on each party, remains limited. Previously published studies mainly focused on analyzing and presenting blockchain technology's potential application in the maritime shipping industry (Sadouskaya, 2017; Dobrovnik et al., 2018; AlTawy et al., 2017). In contrast, our priority is to investigate the beneficiaries in the maritime industry since the inception of blockchain

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technology. Besides, we sought to determine and systematize the benefits of different stakeholders.

This study was structured as follows. We first reviewed related literature about the applications and benefits of blockchain technology. Secondly, we applied the consistent fuzzy preference relation (CFPR) method. We then identified the beneficiary groups, determined the benefit of each group, and weighed these benefits before discussing the results and concluding the study.

2. Literature Review

Blockchain, created in 2008 by Satoshi Nakamoto, is progressively attracting numerous organizations and researchers because of its ability to solve various problems. Blockchain technology is considered a part of the Fourth Industrial Revolution (Schwab, 2017).

Due to its key characteristics—decentralization, persistency, anonymity, and auditability—blockchain technology has many potential applications in various fields, such as finance, education, healthcare, and government (Zheng et al., 2017). For example, Chen et al.(2018) indicated that blockchain technology could be used to solve problems for researchers, developers, and educators. Blockchain technology can be applied in storing complete, trustworthy record of students's processes, teacher's performances, etc. It also can be used to design smart learning activities. In addition, Cheng et al.(2018) explored the potential use of blockchain technology to link patients' electronic health records across healthcare services in China. Moreover, several studies on digital payment and cryptographic money (Papadopoulos, 2015), blockchain regulation (Kiviat, 2015), blockchain technology trends (Peters et al., 2015), blockchain transactions (Watanabe et al., 2015), the Internet of Things (IoT) (Huckle et al., 2016; Atlam et al., 2018; Minoli and Occhiogrosso, 2018), cybersecurity (Kshetri, 2017), and construction management (Turk and Klinc, 2017) are attempting to find new ways to apply blockchain technology.

Blockchain technology has been applied to the shipping and logistics industry in many innovative ways. For example, Dobrovnik et al.(2018) conducted a study on the application of blockchain technology in logistics as classified into five characteristics: relative benefits, compatibility, complexity, enforceability, and observability. They indicated that the detailed application of blockchain technology in logistics can be used to reduce transaction costs, exclude central government agencies, access open information, monitor transmission of products, track product life cycles, ease the workload of employees, and manipulate the Internet of Things (IoT). In addition, AlTawy et al. (2017) introduced a physical delivery system based on blockchain technology, Lelantos 1, to restrict convincing transactions between contracting parties. Moreover, Hasan and Khan(2018) presented a penalty and incentive mechanism for both single and multiple transporters. Until now, researches on blockchain technology's application to shipping industry have focused on only the advantages of utilizing this technology (Sadouskaya, 2017; Dobrovnik et al., 2018; Min, 2019; Reyna et al., 2018) or on introducing blockchain-based programs (AlTawy et al., 2017; Hasan and Salah, 2018).

Blockchain technology has some advantages, including reliability, trust, security, and efficiency, but not all of these are equally advantageous for the whole maritime industry. Takahashi(2016), Chetrit et al.(2018) and Doan(2018) pointed out some of the benefits of transforming traditional paper bills of lading into e-bills; these include saving time, lowering administrative costs, and providing security for shippers, shipping companies, freight forwarders, and financial institutions. According to Dobrovnik et al.(2018), Cheng et al.(2018), and Banerjee(2018), port-related agencies, ports/terminals, and shipping companies can also profit from digitizing and automating shipment documents and work. A limited number of studies have focused on the expected effectiveness of or a strategic direction for the realistic commercialization of blockchain technology. Nakasumi et al.(2017) provided an analysis of information-sharing problems in supply chains using blockchain technology. Using their decentralized platform, not only could data be collected, stored, and shared plainly, but the principles and terms of contracts could also be enforced automatically. As a result, each stakeholder would gain benefits at different levels. In this respect, there is a research gap in previous studies regarding the classification of stakeholders involved in the commercialization of blockchain technology in the shipping industry and the expected effectiveness of each group upon commercialization.

In this study, the issue of choosing and weighing the beneficiaries of blockchain commercialization in the shipping industry, which is a multiple-criteria decision-making problem (as it uses both quantitative and qualitative criteria), is solved using the CFPR method introduced by Herrera-Viedma et al.(2004). Several methods exist to solve multiple-criteria decision-making problems, such as

Analytic Hierarchy Process – AHP (Santy, 1980), fuzzy AHP, and the fuzzy Technique for Order of Preference by Similarity to Ideal Solution – TOPSIS (Buyukozkan and Cifci, 2012). However, the CFPR method is advantageous since it decreases the number of survey questions, leading to quality responses and assured consistency.

3. Methodology

This study adopted the CFPR method suggested by Herrera-Viedma et al.(2004) to determine which benefits of stakeholders in maritime industry are important. Assessing qualitative factors without existing expert knowledge and experience is difficult. In this study, the CFPR method was applied because the linguistic scale relieves some difficulties of the alternatives comparison process. Other advantages of adopting the CFPR method are that it overcomes the problem of imprecise evaluations, as well as lowering the uncertainty in the calculation process. Additionally, the questionnaire problems are comparatively simple and short for the respondents to answer, which increases the chances of receiving responses. Therefore, the CFPR method compared to fuzzy AHP, and fuzzy TOPSIS enables the participants to give their opinions with minimal judgment as well as simplifying the routines by eliminating the inconsistencies in the decision-making process.

The following multiplicative preference relations were denoted by Santy in 1980. A represents a set of alternatives, X, if the scale is 5, which is represented by a preference relation matrix:
$A \subset X \times X, A = (a_{ij}), a_{ij} \in [1/5, 5]$. In this case, a_{ij} is the preference ratio of the alternative x_i to x_j. a_{ij} = 1 means that the alternative xi to xj has equal preference, while a_{ij} = 5 means that x_i is absolutely preferred to x_j. Preference A is assumed to be a multiplicative reciprocal as follows:

$$a_{ij} * a_{ji} = 1, \forall i, j \in 1, 2, \ldots, n. \tag{1}$$

In fuzzy preference relations, the preference ratios of alternatives xi and xj are expressed as expert preferences regarding an alternative set, and X is expressed as a positive preference relation matrix: $P \subset X \times X$. X contains a membership function, $\mu_p(X_i, X_j) = P_{ij}$, and it contributes to the degree of preference for alternative x_i relative to the preference of alternative x_j.

In this case, P is additive reciprocal:

$$P_{ij} + P_{ji} = 1, \forall i, j \in 1, \ldots, n \tag{2}$$

$P_{ij} = \frac{1}{2}$ represents the indifference between x_i and $x_j (x_i \sim x_j)$, and $P_{ij} = 1$ indicates that x_i takes precedence over x_j. $P_{ij} = 0$ indicates that x_i is preferred over $x_j (x_i > x_j)$. In the case of $P_{ij} > \frac{1}{2}$, x_i is preferable to $x_j (x_i > x_j)$. P is an additional inverse.

Proposition 1: The mutually added fuzzy preference relation (2) can be expressed as follows:

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2} \forall i, j, k; \tag{3}$$

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2} \forall i < j < k; \text{and} \tag{4}$$

$$p_{i(i+1)} + p_{(i+1)(i+2)} + \cdots + p_{j(j-1)} + \frac{j-1+1}{2} \forall i < j. \tag{5}$$

Proposition 2: Assuming the existence of alternative set is related to multiplicative preference relation with after adding preference relation to for , we get the following:

$$p_{ij} = g(a_{ij}) = \frac{1}{2}(1 + \log_5 a_{ij}) \tag{6}$$

Equation (6) can be used to transform a matrix in a multiplicative preference relation into various preference relations. If there is no interval [0,1] in the affinity matrix and a value is presented in [-a,1 + a], a linear transformation is required to preserve the mutual and additive values. The conversion function can be expressed as follows:

$$f(p\frac{k}{ij}) = (p\frac{k}{ij} + a)/(1 + 2a) \tag{7}$$

The absolute and minimum values of the negative sign in this symbol matrix are denoted by a. Herrera-Viedma et al.(2004) argued that the multiplicative preference relation (X) for alternative (A) can be determined by the ranking of alternatives as follows:

(8)

To maintain mutual coherence, the ratio of the $X=\begin{bmatrix} 1 & A_{12} & A_{13} \\ A_{21} & 1 & A_{23} \\ A_{31} & A_{32} & 1 \end{bmatrix}$ comparison is converted to a scale of [1/5, 5] by applying the following function:

$$f(x)=x^{1/\log\frac{b}{5}} \tag{9}$$

In multiplicative preference relations, the absolute and maximum values are denoted by b.

4. Empirical analysis

4.1 Identifying the beneficiary groups and benefit for each group

The International Business Machines Corporation – IBM and Maersk(2018) launched a blockchain-based shipping platform called TradeLens in August of 2018. They stated that the beneficiaries of blockchain commercialization in shipping industry are financial institutions, freight forwarders, inland transportation, ocean carriers, port operators, port-related government authorities, and shippers (IBM and Maersk, 2018). In this study, we adopted these suggested beneficiaries and determined the benefit for each group. IBM and Maersk(2018) also presented the benefits from blockchain for each group they listed. For financial institutions, the benefit is improved speed and flexibility through the automation of data and the transformation of traditional paper bills of lading into e-bills, streamlining business processes and allowing all parties to access identical, immutable, and consistently available information. The main benefit for freight forwarders is increased customer service performance. Freight forwarders focus on providing high-value services like compliance and use centralized data and multiple machines to collect inland transport information (mobile phone applications, IoT devices, and application programming interface – API integrations). Connecting source documents with custom fillings also helps to reduce and solve paperwork errors. The main benefit for inland transportation is the decreased waiting and processing times through up-to-date and coherent data that can be shared between parties in real time. Digital documentation also makes it easier to prevent documents from being misplaced, increasing the trust of shippers and enhancing security. For ocean carriers, the main benefit from blockchain is the ability to observe container activities. Ocean carriers can also track phone calls, emails, and keep a record of source documents thanks to IoT and real-time data. The benefit for port operators is a standard platform connecting all stakeholders. Further, precise, continually updated Estimated Time of Arrival – ETAs can result in the accuracy utilization of port assets, suitable yard planning, and fast service times. Moreover, port-related government authorities can improve critical activities, such as targeted risk assessments, via blockchain-based documents, which can be accessed without resulting in a higher workload for traders, leading to more fluent import and export processes. Finally, for shippers, the main benefit is the ability to progressively analyze shipping times or delays. Shippers can also achieve inventory management and cost reduction, and they can routinely generate and exchange documents among trading partners.

To identify the exact benefit for each group, we contacted experts working in seven groups. The experts included chiefs, deputies, and employees of various companies in the logistics field with an average of 9.6 years of work experience in the field and also use blockchain-based logistics platforms. Open-ended questions and discussions were used to extract the exact benefit for each group. The companies responded were as follows: Kookmin Bank, Korean Exchange Bank – KEB Hana Bank, and Lotte Insurance Co., Ltd. for the financial institution group; PANTOS Co., Ltd., Panalpina World Transport (Holding) Ltd., and Savino Del Bene for the freight forwarder group; Dongbu Express, KZX, and kTRAANS for the inland transportation group; HMM Co., Ltd., Maersk, and Korea Marine Transport Co., Ltd. for the ocean carrier group; Dongbang Transport Logistics Co., Ltd., Sebang Co., Ltd., and Access World for the port operator group; Seosan City Hall, the Gangwon Provincial Office, the Korea Customs Service, the International Origin Information Source, and the Goyang Chamber of Commerce and Industry for the port-related government authority group; and Korea Zinc, Hyundai Motor Company, LG Electronics, and Hanwha Chemical for the shipper group. In-depth interviews were conducted via phone call and in person over a period of three weeks (the 17th to 31st of December 2018). Finally, 21 benefits with three ones for each group were identified under the seven beneficiary groups, as shown in Table 1.

