

# *A study on rebuilding the classification system of the Ocean Economy*

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**Abstract:** Many ocean countries have estimated and released the size of the ocean economy or industry. However it is difficult to compare the ocean economy among countries because the definition, classification standard and scope differ by each country. This study aims to provide concrete practical proposals for the definition, classification standard and scope of the ocean economy. With regard to the definition of the ocean economy, a combination of industrial and geographical perspectives is considered at the same time. As a result, the ocean economy is defined as the economic activities that directly or indirectly take place in the ocean, use outputs from the ocean, and put the goods and services into the ocean's activities. To determine the scope of the ocean economy, about 50 common words are extracted from the cases of 10 ocean country accounts, and 3 characteristics of the scope of the ocean economy are inferred from them. These are 'in the ocean', 'from the ocean', and 'to the ocean'. Besides, supply chain and relationship among the ocean economies are considered. According to the newly proposed definition and classification standard, 12 sectors are newly rebuilt as the ocean economy.

**Key words:** Ocean Economy, Definition, Classification Standard, Scope, Sector

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## 1. Introduction

Today, global society seeks economic development and environmental protection at the same time. A paradigm shift is imperative to fight against global crises that drive human civilization towards a grave threat. Global crises can be divided into three big categories. The first is climate change, which causes seawater temperature to rise, sea-level rise, ocean acidification and more. The second is resources depletion, which causes an insufficient supply of food, energy, water, and so on. The third is economic decline, which means the world economy has fallen into recession after the world financial crisis in 1998 and has not been recovered yet. These crises are the global as well as national and regional common challenges for human beings.

In the 21st century, the major ocean countries have reassessed the value of the ocean and coast, and have actively established strategies to develop and protect them. The USA, on April 16, 2013, issued a final plan to manage its oceans and to outline a strategy that aims to reconcile competing interests including fishing, offshore energy exploration, and recreational activities. In March 2011, China released the 12th 5-year Plan for National and Social Development that for the first time adopted a 'five-year-plan' for economic development in which developing the ocean economy has been identified as a key national development strategy. South Korea announced the second Marine and Fisheries Development Basic Plan in 2010. They believe that the global crises such as climate change, resources depletion and economic decline should be overcome through utilization of the ocean and coast.

Ocean and coastal ecosystems provide human beings with enormous economic and ecological services. The Southeast England Development Agency in the UK (2009) [1] estimated total sales of the world's marine industries were approximately US\$4 trillion in 2007, which created a value added equivalent to 3-4% of the world's GDP. Otherwise, while it is difficult to put a dollar value on some of the benefits ocean ecosystems provide, a report (2003) [2] shows that coral reefs among the ocean ecosystems provide US\$29.8 billion in net benefits in goods and services each year to world economies, including, tourism, fisheries and coastal protection.

As the importance of the ocean and coast has increased, each country has focused on the ocean economy. Many ocean countries have estimated and released accounts for their ocean economy or ocean industries. For example, in 2014, the National Ocean Economic Program (NOEP) in the USA announced the size of the ocean economy from 2005 to 2010 [3]. In 2010, the ocean economy comprised over 2.7 million jobs and contributed over \$258 billion (1.8%) to the GDP of the United States.<sup>1</sup> In the case of China, State Oceanic Administration (SOA) has estimated the size of the ocean industry every year from 2003. According to research conducted by each country around the world, the ocean economy or ocean industries produce from 1% to 5% of their country's GDP. Even China estimated total

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<sup>1</sup> The total contribution of the ocean economy, which includes indirect as well as direct contribution, is estimated at \$633 billion or 4.4% of national GDP.

production of its ocean industries was 9.6% of China's GDP in 2012. Regarding South Korea, the Korea Maritime Institute (KMI) estimated the total value-added of the ocean industry was 5.5% (direct 2.46% and indirect 3.04%) of its GDP in 2005 [4].

J.T. Kildow et al. (2009) [5] explained the desire to estimate the ocean economy very well. According to their opinion, the size, nature, and growth trends in these industries provide governments a factual basis for tracking changes in the state of the ocean-related economy as well as those industries that are part of the inputs to and outputs from its activities. In addition, governments are largely involved in regulating offshore resources such as fisheries, and oil and gas, as well as marine transportation, ship building and other marine construction activities.

However, it is difficult to compare the ocean economy among countries because the definition, classification standard and scope of the ocean economy differ by each country. Even the terminology that means the ocean economy is used differently, such as ocean industry, marine economy, marine industry, and so on. Classification standard and scope of the ocean economy are also different among countries. For example, the ocean economy in the USA is divided into 6 main sectors but it is divided into 18 categories in the UK. The UK excludes seafood processing from the ocean economy, while France includes electricity generation such as thermal power and nuclear power in it when other nations do not.

The major differences among the nations in classification standards and scope of the ocean economy comes mainly from three aspects, which are 1) whether public sectors are included or not, 2) whether activities related to the ocean are included or not, and 3) whether new ocean industries<sup>2</sup> are combined or not. In summary, we can't compare ocean economies exactly among countries because of the differences in classification standards and scope of it.

It seems clear that the probability of success in strategic ocean decision-making increases significantly when the availability of information and data on the ocean economy also increases. But the data continues to be dispersed and not homogenous. This study aims to provide concrete practical proposals on the definition, classification standard, and scope of the ocean economy. Even though Juan C. Suris-Regueiro et al. (2013) [6] studied this research topic, they only focused on the EU region. Therefore this study is the first attempt to deal with the entire global ocean economy. With these general aims, after this introduction, the second section will rebuild the terminology and definition of the ocean economy. The third section will look at the classification standards and scope of the ocean economy by each country around the world. The fourth section will show a concrete proposal for the classification standard and scope of the ocean economy. Lastly, the final section will sum up the conclusions.

## **2. Rebuilding the terminology and definition**

### **2.1. Rebuilding the terminology**

To classify the ocean economy, its terminology and definition must first be established. The terminology related to the ocean economy is used differently around the world, such as ocean industry, marine economy, marine industry, marine activity, and maritime sector. At first, 3 words, which are ocean, marine, and maritime, are used as a terminology that means ocean. 'Ocean' is usually used in the USA and Ireland, but 'Marine' is widely used in the UK, France, Australia, Canada, New Zealand and EU. 'Maritime' is commonly used in Spain. In the case of China, Japan, and South Korea, which are non-English speaking countries, those terminologies are mixed when they are translated into English.

It is unnecessary to distinguish among these terminologies because they are interchangeable among the nations.<sup>3</sup> But 'Ocean' could be used as a representative terminology among them. That's because 'Ocean' is more useful than the others. For example, 'Ocean' is usually used as a terminology that is distinguished from 'Coast' as well as 'Land'.

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<sup>2</sup> They include the industries that enter into just R&D stage or early commercial stage within industrial development cycle such as offshore wind industry, marine bio industry, and so on.

<sup>3</sup> However, it would be better to distinguish maritime from ocean and marine. That's because the term of maritime refers primarily to ships in most languages and international institutions.

The NOEP in the USA clearly uses the term ocean economy to distinguish it from coastal economy. Therefore, the term ‘Ocean’ is used in this article among the three terminologies just like in the NOEP.

Table 1. Terminology related to the ocean economy by country

	Terminology related to ‘Ocean’			Terminology related to ‘Economy’			
	Ocean	Marine	Maritime	Economy	Industry	Activity	Sector
USA	•			•			
UK		•				•	
France		•		•			
Australia		•			•		
Ireland	•			•			
Canada	•	•			•		
Spain			•				•
New Zealand		•		•			
EU		•		•			
China*					•		
Japan*					•		
Korea*					•		

\* Terminology related to the ocean isn’t distinguished in China, Japan and South Korea because they are non-English speaking country.

However, as for the terms economy and industry, it is necessary to distinguish between the two terminologies. Figure 1 demonstrates why economy includes much more than industry. Industry alone deals with the private sector of market goods and services. On the other hand, economy includes public sectors as well as private sectors. Besides, economy also includes non-market goods and services. In other words, industry is included in economy.

However, most countries include private and public sectors in their ocean economy, but exclude non-market value. Non-market value of the ocean economy hasn’t been estimated in all countries, and it’s not easy to estimate it. So it would be better to focus on market value instead of non-market value at present.<sup>4</sup>

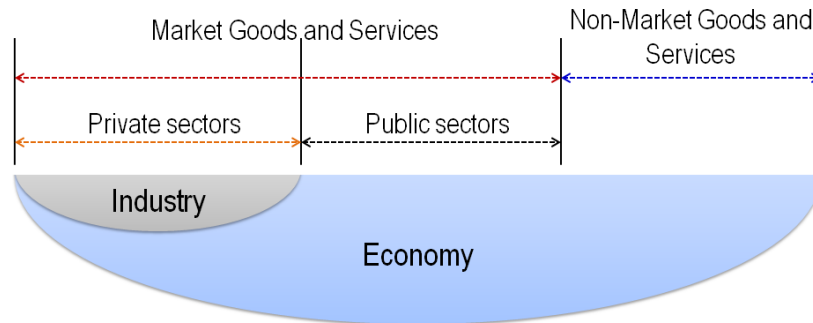


Fig.1. Difference between industry and economy

In conclusion, the ‘Ocean Economy’ is used as a representative terminology in this article. The term ‘Ocean’ can be used interchangeably with marine but the term ‘Economy’ cannot be used interchangeably with industry. If the ocean economy just deals with the private sector, it would be better to refer to the term as ‘Ocean Industry’ not ‘Ocean Economy’. In addition, non-market value is excluded from the ocean economy in this article.

## 2.2. Rebuilding the definition

As the terminology of the ocean economy is used differently by each country, the uniform definition on the ocean economy hasn’t been set up yet. Colgan (2003) [7] introduced the concept of ‘Ocean GDP’ to identify the contribution of the ocean to the United States’ GDP and defined it as the economic activities and industries that utilize ocean resources in a production process or produce a product or service. Using a similar approach, Pontecorvo et al. (1980)

<sup>4</sup> But non-market value must be included into the ocean economy in the future. Because the ocean and coast give us immense economic value, and the non-market value of them could be an important part of the ocean economy.

[8] and Pontecorvo (1988) [9] estimated the contribution of the ocean sector to the United States' economy for the years 1977 and 1987.

However, the ocean economy is defined differently among countries up to date. In the case of the NOEP, the concept of the ocean economy derives from the ocean (or Great Lakes) and its resources being a direct or indirect input of goods and/or services to an economic activity: a) an industry whose definition 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. This is defined in part by the definition of an industry in the North American Industrial Classification System (for example, deep sea freight transportation) and partly by geographic location (for example, a hotel in a coastal town).

Ireland's definition is same with the NOEP's. The UK's definition is also very similar to the NOEP's. The UK includes those activities that involve working on or in the sea. Those activities also involve the production of goods or the provision of services, which will directly contribute to activities on or in the sea.

Australia defines the ocean economy as an ocean-based activity and focuses on whether the ocean resource is the main input or not. New Zealand defines the ocean economy as economic activities that take place in, or use the marine environment, or produce goods and services necessary for those activities, or make a direct contribution to the national economy.

In the case of Asian countries, China defines it as the sum of all kinds of activities associated with the development, utilization and protection of the marine environment. Japan defines it as the industry exclusively responsible for the development, use and conservation of the ocean. South Korea defines the ocean economy as the economic activity that takes place in the ocean, that puts goods and services into ocean activity, and the activity that uses the ocean resources as an input.

Table 2. Definition related to the ocean economy by country

Country	Main substance
USA	The economic activity, which is a) an industry whose definition 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.
UK	Those activities which 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.
Australia	Ocean-based activity (Is the ocean resource the main input? Is access to the ocean a significant factor in the activity?).
Ireland	Economic activity which directly or indirectly uses the sea as an input.
China	The sum of all kinds of activities associated with the development, utilization and protection of the marine.
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.
New Zealand	The economic activity that takes place in, or uses the marine environment, or produces goods and services necessary for those activities, or makes a direct contribution to the national economy.
Japan	Industry exclusively responsible for the development, use and conservation of the ocean.
South Korea	The economic activity that takes place in the ocean, which also includes the economic activity which puts the goods and services into ocean activity, and uses the ocean resources as an input.

Even though the definitions of the ocean economy among countries are different, several common words are found from them. At first, the term 'Ocean' or 'Marine' is used by all countries. That's because the ocean economy is basically close to ocean space. For example, fishing is the industry that takes place in the ocean. We can also find that the terms 'Economic activity', 'Input and Output', 'Directly and Indirectly', 'Goods and Services' have commonalities. That's because the ocean economy is basically an economic activity that gives goods and services to the ocean activity, and takes outputs from the ocean. For example, the ship building industry provides goods into the ocean activity, and seafood processing uses the ocean products as an input.

Therefore, to define the ocean economy, a combination of industrial and geographical perspectives is required at the same time. That's why the ocean economy is related to the economic activity as an industrial aspect, and directly or indirectly related to the ocean (including the coast) as a geographical aspect. Figure 2 shows the relationship between ocean and ocean economy.

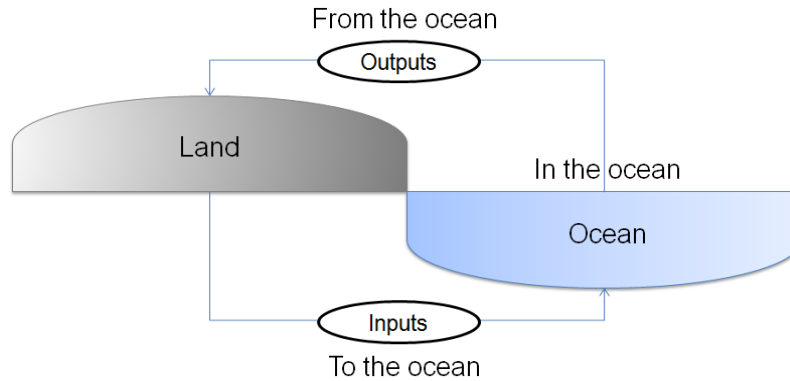


Fig.2. Relationship between ocean and ocean economy

In conclusion, the ocean economy is defined as economic activities that take place in the ocean, receive outputs from the ocean, and provide goods and services to the ocean. In other words, the ocean economy can be defined as the economic activities that directly or indirectly take place in the ocean, use the ocean's outputs, and put the goods and services into the ocean's activities.

### 3. Classification standards and scope of the Ocean Economy by country

#### 3.1. Cases of some countries

##### 3.1.1. USA

The NOEP provides a full range of the economic information and data across the USA and created the concept of the ocean economy and coastal economy. The ocean economy consists of all economic activities that derive all or part of their inputs from the ocean or Great Lakes. The definition of the ocean economy is a function of both industry and geography. While most of the ocean economy is located in coastal regions, a portion of it (for example, boat building and seafood retailers) is located in non-coastal regions.

The estimation of economic activity associated with the ocean is inherently limited by data availability, conceptual difficulties, and the need to make subjective choices about what to include and exclude. The choices that must be made in the design of statistical measures of ocean economic activity should be informed by clear objectives for the system. The NOEP's methodology has the following objectives: 1) comparability across industries and space, 2) comparability across time, 3) theoretical and accounting consistency, and 4) replicability.

Table 3. Classification of the ocean economy in the USA

Sectors	Categories
Construction – Marine	Marine-related construction
Living Resources – Marine	Fishing, Fish hatcheries and aquaculture, Seafood processing, Seafood markets
Minerals – Offshore	Limestone, sand & gravel, Oil and gas exploration, Oil and gas production
Ship & Boat Building	Boat building and repair, Ship building and repair
Tourism & Recreation – Coastal	Amusement and recreation services, Boat dealers, Eating & drinking places, Hotels & lodging places, Marinas, Recreational vehicle parks & campgrounds, Scenic water tours, Sporting goods retailers, Zoos, Aquaria, NEC*
Transportation – Marine	Deep sea freight transportation, Marine passenger transportation, Marine transportation services, Search and navigation equipment, Warehousing

\* Not classified elsewhere.

According to the NOEP's report [10], the NOEP methodology defines the ocean economy with 6 sectors that provide consistent information across time and space. These sectors are marine construction, living marine resources, offshore minerals, ship and boat building and maintenance, coastal tourism and recreation, and marine transportation. The industries comprising these sectors depend on the definition of industries used for government statistical purposes. However, a number of other activities are not included because information about these is not consistently compiled or not publicly available.

### 3.1.2. UK

Three organizations - The Crown Estate, Associated British Ports, and Oil and Gas UK - estimated the economics and employment statistics for marine activities in the UK economy. Their report [11] demonstrated the significant economic contribution that marine activities make to the UK and to provide employment within the UK. The report also emphasized the extraordinary diversity of marine-related activities and provides an accessible guide to their relative contribution.

The above organizations used a relatively narrow definition, also used in earlier UK analyses, and similar to definitions used in analyses in other countries. According to this report, the marine activities of the UK were split into 18 sectors. Choice of these sectors fitted naturally into the way marine activities were structured, and had some general international acceptance. For example, in the case of the oil and gas sector, only the landed values were included. For fisheries, processing was included because of its traditional close association with the ports.

There are many special characteristics in the scope of marine activities in the UK. The fishing sector includes traditional sea fishery activities, fish farming, and fish processing. Oil and gas is separated from aggregates unlike in the USA. Offshore wind is included in marine renewable energy, but construction of offshore wind farms is included in construction. Business services related to shipping are separated from the shipping industry and decommissioning belongs to the marine environment sector.

Table 4. Classification of the ocean economy in the UK

Sectors	Categories
Fish	Sea fisheries, Fish farming, Fish processing
Oil and gas	Offshore extraction of oil and gas
Aggregates	Marine dredged sand and gravel
Ship & boat building and repairs	Ship building and boat building
Marine Equipment and materials	Supply to the offshore oil and gas industry, Supplies to shipbuilding and repairs, Supplies to boat building
Marine renewable energy	Offshore wind, wave and tidal stream power
Construction	Harbor development, Coastal works against erosion and flooding, Construction of offshore wind farms
Shipping operations	Transport of goods by sea
Ports	Storage of freight, Vessel salvage, Cargo handling, Stevedoring, Bunkering passenger handling and services, and many other activities
Navigation and safety	Lighthouse authorities, The hydrographic office, Maritime and coastguard agency, Health and safety executive, Royal national lifeboat institution
Cables	Submarine telecommunications, Power cables
Business services	Marine insurance, Ship chartering, Shipping finance, Ship classification, Legal services, Dispute resolution and accountancy services
License and rental	License and rental marine aggregates, Potash mining, Oil and gas pipelines, Telecommunication and power cables, Aquaculture, Renewable energy, Moorings, Wildfowling and ports marinas
Research and development	Industry sector, University (Higher Education Institutions), Public sector
Marine environment	Decommissioning, Conservation and environment, Wastewater treatment
Defense	Navy
Leisure and recreation	Cruising, Leisure craft services
Education and training	Higher education

### 3.1.3. France

For the case of France, the objective of the 'French marine economic data' report [12] is to assess the weight of the French maritime economy, its position with respect to international competition, and its role within public services in France. The report presents a survey of marine related activities in France and an assessment of their economic weight in terms of value added and employment estimates.

The Ifremer differentiates between the industrial sector (commercial sector) and those activities linked to the non-commercial public sector. In the former case, they consider up to 9 commercial sectors, while for the latter they consider 4 types of public activities. Within the activities that belong to the seafood sector, they distinguish 5 sub-sectors, under shipbuilding another 5 sub-sectors, and in maritime and river transport 6 sub-sectors. In these studies, they preferably use official data sources from different French government ministries or other public institutions or institutes. For the cases where there are no detailed data in official statistics, they also look to information provided by different businesses or professional organizations.

The most striking points in the case of France are that electricity generation such as conventional fossil fuel power plants, nuclear power plants, and wind turbines, are included in the marine economy. This is unique just in France. It is because Ifremer assume that the electricity generation units are located on the coasts. Otherwise, maritime insurance is separated as one industry.

Table 5. Classification of the ocean economy in France

Sectors	Categories
Industrial sector	
Seafood products	Marine fishery, Marine aquaculture(fish farming and shellfish farming), Production of seaweed, Fish markets and fish trade, Seafood product processing industry
Extraction of marine aggregates	Silica sands and gravels, Calcareous sands and sediment
Electricity generation	Conventional fossil fuel power plants, Nuclear power plants, Wind turbines
Shipbuilding and repair	Construction and repair of merchant and military ships, Naval outfitting and boat building
Marine and river civil engineering	Construction of ports, dams, dykes, navigable canals, water supplies, locks and other water course regulation installations / Execution of work: in water(construction of coffer dams, construction of the piles of bridges), dredging, underwater(by diver or other means) / Cleaning of trenches and development of river banks and cutting of water weeds
Submarine cables	Manufacturing, laying and maintenance of submarine cables immersed at depth and, generally buried, intended to carry communications or electrical power
Offshore oil and gas-related industry	Supply of oil and gas-related services and equipment in the fields of exploration and production, refining and petrochemicals
Coastal tourism	Spending of resident and non-resident tourists in characteristic tourist activities : spending on accommodation, catering, and all-in packages (for the non-residents), spending associated with the stays: spending on food, miscellaneous purchases, travel on site (taxi or public transport), services to private citizens, fictive rent
Maritime & river transport	Exploitation and general organization of ports, Port services to vessels and goods
Maritime insurance	Maritime insurance and banking
Non-commercial public sector	
French Navy	National defense
Public intervention	Economic and social (seafarer labor schemes, social protection), Regulation and education
Coastal and marine environmental protection	Prevention, Reduction and elimination of pollution; the repair of damage and the acquisition, processing and circulation of information on environment
Marine research	Activities of French public bodies in the field of marine research and operational oceanography

### 3.1.4 Australia

For the case of Australia, Allen Consulting Group's report [13] provided estimates of the economic contribution of marine industries in Australia with data from 1995-1996 to 2002-2003. There was no statistical classification for marine industries as a distinct category in Australia. Therefore, the approach taken in this study to measure the economic contribution of marine industries is to compile data on those industries which have been categorized as the marine industry on the basis of following 3 aspects: 1) the relationship with the marine environment through the use



of a marine resource (such as commercial fishing, offshore oil and gas), 2) the provision of services through marine transportation (such as shipping and port based industries), 3) the use of the positive attributes of the marine environment (such as marine tourism).

Australia's marine industry is divided into 6 sectors, which are marine tourism, offshore oil and gas, fisheries and seafood, shipping, shipbuilding, and port-based industries. These are major marine based activities. The ocean economy of Australia only includes industrial sectors except public sectors. In addition, taxi transport and air transport belong to marine tourism. Offshore petroleum refining is also included in the ocean industry unlike in other countries. Otherwise, marine equipment and materials, and extraction of marine aggregates are excluded from the ocean sector.

Table 6. Classification of the ocean economy in Australia

Sectors	Categories
Marin tourism	Travel agency and tour operator services, Taxi transport, Air and water transport, Accommodation; Cafes, Restaurants and food outlets, Clubs, pubs, taverns and bars, Other retail trade
Refining of petroleum from offshore sources	Offshore oil and gas extraction, Offshore petroleum refining, Exploration and services
Fisheries and seafood	Marine fishing, Aquaculture, Seafood processing
Shipping	Water transport*
Shipbuilding	Ship building, Boat building
Port-based industries	Stevedoring, Water transport terminals, Port operators, Other services to water transport

\* Note: This sector is defined by the ABS as water transport and water transport was also a component of the marine tourism.

### 3.1.5. China

According to Rui Zhao et al. (2013) [14], the Ocean Economy Accounting System (OEAS) of China was established in 2006 with the aim of furnishing marine policy makers in China with marine activity statistics. China's OEAS was established exclusively for the ocean economy data collection to meet the practical needs of ocean economic management. The system was developed and is operated by the Chinese National Marine Data and Information Service which is under China's State Oceanic Administration. The purpose of the system was to develop the required range and quality of the ocean economy data at the regional and national levels.

China established 'Industrial classification for ocean industries and their related activities' in 2006 and has enforced it since 2007. After that, the China Marine Information Economic Network (CMIEN) has issued 'The Statistical Bulletin of China's Ocean Economy' every year since 2003. Currently the classification system of the ocean economy in China divided into 3 levels: 1) 28 big class levels, 2) 106 middle class levels, and 3) 390 small class levels.

According to the 'Statistical Bulletin of China's Ocean Economy 2012' [15], China's ocean economy is divided into 3 sectors, which are main sectors, public sectors, and related sectors. Sub-industries under main sectors include 12 ocean industries. Public sectors deal with 10 public activities which are conducted mainly by the government and public organization like research, education, marine environment management, and so on. Related sectors are the economic activities which produce value-added by providing goods and services to the ocean industry as inputs.

In particular, China focuses on the main ocean industries. The unique feature of China's ocean economy is that its emerging ocean industries are divided into several independent industries. For example, the marine salt industry is separated from the ocean mining industry. The chemical industry, biomedicine industry, electric power industry and seawater utilization industry are separated and they form each industry respectively.

Table 7. Classification of the ocean economy in China

Sectors	Categories
Main sectors	
Marine fishery	Includes marine culture, marine fishing, marine fishery service industry and marine aquatic processing, etc.
Offshore oil and gas industry	Refers to the ocean exploration and production activities of mining, transportation, processing of crude oil and natural gas.
Ocean mining industry	Includes the activities of extracting and dressing beach placers, beach soil chloride and sand, submarine geothermal energy, and coal mining and deep-sea mining, etc.
Marine salt industry	Refers to the activity of producing salt products with the sodium chloride as the main component by utilizing seawater, including salt extracting and processing.
Shipbuilding industry	Refers to the activity of building ocean vessels, offshore fixed and floating equipment with metals or non-metals as main materials as well as repairing and dismantling ocean vessels.
Marine chemical industry	Includes the production activities of chemical products of sea salt, seawater, sea algal and marine petroleum chemical industries.
Marine biomedicine industry	Refers to the production, processing and manufacturing activities of marine medicines and marine health care products by using organisms as raw materials or extracting useful components therefrom.
Marine engineering building industry	Refers to the architectural projects construction and its preparations in the sea, at the sea bottom and seacoast for such uses as marine production, transportation, recreation, protection, etc., including constructions of seaports, coastal power stations, coastal dykes, marine tunnels and bridges, land terminals of offshore oil and gas fields as well as building of processing facilities, and installation of submarine pipelines and equipment, but not the projects of house building and renovation.
Marine electric power industry	Refers to the activities of generating electric power in the coastal region by making use of ocean energies and ocean wind energy. It does not include the thermal and nuclear power generation in the coastal area.
Seawater utilization industry	Refers to the activities of the direct use of sea water and the seawater desalination, including those of carrying out the production of desalination and applying the seawater as water for industrial cooling, urban domestic water, water for firefighting etc., but not the activity of the multipurpose use of seawater chemical resources.
Marine communications and transportation industry	Refers to the activities of carrying out and serving the sea transportations with vessels as main vehicles, including ocean-going passenger transportation, auxiliary activities of water transportation, pipeline transportation, loading, unloading and transport as well as other transportation and service activities.
Coastal tourism	Refers to the tourist business and service activities with the backing of coastal zone, sea islands as well as a variety of natural and human landscape of the ocean, mainly including marine sightseeing, living a life of leisure and recreation, going on vacation and getting accommodation, sports, etc.
Public sectors	10 categories
Related sectors	6 categories

### 3.1.6. Japan

For the case of Japan, Nomura Research Institute (NRI) published a report [16] and estimated the economic contribution of ocean Industries in Japan in 2005. NRI divided ocean industries into 3 types: ocean space activity type, marine resource utilization type, and material and services supply type. The ocean space activity type is an activity that takes place in the ocean whereas the other types do not.

The ocean space activity type means activities which exclusively explore, produce, and develop ocean resources in the ocean, and use the ocean energy, ocean space and seabed such as mining and extraction of resources. It also means marine environmental protection and safety management, etc. Therefore, this type includes fishing, transportation, salt, offshore oil and gas, and so on.

The marine resource utilization type means activities which exclusively produce goods and services by using the minerals, energy resources and living things that exist in the ocean. So this type includes seafood processing, products of salt, etc. Materials and services supply type means activities which provide goods and services to the ocean space activity to support it. This type includes ship building and repair, ice making, and marine equipment such as ropes and nets. These 2 types can be considered as the ocean industry when the input ratio in the input-out table is greater than 10%.

Table 8. Classification of the ocean economy in Japan

Sectors	Categories
Ocean space activity type	Coastal fishing
	Offshore fishing
	Deep-sea fishing
	Sea aquaculture industry
	Salt
	Open ocean transport
	Port transport
	Water transport facilities management
	Other water transport services
	Gravel and quarrying*
	Crude oil and natural gas*
	Public works of rivers, sewer and other*
	Coastal, inland water transport*
	Fixed telecommunications*
	Goods leasing (excluding car rental)*
	Civil engineering and construction services*
	Other business services*
	Race courses and team competition of bicycle racing, horse racing, etc.*
Other entertainment*	
Professor individual plants*	
Marine resource utilization type	Frozen seafood
	Product of salt, etc.
	Fisheries bottles, canned
	Other aquatic food
	Fresh seafood wholesale trade
Material and services supply type	Ice making
	Rope, net
	Heavy oil
	Steel ship
	Other ships
	Ship repair
	Other communication services

\* Some ratio of this industry can be included in ocean economy.

### 3.1.7. South Korea

Korea has no official agency in charge of accounting for the ocean economy. Korea's ocean economy has been estimated by individuals whenever the need arose. For example, Kwak SJ et al. (2005) [17] used 5 divisions, such as shipping, ports, fisheries, ship building, and other marine sectors. Chul-Oh Shin and Seung-Hoon Yoo (2009) [18] also classified 5 sectors, which were marine transportation, harbor, fisheries and marine products, shipbuilding, and other marine sectors.

The research by K.H Hwang et al. (2011) [19] was regarded as a representative research that was conducted entirely to estimate the total production of ocean industries in South Korea. K.H Hwang et al. divided the ocean industry into 3 sectors which were marine-based industry, forward marine-related industry, and backward marine-related industry, according to 3 standards: 1) the marine-based industry is the activity that exclusively takes place in the ocean, 2) the forward marine-related industry means the activity that support the marine-based industry as an input, 3) and the backward marine-related industry means the activity that use outputs from the ocean.

The marine-based industry consists of 9 industries, which are fisheries, marine mining, ocean renewable energy, marine construction, and shipping. The sub-section of forward marine-related industry includes 5 activities, which are marine equipment and materials industry, ship and offshore plant building, marine technical services, marine research and development, and marine public administration and education. The backward marine-related industry includes 4 activities, such as seafood processing, marine bio industry, port, and marine tourism and leisure.

South Korea's classification standard of the ocean economy is very similar to Japan, but the scope of it is different between the two countries. The most striking point in the case of South Korea is that offshore plant building is

included in the ocean industry. In addition, the oil and gas industry is included in marine mining. South Korea also classifies marine technical services as one industry.

Table 9. Classification of the ocean economy in South Korea

Sectors	Categories
Marine-based industry	
Fisheries	Capture fisheries, Aquaculture, Fisheries-related service
Marine mining	Oil and gas, Sands and gravels, Seabed mining, Salt
Ocean renewable energy	Tidal, Offshore wind power and so on, Offshore cables
Marine construction	Harbor development, Coastal works against erosion and flooding, Construction of cable and bridge, etc.
Shipping industry	Marine passenger and freight transportation, Shipping-related service
Marine-associated industry(forward)	
Marine equipment and materials industry	Marine equipment manufacture
Ship and offshore plant building industry	Ship, boat and offshore plant building and repair
Marine technical services	Engineering, S/W development, Investigation, Certification, Analysis, etc.
Marine research and development	Marine research and development
Marine public administration and education	Marine public administration, Navy, Coast guard, Marine education and training
Marine-related industry(backward)	
Seafood processing	Seafood processing, Transportation, Sale
Marine bio industry	Marine bio food, Drugs, etc.
Port industry	Stevedoring, Frozen and chilled warehouse, Port-related services
Marine tourism and leisure industry	Museum, Beach, Park, Hotel, etc.

### 3.1.8. Other countries

Furthermore, there are different cases among several countries. For the case of Ireland, SEMRU (2010) divided the ocean economy into 2 sectors: the established markets and emerging markets [20]. Furthermore, the established markets consisted of 9 industries and the emerging markets consisted of 4 industries. In particular, aquaculture was separated from sea fisheries.

According to Gardner Pinfold's report (2009) [21], Canada's ocean economy was divided into 2 sectors and 9 industries. It was important that the oil & gas facilities installation was not included in offshore oil and gas but marine construction. Spain's ocean economy (2008) was divided into 2 sectors, which were traditional maritime sectors, and coastal and sea-related recreation and tourism [22]. Recreational boating, coastal tourism and cruise tourism were regarded as different industries. On the other hand, New Zealand (2003) divided the ocean economy into 9 sectors [23].

## 3.2. Implications by each country

### 3.2.1. Classification standard

First, as the terminology and definition related to the ocean economy differs by each country, the classification standard is also different. For instance, in the case of the USA, the ocean economy includes an industry which is explicitly tied to the ocean (Industrial aspect), and an industry which is partially related to the ocean and is located in a shore-adjacent zip code (Geographical aspect). France divided the ocean economy into industrial sector and non-commercial public sector, Ireland divided established markets and emerging markets, and Canada divided primary marine activities and secondary marine activities. China divided it into 3 sectors but focused on the main sector. In the cases of Japan and South Korea, even though terminology of each sector is different, the classification standard is very similar to each other.

Table 10. Classification standards of the ocean economy by country

Country	Main substance
USA	Industrial aspect / Geographical aspect
France	Industrial sector / Non-commercial public sector
Ireland	Established Markets / Emerging Markets
China	Main sector / Public sectors / Related sector
Canada	Primary marine activities / Secondary marine activities
Spain	Traditional maritime sectors / Coastal & sea-related (marine) recreation and tourism
Japan	Ocean space activity type / Marine resource utilization type / Material and services supply type
South Korea	Marine based industry / Forward marine related industry / Backward marine related industry

### 3.2.2. Scope of the ocean economy

In addition, the scope of the ocean economy is considerably different among each country. Table 11 shows the scope of the ocean economy by each country. At first, we can see that the number of categories ranges from 6 sectors (in the case of the USA) to 33 categories (in the case of Japan). This results in different classification sectors and categories among countries. In other words, one industry in one country is divided into several industries in another country and it happens in the opposite direction as well. Also, some industries may be excluded from the ocean economy in one country and not in another.

The main scopes and characteristics of the common industry by each country are as follows:

- Fisheries - it generally consists of fishing, aquaculture, and seafood processing. Some countries such as the USA, France, and South Korea include seafood distribution under fisheries.
- Marine mining - all countries where marine mining exists include it in the ocean economy. Some countries include the salt industry and others separate it from marine mining.
- Offshore oil and gas - all countries where the offshore oil and gas industry exists include it in the ocean economy. However, most countries include just exploration and production activity, and separate offshore oil and gas from marine mining unlike the USA. Some include refining, others do not.
- Ship and boat building - all countries where ship and boat building exists include it in the ocean economy. In the case of South Korea, offshore plant building is also included like the ship building industry.
- Marine manufacturing - even though the scope of marine manufacturing is different by each country, most countries include it in the ocean economy excluding Australia.
- Marine construction - all countries where the marine construction industry exists include it in the ocean economy.
- Marine transportation - all countries include marine transportation in the ocean economy, but some countries separate services related to it as a different industry.
- Port - many countries integrate the port industry into marine transportation.
- Marine tourism - all countries include marine tourism in the ocean economy but this industry is very complex. That's why it is difficult to include the range of the scope related to marine and coastal tourism. The USA includes only those activities that are in coastal zip codes adjacent to the coast to ensure some relationship of tourism and recreation to the coast.
- Public sectors such as education, national defense, R&D, and public administration - most countries include them in the ocean economy excluding Australia.
- Ocean renewable energy - the UK, China and South Korea separate it as an industry.<sup>5</sup>
- Marine bio industry - China and South Korea separate it as an industry.

<sup>5</sup> The USA does include federal expenditures as a separate page on its website.

Table 11. Scope of the ocean economy by country

USA	UK	France	Australia	Ireland	China	Canada	Spain	New Zealand	South Korea
Construction – marine	Fish	Seafood products	Marine tourism	Shipping and maritime transport	Marine fishery	Seafood	Inland navigation	Offshore minerals	Fisheries
Living resources – marine	Oil and gas	Extraction of marine aggregates	Refining of petroleum	Water-based tourism & leisure	Offshore oil and gas industry	Offshore oil & gas	Marine aggregates	Fisheries and aquaculture	Marine mining
Minerals – offshore	Aggregates	Energy	Fisheries and seafood	International cruise industry	Ocean mining industry	Marine transportation	Marine equipment	Shipping	Ocean renewable energy
Ship & boat building	Ship and boat building and repairs	Shipbuilding and repair	Prioritize	Other marine services	Marine salt industry	Ocean based recreation/leisure	Maritime services	Government and defense	Marine construction
Tourism & recreation – coastal	Marine equipment and materials	Marine and river civil engineering	Shipbuilding	Sea fisheries	Shipbuilding industry	Marine construction	Maritime works	Marine tourism and recreation	Shipping industry
Transportation – marine	Marine renewable energy	Submarine cables	Port-based industries	Aquaculture	Marine chemical industry	Manufacturing	Navy and coastguard	Marine services	Marine equipment and materials industry
	Construction	Offshore oil and gas-related industry		Seafood processing	Marine biomedicine industry	Services	Offshore supply	Research and education	Ship and offshore plant building industry
	Shipping operations	Coastal tourism		Oil & gas exploration and production	Marine engineering building Industry	Federal government	Recreational boating	Manufacturing	Marine technical services
	Ports	Maritime and river transport		Marine manufacturing	Marine electric power industry	Provincial /territorial government	Seaports	Marine construction	Marine research and development
	Navigation and safety	Maritime insurance		High tech marine products and services	Seawater utilization industry	Universities and research	Shipbuilding		Marine public administration and education
	Cables	French navy		Marine commerce	Communications & transportation industry	NGOs	Shipping		Seafood processing
	Business services	Public intervention		Marine biotechnology and bio-products	Coastal tourism		Coastal tourism		Marine bio industry
	License and rental	Coastal & marine environmental protection		Marine renewable energy			Cruise tourism		Port industry
	Research and development	Marine research					Fisheries		Marine tourism and leisure industry
	Marine environment								
	Defense								
	Leisure and recreation								
	Education and training								

From Table 11, we can extract common words such as fisheries, marine construction, marine transportation, marine and coastal tourism, marine mining, and so on. We can also infer the characteristics of the scope of the ocean economy from these common words as follows:

- 1) Activities which explore and develop ocean resources
- 2) Activities which use ocean space
- 3) Activities which protect the ocean environment
- 4) Activities which use ocean products as a main input
- 5) Activities which provide goods and services to ocean activities

1), 2), and 3) are the activities which take place in the ocean. Otherwise, 4) and 5) are the activities which support the ocean activities or are derived from them. In other words, the characteristic of the former three ocean economy is 'in the ocean', and each of the latter two is 'from the ocean' and 'to the ocean' respectively.

## 4. Rebuilding the Ocean Economy

### 4.1. Rebuilding the classification standard of the ocean economy

#### 4.1.1. Classification by definition and characteristics of the ocean economy

To determine the scope of the ocean economy, the cases by each country need to be considered. In addition, two classification standards also can be applied as follows:

- 1) Classification by definition and characteristics of the ocean economy
- 2) Classification by supply chain and relationships among the ocean economy

At first, as chapter 2 shows, the definition of the ocean economy can be economic activities that directly or indirectly take place in the ocean, use the ocean's outputs, and put goods and services into the ocean activity. In addition, as chapter 3 shows, the characteristics of the scope of the ocean economy can be categorized into 3 phrases: in the ocean, from the ocean, and to the ocean.

'In the ocean' means the economic activity that takes place in the ocean to use, protect, research, and develop the ocean. 'From the ocean' means the economic activity that receives goods and services from an ocean activity to use, protect, research, and develop the ocean. Lastly, 'To the ocean' means the economic activity that provides inputs for an ocean activity. We can rearrange the common words of the scope of the ocean economy by each country according to three characteristics as can be seen in Table 12.

Table 12. Classification by definition and characteristics of the ocean economy

Characteristics	Classification
In the ocean	Aggregates, Aquaculture, Cruise, Oil & gas E&P, Fisheries, Leisure, Marine construction, Marine mining, Marine tourism, Minerals, Non-living things, Ocean renewable energy development, Offshore supply services, