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Data Usage and the Legal Stability of Transactions for the Commercial Operation of Autonomous Vessels Based on Digital Ownership in Korean Civil Law

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Abstract: Stakeholders in the maritime industry have agreed to expand commercial operations by developing autonomous vessels, the epitome of innovative technologies. However, they are still concerned about the risks of infringing on the rights and interests of individuals or organizations linked to data transactions. Based on Locke's theory of property ownership, and the assurance of absolute ownership as specified in the Constitution of the Republic of Korea, the business model is still in its early stages. This study examined the concept, transaction structure, and application scope of data activating digital platforms to support data transactions, and aid in advancing the new business sector for commercial operations of maritime autonomous surface ships (MASSs). Consequently, this study contributes to and recognizes the future value of knowledge and intellectual property related to maritime data. This is achieved by defining the intellectual property emerging from newer avenues, such as MASSs, blockchain technology, and smart ports, that are consequential to the rapid development of the maritime industry.

Keywords: maritime industry; data; autonomous vessels; ownership; digital platform



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1. Introduction

1.1. Background of the Study

The first Industrial Revolution of 1760–1820—characterized by technological innovation and the transition to machine-based production processes—exponentially increased production capacity. We are now in the fourth Industrial Revolution (Industry 4.0). The chair of the World Economic Forum introduced the term in 2016 to describe the use of smart technology to automate traditional manufacturing, and industrial processes in which the primary level of raw materials has added a secondary level of information and a tertiary level of knowledge [1]. Various stakeholders share convergence content based on information technology through automation and integration. The maritime sector is no exception, having adopted various technologies that use artificial intelligence (AI), big data, the internet of things (IoT), and land-based transportation networks to accelerate the development of maritime autonomous surface ships (MASSs), smart ports, and blockchain-based maritime logistics [2].

This development has been facilitated by a rapid increase in productivity, driving changes in various sectors, including the maritime industry. Commencing the commercial operation of a MASS creates a new need: managing the legal aspects of its data, such as the source, ownership, and destination of the cargo; the crew's and passengers' personal information; and electronic records, photographs, and videos produced during the ship's operations, including docking and undocking [3].

In 2020, in cooperation with the Ministry of Trade, Industry, and Energy (MOTIE), the Ministry of Oceans and Fisheries (MOF) launched the Korea Autonomous Surface Ship (KASS) project to develop the technology needed for self-driving ships to commercialize autonomous vessels. The KASS project will drive the growth of shipbuilding and maritime industries in Korea. By 2025, at least KRW 160 billion will have been invested in building intelligent ship navigation systems, engine automation systems, a self-driving ship performance control center, and operational and standardization technologies. The KASS project is focused on developing and using technologies. However, there is a lack of research related to the laws and regulations required to create a framework for legal and safe data transactions, relative to autonomous vessels.

1.2. Current Issues

Stakeholders in the maritime industry have agreed to develop MASSs—the epitome of advanced technologies—and expand their commercial operations. However, they are concerned about the risks of infringing on the rights and benefits of individuals or organizations, related to data transactions [4]. Thus, to prepare for an era of commercially operated autonomous vessels, we must first review the existence and protection of ownership, providing a stable trading framework that can be roughly summarized as follows: “raw data → information → knowledge → convergence of content on heterogeneous information = data of a higher integrated concept”.

The US and European maritime industries anticipate an increase in the economic value of the data required for commercially operating autonomous vessels and managing smart ports. Recently, Chae et al. identified six research fields and considerations, as well as directions of improvement relating to technological issues [5]. Similarly, Korea has focused on developing innovative technologies that reduce the costs related to autonomous vessels. Overall, the focus has been on developing the MASS technology rather than on the legal ramifications of the smart technologies on which it relies. Thus, it is necessary to conduct an adequate legal review of the foundation to ensure the stability of data collection and transactions. Therefore, this study examined the concept, transaction structure, and application scope of data activating digital platforms to support data transactions and aid in advancing the new business sector for commercial operations of MASSs.

This study focused on the following research questions. First, what types of maritime data and concepts are produced by a MASS? Second, what is the structure of the maritime data transactions required for the commercial operation of an autonomous vessel? Third, what is the legal framework relative to MASS data, and the right to ownership that is necessary to ensure the stability of an autonomous vessel’s commercial operation? Fourth, how can the rights to maritime data ownership for the commercial operation of an autonomous vessel be protected?

1.3. Outline of the Research

MASSs continuously exchange data with third parties during their operation and anchoring. However, there is no explicit legal system governing the ownership and protection of MASS data, unlike conventional vessels [6]. Regardless of the issues concerning the data acquisition source, ownership is recognized if the producers or brokers of the data control that data. Building and activating a digital platform for maritime data will leverage its data storage facilities and expand third-party management through cloud-based outsourcing, weakening the owners’ control over the source of the produced data [7,8]. Figure 1 shows this study’s research process to investigate legal data ownership and the requisite protection for commercially operated autonomous vessels.

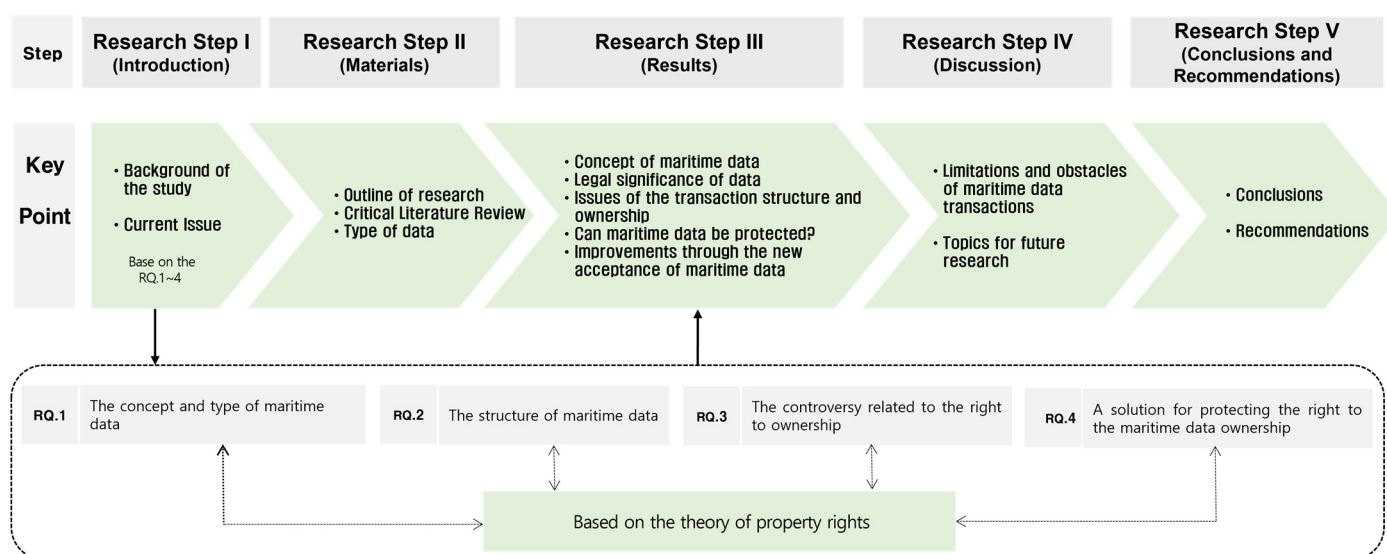


Figure 1. This study’s research process to investigate legal data ownership and protection for commercially operated autonomous vessels.

2. Critical Literature Review

2.1. Legal Concepts of Data

According to John Locke’s 17th-century theory of property rights, private property ownership derives from a person’s direct physical labor employed to transform something from its natural state. The reinterpretation of Locke’s theory of property rights from a modern perspective grants copyrights to creators and patent rights to inventors, in order to protect the tangible and intangible rights of each person due to changes in science and technology [9]. Moreover, ownership can broadly be applied to nonphysical labor and values created by the provision of labor opportunities in the future through commerce [10]. Consequently, the data produced during the operation of autonomous vessels could be considered an intangible property that is generated through nonphysical activities. This can be applied to a representative legal theory that might be included in the scope of ownership.

Article 23 of the Constitution of the Republic of Korea stipulates that the country supports the market economy by protecting individual property, based on the principle of absolute ownership. Thus, the right to data is protected as part of constitutional property. Under Article 23, the content, limitations, and exercise of property rights for all citizens are prescribed by law; the basis for the acceptance, use, or restriction within the scope of public welfare is stated, based on legitimate compensation [11]. In this regard, Article 211 of the Civil Act (“Contents of Ownership”) stipulates that the right to use, earn, and dispose of property exists within the scope prescribed by law. Moreover, Article 212 of the Civil Act stipulates that the ownership of land falls on the upper and lower parts of the land “within a reasonable range of benefits,” thereby avoiding unnecessary legal disputes with neighboring stakeholders. In other words, the ownership of tangible goods is clearly stated. However, if the restrictions, acceptance, and compensation regarding the valuation and criteria of the intangible data fall outside the limitations of the social attributes of current Korean constitutional property rights, the acceptance of property rights would most likely not be legally recognized [12].

Thus, for the commercial operation of autonomous vessels, data brokers should provide monetary compensation to avoid complaints about unfair acceptance and provisions arising from using contractual means of equal standing when acquiring MASS operation data from the vessel owner (supplier), despite the occurrence of such data provision being in the public interest (safe operation). Furthermore, data brokers should agree on matters related to valuation, setting criteria related to intangibles to prevent disputes on grounds of unfair trade.

2.2. Maritime Data Ownership and Trading

Numerous studies have provided valuable insights into the development of legal issues relevant to MASS data trading, namely, data technology, cybersecurity, definitions, standardization, data ownership, and intellectual property rights. Most have been undertaken to prepare for future data-trading markets in the non-maritime sector. However, these studies' findings are not universally applicable to MASS data.

For example, Prinsloo et al. explored the cybersecurity risks involved in the link between industrial manufacturing and Industry 4.0, enumerating the countermeasures that are currently deployed or under development [1]. While their study focused on security breaches related to 3D printing, many issues are applicable to maritime data.

Other research relates more directly to the present study. Jović et al. performed a comprehensive literature review of the positive impacts of blockchain-based information exchange in the maritime transport sector, in addition to the challenges for successful blockchain-based information exchange, considering all three aspects of sustainability (economic, environmental, and social) [2]. Androjna et al. closely examined the landscape of cyber threats and incidents in the maritime sector, and identified trends and challenges related to safe operations in maritime shipping. They identified an important subset of cyber threats that could impact many maritime systems: the vulnerabilities of satellite navigation systems [3]. Chae et al. recognized that introducing MASSs to the maritime industry will usher in a new era, bringing about a paradigm shift in cost efficiency, accident prevention, and human resource allocation [5]. They highlighted the need for a robust, multisystem communication network to minimize potential third-party risks and protect operational systems, networks, and data. Zhou et al. stated that autonomous ships will likely shape the future of the global shipping industry [13]. However, they argued that the application barriers presented by the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) would need to be revisited. Yoshida et al. proposed a way to develop the regulatory framework for the competence of remote operators (ROs), based on the standards of the International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW), by exploring the concept of situational awareness [14]. Felski and Zwolak described the dangers stemming from the specificity of systems used to solve navigational problems and analyzed their first experiences of the transit of an uncrewed surface vessel (USV) across the world's busiest shipping route, the English Channel [15]. They discussed the problems it encountered in the context of system reliability and resilience to interference or other intentional actions, such as criminal activity. Höyhty and Martio reviewed 5G-related standardization in the maritime domain, discussing the main uses and roles of autonomous ships and the people on board, to illustrate the need for a connectivity manager—an intelligent entity managing a complex set of technologies—that could integrate satellite and terrestrial technologies and ensure robust internal and ship-to-shore connections [16]. Hayashi confirmed the widespread acceptance of the Clarksons Research assertion that long-term supply and demand decide the freight rate in the shipping industry, and once deviation occurs because of a short-term cause, the deviation will gradually fade away [17]. Rødseth and Berre proposed a concept called “maritime data space (MDS),” similar to the “industrial data space (IDS)” based on open standards and a common governance model to enforce the ownership of data in a distributed environment [8]. Their adaptation of IDS to the specific nature of shipping comprised a modified digital trust framework, lower connectivity for ships at sea, and highly heterogeneous control of the physical system architecture on ships.