Table 1 Beneficiary groups and the benefit for each group

Beneficiary group	Benefit for the group	References cited
Financial institutions (F1)	Increased cost effectiveness and transparency by enabling e-billing based on blockchain (F1-1)	Takahashi (2016) Chetrit et al. (2018) Doan (2018)
	Reduced risk in foreign exchange transactions due to the commercialization of electronic Bill if Lading - B/L (F1-2)	Takahashi (2016) Chetrit et al. (2018) Doan (2018)
	Possibility of improving the process of pay deals by reducing the risk of document forgery (F1-3)	Dobrovnik et al. (2018) Cheng et al. (2018)
Freight forwarders (F2)	Reduced manpower through the electronicization and automation of shipping documents (F2-1)	Dobrovnik et al. (2018) Cheng et al. (2018)
	Provision of a value-added service by collecting and providing real-time logistics information (F2-2)	Banerjee (2018) Dobrovnik et al. (2018) Nakasumi (2017)
	Increased work efficiency due to reduced errors in shipping documents (F2-3)	Dobrovnik et al. (2018) Cheng et al. (2018)
Inland transportation (F3)	Reduced transportation lead times by sharing real-time logistics information (F3-1)	Dobrovnik et al. (2018) Nakasumi (2017)
	Ensured reliable management of cost and the transportation mode (F3-2)	Chod (2018) Nguyen (2016)
	Secured transportation stability through a simplified process using electronic documents (F3-3)	Dobrovnik et al. (2018) Cheng et al. (2018)
Ocean carriers (F4)	Simplified shipping documents and increased efficiency through the commercialization of electronic B/L (F4-1)	Takahashi (2016) Chetrit et al. (2018) Doan (2018)
	Reduced manpower and improved work efficiency by providing customer service via an e-platform (F4-2)	Li (2019) Wang (2018)
	Real-time management of transportation flow and status using the IOT based on blockchain technology (F4-3)	Reyna (2018) Dobrovnik et al. (2018)
Port operators (F5)	Maximized utilization of terminal assets through accurate ship entry and exit information (F5-1)	Banerjee (2018) Dobrovnik et al. (2018)
	Strengthened yard planning competitiveness through consistent information sharing with port authorities (F5-2)	Banerjee (2018) Dobrovnik et al. (2018) Nakasumi (2017)
	Improved lead times and frequency of inland and maritime transport services (F5-3)	Altawy (2017) Hasan and Salah (2018)
Port-related government authorities (F6)	Improved collection of transparent and reliable logistics information (F6-1)	Reyna (2018) Dobrovnik et al. (2018) Altawy (2017) Nakasumi (2017)
	Decreased risk of document forgery (F6-2)	Dobrovnik et al. (2018) Cheng et al. (2018)
	Accurate and speedy customs clearance process (F6-3)	Banerjee (2018)
Shippers (F7)	Secured payment transaction stability using electronic B/L based on virtual money (F7-1)	Takahashi (2016) Chetrit et al. (2018) Doan (2018)
	Reduced service cost of logistics agencies by increasing customer support service and speed (F7-2)	Li (2019) Wang (2018)
	Systematic management and transparency of logistics and finance costs (F7-3)	Chod (2018) Nguyen (2016)

4.2 Identifying the weights of the beneficiary groups and benefit for each group

The data used for this study was collected from the VIn total, 21 benefits under seven beneficiary groups were obtained for the blockchain commercialization of the shipping industry. It is difficult for decision makers to compare and arrange these factors in a logical order. Thus, to weigh the benefits and the beneficiary groups, the CFPR method was applied. The factors of benefits were divided into nine different groups, as shown in Table 2.

