

KOREA'S OCEAN ECONOMY

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Busan Harbor



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1. Introduction

Background

As humanity begins to recognize the ocean as a new solution at the moment it is searching for a new growth engine, developing a sustainable ocean economy has become a crucial and urgent global task. The OECD (2019) stressed the importance of scientifically evaluating the size of the ocean economy to diagnose the potential for innovation in the marine and fisheries industry and come up with development strategies amid rapid changes in the global economy such as digitalization.

In other words, in order for each nation to develop a sustainable ocean economy, the initial investments should be in evidence-based policies with data and scientific analysis. The major maritime nations have begun to focus on an ocean-oriented economy, enhancing the policy status of the ocean economy by formulating national plans related to ocean economic activities.

In order to diagnose the potential possibilities of the ocean economy, an understanding of the ocean economies of individual countries must come first. A country's ocean economy is closely intertwined with broader factors, including the particular environment, resources, technology, and economy of the nation, and so the type and size of ocean economic activities vary greatly from country to country. According to the OECD report for 2020, the six ocean economy, which are marine fisheries, marine aquaculture, marine fish processing, shipbuilding, maritime freight transport and maritime passenger transport, accounted for 2% of the national GDP of the high-income nations, 11% of GDP for middle-income countries, and 20% for low-income and island countries, with each nation having different characteristics depending on its own particular circumstances and stage of economic development.

Among the 30 domestic industries, Korea's ocean economic activities ranked ninth in terms of total output (based on the 2015 input-output tables). It amounts to 77.8 percent the size of the Korean automobile industry, and is approximately 2.7 times greater than the agriculture and forestry sectors. The ocean economic

activities has contributed to the national economy in terms of production, value-added and employment.¹⁾

However, the industry has seen a slight decline over the past five years, and a growth strategy is necessary in order for it to retake its position.

Despite this recognition by the Korean government and citizens of the importance of the oceans and fisheries industry, there is a serious shortage of major economic indicators and data on the sector. Without a sufficient assessment of the ocean economy in terms of its production, value-added and employment when compared with the national economy, it is difficult to accurately estimate the degree to which the ocean economy contributes to the national economy. The inability to accurately diagnose the present state creates significant limitations towards planning mid- to long-term development goals for the ocean economy five or ten years into the future. It is crucial to perform periodic and continual assessments and analyses in order to understand the ocean economy on a national scale. For this reason, this report intends to produce an annual report aimed at diagnosing the size and status of Korea's ocean economy, looking into trends in the individual industries that constitute it, and addressing the potential for Korea's ocean economy based on the results.

Objectives

This report aims to diagnose the range and size of Korea's ocean economy and recent trends in individual industries from 2015 to 2017. It is designed to help Korean and international experts in the ocean economy better understand Korea's ocean economy and its individual industries as well as contribute to assisting decision-making on policies for nurturing the ocean sector.

1) Korea is one of the world's largest shipping powers, handling 99.7% of its international freight as ocean freight shipping, and with its Port of Busan ranked as the second largest transshipment container port in the world. Korea also ranks first in terms of seafood consumption, at 58.9kg per person, while the number of annual beach users nationwide totalled around 100 million. With 3,348 islands and mudflats stretching 2,487km², Korea's maritime jurisdiction covers an area of territorial waters 4.4 times bigger than its land. With 32.9% of the entire population living in coastal areas, 80% of Korean people believe that the economic activities of the ocean economic activities contribute to national development.

Target industries

The ocean economy is defined as the sum of the ocean-based economic activities together with the services provided by the marine ecosystem. In this report, ocean economy focus on industrial activities in the market domain. Ocean economic activities are defined by taking into account all of their spatial, resource and behavioral aspects. The spatial dimension of ocean economic activities consists of industrial activities carried out in the ocean (including the coastline, sea area and marine spaces), the resource dimension consists of investments based on marine resources and the ocean environment, whereas the behavioral dimension includes industrial activities closely associated with use, development, management and preservation activities.

The ocean economic activities analyzed in this report are ten industrial activities that were selected based on Korea's 2018 Marine and Fisheries Industry Special Classification System.²⁾ The analysis is based on the 2015-2017 input-output tables, the one most recently published by the Bank of Korea.

2) The Marine and Fisheries Special Classification System consists of nine sections, 29 divisions, 67 groups, and 143 classes. This study analyzes 10 industries by dividing them into shipping and port industries.

2. Key Findings

As of 2017, the gross output of the Korean ocean economy amounted to about KRW 129.5 trillion, while its value added totalled approximately KRW 39.8 trillion, accounting for about 2.19% of the gross value added (GVA) of the entire economy. The number of employees working in the sector was 650,000. Marine and fisheries services take up 31.5% of the total amount of value added, followed by the building and repair of ship and offshore plant (21.6%), fisheries production and shipping (8.9%), and combined fisheries industries (fisheries production, processing and distribution) make up 22.6%. In terms of employment, the largest share is taken by the marine and fisheries services industry, followed by fisheries distribution, vessel and offshore plant construction and maintenance and fisheries production, respectively.

Table 1. Gross output and value added by industry in 2017

(In KRW trillion, 10 thousand persons %)

High-Level Industry Classification	Gross output	Share (%)	Value added	Share (%)	Employment	Share (%)
Fisheries production	8.8	6.8%	3.5	8.9%	5.1	7.9%
Fishery-products processing	11.0	8.5%	1.9	4.9%	3.4	5.3%
Fishery-products distribution	6.5	5.0%	3.5	8.8%	8.3	12.9%
Shipping	20.7	16.0%	3.5	8.9%	2.5	3.9%
Port	6.3	4.8%	3.1	7.9%	4.5	6.9%
Building and repair of ship and offshore plant	41.7	32.2%	8.6	21.6%	7.9	12.2%
Marine and fisheries equipment manufacturing	5.5	4.2%	1.5	3.8%	1.6	2.5%
Marine resources development and construction	2.4	1.8%	1.0	2.4%	1.2	1.9%
Marine leisure and tourism	0.9	0.7%	0.5	1.3%	1.0	1.6%
Marine and fisheries services	25.8	19.9%	12.5	31.5%	29.3	45.1%
Total	129.5	100.0%	39.8	100.0%	64.9	100.0%
National economy	4,168.4	-	1,812.1	-	2,453.0	-
Ratio of ocean economy to national economy	3.11%		2.19%		2.64%	

Resource: The author classified and calculated statistics for the ocean economic activities using the input-output tables (based on production price) and the employment table of the Bank Of Korea

From 2015 to 2017, the output of the vessels and offshore plant construction and maintenance industry and the output and value added of the shipping industry decreased significantly. In particular, the value added of the shipping industry decreased by 22.4% on an annual average and total output decreased by 16.7%. Excluding the vessels and offshore plant construction and maintenance (shipbuilding) and shipping, the value added of the ocean economic activities increased by 4.2% on average annually, from KRW 25.5 trillion in 2015 to 27.6 trillion in 2017. The number of workers employed decreased by 2.4 % on an annual average from 681,000 persons in 2015 to 649,000 persons in 2017. In addition, during the same period, the fishery product production, fishery product processing, and port industries showed a high growth trend above the average value-added growth rate of all industries, at 5.2%. However, the vessel and offshore plant construction and maintenance industry also showed a higher rate of value-added growth compared to all industries, owing to the base effect of the extremely low value added in 2015 with the recession in shipbuilding³⁾

Table 2. Changes in the output, value added and employment the ocean economic activities and ratio within national economy (2015-2017)

(In KRW trillion, 10 thousand persons)

Classification		2015	2016	2017
Output	Ocean economic activities	150.7	140.4	129.5
	National economy	3,833.6	3,925.1	4,168.4
	Ratio	3.93%	3.57%	3.11%
Value added	Ocean economic activities	39.1	39.4	39.8
	National economy	1,637.5	1,719.3	1,812.1
	Ratio	2.39%	2.29%	2.19%
Employment	Ocean economic activities	68.1	66.5	64.9
	National economy	2,412.2	2,427.9	2,453.0
	Ratio	2.82%	2.74%	2.64%

3) The increased value added in the industry is owe to the base effect of the increase in the value added. The value added in 2015 decreased significantly due to a large operating profit deficit, however, operating profit turned into a surplus.

Classification		2015	2016	2017
Ocean economic activities excluding shipbuilding and shipping	The Gross output	61.0	63.2	67.0
	Value added	25.5	26.6	27.6
	The number of employment	53.8	54.0	54.4

Resource: The author classified and calculated statistics for the ocean economic activities using the input-output table of the Bank Of Korea (based on production price) and employment table.

Table 3. classification of annual growth rate and growth groups in ocean economic activities (2015-2017)

Classification	Output		Value Added		Employment	
	CAGR	GGC*	CAGR	GGC	CAGR	GGC
Fisheries production	8.6%	⬆️	10.1%	⬆️	0.5%	⬆️
Fishery-products processing	6.3%	⬆️	8.1%	⬆️	4.5%	⬆️
Fishery-products distribution	4.9%	⬆️	4.4%	⬆️	-0.1%	⬇️
Shipping	-16.7%	⬇️	-22.4%	⬇️	-5.6%	⬇️
Port	6.2%	⬆️	5.0%	⬆️	2.0%	⬆️
Building and repair of ship and offshore plant	-16.4%	⬇️	5.3%	⬆️	-16.9%	⬇️
Marine and fisheries equipment manufacturing	-3.8%	⬇️	-5.9%	⬇️	-6.7%	⬇️
Marine resources development and construction	-2.7%	⬇️	-3.9%	⬇️	-11.2%	⬇️
Marine leisure and tourism	4.3%	⬆️	3.4%	⬆️	-0.7%	⬇️
Marine and fisheries services	5.4%	⬆️	4.0%	⬆️	1.2%	⬆️
Total	-7.3%		0.9%	-	-2.4%	-
National economy	4.3%	-	5.2%	-	0.8%	-
Ocean economic activities except shipbuilding	-1.8%		-0.3%		0.3%	
Ocean economic activities except shipbuilding and shipping	4.8%		4.2%		0.6%	

Note: ⬆️ is a high-growth trend group (an industry grows higher than the GAGR of the total industries), ⬆️ is a growth trend group (an industry grows lower than the GAGR of the total industries, but makes a positive(+)growth rate), ⬇️ is a decline tendency group (an industry of which GAGR is negative(-))

* Growth Group Classification

A look into time-series changes reveals that the Korean ocean sector grew slightly from KRW 39.1 to 39.4 trillion in value added between 2015 and 2016, and continued to increase a little more to KRW 39.8 trillion in 2017. The decrease in value added in the shipbuilding industry, caused by a sharp decline in shipbuilding orders due to the global economic recession, improved slightly in 2017 compared to 2015. Excluding the marine and fisheries equipment manufacturing, marine resources development and construction, and the shipping sectors, the value added of all the sectors in the ocean economy increased in 2017 compared to 2015. However, the value added of the shipping industry decreased significantly after 2016 due to the downturn of the shipping industry and the bankruptcy of Hanjin Shipping. The large decrease in value added in the shipping industry offset the rise in value added in other subcategories of the ocean economy, resulting in an overall insignificant increase in value added for the entire ocean economy. The value added of the shipbuilding industry increased as the 2015 operating deficit of 2.48 trillion won improved in 2016 and turned to a surplus in 2017. However, in the case of the shipping industry, the value added of the shipping industry fell sharply as the foreign port transportation industry experienced a large deficit in 2016. The value added of the shipping industry decreased by 2.2 trillion won in 2016 and 166.3 billion won in 2017, plunging 22.4 percent in 2017 compared to 2015. This can be explained by the fact that shipbuilding and equipment manufacturing (21.6 percent), the shipping industry (8.9 percent) and port industry (7.9 percent), which are by nature rather sensitive to external economic changes, accounted for 38.4 percent (based on 2017 statistics) of the value added in Korea's ocean economy.

In the meantime, the global ocean economy (estimated at USD 1.5 trillion in value added, 2010, OECD) is structurally dominated by industries that mostly take advantage of natural resources: Offshore oil and gas (34%) and maritime and coastal tourism (26%) account for 60% of the total value added within ocean-based industries, whereas three other industries combined (shipbuilding and equipment at 15%, shipping at 5%, and port at 13%) account for only 33%.

Figure 1. GVA changes in the ocean economy (Korea)

(In KRW trillion)

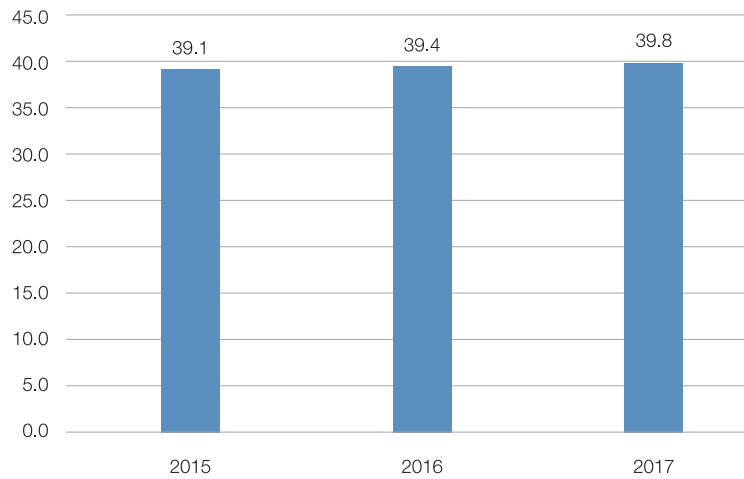


Figure 2. GVA changes in specific ocean economic activities (Korea)

(In KRW trillion)

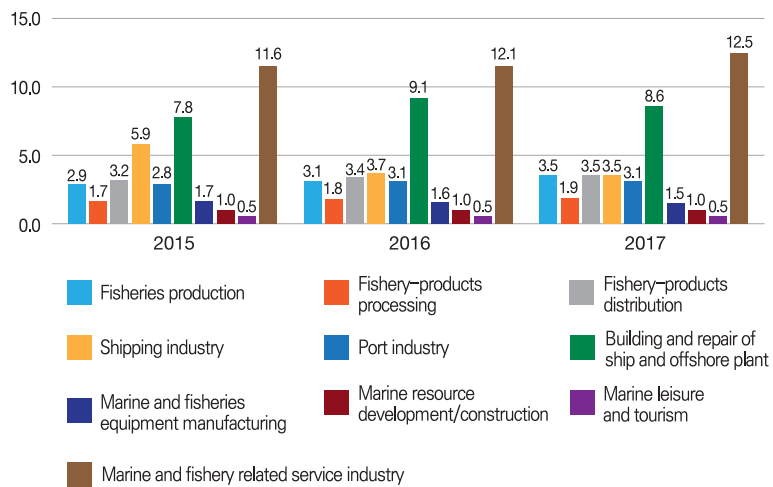


Figure 3. A Structural comparison of the Korean and global ocean economies

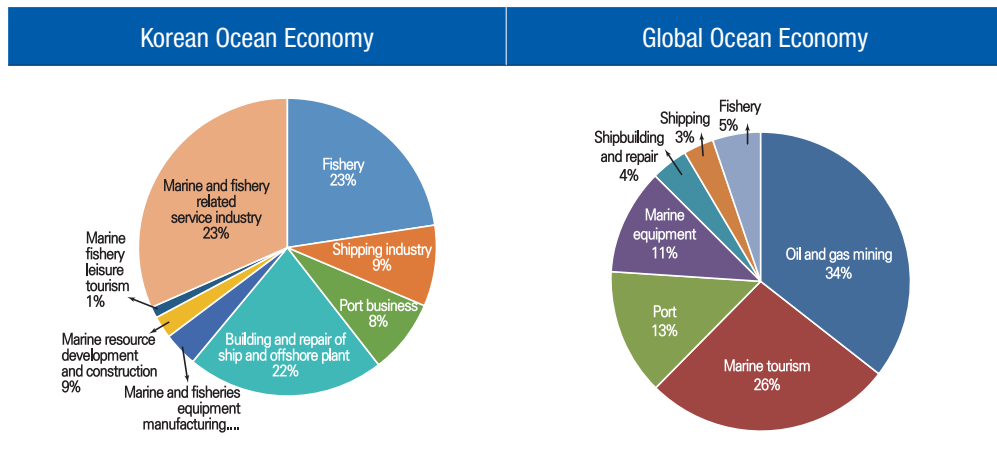


Table 4. Value added in the ocean economy – major economies and Korea

Category	US	China	UK	Ireland	France	Portugal	New Zealand	Australia	Korea
Size of ocean economy (share in GDP)	2016 USD 313.7 billion (1.7%)	2018 CNY 8.3 trillion (9.3%)	2012 GBP 38.5 billion (4%)	2018 2.2 billion Euro (0.7%)	2011 30 billion Euro (1.2%)	2013 4.7 billion Euro (3.1%)	2013 4 billion NZD (1.9%)	2015-16 AUD 39.8 billion (2.3%)	2017 USD 31.58 billion (2.0%)
Top industry (share in the sector)	Oil and gas/sand and gravel mining (36.8%)	Marine tourism (19.6%)	Oil and gas (51.1%)	Maritime logistics (31.3%)	Coastal area tourism (48.3%)	Marine tourism (35.5%)	Marine mineral resources (48.3%)	Marine leisure and tourism (44.3%)	Marine and Fisheries services (26.3%)
Second largest industry (share in the sector)	Marine tourism and leisure (33.3%)	Vessel traffic and marine transport (7.8%)	Marine transport (18.2%)	Marine tourism and leisure (29.1%)	Oil and gas services (14.2%)	Fisheries (25.7%)	Shipping (24.2%)	Oil and gas mining (37.9%)	Vessel and offshore plant construction and maintenance (20.0%)

* Converted at the average exchange rate of Korean won (1130.50) against the US dollar (market price) for 2017, published by the Bank of Korea. As for other countries, food and accommodations are included in marine leisure and tourism industries.

Source: KMI, "2020 The ocean economy Analysis Report– based on the input-output tables of 2016–2017" 2021, p.78-79, Australian Institute of Marine Science, "The AIMS index of marine industries", 2018 p.17

3. Sectoral Findings

(1) Fisheries

Fisheries refer to industries that catch, harvest or cultivate marine animals and plants in seas, rivers, lakes or other bodies of water or industries that process or distribute such marine animals and plants. The Marine and Fisheries Industry Special Classification system classifies fisheries largely into fishery production, processing and distribution industries.

According to the 2018 Marine and Fisheries Industry Statistics Survey conducted by the Ministry of Oceans and Fisheries (MOF), a total of 90,809 businesses are engaged in the fisheries industries (production, processing and distribution). In 2019, exports of marine products rose to \$2.51 billion, while imports were at \$5.79 billion, down 9.7% from \$6.42 billion the previous year. Per capita fishery product consumption in 2018 was 68.1 kg, while the self-sufficiency rate for fishery products was recorded at 69.3%.

The fisheries industry makes fishery products available as sources of quality animal protein at relatively low prices. Recently, however, it has faced various challenges, such as climate change, marine environmental pollution, decreasing marine resources, an aging population of fishermen and women as well as a new problem, the response to Covid-19. In particular, the spread of Covid-19 has led to a decrease in the offline consumption of fishery products, a decrease in foreign worker labor, decreased demand for tourism in fishing villages, and an increase in at-home and online consumption. In the future, policies must be suggested to establish an environment for sustainable fisheries production, to develop future fishery products, to enhance efficiency and transparency in the distribution of fishery products, and to strengthen the safety management of fishery products.

Fisheries production	Fishery-products processing	Fishery-products distribution
- Fishing - Aquaculture - Fishing and services - Salt harvesting	- Fish product processing and preservation - Seaweed processing and preservation - Salt processing - Other fishery processing	- Fishery products brokerage, wholesale and retail - Fishery products transportation and warehousing

Fisheries production (fishing and aquaculture)

Under the Marine and Fisheries Industry Special Classification system, the fishery production industry is divided into fishing, aquaculture, the fishing-related services industry, and salt harvesting. The fishing industry is subdivided into marine and inland fisheries, and marine fisheries are broken down further into deep-sea, offshore, and coastal fisheries. Aquaculture is divided into marine aquaculture, inland aquaculture, and ornamental aquatic animal and plant farming, while fishing-related services is divided into fishery catch transportation and other fishing-related services.

Domestic fisheries production in 2019 was 3.83 million tons (KRW 8.339 trillion in value), of which 914,000 tons were produced by offshore and coastal fisheries, 2.37 million tons by aquaculture and farming, 510,000 tons by deep-sea fisheries, and 35,000 tons by inland fisheries. As of 2019, there were 65,835 vessels engaged in fisheries, weighing 557,000 tons. The total number of aquaculture licenses issued was 10,045 for a total licensed area of 161,750 ha. As for fishing ports, the bases of fisheries production, there are 113 national ports, 287 provincial ports, and 623 residential ports.

The recent situation of the fisheries production industry is characterized by reduced offshore and coastal fisheries production due to diminishing marine resources, continued growth in seaweed farming production, and the deteriorating environment of aquaculture farms. While offshore and coastal fisheries production is on the decrease, aquaculture production is increasing

rapidly. Aquaculture production has been growing at an annual average rate of 6.4% for the past 10 years (2010–2019). Total production growth has been driven by seaweed production, which has been growing at an annual average rate of 8.1%.

The Ministry of Oceans and Fisheries will establish a second framework plan on developing fisheries and fishing villages based on the Framework Act on Fisheries and Fishing Villages Development. This plan will present the mid- to long-term vision and goals for the sustainable growth and competitiveness of fisheries and fishing villages and an action plan will be prepared for policy implementation over the next five years. Under the vision of “a fisheries industry and fishing villages preparing for the future with the people,” policy goals will be set such as production and self-sufficiency, value added in the fisheries industry, fishery food production industry, marine product exports, and fishing household income, and strategies and detailed policy tasks to achieve them will be presented.

Fishing	Aquaculture
- Marine fisheries (deep-sea, offshore and coastal fisheries) - Freshwater fisheries	- Marine aquaculture - Inland aquaculture - Ornamental aquatic animal and plant farming
Fishing related service	Salt-harvesting
- Fishery catch transportation - Fishing–related services	

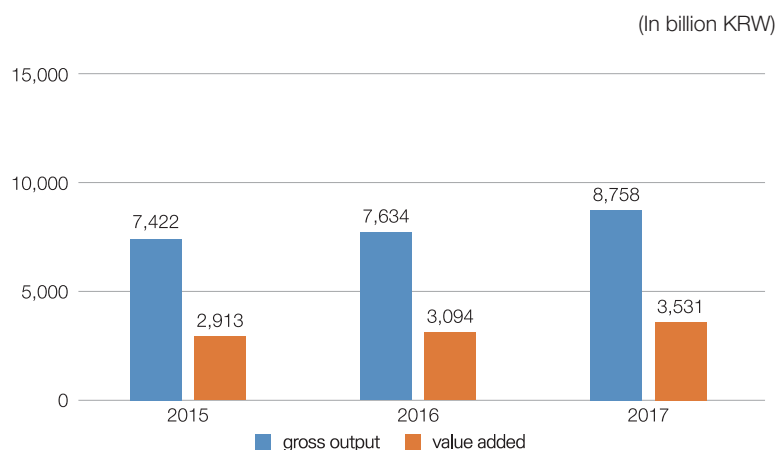
In 2017, the fisheries industry produced a gross output of KRW 8.758 trillion, an increase of 18% from 2015. Value added was reported at KRW 3.531 trillion, recording a 21.2% rise from 2015. Employment stood at 50,900 in 2017, marking an decrease of 1.0% from 2015.

Table 5. Output, value added and employment of the fisheries production industry

(In billion KRW, thousand persons, %)

Category	2015	2016	2017	Growth
Gross output	7,422	7,634	8,758	18.0%
Value added	2,913	3,094	3,531	21.2%
Employment	50.4	52.1	50.9	-1.0%

Figure 4. Trends in the output and value added in fisheries production



Fishery-products processing

Under the Marine and Fisheries Industry Special Classification system, the fishery-products processing industry is divided into fish processing and preservation⁴⁾, seaweed processing and preservation, salt processing, and other fish processing. The fisheries processing statistics for 2019 released by the MOF put the number of fishery processing enterprises nationwide at 5,441, with about 1.08 million tons of processed fish production. Among the various types of processed products, frozen products, which are classified as requiring a relatively low-tech processing method, make up 32.9% of the total production, whereas seaweed products account for 18.2%, fish paste products for 14.5%, and seasoned products for 6.8%.

The fishery-products processing industry is recently witnessing drastic changes in consumption trends due to increases in one-person households and greater participation by women in economic activities, as well as an expanding aging population. As recent seafood product consumption has trended towards more high-end, simple and diversified products, ecological and ethical consumption has emerged as a critical issue. In the post-COVID-19 era, the government is expected to implement policies that promote adaptability in the fisheries processing industry, build a distribution system for sustainable fisheries products, develop new customized products to target consumer markets, and establish a win-win cooperative system between producers and consumers.

Fish processing and preservation	Seaweed processing and preservation
- manufacture of smoked, cooked or similarly prepared aquatic animal products - manufacture of dried and salted aquatic animal products - manufacture of frozen aquatic animal products - other processing and handling of aquatic animal products - manufacture of animal oils and fats	Salt processing
	Other fish processing

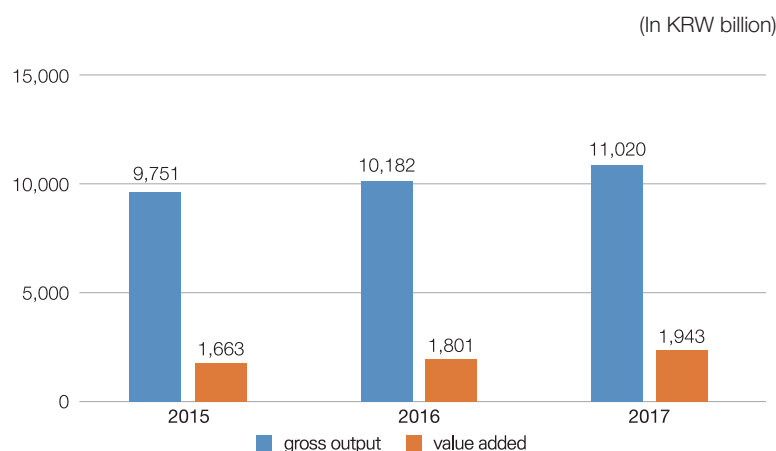
4) It is divided into four sub-industries: the manufacture of smoked and cooked aquatic animal foods and similar products, the manufacture of dried and salted aquatic animal food products, the manufacture of frozen aquatic animal food products and the manufacture of aquatic animal oil and fat-based products.

In 2017, the fishery-products processing industry showed an increase in gross output, value added, and the number of employees compared to 2015. The gross output of the industry in 2017 amounted to KRW 11.020 trillion, a growth of 13.0% against 2015. The GVA reached KRW 1.943 trillion, a 16.9% increase from 2015. The number of employees grew by 9.5% to 34,500, compared with 2015.

Table 6. Output, value added and employment of the fishery-products processing

(In billion KRW, thousand persons, %)				
Category	2015	2016	2017	Growth Rate
Gross output	9,751	10,182	11,020	13.0%
Value added	1,663	1,801	1,943	16.9%
Employment	31.5	31.2	34.5	9.5%

Figure 5. Trends in the output and value added of the fishery-products processing



Fishery-products Distribution

Pursuant to the 'Marine and Fisheries Industry Special Classification Scheme', the fishery-products distribution industry is divided into two sub-industries: wholesale and retail fishery product brokerage and fishery product transportation and warehousing. The brokerage, wholesale and retail industry is subdivided into fishery product brokerage, fishery product wholesale and retail, and ornamental aquatic animal and plant wholesale and retail, whereas the transportation and warehousing industry is broken down into fishery product transportation and refrigerated and frozen fishery product warehousing.

According to a 2018 fact-finding survey conducted by the MOF, there were 42,334 companies engaged in fishery product distribution. As of 2018, there were 222 auction markets (at places of origin) nationwide, and route sales made through this network⁵⁾ totalled 1.608 million tons. Meanwhile, fishery products traded at wholesale markets close to consumers across the country totalled 383,000 tons in 2018.

Currently, the Ministry of Oceans and Fisheries is pushing for various policy tasks to modernize fishery distribution facilities for producers and consumers, establish a sanitary and safety system for auction markets at HACCP standards, expand low-temperature distribution facilities, standardize marine product ratings and packaging, and promote the online and direct distribution of fishery products.

Fishery product brokerage, wholesale and retail	Fishery product transportation and warehousing
- Fisheries product brokerage (domestic and international) - Fisheries product wholesale and retail - Ornamental aquatic animal and plant wholesale and retail	- Fisheries product transportation - Refrigerated and frozen fisheries product warehousing

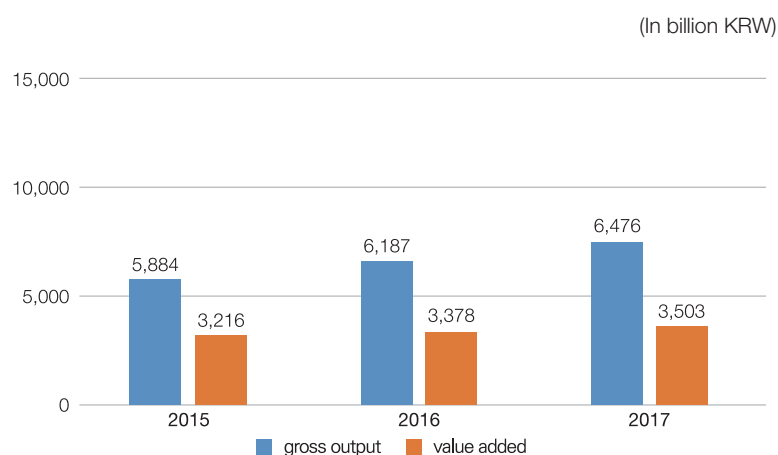
5) Route sales refer to the sale and distribution of fishery products through the distribution system of the National Federation of Fisheries Cooperatives (auction markets at places of origin).

The gross output of the industry in 2017 reached KRW 6.476 trillion, an increase of 10.1% from 2015, while its GVA surged by 8.9% to KRW 3.503 trillion over the same period. The number of employees decreased by a slight 0.1% to 83,500, compared with 2015.

Table 7. Output, value added and employment of the fishery-products distribution

(In billion KRW, thousand persons, %)				
Category	2015	2016	2017	Growth
Gross output	5,884	6,187	6,476	10.1%
Value added	3,216	3,378	3,503	8.9%
Employment	83.6	82.5	83.5	-0.1%

Figure 6. Trends in the output and value added of fishery-products distribution



(2) Shipping Industry

The shipping industry is divided into passenger transportation, freight transportation, and other shipping services supporting the transportation sectors. Both transportation sectors are divided into international water transportation, which takes place outside of and beyond national borders, and coastal water transportation, which occurs within national borders.

Other shipping services include tugboat operations, marine transportation brokerage services for marine freight and vessel chartering, shipping agencies that serve as agents for transactions between marine transportation providers, vessel leasing services that lease vessels owned by one person to another, and vessel management services to support the management of vessels, oil, ship supplies and crew.

Passenger transportation	Freight transportation	Other shipping services
- International water transportation - Coastal water transportation - Other passenger transportation	- International water freight - Coastal water freight	- Tugboat operation - Marine transportation brokerage services - Vessel leasing service - Vessel management service

The type of business that represents the largest share of the shipping industry is international water freight transportation. This can be broken down into container ship, dry cargo vessel, oil tanker and special vessel markets, depending on the characteristics of the freight transportation and vessels involved. In a trading nation with an outward-oriented economic structure like Korea, the shipping industry serves as part of the export/import logistics infrastructure and contributes greatly to the development of the national economy.

Korea's seaborne trade volume for exports and imports recorded 1.43 billion tons (927.85 million tons in imports, 401.3 million tons in exports) in 2019, which means that 99.7% of all trade (exports and imports) was transported by sea. About 150 shipping carriers conduct business transporting export and import

cargoes. In 2019 alone, 124 of these carriers grossed KRW 32.66 trillion in revenue from export/import freight transportation and marine transportation services for third-country markets. This revenue includes foreign exchange earnings worth USD 14.9 billion earned through export cargo and freight for third-countries. When foreign exchange earnings from passenger transportation and vessel leasing are added to this, the total foreign exchange earned by the international water transportation industry in 2019 amounts to USD 19.1 billion.

The international water freight transportation industry in particular faces a high risk of fluctuations in market prices, such as freight rates and vessel prices, due to global economic fluctuations and inelastic vessel supply. To manage such market risks, carriers and shippers enter into long-term contracts, and freight rate derivatives are offered in the dry cargo vessel and oil tanker markets.

The total freight transported by the domestic coastal water transportation industry was 214.82 million tons as of 2019. A total of 789 coastal freight transportation operators owned a total of 1,972 vessels. In comparison, a total of 14.59 million passengers traveled using coastal water transportation services in 2019. A total of 59 coastal passenger transportation operators owned a total of 162 vessels.

In 2016, Hanjin Shipping, which had been the largest container shipping company in Korea, filed for court receivership and was liquidated in 2017. It is urgent that the government and private industry cooperate and devote greater efforts to restore the industry to a level appropriate to the status of Korea as a trade nation. To that aim, the government founded the Korea Ocean Business Corporation in July 2018 to support shipping companies with ship financing and effectively carry out the implementation of Mandatory National Marine Transport programs and the provision of ship scrapping subsidies.

Meanwhile, the Ballast Water Management Convention, whose enforcement was deferred by two years in 2017, entered into force in September 2019, and regulations on sulfur oxide (SOx) emissions were further reinforced in 2020. It should be particularly noted that the SOx regulations will force shipping companies to switch to low-sulfur fuel such as LNG or install scrubbers to remove sulfur oxides.

From 2015 to 2017, the shipping industry tumbled significantly in total production, value added, and employment. In particular, value-added declined in 2016 due to a large operating deficit of the international water transportation industry. The international water transportation industry then bounced back with an operating surplus in 2017, however, the actual GVA decreased sharply compared to the operating profits of 2015.

In 2017, the shipping industry produced a gross output of KRW 20.743 trillion, down by 30.7% from 2015, whereas its GVA recorded KRW 3.537 trillion, posting a decline of 39.7% from 2015. Employment also fell by 10.6% to 25,200 persons over the same period.

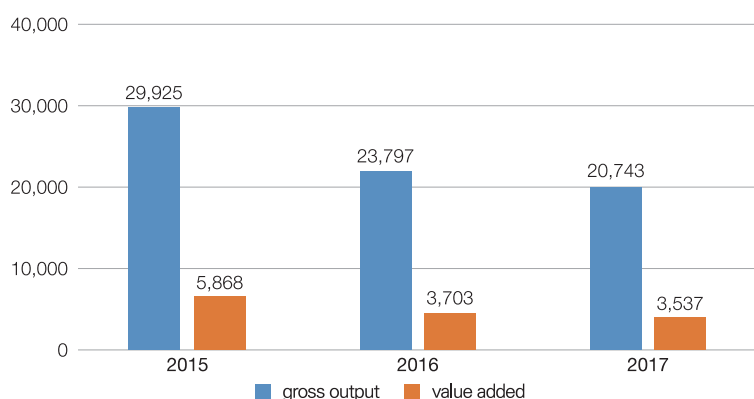
Table 8. Output, value added and employment of the shipping industry

(In billion KRW, thousand persons, %)

Classification	2015	2016	2017	Growth
Gross output	29,925	23,797	20,743	-30.7%
Value added	5,868	3,703	3,537	-39.7%
Employment	28.2	28.4	25.2	-10.6%

Figure 7. Trends in the output and value added of the shipping industry

(In billion KRW)



(3) Port Industry

The port industry is divided into two sectors: port transport support services which provide logistics services within a port and other port services that provide a wide range of incidental services. The port loading business, which offers services to load and unload international trade cargo and domestic coastal freight at ports, plays a very important role in the national logistics system.

The port storage business provides warehousing services for freight at ports, while the 'cargo inspection, certification and weighing services' business provides services for calculating the quantity of cargo, verifying the delivery and acceptance of cargo, and measuring cargo weights in the process of handling cargo at ports. The freight packaging business offers packaging services for freight, while the port and other marine terminal operations business provides terminal services. The specialized ship supplies business provides food, supplies and spare parts to vessels arriving in ports, and the port guard and security services business plays the role of safeguarding the ports.

In the meantime, other marine transport support services provide various support services such as pilotage, sea-fastening of cargo, and line handling.

Port transportation services	Other port business
- In-port storage - Port loading business - Cargo inspection, certification and weighing services	- Freight packaging business - Port and other marine terminal operations business - Specialized ship supplies business - Port guard and security services business

Korea has a total of 60 designated ports with 31 trade ports and 29 coastal ports. Despite intensifying trade disputes between the U.S. and China since July 2018, spreading protection trade, and Japan's export regulations, Korea's port cargo volume maintained a small but solid growth rate of 3.2% in 2018 and

1.2% in 2019. Korea's port cargo volume reported in 2019 was broken down into 501.3 million tons in exports, 927.85 million tons in imports, and 214.82 million tons of domestic coastal cargo.

In 2019, cargo handling by port was 468.76 million tons at Busan Port, 39.71 million tons at Gwangyang Port, 22.38 million tons at Ulsan Port, and 157.45 million tons at Incheon Port.

The Port of Busan is a major container transshipment hub in Northeast Asia, which serves China north of Shanghai, the west coast of Japan and many other regions with container cargo transshipment. As of 2019, the Port of Busan handled a total container volume of 21.99 million TEUs and Gwangyang Port handled 2.38 million TEUs during the same year, serving as a Korea's key logistics port along the ocean routes for international trade together with the Port of Busan.

The Ministry of Oceans and Fisheries is currently establishing the 4th Port Master Plan ('21-'30) to cope with changes in global economic conditions, shipping and port environments. The Port Master Plan (in 10-year increments) is a top-level plan (Article 5 of the Port Act) for a total of 60 ports that includes port development strategies, policy directions for individual ports, and development and operation plans. Through this plan, the Ministry of Oceans and Fisheries plans to strengthen the comprehensive logistics function to ensure the global competitiveness of Korea's ports* and to focus on creating new jobs and increasing value added in the port area by expanding related infrastructure in due course.

In order to increase the competitiveness of Korea's port industry, the government needs to push aggressive policies such as improving port operation efficiency, attracting industrial complexes for companies that create high value-added, and consolidating port security and safety.

The gross output of the industry in 2017 was reported at KRW 6.260 trillion, growing at a rate of 12.8% since 2010, its GVA climbed by 10.2% to KRW 3.140 trillion from 2015, and employment rose by 4.0% from 2015 to 2017 to around 44,600.

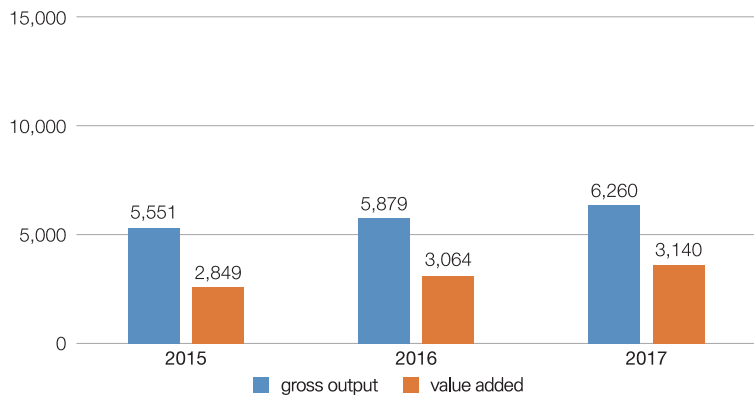
Table 9. Output, value added and employment of the port industry

(In billion KRW, thousand persons, %)

	2015	2016	2017	Growth
Gross output	5,551	5,879	6,260	12.8%
Value added	2,849	3,064	3,140	10.2%
Employment	42.9	41.9	44.6	4.0%

Figure 8. The Trends of output and value added in the port industry

(In billion KRW)



(4) Building and Repair of Ship and Offshore Plant

Building and repair of ship and offshore plant is a knowledge-intensive key industry that designs and builds a great variety of vessels and offshore structures for such industries as shipping, ocean development and resource production, fisheries, marine leisure and tourism, and the arms industry. Korea's shipbuilding industry is driving the development of its global counterparts on the strength of its world-class competitiveness. According to Clarkson Research, a British shipbuilding and shipping market analysis agency, total global ship orders declined from 31.08 million compensated gross tonnage (CGT) in 2018 to 25.29 million CGT due to the US-China trade dispute and environmental regulations that moved shipowners to slow operation. Korea, however, completed 9.43 million CGT through concentrated orders in the second half of 2019.

The building and repair industry of ship and offshore plant is classified largely into the construction and maintenance of various types of vessels, the construction and maintenance of offshore plants and structures, and components manufacturing for vessels and offshore plants. First, building and repair of ship is defined as industrial activities that build or repair all types of vessels with varying purposes, ranging from freight or passenger transport, fishing and angling to specialized purposes such as medical, fire-fighting and security tasks. Second, building and repair of offshore plant refers to industrial activities that build or repair offshore plants, offshore oil-and gas-producing structures, or non-seagoing vessels. Lastly, manufacture of sections for ship can be defined as industrial activities that manufacture parts and components for various types of vessels as well as offshore plants and structures.

The building and repair industry of ship and offshore plant has the following characteristics. First of all, it has profound ripple effects on downstream industries that require vessels for their operations, such as shipping and fishery industries, as well as upstream industries, such as steel, machinery, electricity, electronics and chemicals. Second, it creates a large number of jobs because the industry requires not just design, production and control technologies, but also advanced information technology (IT). Besides this, it is also critical for the industry to

secure an adequate level of skilled labor since there are limitations in automating the great diversity of shipbuilding processes and the process of constructing large-scale structures inherent in the industry. Third, it is a capital-intensive industry as it needs to be equipped with large-scale production equipment and facilities including fleet, docks and cranes. Fourth, it contributes greatly to the improvement of the trade balance as the construction of high-priced export ships can generate high foreign exchange earnings and subsequently make high contributions to exports. Fifth, it is also very important from the perspective of national defense. There are many countries in the world that strive to maintain and develop vessel and offshore plant construction into a national industry, regardless of its market competitiveness.

According to the Ministry of Trade, Industry and Energy, the shipbuilding industry of Korea received 47% of the total global orders in the second half of 2019. Korea’s total shipbuilding orders in 2019 reached 9.43 million CGT, ranking first in the world for two years in a row. Over the same period, Korean shipbuilders maintained this success by racking up orders worth 22.3 billion USD. Although the extension of the US-China trade conflict would bring economic uncertainty, the Korean shipbuilding industry continues to grow from the increased need to replace older vessels due to the tightened regulations of the International Maritime Organization.

Building and repair of ship	Manufacture of sections for ship
- Construction and maintenance of vessels for freight or passenger transport - Construction and maintenance of vessels for fishing and angling - Construction and maintenance of vessels for other uses	- Manufacture parts and components for various types of vessels - Manufacture parts of vessels for fishing and angling - Manufacture parts of vessels for other uses - Manufacture offshore plants and structures
Building and repair of offshore plant	
- Construction and maintenance of offshore plants and structures	

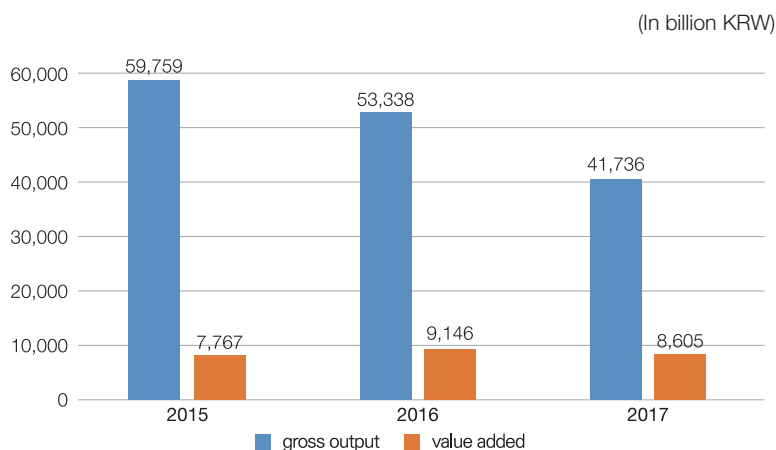
In 2017, the gross output from the building and repair of ship and offshore plant amounted to KRW 41.736 trillion won, down 30.2 percent from 2015. On the other hand, its GVA increased to 8.605 trillion won, up 10.8 percent from 2015. The increase in the industry's GVA, despite its sharp decrease in output, owes to the reduced deficit in operating profits, one of the value added components, resulting in a surplus.⁶⁾⁷⁾ The number of persons employed drastically fell by 30.9% to 79,000 in 2017, compared to 2015.

Table 10. Output, value added and employment of the building and repair of ship and offshore plant

(In billion KRW, thousand persons, %)

	2015	2016	2017	Growth
Gross output	59,759	53,338	41,736	-30.2%
Value added	7,767	9,146	8,605	10.8%
Employment	114.4	96.9	79.0	-30.9%

Figure 9. Trends in the output & value added in the building and repair of ship and offshore plant



6) Value added consists of the sum of employee remuneration, operating surplus, fixed capital consumption, and production tax (subsidy deduction).

7) In 2015, operating profits suffered a significant loss, but the deficit decreased in 2016 and operating profits shifted to a surplus in 2017. In addition, as output decreases, employee remuneration among components of value added gradually decreases.

(5) Marine and Fisheries Equipment Manufacturing

This industry produces equipment, devices and materials specialized for ocean-based activities as well as equipment and materials for processing marine resources. It includes the designing and manufacturing of various types of equipment and materials installed in vessels and offshore plants, such as power and propulsion systems and auxiliary machinery, navigation and communication equipment, mooring and unloading equipment, and accommodation and safety equipment. The production and international trade of marine and fisheries equipment have recently been expanding. At the same time, the industry's relationship with the vessel and offshore plant construction and maintenance industry has also been shifting gradually from a previously vertical relationship to a horizontal cooperation under the industrial structure.

The marine and fisheries equipment manufacturing industry is divided largely into marine equipment manufacturing and fisheries equipment manufacturing. Marine equipment manufacturing is defined as industrial activities that produce equipment and materials for vessels such as radio navigational aid apparatuses, deck machinery, and marine pollution prevention equipment; equipment and materials for offshore plants such as drilling rigs, oil and gas processing equipment, and mooring equipment and facilities; equipment and devices for marine leisure and sports such as surfboards and scuba gear; and equipment and devices for exploring and developing marine resources, researching and analyzing the ocean, and cleaning and restoring the ocean environment. On the other hand, fisheries equipment manufacturing refers to industrial activities that produce equipment and materials for fishing such as cords, ropes and nets; aquaculture or fish farm facilities; aquaculture equipment and materials such as feeds, and equipment and materials for non-commercial fishing such as recreational fishing gear and bait.

A total of 1,654 businesses are engaged in the marine and fisheries equipment manufacturing industry, 553 businesses in marine equipment manufacturing and 1,101 businesses in fisheries equipment manufacturing, which account for a large proportion of the fishery equipment manufacturing industry. Since the marine and fisheries

equipment manufacturing industry is linked to diverse manufacturing sectors, it will lead the development of the ocean economy through high value-added.

Marine and fisheries equipment manufacturing	Fisheries equipment manufacturing
- Manufacture of equipment and instruments for vessel - Manufacture of equipment and instruments for offshore plants - Manufacture of equipment and devices for marine leisure and sports - Other marine equipment manufacturing	- Equipment and materials for fishing - Aquaculture equipment and materials - Manufacture of processing fisheries products - Manufacture of angling gear

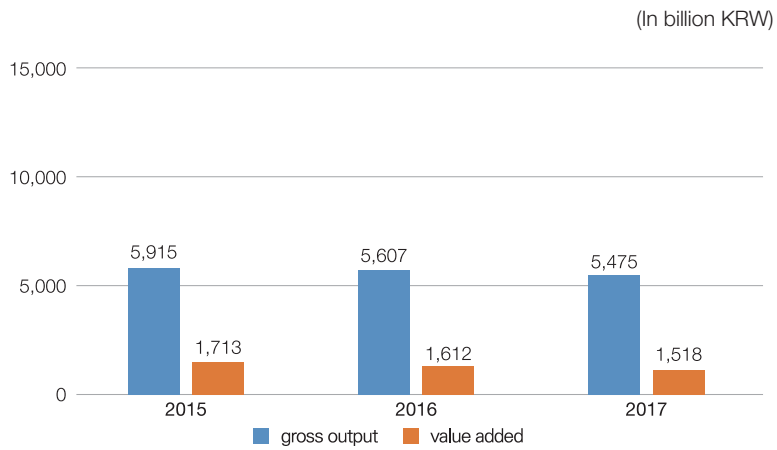
The marine and fishery equipment manufacturing industry experienced a decreasing trend from 2015 to 2017 in terms of total output, value added, and number of persons employed.

In 2017, the gross output of the marine and fishery equipment manufacturing industry was KRW 5.475 trillion, down 7.4% from 2015. The value added was KRW 1.518 trillion, an increase of 11.4% compared to 2015. The number of persons employed was 15,900 in 2017, down 13.1% from 2015.

Table 11. Output, value added and employment of the marine and fisheries equipment manufacturing industry

(In billion KRW, thousand persons, %)				
Classification	2015	2016	2017	Growth
Gross output	5,915	5,607	5,475	-7.4%
Value added	1,713	1,612	1,518	-11.4%
Employment	18.3	16.2	15.9	-13.1%

Figure 10. Trends in the output, value added and employment in the marine and fisheries equipment manufacturing industry



(6) Marine Resources Development and Construction

The marine resources development and construction industry involves activities related to the mining, harvesting and processing of minerals and other water resources from coastal regions and oceans, activities related to the production of marine biotech products and the construction of ports, bridges, and offshore plants and structures. Korea harvests sand and mines and extracts offshore oil and natural gas in its coastal region and exclusive economic zone (EEZ).

Sea sand accounts for over 10% of Korea's total aggregate supply, but the issue of resource depletion led the government to announce a policy in 2017 to reduce its use of sea sand. The government also plans to gradually reduce sea sand mining until 2022. Deep-sea water is also mined to produce a diversity of products such as bottled water, beverages and cosmetics. The Korean marine renewable energy industry seeks to generate power using tidal currents, tidal power, wave power, offshore wind power, offshore solar power, and ocean thermal energy conversion. The share of marine energy in renewable energy is about 1.1%.⁸⁾ The marine biotechnology⁹⁾ industry includes businesses that produce marine bio-tech food products, pharmaceuticals, and chemical products (cosmetics). According to the Marine Biotechnology fact-finding survey conducted in 2018 by the Ministry of Ocean and Fisheries, the marine biotech industry has a total of 390 businesses, and the number of research institutions is estimated at 154.¹⁰⁾

Korea's marine construction industry is mostly engaged in constructing and maintaining ports, building structures to protect the coastlines¹¹⁾ under coastal

8) Ministry of Trade, Industry and Energy, 2016, New and Renewable Energy White Paper for 2016, p.90

9) The industry that provides products and services using marine bio-resources including fish, seaweed, shellfish and other organisms through the application of marine life sciences

10) Ministry of Oceans and Fisheries (2019), Trends in the Marine Biotech Industry in 2018

11) The Ministry of Oceans and Fisheries has been implementing coastal protection projects for about 370 coasts, with a budget of about KRW 1.9 trillion, for a 10-year period (2010-2019)

improvement programs, reclaiming land, and constructing offshore plants as well as building bridges and laying submarine cables.

The total output of the marine resource development industry was KRW 2.351 trillion as of 2017, accounting for 1.8% of the total output of the ocean economy of KRW 129.5 trillion, and 2.4% of the total value added of the ocean economy of KRW 39.8 trillion. The marine resource development and construction industry is also on a decline in total output, value added, and the number of employed over the past three years.

In 2017, the gross output from the marine resource development and construction industry totalled KRW 2,351 billion, accounting for 1.8% of the total output of the ocean economy, which is KRW 129.5 trillion. It decreased by 5.4% from KRW 2,485 billion in 2015 to KRW 2,351 billion in 2017. The recent change in the gross output of the marine resources development and construction industry saw a drop to KRW 2,485 billion, down 5.4% from 2015. Meanwhile, it's the industry's GVA decreased to KRW 960 billion, down 7.6% from KRW 1.039 trillion in 2015. Employment stood at 12,300 persons in 2017, posting a decrease of 21.6% from 15,700 persons in 2015.

Marine resource development	Marine construction
- Marine mineral resource mining - Seawater processing and supply - Marine renewable energy development - Marine biotech product manufacturing	- Port and marine bridge construction - Offshore plant and structure construction

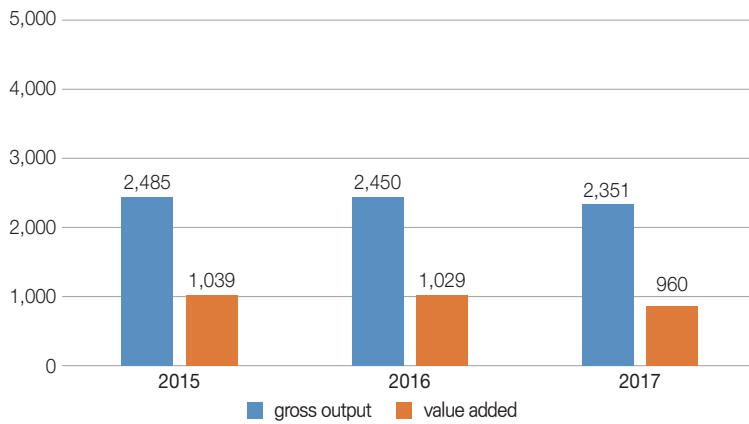
Table 12. Output, value added and employment of the marine resource development and construction industry

(In billion KRW, thousand persons, %)

Classification	2015	2016	2017	Growth
Output	2,485	2,450	2,351	-5.4%
Value added	1,039	1,029	960	-7.6%
Employment	15.7	13.6	12.3	-21.6%

Figure 11. Trends in the output, value added and employment in the marine resource development and construction Industry

(In billion KRW)



(7) Marine Leisure and Tourism

Marine leisure and tourism is defined as “tourism-related activities in communities near or adjoining the sea and coast” and relies directly or indirectly on ocean space.¹²⁾ It can also be defined distinctly into two different aspects, space and activity. In spatial terms, marine leisure and tourism refers to leisure and tourism that takes place in coastal areas or ocean space where there is a sphere of living or activity that occurs via the medium of the sea. In terms of activity, it includes all leisure and tourism activities that are related to the sea or use the sea directly or indirectly, as well as fishery-related leisure and tourism activities such as recreational fishing. That is, all leisure and tourism activities carried out in an ocean space such as the beach, on the sea or under the sea, as well as all other businesses related to them, can be defined as the marine leisure and tourism industry.¹³⁾ Also included are the marina industry, cruises, marine amusement parks and theme parks, maritime museums, and marine nature parks as well as marine tourism such as fishing and tourism businesses. In 2010, the Ministry of Oceans and Fisheries developed its First Marina Port Framework Plan (2010-2019) to initiate the systematic development of marina ports and later revised the plan (2015-2019).

In 2020, the Ministry of Oceans and Fisheries announced its Second Marina Port Framework Plan (2020-2029) to promote marine leisure culture based on ‘marina ports’ and to build a support system for invigorating the marina industry. Throughout the Second Marina Port Framework Plan, the Ministry designated eight marina ports and 70 planned regional marina ports. There are 272 MOF-designated beaches nationwide as of 2019 by the Act on the Management and Use of Swimming Beaches, with the annual number of visitors estimated at around 71.59 million in 2019. The angler population increased to 8.5 million in 2018. Thus, with the announcement of the Second Master Plan for the Promotion of Recreational Fishing (2020-2024), the Ministry of Oceans and Fisheries set out a vision for a safe and sustainable and recreational fishing industry to invigorate the

12) Korea Maritime Institute (2015), p.9.

13) Korea Maritime Institute (2015), p.9.

fishing industry and regional economies, and prepared a variety of promotional projects. Also, the Ministry of Oceans and Fisheries made plans for a regional base development project and is promoting ocean leisure tourism spots to meet the booming demand in ocean leisure tourism. Accordingly, the MOF announced that it would regionalize seven ocean leisure and tourism zones, and develop high potential regions in each zone as ocean leisure and tourism bases. As of 2020, five bases in total have been selected with operating expenses ranging from 40 billion to 50 billion KRW per base.

The gross output of the marine leisure and tourism industry was KRW 880.3 billion as of 2017, accounting for 0.7% of the total gross output of the entire ocean economy (KRW 129.5 trillion), whereas its GVA totalled KRW 503.8 billion, accounting for 1.3% of the sector (KRW 39.8 trillion). As measured by its share of the sector, the marine leisure and tourism industry still remains at a very low level in both output and value added.

The gross output of the industry in 2015 jumped by 8.7% from KRW 809.7 billion in 2015 to KRW 880.3 billion in 2017. Its GVA also increased by 6.9% from KRW 471.5 billion in 2015 to KRW 503.8 billion in 2017. By contrast, the number of persons employed was 10,200 in 2017, a slight decrease compared to 2015.

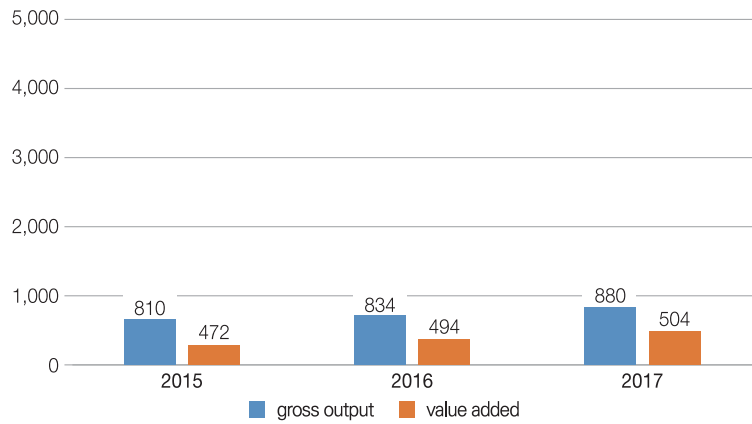
Table 13. Output, value added and employment of the marine leisure and tourism industry

(In billion KRW, thousand persons, %)

	2015	2016	2017	Growth
Gross output	810	834	880	8.7%
Value added	472	494	504	6.9%
Employment	10.4	10.5	10.2	-1.9%

Figure 12. Trends in the output and value added of the marine leisure and tourism industry

(In KRW billion)



(8) Marine and Fisheries Services

The marine and fisheries services industry is defined as “industrial activities that provide professional services specializing in ocean economic activities such as information, finance, insurance, law, management consulting, and leasing services.”¹⁴⁾ According to the Marine and Fisheries Industry Special Classification Definitions approved by Statistics Korea, this industry includes marine waste treatment and ocean cleaning/restoration, wholesale and retail of marine and fisheries equipment and materials, maintenance of marine and fisheries equipment and materials, marine and fisheries employment services and suppliers, marine and fisheries education and training services, marine and fisheries professional, science and technology services, marine and fisheries finance and insurance, marine and fisheries associations and groups, and restaurants specializing in fishery products.

It can also be classified according to the types of services offered in the field of oceans and fisheries: information provision services, financial and insurance services, legal and consulting services, and other professional services. Marine and fisheries services can create synergy if converged with major industries that currently play large roles in the Korean economy (fisheries, marine ports, shipbuilding, equipment and materials).

- Marine waste treatment and ocean cleaning/restoration
- Marine and fisheries equipment and materials - wholesale and retail
- Marine and fisheries employment services and suppliers
- Marine and fisheries education and training services

- Marine and fisheries professional, science and technology services
- Marine and fisheries finance and insurance
- Marine and fisheries associations and groups
- Restaurants specializing in fishery products

14) Ministry of Oceans and Fisheries (2016), pp.17-18.

Table 14. Output, value added and employment of the marine and fisheries services industry

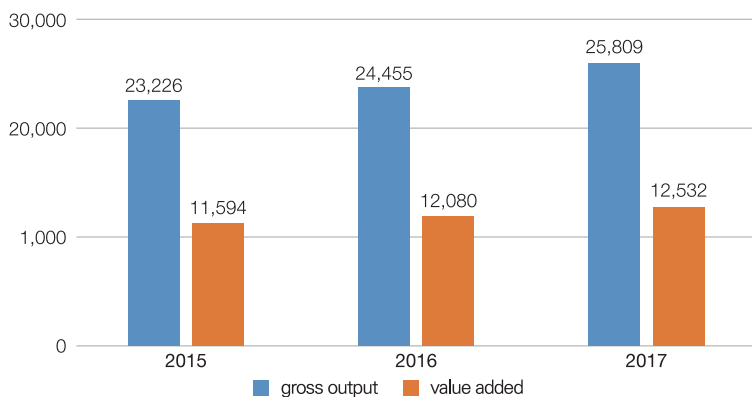
(In billion KRW, thousand persons, %)

	2015	2016	2017	Growth
Gross output	23,226	24,455	25,809	11.1%
Value added	11,594	12,080	12,532	8.1%
Employment	285.5	291.9	292.5	2.5%

The overall gross output, value added and the employment of the industry has tended to increase. As of 2017, the gross output of the industry totalled KRW 25.809 trillion, increased from KRW 23.226 trillion by 11.1%. Its GVA increased by 8.1% from KRW 11.594 trillion in 2015 to KRW 12.532 trillion in 2017. On the other hand, the number of persons employed slightly increased from 285.5 thousand in 2015 to 292.5 thousand people in 2017.

Figure 13. Trends of the output and value added of the marine and fisheries services industry

(In billion KRW)



4. Conclusions

With the pandemic of 2020, the world is undergoing tremendous economic changes. Delayed economic activities intensify the volatility of the global trade volume, which will bring many changes to Korea's shipping and port logistics industry in the future. At a time of high uncertainty, when policies for the economic reconstruction and maritime economic development need to be prepared, it is ever more significant to have an objective diagnosis of the past and present state of the fisheries industry and its prospects for the future. The Ocean Economy Research Division of the Korea Maritime Institute has carried out the task of diagnosing and analyzing Korea's maritime economy. Following the establishment of the input-output tables (2010-2015) based on the ocean economy in 2018 and 2019, in 2020, the research division determined the scale and industrial structure of the ocean economy from 2016-2017.

The gross output of the ocean economy in 2017 is estimated at about KRW 129.5 trillion, with its gross value added at around KRW 39.8 trillion, making up 2.2% of the total national GVA. In terms of the GVA, the gross output of marine and fisheries service industry accounted for 31.5% and made up the largest portion. Next came the building and repair industry of ship and offshore plant (21.6%), fisheries production industry (8.9%), shipping industry (8.9%), and fisheries product distribution industry (8.8%). In 2017, the output of the shipbuilding industry and the output and value added of the shipping industry plunged significantly compared to 2015. If the shipbuilding and shipping industries are excluded, however, the value added of other ocean economic activities grew from KRW 25.5 trillion in 2015 to KRW 27.6 trillion in 2017 at an annual average of 4.2%.

Industries with high growth potential, such as fisheries distribution, marine leisure and tourism, and marine fisheries services need a high value added

strategy, as well as major industries with a large ratio in the marine and fisheries industry, such as shipping, ports, and the fisheries industry. In particular, there is a need to strengthen the competitiveness of the fisheries distribution industry and to increase the added value of the fisheries processing industry on account of the change in demand patterns due to the COVID-19 situation. Shipping and shipbuilding sectors need convergent ways to link related services such as finance and law. Since the marine leisure and tourism industry has high growth potential in terms of added value and employment, a new growth strategy should be prepared in consideration of the marine leisure trends and demand that have changed since the COVID-19 outbreak. As the proportion of services in the domestic industry increases, the importance of marine and fisheries services is also expanding. This sector is expected to continue to grow in the future in terms of job creation and added value.

Future tasks related to the measurement of the ocean economy are as follows. Although the size of the current supply side of the marine leisure and tourism sector is small, it is necessary to analyze the effect in consideration of the demand side in the future. For this, it is necessary to redefine the spatial range of marine leisure and tourism industry activities in the marine sector, and to provide a measurement system that can grasp the scale of consumption and expenditure as well as the supply side currently being measured. Lastly, a satellite account for the marine and fisheries industry should be established, which can secure the punctuality of GDP data of the marine and fisheries industry in connection with national account data, and use this data to supplement the results of Interindustry analysis. To this end, with the support of the Ministry of Oceans and Fisheries, a three-year pilot study of the marine and fisheries satellite account is underway (2020-2022) and is scheduled to be published in 2023. The establishment of ocean economy satellite accounts will contribute to the accuracy of ocean economy measurement work in the future, to the development of an economic effect experimental (simulation) models and to the linking of mid-to-long-term prospects to future forecasting.

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Appendix 1. Marine and Fisheries Industry Special Classification Table

High-level classification	Mid-level classification	Low-level classification
Fisheries production	Fishing	Marine fishing
		Freshwater fishing
	Aquaculture	Marine aquaculture
		Inland aquaculture
		Aquarium fish and seaweed culture
	Services incidental to fisheries and aquaculture	Services incidental to fishing and aquaculture
	Salt production	Salt collection
Fishery-products processing	Fishery-product processing	Aquatic animal processing and storage
		Seaweed processing and storage
		Salt processing
		Other fisheries processing
Fishery-products distribution	Fishery-products brokering and wholesale/retail	Fisheries brokerage
		Fisheries wholesale/retail
		Aquarium fish and seaweed wholesale/retail
	Fishery-products transportation and storage	Fisheries transportation
		Cold storage warehouse for fisheries
Shipping and port industries	Shipping industry	Passenger transportation
		Freight transportation
		Other shipping services
	Port industry	Port transportation support services
		Other port business
Building and repair of ship and offshore plant	Building and repair of ship	Building and repair of cargo ship
		Building and repair of fishing boat
		Building and repair of other ship
	Building and repair of offshore plant and platform	Building and repair of offshore plant and platform
		Manufacture of sections for cargo ship
	Manufacture of sections for ship and offshore plant	Manufacture of sections for fishing boat
		Manufacture of sections for other ship
		Manufacture of sections for offshore plant and platform
Marine and fisheries equipment manufacturing	Marine equipment manufacturing	Ship-related equipment manufacturing
		Offshore plant-related equipment manufacturing
		Marine leisure and sports equipment manufacturing
		Other marine equipment manufacturing
	Fisheries equipment manufacturing	Fishing equipment manufacturing
		Aquaculture equipment manufacturing
		Fisheries processing equipment manufacturing
		Leisure fishing equipment manufacturing

High-level classification	Mid-level classification	Low-level classification
Marine resources development/construction	Marine resources production, supply, and development	Marine mineral resources mining
		Seawater processing and supply
		Marine renewable energy development
	Marine bio-products manufacturing	Marine bio-products manufacturing
	Port and sea-crossing bridge construction	Port construction
		Sea-crossing bridge construction
	Marine and fisheries plan and structure construction	Marine plant and structure construction
		Aquaculture facility and artificial reef installation and construction
Marine and fishing leisure and tourism	Marine leisure and tourism	Marine leisure facility operation
		Marine tourism facility operation
	Leisure and tourism	Recreational fishing tourism
		Other fishing leisure tourism
Marine and fisheries services	Marine waste processing, cleanup, and recovery	Marine waste processing, cleanup, and recovery
		Marine leisure and sports equipment wholesale and retail
	Marine and fisheries equipment wholesale and retail	Offshore plant and other equipment wholesale and retail
		Leisure fishing equipment wholesale and retail
		Ship, vessel components, and related equipment brokerage, wholesale, and retail
		Fishing and aquaculture equipment wholesale and retail
		Fisheries processing machine wholesale
	Marine and fisheries equipment repair	Marine equipment repair
		Fisheries equipment repair
	Marine and fisheries HR employment and supply services	Marine and fisheries HR employment and supply services
	Marine and fisheries education services	Marine and fisheries education services
	Marine and fisheries science and technology services	Marine science and technology services
		Fisheries science and technology services
		Marine R&D
		Fisheries R&D
		Marine and fisheries publishing and information system development
	Marine and fisheries finance and insurance	Marine and fisheries finance and insurance
	Marine and fisheries associations and organizations	Marine and fisheries associations and organizations
	Fish and seafood restaurants	Fish and seafood restaurants

Appendix 2. Output, Value Added and Employment Table for the Marine and Fisheries Sector in 2017 (in USD)

High-Level Industry Classification	Output (USD millions)	Value-added (USD millions)	Employment
Fisheries production	7,746.9	3,123.4	50,910
Fishery-product processing	9,727.2	1,713.3	34,418
Fishery-product distribution	5,728.0	3,098.7	83,450
Shipping industry	18,348.3	3,128.4	25,166
Port industry	5,537.4	2,777.8	44,592
Building and repair of ship and offshore plant	36,917.8	7,612.0	79,003
Marine and fisheries equipment manufacturing	4,842.8	1,343.0	15,897
Marine resource development and construction	2,079.9	849.0	12,343
Marine leisure and tourism	778.7	445.7	10,220
Marine and fisheries services	22,829.3	11,085.1	292,510
Total	114,536.4	35,176.3	648,509

Note: USD 1 = KRW 1,130.50 in 2017

Appendix 3. Method for Calculating the Ratio of the Marine and Fisheries Industry

1. Materials Used

The ratio of the marine and fisheries industry was calculated using the ‘Supply Amount by Sector Table’, which is appended to the Input-Output Table for 2015, 2015 economic census data, as well as marine and fisheries industry statistical surveys from 2016 to 2017. Statistics Korea’s pertinent surveys were utilized, such as the transportation industry survey and the service industry survey, as well as other industrial surveys.

2. Principles for Calculating ratio

The proportional size of each group on the Marine and Fisheries Industry Special Classification System was calculated utilizing the following five principles.

1) One-To-One Connection

If the Marine and Fisheries Industry’s Special Classification and the basic sector of the Input-Output Table are matched one-to-one, the ratio should be reflected as 1.

2) Utilizing the Attached Table (Supply Amount Table)

If the groups and categories in the Marine and Fisheries Industry Special Classification System do not connect one-to-one with the basic sectors of the Input-Output Table, the ratio is calculated by associating the classification in the Supply Amount Table by sector and by item, which is annexed to the Input-Output Table, and contains the supply amount for more detailed subcategories than the basic groups and classes in the Input-Output Table.

3) Utilizing the Ratio of Sales Survey Statistics

When the groups and categories of the Marine and Fisheries Industry Special

Classification System and the Supply Amount Table by sector cannot be linked one to one, a survey statistics authorized by Statistics Korea is used to calculate the proportion of the sales. Economic census microdata sales are used as the denominator, and marine and fisheries industry statistical surveys and relevant industrial statistics sales are used as the numerator.

4) Utilizing Statistics Besides Sales

When calculating the ratio of the marine and fisheries industry based on sales is difficult, the ratio of the ocean sector is calculated utilizing statistics besides sales. For example, the ratio of visitors to marine resource parks among all domestic natural parks is utilized for marine leisure and tourism and the ratio of sea aggregate collection out of the total amount of domestic aggregate collection is respectively utilized for marine resources and construction (aggregate collection).

5) Utilizing the Intermediate Demand Rate

In some sectors of the marine and fisheries equipment manufacturing industry and the marine and fisheries service industry, the demand for equipment (service) from the marine and fisheries industry becomes a numerator and the total intermediate demand for equipment as denominator

3. Targets and Time Series Processings

The ratio of the marine and fisheries industry derived in this study was applied to the row and column of each relevant marine and fisheries industry in the Domestic Transaction Table. That is, the derived ratio was applied to the output, including intermediate transactions and final demand, as well as added value. Also, in terms of employment, it is assumed that the employment coefficient of the parent industry in the sector based on the Input-Output Table is the same as that of the marine and fisheries industry. The same ratio of the marine and fisheries industry was applied to the Employment Table, which contains information on the number of employers and the number of employees per 1 billion won of output.

The ratio by year is calculated based on (1), (4), and (5) of the five principles for calculating proportion size introduced above, as well as the Domestic Transaction Table for the year (in the cases of (1) and (5)) and other statistics for the year. Other annual statistics (in the case of (4)) are used to calculate the ratio for each year. However, in the cases of principles (2) and (3), the ratio is calculated using the Supply Amount Table or economic census data published every 5 years under the assumption that the economic structure has not changed significantly. At this time, the standard for the utilization of published data every five years is to use the data from the year closest to the time of analysis. In this study, the ratio of the relevant sectors for 2016-2017 was calculated collectively and applied based on the 2015 reference data.



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