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## Exploring South Korea's Ocean Economy : the Korea National Ocean Economy Survey 2017-2019

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## Exploring South Korea's Ocean Economy : the Korea National Ocean Economy Survey 2017-2019

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## 1. INTRODUCTION

In recent years, there has been a growing interest in the ocean, which is a rich repository of natural resources, and assessments of the ocean economy and ocean assets have been conducted worldwide. The World Wide Fund for Nature (WWF, 2015) estimated the global ocean asset value at \$24 trillion, with an annual gross marine product of at least \$2.5 trillion, about 5% of the world's GDP. The OECD (2016) announced that the total economic output of the ocean economy in 2010 was \$1.5 trillion, accounting for 2.5% of world gross value added (GVA), and it will reach \$3 trillion by 2030, more than double the 2010 level. Major maritime countries have also started to assess their ocean economy and use it as objective evidence for policymaking. The GVA of the US ocean economy as of 2018 was \$372.8 billion, which is 1.9% of the national GVA (CBE, Ocean Economics Statistics Data), and the GVA of China's 2020 ocean economy was \$1.23 trillion (8 trillion Chinese yuan), accounting for 1.9% of the added value of all industries (China Oceanic Information Network, 2021). The GVA of the EU's ocean economy as of 2018 is €176.1 billion, which is 1.5% of the added value of all industries (European Union, 2021).

In addition, international organizations and many countries seeking opportunities and driving forces for sustainable development in the ocean have promoted national policies and agendas related to the maritime economy and industry. In 2020, the High Level Panel for a Sustainable Ocean Economy (hereinafter Ocean Panel) announced Transformations for a Sustainable Ocean Economy: A Vision for Protection, Production and Prosperity. The leaders of the 14 countries<sup>1</sup> participating in Ocean Panel agreed to develop and implement a sustainable ocean plan to holistically manage 100% of their national waters by 2025. In the same year, the OECD published Sustainable Ocean for All - Harnessing the Benefits of Sustainable Ocean Economies for Developing Countries. It included the latest trends in ocean-based industries, estimates on

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<sup>1</sup> Australia, Canada, Chile, Fiji, Ghana, Indonesia, Jamaica, Japan, Kenya, Mexico, Namibia, Norway, Palau, Portugal. (The Ocean Panel, <https://www.oceanpanel.org/>)

financial investment costs for a sustainable ocean economy, and policy instruments to promote ocean sustainability to support policymakers in developing countries. Prior to this, in 2018, the United States announced Ocean Policy to Advocate the Economic, Security, and Environment Interests of the United States, while Canada identified the three oceans as the driving force for economic development and promoted the strategic framework for Canada's Blue Economy.

In order to establish and implement ocean policies and plans suitable for each country's situation and conditions, it is necessary to classify the ocean and fisheries industry and estimate the size of the ocean economy above all else. By understanding the current status of the ocean economy, the government can secure necessary data for establishing national policies and strategies. In addition, it is possible to identify the impact of external shocks such as COVID-19 and the financial crisis on the ocean economy and take appropriate measures. To prepare a systematic management and support system for the ocean and fisheries industry, it is most important to understand the current status of the ocean economy based on statistics. However, there has been a lack of research on the establishment of an industrial classification system that reflects the intrinsic characteristics of the ocean and fisheries industry in South Korea. Therefore, this study aims to introduce the specialized classification system of the ocean and fisheries industry in South Korea and, further intends to analyze industry trends using the survey data based on the classification system.

The rest of the paper is organized as follows. Section 2 reviews the definition, scope, industrial classification system of ocean and fisheries. The theoretical background and data source are presented in Section 3. Section 4 presents the result of the survey based on the industrial special classification, following this, the conclusion and limitation of this study are stated in Section 5.

## 2. LITERATURE REVIEW

### 2.1 Definition of Ocean and Fisheries Industry

#### 2.1.1 Terminology and Concept

In order to assess the value of a specific industry, the definition, concept, and scope of the industry should first be established. Only through this process can the size of the industry be grasped, and support systems and appropriate policies for systematic management can be prepared. However, it is not easy to establish the concept of ocean and fisheries industry because there exist various types of inputs and outputs from the primary industry such as fisheries to the tertiary industry such as tourism and ecological services, and also the geographical perspectives of the ocean need to be considered in addition to industrial perspectives.

