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A Survey on User Requirements for Smart Container Development

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Abstract: ***A Smart Container refers to a new concept of container that promotes the safe transport of cargo by incorporating Fourth Industrial Revolution technologies such as IoT, artificial intelligence, and big data. It has functions to check cargo status inside of containers, to detect whether the door is open or closed, and to communicate the sensing and location information to the outside. Since Smart Container manufacturing costs are higher than general containers, it is strategically necessary to adjust the trade-off between increased cost burden and added value through customer service improvement. In this study, we tried to make a survey to define new functions to be added in Smart Containers, new services based on Smart Container information, and figure out users' willingness to additional cost burden. The result of this study will influence the function priorities of a Smart Container considering the tolerance of the cost burden of the user of the Smart Container, which is very important for successful commercialization. The study surveyed 104 container cargo owners and 172 logistics companies by telephone and visits. The surveys were conducted from November 18 to December 15, 2021. The research findings indicate that when assessing the envisioned functionalities of Smart Containers, the primary expectation is the real-time monitoring of cargo conditions within the container. Subsequently, the monitoring of container door openings and closings ranks second, followed by impact detection. The cargo owners (61.6%) expressed a reluctance to bear the additional expenses associated with the deployment of relatively costly Smart Containers for sea transportation. Similarly, shipping companies (69.2%) exhibited a negative inclination toward shouldering the supplementary costs. As shipping companies and shippers are negative about accepting additional costs due to Smart Containers, Smart Container developers must be very sensitive to development costs, so price differentiation through options is necessary. Additionally, in the early stages of commercialization, institutional support will be needed from the government to partially subsidize the purchase and operating costs of Smart Containers.***

Keywords: Smart Container, User Requirement Survey, Cargo Status, Location Tracking

1. Introduction

Container transportation is helping accelerate the global trade economy due to the rapid development of commercial containerization and standardization. The backbone of global commerce is the shipping line. In the 1950s, the "Gateway City" became the first standardized intermodal ship ever built. Containerization was not only about ships; it was an innovative approach to structuring transportation that has fundamentally altered the way that freight is transported around the world. Global containerized cargo ship travel grew from about 11 million metric tons in 1980 to about 293 million metric tons in 2022. According to Vantage Market Research, the global Shipping Container Market is estimated to be valued at USD 15.5 Billion by 2030 and is expected to exhibit a CAGR of 12.5% from 2023 to 2030. The global Shipping Container market grew to USD 6.8 Billion in 2022. 'Container' means, an article of transport equipment of a permanent character and accordingly strong enough to be suitable for repeated use (ICSC, 1972) or any type of container, transportable tank or flat, swap body, or any similar unit load used to consolidate goods, and any equipment ancillary to such unit load (United Nations, 2009). In 2021, the international liner shipping industry transported approximately 241 million containers, with cargo transported valued at more than $7 trillion (CouncilShipping, 2022). Today, 90% of non-bulk cargo transported by sea worldwide travels in standardized container boxes from the point of stuffing through the place of stripping utilizing all available modes of transportation, including via sea, inland waterways (barge), rail, and road (United Nations, 2018). Accordingly, The World Shipping Council estimates that there were generally 1,629 containers lost at sea each year, which is a significant increase (18%) from the average annual loss for the twelve years ending in 2019. The 2022 Update to the Containers Lost at Sea Survey includes the total number of containers lost at sea.

Recent technological developments have made it possible to permanently attach low-cost tracking and monitoring equipment to marine and inland waterway cargo containers, effectively transforming them into Smart Containers. Smart Container is shipping lines and cargo-related stakeholders can have access to container data coming from the source regardless of whether the container is on a ship, in a yard, or at any other point during its pre-haul and post-haul journey. Smart Containers are advancing the modern era of shipping well beyond conventional paperless procedures by embracing the Fourth Industrial Revolution technologies to foster more informed decision-making among stakeholders within various sectors. This increases visibility for all parties involved in the transaction as well as for regulatory organizations who require thorough information on the shipments before they arrive at the border. To further facilitate the trading community using new technology it can be integrated with other innovations such as blockchain, big data, IoT, artificial intelligence, or data pipelines. Besides the latest technology, the e-seal informs the customers on the location of the containers, the security of the container for example the opening/closing of the container, temperature, and humidity by email and SMS alert, but it is limited to cellular network coverage (Sharma RoneshSeong, 2013).