Other researchers have examined maritime data ownership and rights in the digital shipping industry, with many highlighting the need for a balance between sharing and protecting information. Aleixandre-Benavent et al. examined the state of data sharing among Spanish researchers as a basis for identifying all researchers' needs to share data, optimize existing infrastructure, and promote data sharing [4]. Kapidani et al. provided an outline for improving the quality and speed of digitalization in non-EU countries that have been functioning for decades in transitional conditions [6]. Furthermore, they conducted

benchmarking using findings from developed maritime business environments in the EU countries of Croatia, Greece, Italy, and Slovenia, using the same model. Sanchez-Gonzalez et al. verified the state-of-the-art technology in eight digital domains: autonomous vehicles and robotics; AI; big data; virtual, augmented, and mixed reality; the IoT, cloud and edge computing; digital security; and 3D printing and additive engineering [7]. They also described the maritime industry's three sectors: ship design, shipbuilding, shipping, and ports. Koltay discussed crucial issues related to research data quality—especially big data—focusing on data governance and the differences between corporate and academic interests [18].

Florea and Florea qualitatively examined current issues regarding data privacy, anonymity, informed consent, and confidentiality in the field of data-centric higher education research, focusing on data collectors, subjects, and users [19]. Although their area of interest was higher education, they argued that current data protection regulations are insufficiently concerned with the data's use, and that the big data-centric paradigm needs to address critical data privacy issues immediately. Lee and Park proposed a data platform for collecting government agencies' metadata to enhance user accessibility and data-driven decision-making [20].

After reviewing 279 studies on big data and AI applications in the maritime industry, Munim et al. called for more sociocultural and commercial research on the drivers and barriers to increasing trust and transparency in the maritime industry, including such legal issues as cybersecurity and data ownership [21]. There has also been considerable research on the theories, principles, and protections of data ownership. Zhu analyzed the socioeconomic impact of the meteoric rise of innovative companies, weighing whether they represented an equitable or sustainable alternative to current practices, or an expansion of commercial exploitation. She proposed a way of examining how organic collaboration is structured by the laws of property, and the dynamics of nascent platform economies: a conceptual "labor-service" mechanism in which labor and value flow through webs of material objects [22]. Rodríguez-Molina et al. proposed a maritime data transfer protocol, to interchange standardized pieces of information from MASS data, and procedures that would be required for the information interchange [23]. Arneil investigated how English settlers used Locke's theory of property in the *Two Treatises of Government* as an ethical justification for its colonial actions, including appropriating Indian-occupied land and tilting the balance of power in favor of property owners [9].

Nawaz et al. proposed a blockchain-based data security IoT platform, enabling devices to trade data directly with third parties and without intermediaries, while protecting data ownership and end-users' privacy [24]. Sun et al. proposed an extension to an existing data management framework, enabling access to public and encrypted data sources to enhance information transparency, enable semantic data treatment, and provide an appropriate data fusion context [25]. Brancaccio discussed some of the main structural modifications affecting modern law because of cognitive capitalism and digital platforms (particularly the IoT and cloud computing), then mused about a new conceptual meaning for the logic of appropriation and the law of common property [26]. The scope of the analysis was limited to non-personal data.

Contarinis et al. (2020) discussed possible data architectures for marine spatial "open" data infrastructures (MSDIs), examined the maturity of their possible open data platforms, and compared the most prominent MDSI models for their applicability in three marine information domains (environment and protection, safety, and spatial planning) [27]. Barykin et al. used a literature review (keywords: "ecosystem" and "biological ecosystem") to develop a theoretical foundation for digital ecosystems [28]. They argued that the emerging trend in such ecosystems' transformations toward expanding the collaboration of economic agents is reasonable, and digitalization helps replace competition with collaboration. Distinguishing between digital data (raw data) and digital technologies (including software platforms and hardware solutions), Inkinen et al. defined *open data* as publicly available, and machine-readable, nonchargeable data (information content) [29]. They ar-

gued that port digitalization (which we might logically extend to MASS data) is unlikely to ever be fully open, owing to privacy, security, and ownership concerns. Stepanov discussed the nature and justification of introducing data producers' rights into intellectual property rights (IPR) [30]. The European Commission might introduce an IPR for data producers to boost the European data economy, treating data as created property. Stepanov argued that such a measure was unlikely to achieve the desired results.

Carroll discussed general intellectual property and contractual issues for publicly available research data, focusing on legal rights, ownership, and sharing data for downstream use, although without diving too deeply into privacy and national security laws [31]. In one example of this kind of publicly available data, Ray et al. described the dataset containing four categories of ship information collected through the Automatic Identification System (AIS): navigation data, vessel-oriented data, geographic data, and environmental data [32]. They proposed using the dataset for easy integration with relational databases, relying on the open-source relational database system, PostgreSQL, and the geospatial extension, PostGIS. However, they did not discuss matters of data ownership or security. Hummel et al. identified four conceptual dimensions of calls for data ownership in general, arguing that the dimensions help systematize and compare different positions within the pluralism of data ownership claims [33]. They introduced, described, and defended the constructive, interpretative proposal that data ownership claims could be understood as calls for the redistribution of material resources and the sociocultural recognition of data subjects. Evans noted that, in the United States, ownership of the research data in administrative and clinical databases is a matter of state law, and most states have not clearly defined data ownership [34]. She pointed out that existing regulations lack the tools to resolve the complex dilemma between individuals' protections (and wishes) and broader public interests. Ritter and Mayer stated that the global community urgently needs precise and clear rules defining the ownership of data and expressing the attendant rights to license, transfer, use, modify, and destroy digital information assets [35]. In response, the current study proposes a new approach for regulating data as an entirely new class of property.

2.3. Digital Data-Trading Platforms

Open data are publicly available and nonchargeable data (information content) that are machine-readable [29]. Open data enables software and application development for external partners and users. For example, Liu et al. compiled a web crawler program to collect large quantities of online user comment data to analyze the dimensions of customers' perceived value, and the importance of each dimension, in China's huge e-commerce market [36]. Ebinger and Omondi initiated a discussion on digitalization in sustainable supply chain management (SSCM); they developed a heuristic research framework based on sustainability-oriented transparency (e.g., transparency, traceability, and compliance) in supply chains [37]. They identified several digital approaches to supply-chain transparency and control, with differing levels, functional purposes, and degrees of success. Veen et al. assessed how accurately experts could predict new data by extending an existing prior-data (dis)agreement measure (data agreement criterion) and compared the approach using Bayes factors to evaluate the prior specifications [38]. Lim identified nine factors characterizing big data-based value creation: (1) data source; (2) data collection; (3) data; (4) data analysis; (5) information about the data source; (6) information delivery; (7) customers (information users); (8) the value of the information's use; and (9) the provider network [39]. Lambrou et al. developed a comprehensive framework of digitalization technologies and their implications for maritime business, based on the available evidence [40]. Sun et al. proposed an extension to an existing knowledge-management framework to ensure information transparency, while also considering the "Privacy by Design" option, demonstrating its use with the delivery logistics data for a cross-border e-commerce fast-fashion e-retailer based in China [41]. Westermeier discussed money as a form of transactional data, a phenomenon engendered by tech-driven companies that embed payments within their platforms [42].

She argues that the platforming of financial transactions is not a purely technical issue, but is instead an example of how political decisions about the materiality of data can have broad economic and social consequences.

2.4. Legal Issues Related to Data Ownership

Yoon wrote that the Japanese Meiji Civil Code, and Japanese legal study before WWII, significantly influenced the Korean Civil Code [43]. In turn, the Japanese Meiji Civil Code, the product of various comparative legal studies, was affected by the draft of the German Civil Code, French Civil Code, and other civil codes of the time. One outstanding historical challenge in Korean civil studies is the lack of clarity concerning the distortions and undue influences of the Japanese Meiji Civil Code and Japanese legal studies on the Korean Civil Code, and the independent development of Korean civil law studies to resolve the legal conflicts [43]. Yiannopoulos stated that the German Civil Code aptly distinguishes between “object” (*Gegenstand*) and “thing” (*Sache*) [44]. An “object” is a generic concept comprising any possible subject matter—corporeal or incorporeal—in a legal relationship, except strictly personal relations. However, “things” are only corporeal objects of an impersonal nature and are susceptible to appropriation. Andanda sketched the fuzzy contours of data ownership and related IPR, to show how ownership is ill-suited for governing rights regarding big data, necessitating an alternative normative framework [45]. Gerke et al. mapped the ethical and legal challenges posed by AI in healthcare—many of which could apply to MASS data [46]. The primary ethical challenges were: (1) informed consent to use (share); (2) safety and transparency; (3) algorithmic fairness and biases; and (4) data privacy. The primary legal challenges in the United States and Europe were: (1) safety and effectiveness; (2) liability; (3) data protection and privacy; (4) cybersecurity; and (5) intellectual property law [45]. As a way of highlighting the need for social and legal tools for controlling AI systems’ functions and outcomes, Yanisky-Ravid addressed the copyright issues surrounding artworks generated by AI systems: ownership and accountability [47]. She asked who should enjoy the benefits of copyright protection, and who should be responsible for the infringement of rights and damages caused by AI systems that independently produce creative works. She also discussed the need for accountability for AI systems in such legal regimes as tort and criminal law, and in various industries [47]. Suri used recent literature and case law to examine various interpretations of the word “ship” [48]. He sought to determine which interpretations might have a bearing on autonomous vessels and whether the foreseeable technological incorporation might be challenging, by showcasing the definitions across jurisdictions [48]. Androjna et al. argued that a shift in mindset would be essential to make manufacturers direct more attention and resources toward cybersecurity, noting that shipping systems currently remain vulnerable to cyber criminals [3]. Pejović’s theoretical examination of the differences between common and civil laws focused on their distinctive features and consequential differences in both substantive and procedural laws [49].

The current study uses a systematic approach to analyze its subject—the use of data and the legal stability of transactions regarding the commercial operation of autonomous vessels—against the backdrop of digital ownership in Korean civil law.

2.5. Data Types Associated with Autonomous Vessels

In Korea’s maritime sector, the Ministry of Oceans and Fisheries runs the marine fisheries’ big data platform and exchange, processing the data received from related public institutions, and providing free or low-cost access to the data. The paragraphs below discuss how and in which forms MASS data gets traded and classify it into standardized or non-standardized data and personal or non-personal data.

2.5.1. Standardized or Non-Standardized Data

The data produced by conventional vessels’ operations comprise a mixture of uncategorized primary standardized and non-standardized data. Therefore, autonomous vessels

must be standardized according to the framework agreed upon by the International Maritime Organization, the International Electrical Union, the International Standardization Organization, and the International Communications Union, to enable commercial trade through effective transmission, receipt, and reprocessing [50]. Standardized data are those that follow an established protocol for coding and decoding information, such as the ship's location, operational efficiency, fuel consumption patterns, weather conditions, and so on [23]. Non-standardized data are those with forms, sizes, or confidentiality clearances that differ from those of standardized data [15].

2.5.2. Personal or Non-Personal Data

Autonomous operation systems are the sum of integrated digital technologies combining multisensor cognitive technology, risk avoidance and optimal response technology, optimal route and status technology, integrated control technology, and satellite communication, network, and security technology [14,16]. Advances in digital technology have transformed the maritime industry ecosystem's data platforms to facilitate the continuous production, storage, and use of data at different levels and locations. There are also ongoing transformations related to the ownership and usage rights of the data.