Table 2 Linguistic variables of the importance weights of the factors

Definition	Intensity of importance
Absolute importance	5
Very important	4
Strong importance	3
Weak importance	2
Equal importance	1
Less weak importance	1/2
Less strong importance	1/3
Less very important	1/4
Less absolute importance	1/5

To provide weights for these seven factors, a second round of surveys was sent to the 280 respondents who responded to the first round of surveys. The respondents were divided into the seven beneficiary groups, each group consisting of 40 experts. It took one month (January 7 - February 5, 2019) for them all to respond to the face-to-face interviews, telephone calls, and emails. Questionnaires were sent to the 280 experts, and 110 results were collected and employed in the analysis of the study.

The CFPR method was used to calculate the weight, and thus the importance, of each factor. After completing the computational process, a normalized and aggregated pairwise comparison matrix was created for all the factors assessed. As shown in Table 3, the ranking of the seven groups of beneficiaries was as follows: ocean carriers (F4, 0.155) > financial institutions (F1, 0.153) > inland transportation (F3, 0.150) > port operators (F5, 0.145) > freight forwarders (F2, 0.142) > port-related government authorities (F6, 0.129) > shippers (F7, 0.126). Among the factors, the benefit for ocean carriers was shown to be the largest (0.155), followed by that of financial institutions (0.153) and that of inland transportation companies (0.150).

Table 3 Benefit for each group

Main factor	Local importance	Benefit for each group	Local importance	Global importance	Ranking
Financial institutions (F1)	0.153	F1-1	0.318	0.049	9
		F1-2	0.329	0.050	6
		F1-3	0.352	0.054	3
Freight forwarders (F2)	0.142	F2-1	0.297	0.042	18
		F2-2	0.331	0.047	12
		F2-3	0.371	0.053	5
Inland transportation (F3)	0.150	F3-1	0.300	0.045	16
		F3-2	0.329	0.049	8
		F3-3	0.371	0.056	2
Ocean carriers (F4)	0.155	F4-1	0.308	0.048	11
		F4-2	0.324	0.050	7
		F4-3	0.368	0.057	1
Port operators (F5)	0.145	F5-1	0.316	0.046	15
		F5-2	0.320	0.046	14
		F5-3	0.365	0.053	4
Port-related government authorities (F6)	0.129	F6-1	0.297	0.038	20
		F6-2	0.332	0.043	17
		F6-3	0.371	0.048	10
Shippers (F7)	0.126	F7-1	0.295	0.037	21
		F7-2	0.334	0.042	19
		F7-3	0.371	0.047	13

In addition, global ocean carrier Maersk announced the results of their proof of concept utilizing blockchain in March of 2017 and released "TradeLens," a blockchain platform jointly developed with IBM, in October of 2018. Maersk began managing the ship booking and loading and cargo tracking processes of the marine logistics process using TradeLens, providing innovative international trade services that combine marine logistics services with trade finance services. As can be seen, the benefit for ocean carriers is the greatest in terms of the utilization of blockchain technology.

Letter of credit - L/C, Document against payment - D/P, and Document against acceptance - D/A are payment methods that play important roles in traditional import and export transactions for financial institutions. Among them, L/C is the most common payment method, as it reduces risks for importers and exporters. L/C transactions involve the submission of major shipping documents, including B/L, by exporters to negotiating banks, allowing exporters to receive payment from banks. In return, the bank is compensated for risks as well as interest for the number of days the payment is in advance. For this reason, credit transactions incur high costs, are inefficient, and involve risks, including those pertaining to the forgery of shipping documents, shipping delays due to delays in L/C opening, and payment delays due to delayed document review of parties. As such, for financial institutions, the benefit of blockchain commercialization is that relevant data and electronic documents can be accurately shared in real time without the risk forgery. Thus, financial institutions can improve transaction processes via electronic information and documents that cannot be forged. In addition, since logistics and financial processes can be implemented simultaneously in the blockchain-based logistics platform operation plan, the lead time for document verification is reduced and logistics and financial costs can be systematically managed.

The carrier's role in shipping and logistics is to reliably bring its cargo into terminals linked to maritime transportation services in export logistics. Once the carrier's use of the shipping and logistics blockchain platform becomes a reality, the following advantages can be expected. First, accurate entry and exit information can be accurately shared within the blockchain platform and the estimated amount of terminal incoming and outgoing shipments by time zone can be calculated to reduce carrier terminal cargo waiting time. Second, it is expected that the work waiting time will be significantly reduced as the status of cargo shipments and shipments by exporters and importers will be accurately shared. Third, the sharing of shipping document transport information through mail and fax based on paper documents can be quickly and accurately shared through the platform to improve transport service efficiency.

The detailed factor analysis showed that the "real-time management of transportation flow and status using the IOT based on blockchain technology" (0.057) was the most important factor for ocean carriers. This factor was followed by "secured transportation stability through a simplified process using electronic documents" (0.056) and "possibility of improving the process of pay deals by reducing the risk of document forgery" (0.054).

5. Conclusion

Blockchain technology can be used to record transactions in order to prevent double payment using bitcoin. Blockchain's recording method is safe from hackers because the data are not managed nor maintained through a centralized system but rather by the participants in a transaction. As shown in this study, using blockchain technology throughout the logistics industry would increase the efficiency and transparency of logistics transaction processes. In particular, blockchain-based logistics platforms can allow all participants in the shipping and logistics industry to share digital information quickly and stably at a low cost. Nevertheless, previous studies on the commercialization and benefits of blockchain technology are limited in the field of marine logistics. Therefore, the purpose of this study was to predict the benefit for each group involved in marine logistics when blockchain technology is applied. As such, 21 factors of benefits were selected for seven major logistics groups (financial instituations, freight forwarders, inland transportation, ocean carriers, port operators, port – related government authorities, shippers) in order to study the benefit expected for each through the commercialization of blockchain technology. These benefits were identified by surveying actual stakeholders who use blockchain-based logistics platforms.

Based on the results, a different benefit level is expected for each group when blockchain technology is used. In order, ocean carriers (0.155), financial institutions (0.153), inland transportation (0.150), port operators (0.145), freight forwarders (0.142), port-related government authorities (0.129), and shippers (0.126) were found to benefit most from the utilization of blockchain technology. For ocean carriers, all marine logistics processes can be managed through a blockchain-based logistics platform. Furthermore, new services can be created to value, acquire new customers, maintain existing customers, and prevent customer churn. In this respect, the benefit for ocean carriers was found to be the largest. For ocean carriers, can take advantage of blockchain technology and have the opportunity to rapidly emerge as the main players in future trade deals. For example, Maersk is showing the possibility of providing innovative international trade services that manage the shipping logistics pre-booking, shipping, and cargo tracking processes through the TradeLens Blockchain platform and incorporate trade and financial services into shipping and logistics services. If electronic BL that cannot be tampered with are transferable to participants in trade transactions through blockchain, there is a significant reduction in the scope of traditional trading finance companies' involvement. In other words, the ocean carriers,, which issues B/L, can provide a safe trade payment service based on the collateral rights of the cargo in transit directly and, on this basis, advance electronic B/L distribution to the exporter/importer. This means a big reduction in traditional LC(Letter of Credit) transactions and suggests that the ocean carriers can proceed with the logistics and financial services of trade transactions. Moreover, the factor "real-time management of transportation flow and status using the IOT based on blockchain technology" (0.057) was found to be the most important for ocean carriers.

For financial institutions, an innovative future in trade finance can be pursued using blockchain technology. Hong Kong and Shanghai Banking Corporation - HSBC recently launched a platform called Voltron that is based on a blockchain technology called R3's Corda. Using Voltron, HSBC completed a pilot test for trade transactions using an electronic B/L called Bolero, in which L/C transaction participants were able to transfer e-bills of lading in real time. This is significant, as a financial institution was able to demonstrate the commercial and operational feasibility of electronic B/L using blockchain technology for use in trade finance. Thus, financial institutions are expected to commercialize blockchain technology first of the groups studied and create innovative benefits while providing safe and fast trade finance services.

This study has industrial implications in that it presented the benefits expected when blockchain technology is realized and used in marine logistics by groups involved in logistics transaction. In future studies, it is necessary to analyze these groups' benefits regarding their differences in particular. In addition, to find out more beneficiary groups on the analysis is needed.

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