Over time, the requirements for the supply chain have evolved. To identify the inbound flow of goods, supply chain stakeholders require better visibility today. This is critical to satisfying increasing consumer demand as well as reacting to the unexpected. Smart devices unlock the potential to provide accurate real-time data for further analysis, alerts, or general reporting. The Smart Container measurements may also consist of the following more detailed data elements Estimated time of arrival (ETA) update, actual Executed transit time (ETT); Empty at Gate-In at the Depot, Depot Reconciliation, Trip Tracking, Haulage Container Time, and all routing points passed; and Exception Alerts such as Schedule Deviation Alert, Unexpected Door Opening, Unexpected Temperature or Humidity Change, and Overlanded Container.

A Smart Container can develop from any container. Electronics for Smart Containers can be integrated during production, added to various kinds of existing containers, or even incorporated within the container's contents. The containers have a useful life of about 12 to 15 years and the standard twenty-foot container costs about $2,000 to manufacture while the forty-footer costs about $3,000. Therefore, a twenty-foot container costs $1.71 per cubic foot to manufacture while a forty-foot container costs $0.80, which underlines the preference for larger volumes as a more effective usage of assets (EdirisingheLalith, 2017). Having Smart Container data may also decrease cargo loss, packaging costs, non-quality costs, the levy of fines, insurance fees, investigation processes, damage to goods, the number of back orders, canceled orders, and the number of defective products delivered. The Global Navigation Satellite System (GLONASS) and GPS are used in this container-tracking system to obtain location and time information for the real-time container-tracking device. Traditionally used ZigBee, Wi-Fi, and Bluetooth low energy (BLE) technologies, Long Range Wide Area Network (LoRa WAN) offers higher bandwidth capabilities that facilitate in-depth indoor penetration and minimize signal reflection from the surface of the container.

The Digital Container Shipping Association (DCSA), which represents nine carriers, including MSC, Maersk, Hapag-Lloyd, and CMA CGM, has published three Smart Container standards intended to ensure interoperability between Smart Container solutions and remove the obstacles posed by proprietary solutions. The DCSA is eager to work with all partners in the marine supply chain to promote the use of standards-compliant solutions. All DCSA standards are open source, vendor-neutral, and technology-agnostic. The global leader container shipping companies are introducing Smart Containers as MSC Mediterranean Shipping Company introducing TRAXENS (Choi Hyung Rim et al., 2021). MSC is committed to equipping 50,000 dry cargo containers. HMM, a South Korean shipping business, has disclosed that it uses its IoT technology to manage reefer containers carrying delicate cargo. The Ministry of Oceans and Fisheries of South Korea announced that performance verification of products made through the ‘Smart Container Commercialization Technology Development Project’ will be conducted for three months starting on July 14th. The section of this verification work is Busan New Port~Singapore~India~Brazil~Busan New Port. The vessel (Brave, 8,600 TEU) that will transport Smart Containers is supported by HMM. “Maersk Line invested in 30,000 new reefer containers in 2015 over the past years equipped more than 270,000 refrigerated containers or ‘reefers’ with Remote Container Management (RCM). The global Smart Container market is expected to exhibit a growth rate (CAGR) of 16.2% during 2023-2028.

Figures 1 and 2 show the inner and outer shapes of the Smart Containers which can be applied to both conventional dry containers and reefer containers. In general, the cargo status sensing module (temperature, humidity, impact, illumination, etc.) checks the cargo condition inside the container, the door lock sensing module detects whether the door is open or closed, and the communication module communicates the sensing information to the outside.

Figure 1: Inside view of Dry Smart Container

Since the manufacturing cost of a Smart Container with a built-in smart unit will be higher than that of the existing general container, high-cost performance is essential in terms of functions that can offset the increased cost. Therefore, it is necessary to identify the need for new functions of Smart Containers for potential users of Smart Containers, such as shippers and logistics companies, and to investigate the extent to which users can pay additionally for Smart Containers commercially.