Thus, we need to distinguish between personal and non-personal data in order to promote data usages linked to autonomous vessels [21]. The personal data associated with MASSs can vary according to the number and type of people on board, and the vessels' degree of autonomy. However, the data would include at least some information about the passengers, ship owners, the cargo owners (and possibly the buyers), any backup crew, and other data collected through various internal systems or equipment. The non-personal data is the data provided from external sources after reprocessing (e.g., anonymizing or deidentification) and includes information related to the cargo, navigation, and the ship, without the conflict of rights relations regarding external exposure. However, for merchant vessels, it can be difficult to clearly distinguish between personal and nonpersonal information. Therefore, we need to acknowledge that nonpersonal data might contain personal information in our discussions of and deliberations on establishing a relevant legislative framework.

3. Results

3.1. Concepts of Maritime Data Linked to Autonomous Vessels

3.1.1. Primary-Level Raw Materials

Earlier, we established that the raw materials in the fourth Industrial Revolution now include information and knowledge [1]. From this perspective, maritime data are raw material. Thus, this study presupposes that the concept of "raw materials → information → knowledge → convergence content on heterogeneous information" introduced above applies to the maritime industry within the modern trading system. The primary-level raw materials that make up the comprehensive conceptual data include the raw facts and evidence needed to apply feasible theories, empirical evidence verified by proven methods, or experiments derived from scientific simulations, and facts, letters, voices, and pictures acquired through a phenomenological survey of literature [24].

3.1.2. Secondary-Level Raw Materials

Secondary-level information is derived by processing the raw materials. Therefore, data comprise facts or values measured or collected using people, systems, equipment, or other means. For example, the vessels' AIS broadcasts information reporting their position and nominative information, alerting all the vessels that are in the area of the others' presence and path, and relaying other information that is displayed on screens as numerous data points [32]. However, this information is only provided after it is statistically processed by season, cargo, and shipper [13]. That is, information is not a representation of simple facts such as raw materials; rather, it denotes the tangible and intangible forms of

numbers, letters, and logic that are standardized or can be customized as the foundation of reprocessing [27].

3.1.3. Tertiary-Level Raw Material

The tertiary-level raw material, knowledge, results from the secondary-level raw materials (information) being reprocessed and given a commercially significant value subject to simple online transactions [8]. Thus, knowledge refers to an advanced level of service, produced by combining and refining other information by databasing the changed secondary level information through the production, collection, and storage of raw materials transferred through observation or measurement [25].

3.1.4. Quaternary-Level Convergence Contents

Digital data, whether as raw materials or information, can be decoded using computers. Such data denote objects that can be commercially traded in the cloud environment with unlimited reproducibility, without quality degradation, and with the possibility of continuous value creation through data processing [41]. Here, the highest level of “convergence content” at the quaternary level can be defined as the subject of transactions with new values that can be recognized in the market, combined with other raw materials, information, and knowledge.

3.2. Legal Significance of Data Related to Autonomous Vessels

As a legal concept, data rights cannot be conclusively defined, based on the concepts of ownership and occupation rights, because data are inexhaustible and not subject to ownership and occupation rights under Korean civil law. Likewise, data are not stipulated under an independent law but are, instead, included as part of some definitional provisions.

For example, Article 2 (“Definitions”) of the Act on the Provision and Use of Public Data in Korea uses the term public data to mean data or information created or acquired by public institutions, such as databases and electronic files, for those purposes prescribed by the statutes [51]. As stated above, the data continue to exist in conceptual definitions from a technical perspective. However, there are still no explicit definitions—except for individual definition provisions—from a legal perspective. This can cause confusion for recipients. In other words, although the current law does not prescribe general and unified rights to MASS data, various laws specify regulations that grant or protect the rights for each subject according to the data’s content [19].

Ownership is the basis for data transactions linked to the activation of a digital platform for maritime data transactions (including the commercial operation of autonomous vessels). Thus, we need to consider legal protections by reviewing the applicability of ownership under civil law. Under Article 211 of the Civil Act of the Republic of Korea, (“Contents of Ownership”), the owner of data produced directly or indirectly by an autonomous vessel during operation has the right to use, profit from, or dispose of the property within the scope of the law. At this point, data is presupposed as a “thing,” defined in Article 98 (“Definition of Things”) as “corporeal things, electricity, and other natural forces that can be managed” [52]. This definition allows claims of data ownership. The legal definition can be extrapolated and construed by asking the question, “Can the owner of data include data in the scope of objects?”

Either corporeal or intangible things could be considered to be within the scope of manageable things [12]. Thus, from the perspective of Locke’s theory of property rights as a background to the broad perspective of the above-mentioned imperialist laissez-faire ideas, data exist within the scope of ownership, depending on the value derived from nonphysical activities [9,10]. However, there are inevitable limitations to data ownership rights because of the need to consider public welfare, the rule of law, and the values upheld by the Constitution of Korea; these can affect alter the applicability of restrictions, acceptance, valuation compensation, and criteria setting of intangible data [20]. Furthermore, from a consultative perspective, MASS data could be interpreted as non-exclusionary and noncompetitive,

which might place them outside the category of things that can be managed under Article 98 of the Civil Act of the Republic of Korea [52].

3.3. Transaction Structure and Maritime Data Ownership Issues for MASSs

In the maritime industry, research on data transactions has relied heavily on reports and statistics related to global freight rates, golden dragon index, trading volumes, and new shipbuilding and used ship sales indexes provided by such private companies as Markit, Clarkson, and VesselValue [17]. However, no definitive laws or systems are in place that impose the subject, structure, need, or value on the transmission of labor through objects by related stakeholders, even though sea transportation, operations, weather, cargo, port, and logistics data are traded on a legitimate compensatory basis. Considerations of data transactions have primarily focused on land-based manufacturing, finance, and marketing industries. Thus, gaps remain in the laws and systems for data transactions between land and sea [22]. Data transactions will emerge when maritime logistics are powered by autonomous vessels, smart ports, and blockchains [37]. Therefore, Section 4 will review the transaction subjects and structures.

3.3.1. Transaction Subjects

The transaction of data needed for the operation of autonomous vessels will be completed through the transmission, use, and transfer of proven data online or offline using the “digital platform for trading maritime data (tentative name)” [28]. Data—a major source of such transaction markets—might be legally protected under the Personal Information Protection Act and the Copyright Act [53]. These are the presuppositions of the source supplier, buyer, broker, and so on, to obtain consent within a certain scope.

First, the data providers required for commercial MASS operations are direct producers, with exclusive rights to the underlying production of data as rights holders or people with rights granted by such producers; they provide the data to a “digital platform for trading maritime data (tentative name)” [29]. Typical data providers include ship owners operating autonomous vessels. However, they could also be ship managers or agents entrusted with the vessels’ operation, who have accepted the vessel owners’ rights, responsibilities, and obligations.

Second, data buyers are people with access to a “digital platform for offshore data transactions”, who receive services under legally agreed terms and conditions intended for value addition [36]. Examples include marine insurers, shipyards, vessel materials companies, ship owners, governments, research institutes, universities, and shipping companies.

Third, data brokers support or manage data transactions related to MASS operations using a one-stop authorized brokerage platform; such platforms enable data consumers and suppliers to conduct the entire data transaction process (e.g., data retrieval, contracts, payments, and analyses) with a legal safety net [29]. In addition, data brokers manage the “digital platform for trading maritime data (tentative name)”, purchasing data from suppliers and selling it to buyers. Data brokers are obliged to manage the platform’s system security to prevent data leakage and damage.

3.3.2. Transaction Structures

Data transactions are often directly contracted between two parties: data providers (sellers) and consumers (purchasers). However, many transactions are sequentially contracted among the original data holders, data providers (seller), data brokers, and data consumers (purchaser) [37]. For example, digital platform-based ship management companies can create new businesses by delegating the data produced through MASS operations from shipowners to data consumers (e.g., shipyards, insurers, or shippers), and providing collected data and application programming interfaces to third parties. In this case, digital platform-based ship management companies should preemptively sign delegation contracts with shipowners at the ship management stage, to reserve their rights to the data.

Generally, data brokers sign data transaction contracts with suppliers and consumers as license and transfer agreements. License agreements are contracts allowing nonexclusive payments to consumers for exclusive or nonexclusive data use. Such agreements are mainly used for data transactions not related to ship and freight operations. In contrast, transfer agreements convey all or part of the IPR and change the data's ownership; after the transfer agreement, the data provider is no longer entitled to the data [38]. The scope and target of the contract should focus on whether the transfer contract includes the data architecture that forms the core operating assets of the shipping company, such as various drawings, contracts, bills of lading, and ship procedures.

3.4. Can Maritime Data Be Protected under Personal Information Protection Laws?

Information protection legislation needs to consider the de-identification of shipper information for cargo shipped on autonomous vessels. Article 4 ("Rights of Data Subjects") of the Personal Information Protection Act of the Republic of Korea recognizes that data subjects have the following rights concerning their personal information: (1) the right to be informed of the processing of such personal information; (2) the right to determine whether to provide consent, and the scope of the consent regarding the processing of personal information; (3) the right to confirm whether personal information is being processed, and to request access (including the provision of copies) to such personal information; (4) the right to suspend the processing of and to request the correction, deletion, and destruction of, personal information; and (5) the right to appropriate redress for any damage arising from the processing of personal information through a prompt and fair procedure [53]. Furthermore, Article 5 of the same Act ("Obligations of the State, etc.") stipulates that the State and a local government should formulate policies to prevent the harmful consequences of beyond-purpose collection; the abuse and misuse of personal information; indiscreet surveillance and tracking; and so on. The policies should also enhance the dignity of human beings and their individual privacy. Article 5 also states that "the State and local government shall establish policy measures, such as improving statutes, necessary to protect the rights of data subjects" [53]. For example, subdivided maritime data lacking shipper information and accuracy at the reprocessing stage on a "digital platform for maritime data transactions (tentative name)" might lead to a data buyer considering it unreliable and declining the purchase. This might also lead to some maritime data buyers not accepting the level and quality of the data's protection and demanding enhancements before agreeing to legitimate data transaction costs. Therefore, it is necessary to discuss the benefits of using sensitive personal information [53]. There needs to be considerable discussion and social consensus regarding the information available on the shippers, shipowners, ship personnel, and the contract because personal information belongs to individuals and not to the wider public. Thus, if individuals' protected information is leaked, the value of the enterprise decreases or incurs significant social losses and individual losses [3]. Therefore, maritime data brokers need to apply technologies for anonymizing personal information, and stipulate related mandatory provisions in the contract on the "digital platform for maritime data transactions (tentative name)" [28].

3.5. Science- and Technology-Driven Improvements Related to Marine Data Ownership

As mentioned previously, Article 98 of the Korean Civil Act recognized "things" for their property values if they were "corporeal" or were "natural forces that can be managed" [48,52]. The concept of high-level objects determining the elements of existing goods is expanding, relative to securing business stability, because of the introduction of such new technologies as autonomous vessels, smart ports, and blockchain-based marine logistics. Countries with advanced maritime industries, like Germany and Japan, are modifying their legislation to limit their scope, but the expanded opportunities for data trading necessitate a redefinition of "things" [43]. Eventually, the realization of a digitalized shipping industry, and autonomous shipping vessels becoming a reality, will mean that the concept of "things" must be adapted to accommodate these rapid technological changes.

The current definition under the Korean Civil Act is meaningful from a general rule viewpoint. However, the definition should be changed explicitly or in interpretation to reflect the new demands imposed by the technological changes in the maritime industry.

Recently, digital platforms like Freightos, Twill, iContainer, NYShex, CargoX, TradeLens, Global Shipping Business Network (GSBN), Digital Container Shipping Association (DCSA), and Cello have been gradually expanding their digital trading services with solutions, device-based services, or match-maker methodologies. Consequently, Korea needs to have laws and systems in place to protect the legal interests in data ownership in any form for maritime data transactions [45]. As noted above, the concept of data ownership cannot be recognized under the current strict framework of the Civil Act of the Republic of Korea. However, data transactions can be implemented through license agreements or transfer agreements, to gain substantial control over the use and disposal of data in practice [46]. After all, shipping industry competitors will soon seek to expand their fleets, increase digital competitiveness, and gain a competitive edge. Therefore, just as the general land-logistics industry is growing thanks to online services in the digital transformation era, the maritime industry should also institutionalize port, logistics, cargo, shipping, navigation, storage, and other forms of maritime data to expand online transactions, based on platforms. This will require a comprehensive reinterpretation to legally support the stability of data transactions by expanding the category of exclusively controllable data, rather than the traditional view of ownership from the Roman era to the present: the right to use, profit from, and dispose of property [35].

Articles 2 and 3 of the Korean Intellectual Property Act stipulate that intellectual property is created by creative activities or experiences, and extends to the following: knowledge, information, technology, idea, emotional expression, representation of sales and things, biological species, oil-based resources that are created or found through creative activities or experiences, and intangibles whose property value can be realized under the basic intellectual property laws [35]. Moreover, it defines intellectual property emerging from new areas, such as autonomous vehicles, blockchains, and smart ports, that have been created by economic, social, cultural, and scientific and technological advancements, preparing for future applications of property rights to maritime data [35]. To facilitate the smooth use of maritime data, stakeholders (e.g., data providers, brokers, and consumers) should mutually agree at the contract stage to realize legally protected rights, based on their current legal rights. In addition, they should try to establish legal provisions that provide definitions and examples for the future [42]. Furthermore, governments should organize a governance system for the maritime industry to adapt to a platform-based digital data era, to ensure that their intellectual property policies and promotion system consider the various stakeholders [22].

4. Discussion

4.1. Limitations and Obstacles in Maritime Data Transactions

Several limitations and obstacles exist in structuring transaction stability through the step-by-step establishment and transfer of ownership of maritime data [30]. This is due to the various sources of data ownership and data protection. The limitations and obstacles are clear, especially where different legal systems are concerned. The typical obstacles associated with this approach are described in the following paragraphs.

First, the ownership of maritime data has not been clearly stipulated [31]. As identified through both traditional and modern legal theories, the source of data ownership has been applied in various forms, depending on the limitations of social attributes. This obstacle clarifies the substance of novel intangible rights called “maritime data.”

Second, no criteria or methods exist for setting a reasonable price for maritime data. There have been no accepted cases in which the criteria and methods for determining the price of maritime data have been formulated. Maritime data are produced while vessels are operational. Thus, after satisfying the needs of primary data consumers, there are nonconservative features and capabilities that do not require an extra cost to meet the

application requests of secondary data consumers. Maritime data does not fit neatly into pricing methods that are based on the traditional supply-and-demand model because the marginal cost corresponds to “0”, due to the possibility of n th replications [54].

Third, maritime data are recognized in the industry as public social capital because of their intangible nature and long production history in public institutions. Therefore, from the data provider and consumer perspectives, the status of reserved value and rights as an object is unclear when trading data using a “digital platform for maritime data trading (tentative name),” leading to difficulties in the occurrence of actual transactions [39].

Fourth, the quality and reliability of the maritime data have not been confirmed. Because maritime data can be characterized as personal or non-personal data, consumers seeking to verify the quality and reliability of data must depend on intermediaries or providers when trading anonymized data through a “digital platform for maritime data trading (tentative name).” However, there are no quality standards at the register level and maritime cyber compensation liability insurance level to guarantee this, which makes it difficult to ensure the quality and reliability of data [2].

The price of maritime data will be determined, based on a digital platform in which data are traded, used, and transferred online and offline between providers and consumers. However, legal issues relating to the value of data, purchasing power, quality and standards, ownership, and privacy of the data hinder the pricing of maritime data based on mutual strategic decision-making [55]. To overcome the obstacles, data providers need to contribute to initial market circumstances by applying a buyback strategy associated with data purchases, anticipating how the standardized quality data are provided according to the consumers’ strategic decisions or how the outcome will affect the consumers [56]. Control of maritime data will significantly affect the scalability of the maritime industry. Currently, the price of maritime data unreasonably depends on information asymmetry rather than strategic decision-making. Consequently, launching a new initiative in the maritime industry by enhancing the fair trading, efficiency, and competitiveness of maritime data will require first establishing an economic environment in which data providers and consumers can trade fairly, based on an integrated fuzzy sustainability framework [57].

4.2. Topics for Future Research

4.2.1. Is Maritime Data Subject to Ownership under Korean Civil Law?

Article 211 of the Civil Act of the Republic of Korea (“Contents of Ownership”) grants owners the right to use, profit from, or dispose of property within the scope of the Act. To constitute ownership under Korean civil law, “possession” must be specified for an object. To verify the ownership of dissolution data from a legal perspective, the owner must demonstrate exclusive control, specificity, and independence of the property, and meet the conditions for objectification that are suitable for the transaction [26]. Maritime data are classified as intangible under the Civil Act. Therefore, it is critical to understand whether data are included in “corporeal things, electricity, and other natural forces which can be managed” as defined under Article 98 (“Definition of Things”) of the Civil Act. This concept extends beyond the concept of limited things as corporeal things, as stated in Article 85 of the Japan Civil Code, which described “things” as tangible objects. The Civil Act of Korea was heavily influenced by Japanese civil law, which was in turn heavily influenced by German civil law [43]. It is important to determine whether maritime data are included in the scope of manageable natural forces, under Article 98 of Korea’s Civil Act, because “natural forces”—electricity, heat, light, radioactivity, wind, sound, and scent—do not have mass or volume, as is similar to how they were defined under the German Civil Act [44].

If various maritime data were produced to operate a ship owner’s autonomous vessel, the maritime data would be the object of rights corresponding to the ownership of the vessel owner. Consequently, regarding the recognition of the ownership of maritime data, its application should be checked for exclusive controllability, specificity, and independence, to meet the conditions as a right object in the future [32].

First, there is the issue of whether there is the possibility of exclusive control of maritime data as an object of ownership. Unlike conventional fax, telephone, and telex data, maritime data are most likely electronic data using blockchain encryption, where exclusive dominance is secured digitally [40]. Nevertheless, when these maritime data are transmitted and traded on a “digital platform for maritime data transactions (tentative name),” domination is allowed within a limited range, given the nature of the digitized data—the possibility of n th replications and cybersecurity vulnerabilities [58,59]. That is, maritime data do not meet the standards for exclusive possession.

Second, there has been no definitive answer regarding whether maritime data have specificity as an object of ownership. It would seem that the requirements have not been met because of the potential for n th replications and distributions, since MASS data ship-to-ship and ship-to-shore interchanges are conducted digitally. Therefore, the specificity of the maritime data has not been acknowledged [33].

Third, it is not clear whether maritime data are independent of ownership. For maritime data to be recognized as an independent form and an object of rights, we must apply the principle of the real rights of one thing, recognizing one right. However, maritime data are often transmitted in the form of sensor-based unit elements during MASS operations; therefore, it is not appropriate to separate them from the subject and make them independent objects. In addition, judging whether maritime data are independent is problematic because independence as an object of rights requires decisions based on social conventions, trading ideas, and physical forms.

Finally, maritime data occupy part of the space that Article 98 was intended for and are not a solid, gas, or liquid that human senses can perceive. Moreover, they cannot be controlled or naturally disposed of [34]. Thus, they can only be accepted as conceptual objects. This would suggest that ownership cannot be recognized, because maritime data do not meet the requirements derived under the concept and characteristics of traditional ownership under Korean civil law.

4.2.2. Can Maritime Data Be Protected under Copyright Law?

This question pertains to whether maritime data are included in databases in accordance with Article 2(19) of the Copyright Act of the Republic of Korea. The Copyright Act states that the term “database” implies a “compilation whose materials are systematically arranged or composed, so that they may be individually accessed or retrieved” [53]. Therefore, copyright protection would require that maritime data satisfy the following definition. In other words, if the data defined in Section 3 are based on modern concepts, including “raw material → information → knowledge → content that is fused,” the database function occurs when a data broker uses the “digital platform for marine data trading.” Therefore, we believe that maritime data could be protected under the Copyright Act, under the assumption that all elements in the database definition are met, and significant expenditures of human and physical resources have been made on databases [45,46]. However, since the data produced by AI algorithms in autonomous vessels are not explicitly mentioned in Article 91 (“Protected Databases”) of the Copyright Act, there is an issue of the existence of rights to their AI algorithms, under the current law [47]. However, in practice, works reproduced by AI algorithms cannot be judged as copyrighted work, because they are not a representation of a person’s thoughts or emotions under Article 2 (“Definitions”) of the Copyright Act. Nevertheless, because a computer program’s work is included as an example of work under Article 4(9) of the Copyright Act, various interpretations are possible. Therefore, we need to consider practical alternatives while specifying the regulations to identify the “author” of work produced by AI algorithms or similar rights in the contract to data brokers that operate the “digital platform for maritime data transactions (tentative name)” [47].

5. Conclusions and Recommendations

Recently, the discussion and attention of the maritime industry have been focused on digital platform businesses represented by autonomous vessels, smart ports, and blockchains. In the era of digital data, data are expected to gain traction faster than oil- and mineral-based resources like oil, coal, and iron ore. With the advancement of information and science technology in the maritime sector, various forms of material goods and accumulated information play vital roles in ports, marine transportation control, satellite communication, logistics, and vessel operation. There are increasing numbers of intangible forms that cannot be included in the scope of “things” as defined by the Korean Civil Act, including software, networks, the cloud environment, digital records that exist in the virtual space of online programs, and, quite possibly, data. Intangible things, generated from new technological changes affecting land and sea, are challenging the existential scope of the definition of “things” in Article 98 under the Korean Civil Act. Maritime data will soon be at the center of various legal debates that individual laws cannot resolve (e.g., the Basic Intellectual Property Act, the Copyright Act, or the Privacy Act). Nevertheless, they will affect ship operations and the entire shipping and logistics industries [31].

In particular, legal issues related to maritime data need to be interpreted and resolved, based on the Civil Act, because of the lack of individual laws related to actual maritime data, such as the Basic Law on Intellectual Property, Copyright Act, Personal Information Protection Act, Maritime Safety Act, Marine Environment Management Act, and Seafarers Act. These are based on the International Convention for the Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships (MARPOL), the International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW), and the Maritime Labor Convention (MLC; International Labor Organization) formed by the International Maritime Organization. Therefore, this study, despite being at its initial stage, has analyzed the concept and trading structure of maritime data linked to autonomous vessels and reviewed whether data should be considered as “things” in the Civil Act and the object of the right to ownership as key issues because these are the core elements required to interpret the right to ownership.

This study reviewed the protections outlined under Korea’s Copyright Act and Personal Information Protection Act. In accordance with existing academic theories and criteria stated in the legislation, the Acts do not recognize the right to data ownership. However, economic, social, and cultural changes and scientific and technological advancements are making it necessary to explicitly state whether data are “things”; without this, we are blindly navigating the newly developing areas and are unable to ensure that data meet special requirements under the Bond Act. Thus, we propose establishing detailed provisions to advance the logistics of contracts, by developing a standard maritime transaction license agreement or a transfer agreement, in collaboration between the Korean Commercial Arbitration Board and relevant universities and specialized institutions. This could ensure that copyright protections as property rights could be applied to maritime data-trading contracts, establishing maritime data as a “thing” under the provisions of the trading contract after meeting general requirements.

It is necessary to prepare the scope and criteria for data interpretation because data that are the purchase object of maritime data sales contracts can be applied to the data that were reprocessed and included in databases to create copyrighted work. The shipowners’ association should take the lead in collaborations with the government, academia, and research organizations to prepare guidelines on the use and application of standard sales contracts of maritime data and to compose appropriate governance. They also need to support the digital data transaction contracts necessary in the era of platform businesses.

Our explorations of the importance of data protection and trust used the legal frameworks of John Locke’s theory of property rights and the principle of absolute ownership associated with Article 23 of the Constitution of the Republic of Korea, linked to the government-wide digitalization paradigm shift. This study has contributed to establishing a balance in data use, by proposing trust-based opportunities for individual entities in the

maritime industry to participate more actively in platform-based data governance through the recognition of the previously mentioned theories and cases.

Future studies should examine whether the relevant stakeholders should create a system to make information more transparent and complementary, share values, and strengthen information security, regardless of whether the information is personal or non-personal. Moreover, moral and technical standards should be followed to establish a culture of security management and respect for personal rights.

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