The Framework Act on Marine Fishery Development, the highest law in the ocean and fisheries sector in South Korea, defines the ocean and fisheries industry as “industries related to the management, preservation, development or use of the ocean and fishery resources.”<sup>2</sup> Furthermore, the definition of the ocean and

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<sup>2</sup> The term "ocean and fisheries industry" means the following industries related to the management, preservation, development, or use of the ocean and marine fishery resources:

(a) Industries related to the gathering, capture, culture, process, and distribution of fishery resources;

(b) Industries related to the marine logistics and marine transportation such as the marine transportation business and harbor construction or operational business;

(c) Industries that explore, collect, extract, smelt or produce the marine minerals (excluding the submarine minerals under subparagraph 1 of Article 2 of the Submarine Mineral Resources Development Act) from the seabed or seal water (including the deep-sea water; hereinafter the same), and related to the development and operation of the facilities or equipment for such;

(d) Industries related to the development and utilization of marine energy;

(e) Industries related to the construction, establishment, or composition of the marine facilities or marine space, or those related to the development and operation of the facilities and equipment for such;

(f) Industries related to the preservation and restoration of the marine environment and marine ecosystem;

(g) Industries related to marine tourism or leisure such as the fishing villages, marine tourism, or marine leisure sports;

fisheries industry can be confirmed in each local government ordinance in South Korea. Busan, South Korea's second-largest city, adds “shipbuilding, marine biotechnology, marine environment, and disaster prevention, and maritime finance” to the definition of the ocean and fisheries industry in the Busan Metropolitan City Marine Industry Promotion Ordinance. In addition to Busan, major local governments such as Gyeonggi-do, Geoje-si, and Jeju-do also adopt Busan's definition of the ocean and fisheries industry.

Meanwhile, the terminology of the ocean and fisheries industry varies from country to country in terms of space, resources, and behavior (Table 1). The US defines the ocean and fisheries industry as ocean-related industries or economic activities that are partly related to the oceans or adjacent to the coast (National Ocean Economics Program, 2016), while the United Kingdom defines as activities that produce products from the oceans and services that directly contribute to activities in the sea (Pugh, 2008). Ireland regards the ocean and fisheries industry as an economic activity that directly or indirectly uses the sea as an input or produces an output for use in a sea-specific activity (SEMUR, 2019). Canada defines the ocean and fisheries industry as industries based on Canada's waters and coasts, or industries dependent on the activities of these areas (Canada Economic Analysis and Statistics, 2009). China states ocean and fisheries industry as all activities related to the development, use, and protection of oceans (China Information Security Certification Center, 2006), while Japan defines that as industries responsible for the development, utilization, and conservation of oceans under Article 5 of the Framework Act on Oceans (The Cabinet Office of Japan, 2007).

Table 1. Definitions of Ocean and Fisheries Industry from around the world

Country	Definition	Source
U.S.	The economic activity, which is (a) an industry whose definition	National Ocean Economics Program, State of

(h) Industries related to the use of seawater directly or by refining and processing, or to the manufacturing of salt;

(i) Other industries related to the sea or marine fishery resources, as prescribed by Presidential Decree. (The Framework Act on Marine Fishery Development, Article 3)

Country	Definition	Source
	explicitly ties the activity to the ocean, or (b) which is partially related to the ocean and is located in a shore-adjacent zip code	the U.S. Ocean and Coastal Economies, 2016 Update
U.K.	Those activities involve working on or in the sea. Also, those activities that are involved in the production of goods or the provision of services that will directly contribute to activities on or in the sea	Crown Estate, Socio-economic indicators of marine-related activities in the UK economy, 2008.3
Ireland	Any economic activity that directly or indirectly uses the sea as an input or produces an output for use in a sea-specific activity.	SEMRU, Ireland's Ocean Economy, June 2019
Canada	Those industries that are based in Canada's maritime zones and coastal communities adjoining these zones, or are dependent on activities in these areas for their income	Canada Economic Analysis and Statistics Branch, Economic Impact of Marine Related Activities in Canada, 2009
China	All activities related to the development, use, and protection of the oceans	China Information Security certification center, Industrial classification for ocean industries and their related activities (GB-T 20794-2006), 2006.12.29
Japan	The industries bearing the development, use, and conservation of the oceans	The Cabinet Office of Japan, Basic Act on Ocean Policy (Act No. 33 of April 27, 2007)

Given that combined with related laws in South Korea and other international cases, "ocean", "coastal", and "sea area" are the main keywords in terms of space,

whereas marine “resources”, “goods” and “services” are the main keywords in terms of resources. In addition, “economic activities”, “usage”, “development”, “management”, “provision”, and “conservation” appear frequently from the perspective of behaviour. Taking these three dimensions of space, resources, and behavior, ocean and fisheries can be defined as "an industry that is carried out in the ocean or related to the management, preservation, use, and development of the ocean and that provides goods or services to these activities".

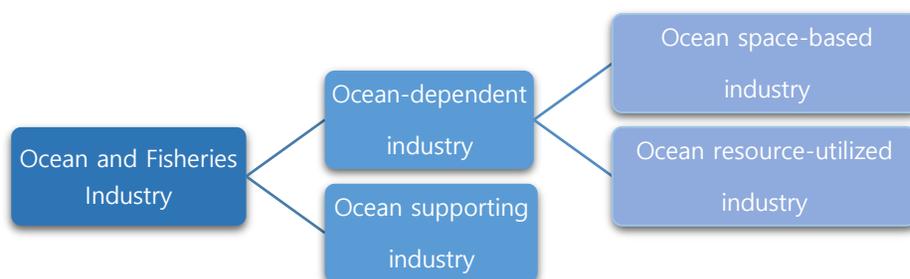
### **2.1.2 The Scope of Ocean and Fisheries Industry**

There has not been an agreement on the international standard for the scope of the ocean and fisheries industry, thus each country sets the scope according to their conditions. In particular, geographical and industrial aspects are considered as criteria for setting the scope of the ocean and fisheries industry. Fisheries and Oceans Canada (2021) set the scope of the ocean and fisheries industry as “ocean sectors operating in Canada today provide products and services ranging from food and transportation to energy and health”. The ocean sectors are composed of ocean-based energy, marine transport, ports and shipbuilding, aquaculture, commercial fisheries and seafood processing, coastal and marine tourism, ocean technology, and future-oriented industries. In addition, the Centre for Economics and Business Research UK (2017) defined the scope of the ocean and fisheries industry as “encompassing a wide range of constituent activities, categorized under either Leisure Marine or Marine Engineering”.

Meanwhile, the Ministry of Oceans and Fisheries of Korea (MOF) considered three characteristics when determining the scope of the ocean and fisheries industry: the dependence on ocean space of industrial activities, irreplaceability of marine products, and expertise of inputs. First, the industry that is carried out in the oceans can be included in the scope of the marine fisheries industry. It includes activities that use ocean space, activities that extract or develop resources from the ocean, and activities that manage or preserve the ocean. In addition, activities that are spatially performed in inland water are included in the ocean and fisheries if they are identical to the products produced in the ocean or cannot be replaced by land resources. Moreover, it also includes offshore wind power generation and offshore bridge construction, where industrial activities are difficult without using marine space, even if the aerodynamics rather than the

hydrosphere is used. Second, activities using marine products are included in the ocean and fisheries but exclude cases that can be replaced by land products. For example, marine biotechnology and marine tourism are included in the ocean and fisheries because marine resources are used as primary input factors in production and there is no possibility of substituting them with land resources. Lastly, activities that provide inputs to support industries that take place in the sea and industries that use marine resources are included in the marine and fishery industry but excluded if the inputs are universal with other industries. Equipment such as fishing nets are specialized goods for fishing activities, and the activities to produce them are included in the ocean and fisheries industry. On the other hand, food and medical products are essential for fishery activities but are not specialized goods, so production activities are excluded from the scope of the ocean and fisheries industry.

Figure 1. Scope of the Ocean and Fisheries Industry



Source: Ministry of Oceans and Fisheries of the Republic of Korea (2015), p.93

Definitions and classification systems for the ocean and fisheries industry in countries around the world generally divide the types of the ocean and fisheries into “activities in the sea” and “activities using marine resources” (MOF, 2015). In other words, it can be broadly divided into industries that use the ocean or ocean resources and industries that support them. The ocean-dependent industry is the industry that makes essential use of ocean or marine resources and can be further divided into ocean space-based industry and ocean resource-utilized industry. On the other hand, the ocean supporting industry refers to the industry that provides specialized inputs to the ocean-dependent industry. According to the

above criteria, the scope of the ocean and fisheries industry can be classified into three categories: ocean space-based, ocean resource-utilized, and ocean supporting industry.

## 2.2 Industrial Classification System

The Korean Standard Industrial Classification system (KSIC) is designed to ensure the accuracy and comparability of statistics related to industries. This is a systematic typification of industrial activities mainly performed in units of production such as businesses or entities. After the enactment of the industry classification system for mining and manufacturing industries in 1963, the first KSIC was established with the addition of non-manufacturing industries in the following year. It has been continuously revised up to the 10th round, reflecting changes in industrial structure and technology in South Korea. Despite the existence of an overall classification system for industrial activities, the need for an industrial classification system in a particular sector has surged. The KSIC applies consistent standards and principles based on the UN's International Standard Industrial Classification for the purpose of comparing and identifying not only domestic industries but also international industries. Therefore, a separate re-aggregation process is required to analyze a specific industry and related industries together. To prevent inefficiencies caused by such re-aggregation, the industrial classification system is a reorganization of the relevant classification of the KSIC for the internationally used industrial sectors and the industries requested by administrative agencies.

Table 2. List of Industrial Classification Systems in Korea

Sectors	
Employment Occupations	Sports Industry
Spatial Data Industry	Energy Industry
Tourism Industry	E-learning Industry

Agriculture, Food and Rural Affairs Industry	Disaster and Safety Industry
Design Industry	Copyright Industry
Robot Industry	Professional and Technical Resources
Logistics Industry	Information and Communication Technology Industry
Social Service Industry	Information and Communication Technology Jobs
Fire Industry	Intellectual Property Services Industry
Ocean and Fisheries Industry	Content Industry
Environmental Industry	

Accordingly, as of 2021, there are a total of 21 Korean industrial classification systems (see Table 2), and the industrial structure of each sector that cannot be directly identified through KSIC is being analyzed. The industrial classification systems have been made on legal grounds or in accordance with the international classification system, and the Energy industrial classification was first approved in 2000.

There is literature on the ocean and fisheries industry classification system in many countries. The US estimates the size of the ocean and fisheries industry at the National Ocean Economics Program (CBE). In the case of China, the China Marine Economic Information Network (CMEIN) publishes annual economic statistics on marine fisheries. In addition, New Zealand, Australia, Canada, Ireland, the UK, France, and Japan are investigating the classification structure of ocean and fisheries (MOF, 2015). In South Korea, prior research on the classification of the ocean and fisheries industry has been sporadically conducted before the current Korean Industrial Classification of the Ocean and Fisheries (KIC-OF) was enacted. Korea Maritime Institute (2009) classified the ocean and fisheries industry into 11 categories, referring to the definition of ocean and fisheries, overseas classification cases, and the KSIC. Korea Institute of Marine Science and Technology Promotion (2010) conducted a study to redefine the

definition and scope of ocean and fisheries so that it identified the new concept of the industry that was not extracted from the KSIC. However, they did not include downstream industries which are indirectly related to the ocean and established a separate classification for marine science and technology industries with high potential for future development. In addition, based on the technology linkage, the Korea Institute of Marine Science and Technology Promotion (2011) classified the ocean and fisheries into ocean-based industries and ocean-related industries, of which ocean-related industries were divided as forward and backward linked industries. Park and Kildow (2014) redefined the definition of the ocean economy and restructured the classification standard of South Korea's ocean industry into 12 categories.

Table 3. Korean Industrial Classification in the Ocean and Fisheries (Units: EA)

Large categories	Medium categories	Small categories	Sub-categories
1. Marine resources development and construction industry	4	8	15
2. Shipping and port industry	2	5	17
3. Shipbuilding and offshore plant construction & repair industry	3	8	15
4. Fishery production industry	4	7	12
5. Fishery processing industry	1	4	8
6. Fishery distribution industry	2	5	11
7. Oceans and fisheries leisure tourism industry	2	4	10
8. Oceans and fisheries equipment manufacturing industry	2	8	13

9. Ocean and fisheries related services industry	9	19	42
Total	29	68	143

Most of the preceding studies had the advantage of being able to present characteristics of the ocean by applying the classification criteria, but there was a possibility that overlapping items may occur between individual industries. Therefore, it was necessary to set up clear criteria and principles and then classify them sequentially to avoid redundancy and omission. In 2015, the industrial classifications for the fisheries and ocean industries were newly established, respectively, and a national survey on the fisheries and a national survey on the ocean industry were conducted separately. After that, an integrated management plan for the national survey of the ocean and fisheries industry was established, and the classification system of the ocean and fisheries was integrated. The KIC-OF, approved by Statistics Korea in 2018, consists of nine large categories, 29 medium categories, 68 small categories, and 143 sub-categories (see Table 3). The large categories were constructed in consideration of the aspects of policy utilization related to the ocean and fisheries and the creation of integrated survey statistics. In addition, the subdivisions (medium, small, and sub-categories) were determined based on the characteristics of the inputs and outputs, related activities, and the levels of scale within the industry.

### 3. METHODOLOGY

This section provides the process of identifying industry trends in the ocean and fisheries using the survey data based on the industrial classification system, which is previously established. To identify the overall status of the ocean and fisheries industry, it is necessary to construct the accessible list of the target population, design an appropriate sampling process, and then estimate the population parameters in consideration of the proper weights.

### 3.1 Process of the population building

The target population in this research is defined as businesses with one or more employees that are doing (or did) business activities related to the ocean and fisheries industry in Korea as of the survey reference date. To construct an accessible list of the population, the first step is to collect multiple lists from different sources. The primary source is the population list from the Census on Establishments. The census is the national survey conducted annually by Statistics Korea, and it generally works as the survey population for other surveys on establishments in Korea. Among approximately 4.4 million establishments from the census, their KSIC codes and contents of main/sub business activities are checked, and only the relevant companies are selected. However, the census generally excludes fisheries businesses that do not own inland workplaces, so additional lists are needed. One of the supplemental lists is the list of fishing licenses/ permits /declarations governed by the MOF. It can work as part of a preliminary population for the fishery production industry sector. Also, various lists of member companies of organizations and associations related to the ocean and fisheries industries are collected and merged with other lists.

The next step for the population building is to refine the collected list based on the classification system of the Ocean Economy. Each list is subject to duplication due to different sources and differs in the quality and quantity of information it contains. Therefore, in the process of integrating the list, duplicates are removed, and the list is organized according to the company name, address, representative, and business registration number. After the list is compiled, each establishment is classified and assigned a code according to the classification system.

In the final step, the list is finalized by reflecting the closed business information and collecting expert opinions. Since the census list was written one year before the reference data of the survey, it is necessary to reflect information on business closures during one year. For each establishment in the list, business activity at the survey reference date is checked through the DART(Data Analysis, Retrieval, and Transfer) system and other private databases such as NICE(National Information & Credit Evaluation) and KED(Korea Enterprise Data). Finally, the list is reviewed by experts with many years of experience in the field.

### 3.2 Process of the sample design

The sampling process of this research can be divided into four steps: stratification, sample size determination, distribution, and extraction. In the first step, stratification, a multi-stratification method is used. The first stratification is carried out based on the 29 medium classes of the classification system of the Ocean Economy, followed by the second stratification based on the size of the employees. In consideration of the possibility of obtaining information and the distribution of businesses by employee size, the second stratification is divided into seven levels: 1 to 4, 5 to 9, 10 to 19, 20 to 49, 50 to 99, 100 to 299, and 300 or more employees. For each layer, the relative standard error (RSE) using the number of employees in the population can be calculated.

The second step is to determine the sample size for each layer. Using RSEs calculated previously and maximum allowable RSEs, the sample size required for each layer can be determined by the following formula.

$$n = \frac{(C/C_{\bar{y}})^2}{\left[1 + \frac{1}{N} \left(\frac{C}{C_{\bar{y}}}\right)^2\right]}$$

where  $C$  is the population RSE,  $C_{\bar{y}}$  is the maximum allowable RSE, and  $N$  is the population size. According to Statistics Korea, an RSE of less than 30% is recommended to ensure the reliability of the estimate.

The next step is to distribute the sample into each layer. For the distribution, the modified cut-off method is applied. All large-scale businesses with 100 or more employees and those belonging to a classification with a small number of businesses are extracted entirely and assigned to the sample. And it also distributes the samples so that the sample size of each classification is at least 5. For the rest of the samples, the square-root proportional allocation method is used for the distribution.

In the last step, samples to be investigated are extracted using the systematic sampling method. For each layer of the population, the list is sorted in descending order, and samples are selected according to a random starting point but with a fixed, periodic interval as much as the number of samples obtained by determining the sample size. In addition, in case replacement samples are needed, preliminary samples are extracted. The size of the preliminary sample is determined by twice the actual sample size, which is 9,000. When conducting an actual survey, the first-priority-selected business should be investigated first, but if the survey is denied, a preliminary sample will be substituted.

### 3.3 Parameter estimation

In this study, weights are calculated by considering design weights and non-response adjustments.

$$\text{design weights : } w_{ij}^D = \frac{N_{ij}}{n_{ij}} , \quad \text{non-response adjustments : } w_{ij}^A = \frac{R_{ij}}{N_{ij}}$$

where  $N_{ij}$  is the population size for level  $j$  in class  $i$ ,  $n_{ij}$  is the sample size,  $R_{ij}$  is the investigated sample size,  $i$  is 1 to 29 assigned for each class of the classification system, and  $j$  is 1 to 7 assigned for each level of the size of employees. Then, the final weight for each layer is the multiple of design weight and non-response adjustment.

For the estimation of each population parameter, a weighted sum or weight average is calculated, and estimates are evaluated based on their RSEs. For the calculation, statistical packages such as SPSS and R are used.

Table 4. Formulas to estimate parameters for the total and proportion

	Estimation for the total	Estimation for the proportion
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Point estimate	$\hat{T}_i = \sum_j \sum_k w_{ij} x_{ijk}$	$\hat{p}_i = \frac{\sum_j w_{ij} \sum_k x_{ijk}}{\sum_j w_{ij}}$
Variance	$\text{Var}[\hat{T}_i] = \sum_j N_{ij}^2 \left( \frac{N_{ij} - n_{ij}}{N_{ij}} \right) \frac{s_{ij}^2}{n_{ij}}$	$\text{Var}[\hat{p}_i] = \sum_j \left( \frac{N_{ij} - n_{ij}}{N_{ij}} \right) \left( \frac{\hat{p}_i(1 - \hat{p}_i)}{n_{ij} - 1} \right)$
Standard error	$\text{SE}(\hat{T}_i) = \sqrt{\text{Var}[\hat{T}_i]}$	$\text{SE}(\hat{p}_i) = \sqrt{\text{Var}[\hat{p}_i]}$
RSE	$\text{RSE}(\hat{T}_i) = \frac{\text{SE}(\hat{T}_i)}{\hat{T}_i}$	$\text{RSE}(\hat{p}_i) = \frac{\text{SE}(\hat{p}_i)}{\hat{p}_i}$

#### 4. RESULT

In this section, three-year (2017-2019) statistics on the characteristics of businesses by large categories were extracted according to the KIC-OF. As a result, changes in the number of businesses and workers, sales, annual labor costs, and business outlook in the ocean and fisheries industry were analyzed. Table 5 summarizes the number of businesses in the ocean and fisheries industry from 2017 to 2019. The total number of businesses decreased by 4,254 from 172,003 in 2017 to 167,749 in 2019. While the overall number of businesses is declining, the number of businesses in the ocean and fisheries related services industry increased by 3,151, and the ocean and fisheries leisure tourism industry increased by 260. Looking at the proportion by industry, in 2019, the ocean and fisheries related services, fishery production, and fishery distribution industry accounted for 35.5%, 25.8%, and 24.5%, respectively, and there were no other industries that accounted for more than 10%.

Table 5. The Number of Businesses in Ocean and Fisheries Fields (Units: Each)

Industries	The Number of Businesses		
	2017	2018	2019
Marine resources D&C industry	701	632	497

Shipping and port industry	8,272	7,724	7,481
Shipbuilding and offshore plant C&R industry	6,613	6,093	5,783
Fishery production industry	47,049	42,694	43,275
Fishery processing industry	5,934	5,781	5,843
Fishery distribution industry	42,997	42,334	41,098
Ocean and fisheries leisure tourism industry	2,364	2,462	2,624
Ocean and fisheries equipment manufacturing	1,648	1,654	1,572
Ocean and fisheries related services industry	56,425	60,759	59,576
Total	172,003	170,133	167,749

The number of workers in the ocean and fisheries industry is shown in Table 6. The total number of workers was 1,181,607 in 2017 and has continued to decline, reaching 1,120,200 in 2019, a decrease of 61,407 compared to 2017. The shipbuilding and offshore plant construction & repair industry showed the largest decline by 32,027, followed by fishery production and fishery distribution industries. Meanwhile, in 2019, the number of workers in the fishery processing industry, ocean and fisheries equipment manufacturing industry, and ocean and fisheries related service industry increased by 1,624, 221, and 8,284, respectively, compared to 2017. The proportion of workers in the fishery production industry was the highest at 40.8% in 2019, followed by the ocean and fisheries related services industry at 22.3%.

Table 6. The Number of Workers in Ocean and Fisheries Fields (Units: Person)

Industries	The Number of Workers
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	2017	2018	2019
Marine resources D&C industry	9,530	10,019	7,882
Shipping and port industry	104,427	99,877	96,705
Shipbuilding and offshore plant C&R industry	167,588	146,566	135,561
Fishery production industry	477,382	455,500	457,527
Fishery processing industry	45,476	43,440	47,100
Fishery distribution industry	115,789	112,385	105,597
Ocean and fisheries leisure tourism industry	8,171	8,675	8,079
Ocean and fisheries equipment manufacturing	11,672	13,391	11,893
Ocean and fisheries related services industry	241,572	241,739	249,856
Total	1,181,607	1,131,592	1,120,200

The amount of sales in the ocean and fisheries industry is summarized in Table 7. The total amount of sales in the ocean and fisheries increased slightly from 173.9 trillion won in 2017 to 177.5 trillion won in 2019. Specifically, the industry with the largest decrease in sales in 2019 compared to 2017 was the shipbuilding and offshore plant construction & repair industry with 2.0 trillion won, while the industry with the largest increase in sales was the ocean and fisheries related services industry with 3.3 trillion won. As of 2019, the shipping and port industry generated the largest sales at 50.7 trillion won, followed by the shipbuilding and offshore plant construction & repair, fishery distribution, and ocean and fisheries related services industries. In addition, sales of the ocean and fisheries leisure tourism industry were the lowest at 0.7 trillion won.

Table 7. Amount of Sales in Ocean and Fisheries Fields (Units: Billion Won)

Industries	Sales		
	2017	2018	2019
Marine resources D&C industry	4,506	4,450	3,877
Shipping and port industry	50,869	51,252	50,711
Shipbuilding and offshore plant C&R industry	48,813	45,008	46,785
Fishery production industry	10,856	9,282	10,193
Fishery processing industry	8,762	9,610	10,992
Fishery distribution industry	24,689	24,616	25,977
Ocean and fisheries leisure tourism industry	688	739	703
Ocean and fisheries equipment manufacturing	2,380	2,575	2,649
Ocean and fisheries related services industry	22,318	23,158	25,658
Total	173,881	170,690	177,546

According to the annual labor costs in Table 8, the total amount of the annual labor costs in the ocean and fisheries industry was the largest at 21.3 trillion won in 2017, but gradually decreased to 19.4 trillion won in 2019. The ocean and fisheries related services industry had the highest payouts over the three years, while the ocean and fisheries leisure tourism industry have the lowest payouts over the same period. The two industries where annual labor costs increased in 2019 compared to 2017 were fishery processing and ocean and fisheries equipment manufacturing, while the other industries experienced a decrease in

annual labor costs. In particular, annual labor costs in the ocean and fisheries leisure tourism industry and shipbuilding and offshore plan construction and repair industry decreased by 21.3% and 19.4%, respectively.

Table 8. Annual labor costs in Ocean and Fisheries Fields (Units: Billion Won)

Industries	Annual Labor Costs		
	2017	2018	2019
Marine resources D&C industry	309	322	272
Shipping and port industry	3,632	3,497	3,436
Shipbuilding and offshore plant C&R industry	5,519	4,975	4,448
Fishery production industry	2,214	1,879	2,049
Fishery processing industry	1,016	997	1,140
Fishery distribution industry	2,389	2,169	2,237
Ocean and fisheries leisure tourism industry	190	183	149
Ocean and fisheries equipment manufacturing	307	358	345
Ocean and fisheries related services industry	5,732	5,267	5,347
Total	21,308	19,647	19,424

This study further analyzed the business outlook compared to the base year by analyzing how much the outlook, in terms of the gross sales, is expected to increase or decrease and measured in percentages based on the survey results of each business entity. Then, the figures in Table 9 are the weighted average of percentages in forecast for industries. As a result, it was found that a negative

business outlook was predicted for all industries in the ocean and fisheries industry during the survey period. Moreover, in the survey as of 2019, the business outlook for 2020 showed the most negative estimates, reflecting the contraction of domestic and global consumption and the economic recession caused by the COVID-19. The overall business outlook in the ocean and fisheries industry fell by 15.8% point from -7.6% in 2018 to -23.4% in 2020. More specifically, the ocean and fisheries leisure tourism industry had the lowest at -32.3% in 2020, followed by the ocean and fisheries related services industry and fishery production industry.

Table 9. Business Outlook in Ocean and Fisheries Fields (Units: %)

Industries	Business Outlook		
	2018	2019	2020
Marine resources D&C industry	-0.9	-3.8	-10.6
Shipping and port industry	-2.9	-3.3	-15.6
Shipbuilding and offshore plant C&R industry	-1.6	-3.1	-12.7
Fishery production industry	-12.3	-7.6	-22.7
Fishery processing industry	-6.3	-8.1	-20.2
Fishery distribution industry	-8.4	-11.2	-22.1
Ocean and fisheries leisure tourism industry	-7.2	-9.3	-32.3
Ocean and fisheries equipment manufacturing	-6.8	-7.7	-14.5
Ocean and fisheries related services industry	-6.7	-7.5	-27.0
Total	-7.6	-8.1	-23.4

## 5. CONCLUSION

Countries around the world are implementing national strategies to secure the competitiveness of the ocean and fisheries industry. As the importance of the ocean and fisheries industry increases, it is essential to establish the industrial classification system and produce reliable statistics in consideration of the characteristics of the industry. Therefore, in this paper, the industrial special classification in the ocean and fisheries industry is presented, and industry trends are identified for each of the nine major industries in the ocean economy to provide milestones in panel data construction.

This paper identified three-year (2017-2019) industrial trends for each of the nine major industries according to the KIC-OF. The main results provided information and analysis of the number of businesses and workers, sales, annual labor costs, and business outlook. Regarding the number of businesses in the ocean and fisheries industry as of 2019, the ocean and fisheries related services industry accounted for the largest portion at 35.5%, followed by the fishery production industry and fishery distribution industry at 25.8% and 24.5%, respectively. In the case of employment, the numbers of workers in the fishery production industry and ocean and fisheries related services industry were also higher compared to other industries. On the other hand, the number of employees in the shipbuilding and offshore plant construction & repair industry was significantly higher when considering the number of businesses in the industry. It also recorded the second-highest sales among the ocean and fisheries industries. Therefore, continuous efforts for government support and industry protection are needed to improve the employment creation effect and competitiveness in the shipbuilding and offshore plant construction & repair industry.

In the case of the fishery industries (production, processing, and distribution), the number of businesses and workers had decreased relatively significantly, reflecting a negative business outlook. More specifically, in the production and distribution industries, almost 5,600 businesses and nearly 30,000 employees decreased, and the production industry also saw a 6% decrease in sales. The fishery industry is easily affected by external shocks such as natural disasters and Covid-19 due to its traditional industrial characteristics. Moreover, despite being a

labor-intensive industry, there is a limit to the supply of labor due to the retirement of the elderly, the reluctance of young people to find employment, and the limit of the influx of foreign workers. Therefore, it is important to strengthen the labor supply chain management between production, processing, and distribution in the fishery industry. Furthermore, it is necessary to propose sustainable industrial development plans to strengthen resilience against external shocks and alleviate the rigid labor market.

This study has academic significance by identifying industry trends according to the industrial classification system that reflects the characteristics of the ocean and fisheries industry. Despite these contributions, there are limitations. First, since the statistical surveys based on KIC-OF have only been three years, time series data for advanced analysis are insufficient. Thus, it is vital to continuously accumulate statistics data for ample research. Last but not least, further studies require value-added calculations to compare the size of ocean economies between countries.

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