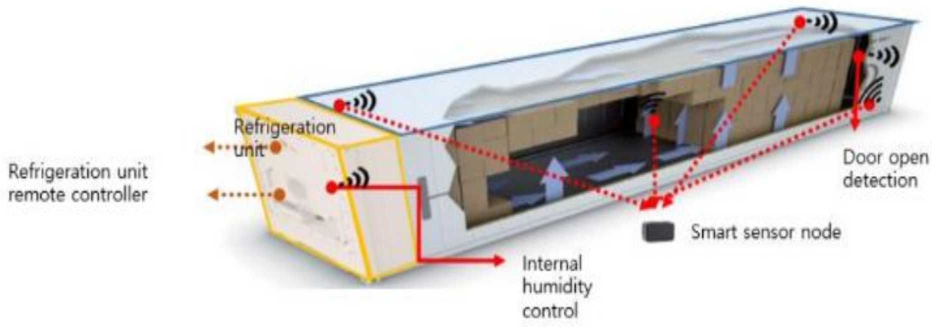

Figure 2: Outside view of Reefer Smart Container

The remainder of this paper is organized as follows: Section I introduces a brief review of containers and Smart Containers. Section II presents background information about the literature review. Section III provides methodology and data collection which is survey data. Section IV presents the empirical analysis and results with descriptive statistics. In section V we conclude this paper.

2. Review of the Literature

This section presents an overview of the relevant research on Smart containers. The first entirely containerized ship, called "Gateway City," was discovered in 1950 (CudahyB, 2006), and containerization was commercially adopted in the US in the mid-1950s (D Bernhofen et al., 2016). Containerization is the primary force behind twentieth-century economic globalization, and in 2012, the number of 20-foot equivalent units (TEUs) shipped globally increased by an estimated 3.8% to 601.8 million (UNCTAD, 2013). Technically, the CSC (Container Safety Convention) and ISO (International Standards Organization) control containers. According to the ISO classified a container as an "article of transport equipment" in 1968. One of the most dramatic changes to the global economy since World War II has been the enormous increase in international trade. The shipping industry developed alongside the global economy by observing and taking advantage of the ebb and flow of trade (Stopford, 2009). With the rapid development of Machine to Machine (M2M) communication, a Smart Container supply chain management is formed based on high-performance sensors, computer vision, Global Positioning System (GPS) satellites, and a Global System for Mobile (GSM)Communication (Sharma RoneshSeong, 2013).

The United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) launched the Smart Container Project to develop data exchange standards, aiming to promote and simplify the deployment of Smart Container solutions (Yang Peng Dai et al., 2002).

The Digital Container Shipping Association (DCSA), launched in 2019, proposes the DCSA IoT standards to allow for the widespread use of interoperable Smart Container technologies. To fully construct a smart maritime logistics system, organic connection through smartization is necessary for the three main objects: ships, ports, and containers. To realize this, the Ministry of Oceans and Fisheries of Korea has established and is promoting the 'Marine and Fisheries Smartization Promotion Strategy' in 2019 (Choi Hyung Rim et al., 2021).

A main requirement was the ability to use tracking devices to connect WSN technology to establish an intra-container network to save on data connections, roaming fees, and overall energy consumption. The researcher provided a container monitoring prototype and discussed the technique that allowed us to develop a customized solution for container monitoring with criteria in difficult circumstances (Peter Ruckerbusch et al., 2018). This study describes the fundamental technical characteristics of RFID systems, relates them to real-world applications, assesses the numerous trade-offs associated with E-seal design, and determines how the technologies function in real-world operational situations (Jin Zhang et., 2009). (Shibo Xu et al., 2016) presents an Ad-hoc ZigBee network-based container monitoring system design. The monitoring system uses an upgraded routing algorithm built on the current ZigBee routing protocol to reduce energy use, increase efficiency, and decrease costs. In the container yard, some field tests have also been conducted. (O. Alkhoori et al., 2021) introduced a blockchain-powered Smart Container system called Crypto Cargo, which monitors the conditions of shipments and detects any violations that may damage their contents. These violations are recorded on the blockchain through smart contracts, providing secure and immutable storage, thus enhancing trustworthiness in an inherently trustless environment with multiple stakeholders. Furthermore, researchers offer details of a comprehensive system evaluation to validate its functionality and assess its performance efficiency and real-time operation. Our smart contract code is publicly available on GitHub.

We propose Smart Containers to reduce costs and create new services by securing visibility of logistics and efficiently relocating containers by utilizing IoT equipment to determine real-time location, condition monitoring, and automation.

Additionally, by providing a power supply using solar tubes and cooling functions using Peltier elements, we aim to expand the scope of use to a full cold chain platform, which is the core of fresh food. (Kang Ji Su et al., 2019).

The 7th Framework Program of the European Commission (FP7) and partners from the freight-related industries are co-sponsoring the research project known as Smart Container Chain Management (Smart-CM). To make the container transport chain more effective, secure, market-driven, competitive, and environmentally friendly, Smart-CM undertook a thorough analysis of the entire chain. (CarnJulia, 2011). In addition to the newest technology, there is a system called E-seal that sends email and SMS alerts to clients about the location of their containers, their security, such as when they are opened or closed, temperature, and humidity. However, this system is only compatible with cellular network coverage. However, earlier research shows that end-to-end real-time operation has no accessibility to the supply chain's complete data when the ship is sailing the ocean where a cellular network is not available due to the high cost of satellite internet access (Sharma RoneshSeong, 2013).

This paper focuses on the examination of the recognition of the necessity for Smart Containers and the identification of the requirements for new services based on Smart Containers. Additionally, it seeks to determine the stakeholders capable of recognizing and assessing the associated additional costs. In this regard, this paper focuses on the studies and implementation of real-time container chain management with the development of the container identification system and automatic alert system for interrupts and normal periodical alerts. The requirement for customers transporting goods and stuff using containers now has moved from cost cost-saving aspect to a service-based aspect, where real-time container tracking solutions are provided.

3. Method of Data Collection

The sampling primary data for this research was collected from 104 cargo owners and 172 logistics companies located in Korea. The questionnaire was through telephone and visit interviews by survey method from November 18 to December 15, 2021. The contents of the questionnaire are guided and reviewed by involving consultations with experts affiliated with the Port Authority and national research institutes specializing in maritime and port operations. Before the commencement of the comprehensive survey, a pilot test was conducted in October 2021. The findings and insights gleaned from this preliminary survey played a pivotal role in refining and enhancing the survey's content.

Fundamentally, the survey questionnaire encompassed a combination of closed-ended multiple-choice questions and open-ended inquiries designed to elicit subjective responses. The questionnaire consisted of 125 questions in four areas (1) recognition of the necessity for Smart Containers; (2) requirements for Smart Container functions; (3) requirements for new services based on Smart Containers; (4) recognition of acceptance of the additional cost of Smart Containers. Table 1 and Table 2 show the demographic characteristics of the respondents.

Table 1: Demographic data of logistic company

Demographic Characteristics		*Number of People (N=172)*	*Percentage (%)100*
Address	Near to Seoul	39	22.7
	Chung Cheong	7	4.1
	Chul La	39	22.7
	Kyung Sang	87	50.6
Business Type	Transportation/Warehousing/Handling	137	79.7
	Other	35	20.3
Revenue	Less than 500 million	54	31.4
	50million-1 billion	28	16.3
	1billion-5billion	60	34.9
	5billion-10billion	9	5.2
	More than 10billion	21	12.2
Number of employees	1-9	16	9.3
	10-49	80	46.5
	50-99	18	10.5
	More than 100	58	33.7

Table 2: Demographic data of cargo owner

Demographic Characteristics		Number of People (N=104)	Percent Tage (%) 100
Address	Near to Seoul	45	43.3
	Chung Cheong	22	21.2
	Chul La	10	9.6
	Kyung Sang	26	25
	Jeju	1	1
Business Type	Typical Manufacturer	100	96.2
	Other	4	3.8
Revenue	Less than 1 billion	7	6.7
	1 billion- 5 billion	26	25
	5billion-10billion	22	21.2
	More than 10billion	49	47.1
Number of employees	Less than 100	15	14.4
	100-299	48	46.2
	300-499	14	13.5
	500-999	17	16.3
	More than 1000	10	9.6

The majority of respondents were located near Seoul 39, Chung Cheong 7, Chul la 39, and Kyung Sang the most 87 companies (50.6%) located. The business type of the respondents was transportation, warehousing, and handling, with a total of 137 companies (79.7%) falling into this category. In terms of revenue 1 billion to 5 billion with a total of 60 companies (34.9), less than 500 million revenue companies 54 (31.4%), 50 million to 1 billion companies 28(16.3%), more than 10 billion 21 companies (12.2%), only 9 companies (5.2%) in the range of 5 billion to 10 billion indicating the smallest number of companies in this category. Most companies, specifically 80 of them, had from 10 to 49 employees. On the other hand, a smaller number of companies, which is 16, had from 1 to 9 employees.

Most of the respondents located near Seoul are 45 (43.3%), Chung Cheong 22(21.2%), Chul La 10 (9.6%), Kyung Sang 26 (25%), and Kang Won and Jeju 1. The business type is the majority typical manufacturer which is 100 companies (96.2%). In terms of revenue, more than 1 billion companies are 49 (47.1%), 1 billion to 5 billion companies 26 (25%), 5 billion to 10 billion revenue companies 22 (21.2%), and less than 1 billion companies are only 7 companies (6.7%). The cargo owner's workforce size is bigger than logistics companies. It is indicating from less than 100 to more than 1000 employees

4. Empirical Analysis and Results

4.1. Internal consistency reliability analysis

Table 3: Internal consistency test results of the logistics company

Variable	*Number of Scales*	*Items*	*Cronbach's alpha value (α)*
Challenges with cargo transportation and storage	172	15	0.951
Cargo transportation and storage needs of the Smart Container	172	9	0.952
Information needs of shipping cargo	172	4	0.813
Alarm service	172	5	0.897
The intention of Smart Containers to operate time	172	4	0.904
Important factors in securing Smart Container durability	172	6	0.905
Necessity for Smart Container function	172	6	0.927
Smart Container operation management	172	3	0.914
During the cargo transportation process information-sharing personality	172	9	0.612
Effectiveness of Smart Container	172	6	0.895
Willingness to pay additional cost for Smart Container	172	2	0.953
Smart Container service usefulness	172	8	0.954

※Cronbach's alpha = 0.889

The survey data are used for analysis, it is necessary to report internal consistency and reliability. Cronbach's alpha (Cronbach, 1951) is a generally used measure of internal consistency reliability. It figures out the overall average correlation of all the scale or questionnaire items. Higher numbers indicate stronger internal consistency; the range is 0 to 1. It determines the variance of the final score as well as the average inter-item correlation between item pairs. According to many statisticians, a minimal coefficient should be between 0.65 and 0.8 (or higher in some circumstances), with a coefficient of less than 0.5 typically being seen as unsatisfactory. In this study, the survey instrument's alpha values for every variable are all higher than 0.60, indicating its reliability.

Table 4: Internal consistency test results of the cargo owner

Variable	*Number of Scales*	*Items*	*Cronbach's alpha value (α)*
Challenges with cargo transportation and storage	104	15	0.908
Cargo transportation and storage needs of the Smart Container	104	9	0.900
The intention of Smart Containers by operate time	104	2	0.904
During the cargo transportation process information-sharing personality	104	9	0.712
Important factors of Smart Container durability	104	2	0.960
Smart Container service usefulness	104	9	0.910
Willingness to pay the additional cost for Smart Container	104	2	0.831

※Cronbach's alpha = 0.875

4.2 Descriptive analysis

Descriptive analysis is a sort of data analysis that aids in accurately describing, displaying, or summarizing data points so that patterns may appear that satisfy all the data's requirements. It is one of the most crucial processes in the examination of statistical data. It provides you with an analysis of the distribution of your data, aids in the detection of errors and outliers, and enables you to spot patterns between variables, preparing you for future statistical analysis. The analysis of the responses shown in the tables and figures below was the main goal of this study.

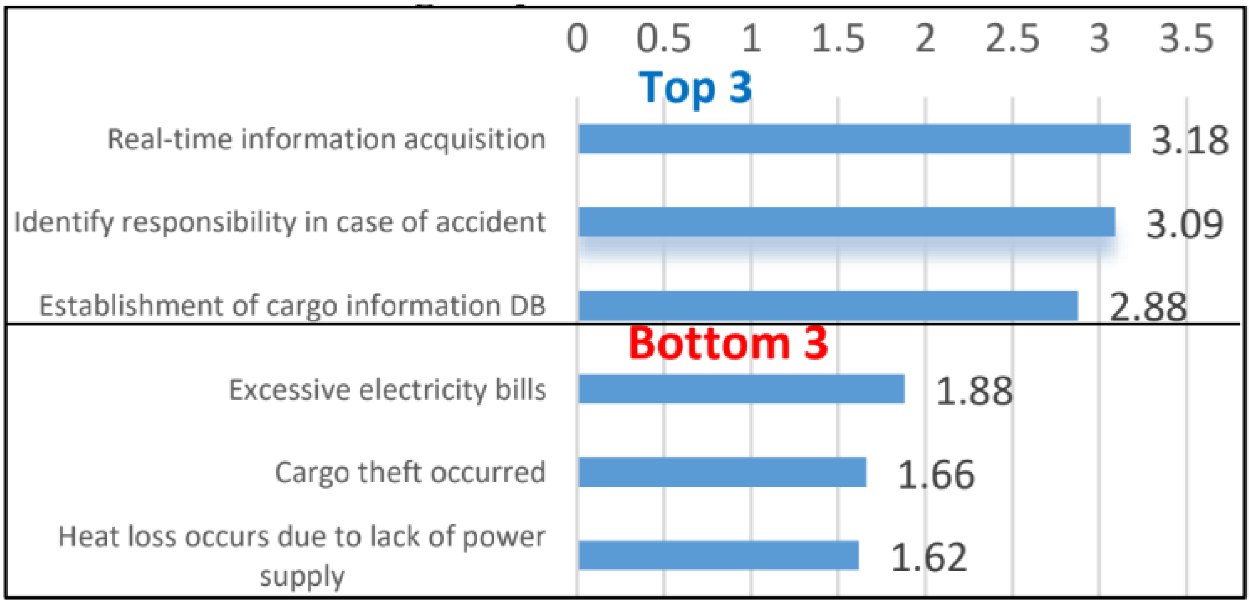

Figure 3: Challenges with cargo transportation and storage top and bottom ranks

The research questionnaire used the Likert 5-point scale. When examining the challenges associated with cargo transportation and storage, the aspect rated most prominently was the 'Acquisition of real-time information,' garnering the highest score of 3.18 points. Following closely behind, we find 'Identification of liability in case of an accident' at 3.09 points and the 'Establishment of cargo information database' at 2.88 points.

Conversely, the factors with the lowest ratings were 'heat loss due to lack of power supply,' which received a minimal score of 1.62 points, followed by 'cargo theft' at 1.66 points, and 'excessive electricity bill burden' at 1.88 points.

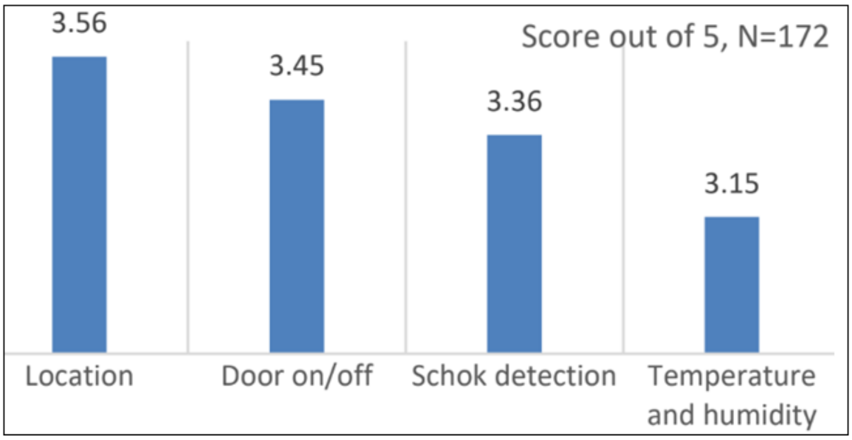

Figure 4: Utilization of Smart Container information

The survey encompassed a cohort of 172 logistics companies, unveiling fundamental determinants of significance entrenched within their operational framework. Foremost among these determinants is the facet of 'Location,' which emerges as preeminent, commanding a substantial rating of 3.56. This underscores the pivotal role played by geographical location in the sphere of logistics. Following closely in terms of importance is 'Door On-Off Information,' which accrues a notable score of 3.45. This underscores the critical nature of vigilantly monitoring the opening and closing of container doors, a pivotal aspect that ensures security and affords meticulous oversight of handling activities. Moreover, 'Shock Detection' emerges as another pivotal dimension, securing a commendable rating of 3.36. This underscores the profound significance of promptly identifying and addressing potential shocks and impacts during transportation, thereby mitigating the peril of cargo damage. Lastly, the survey brings into focus 'Temperature and Humidity Monitoring,' achieving a score of 3.15. This highlights the imperative nature of maintaining optimal environmental conditions to safeguard the quality and integrity of goods, particularly those susceptible to fluctuations in temperature and humidity.

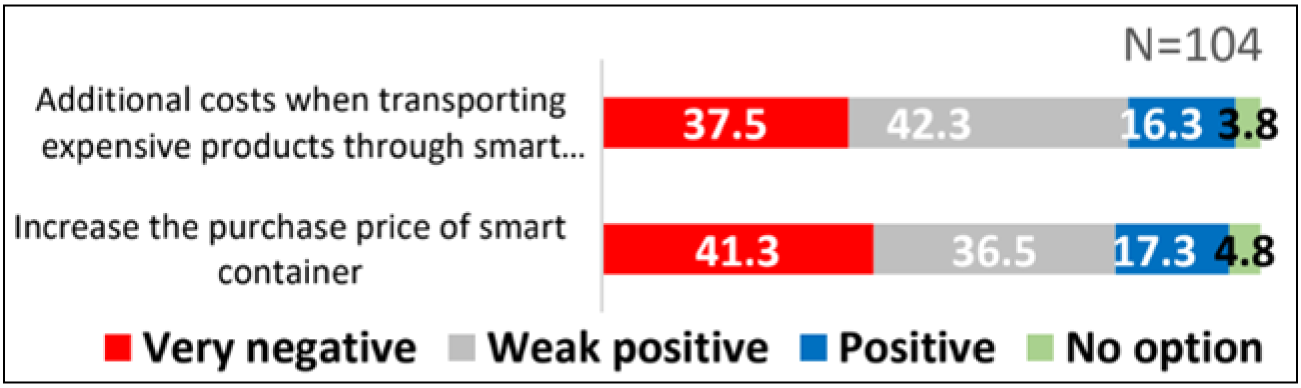

Figure 5: Willingness to bear the cost increase

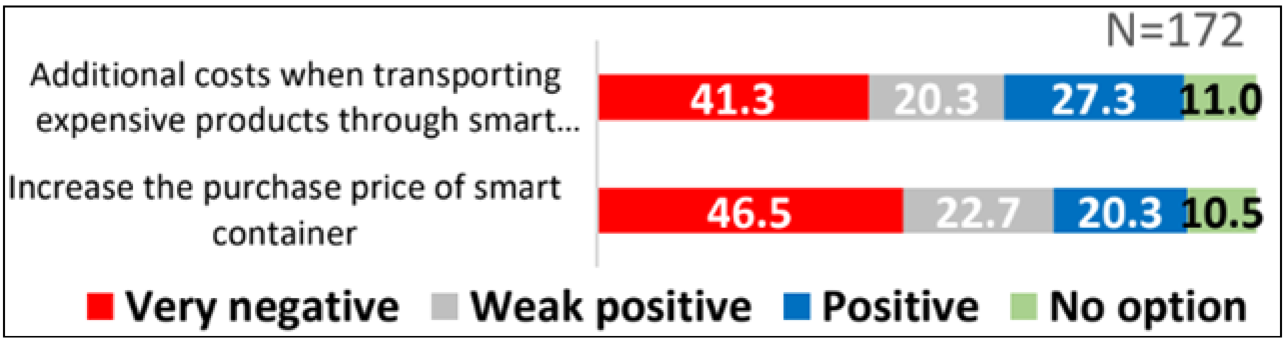

Figure 6: Willingness to bear the cost increase

Within the community of cargo owners, a notable contingent, comprising 41.3 percent, conveyed a strongly adverse stance concerning the prospect of absorbing elevated transportation fees. Furthermore, 20.3 percent exhibited a modestly positive inclination, while 27.3 percent responded affirmatively. A smaller fraction, constituting 11.0 percent, appeared to remain undecided or uncommitted. In the case of shippers, the preponderance, accounting for 46.5 percent, demonstrated a decidedly negative willingness to shoulder the augmented costs associated with procuring Smart Containers. A lesser fraction, specifically 22.7 percent of shippers, displayed a relatively tepid affirmative disposition, while 20.3 percent expressed a more resolute approval. Similarly, a minority of 10.5 percent seemed to indicate an absence of alternative options or remained neutral in their stance regarding the escalation of Smart Container purchase prices.

Over 10% of respondents responded to questions without using a "Don't Know" (DK) response. The DK response option in the questionnaire allows respondents to complete it if they are inexperienced with some of the service features. Three arguments are provided as to why a respondent with strong points of view prefers the DK rather than expressing their opinions. First, if a respondent is unsure of the interpretation of a question, they will choose DK (F.FeickLawrence, 1989). Second, to avoid making decisions or thinking (A.Oppenheim, 1994). Third, when they are unable or unwilling to complete the survey (KrosnickJon, 1991). A DK response choice has the advantage of reducing the noise made by those who respond to a closed-ended response option. In other words, persons who haven't given a subject much thought or don't have the knowledge, background, or outlook necessary to answer a question are indistinguishable from those who do.

Table 5: During the cargo transportation process information-sharing personality

Variable	Logistics Company	Cargo owner
Inland transportation company	23.4%	13.2%
Shipping industry	20.6%	20.1%
Freight forwarding company	16.8%	21.4%
Terminal operation company	15.2%	9.5%
Cargo handling operator	10.4%	10.9%
Agency or broker	5.9%	8.8%
Cross-border authorities	4.0%	7.9%
Port service company	2.1%	7.2%
Other	1.6%	1%
Total	100%	100%

The survey results show the shipping industry and logistics companies have started digitizing the cargo transportation process that used to be information-sharing through Application Programming Interface or Electronic Data Interchange, such as mobile apps or online portals.

5. Conclusion

A Smart Container refers to a new concept of container that promotes the safe transport of cargo by incorporating Fourth Industrial Revolution technologies such as IoT, artificial intelligence, and big data. It has functions to check cargo status inside of containers, to detect whether the door is open or closed, and to communicate the sensing and location information to the outside.

The study is the result of a survey and analysis to identify user needs conducted to reflect user opinions at the development stage for the successful commercialization of Smart Container. We made a survey to define new functions to be added in Smart Containers, and new services based on Smart Container information. We surveyed 104 container cargo owners and 172 logistics companies by telephone and visits. The surveys were conducted from November 18 to December 15, 2021. The research findings indicate that when assessing the envisioned functionalities of Smart Containers, the primary expectation is the real-time monitoring of cargo conditions within the container. Subsequently, the monitoring of container door openings and closings ranks second, followed by impact detection. When examining the challenges associated with cargo transportation and storage, the aspect rated most prominently was the 'Acquisition of real-time information,' following closely behind, 'Identification of liability in case of an accident', and the 'Establishment of cargo information database'. Conversely, the factors with the lowest ratings were 'heat loss due to lack of power supply,' followed by 'cargo theft', and 'excessive electricity bill burden'.

Since the manufacturing cost of Smart Containers is higher than that of general containers, it is strategically necessary to adjust the trade-off between increased cost burden and added value through customer service improvement. We also figured out users' willingness to additional cost burden. It has an influence on the function priorities of a Smart Container considering the tolerance of the cost burden of the user of the Smart Container, which is very important for successful commercialization. The cargo owners (61.6%) expressed a reluctance to bear the additional expenses associated with the deployment of relatively costly Smart Containers for sea transportation. Similarly, shipping companies (69.2%) exhibited a negative inclination toward shouldering the supplementary costs. As shipping companies and cargo owners are negative about accepting additional costs due to Smart Containers, Smart Container developers must be very sensitive to development costs, so price differentiation through options is necessary. Additionally, in the early stages of commercialization, institutional support will be needed from the government to partially subsidize the purchase and operating costs of Smart Containers.

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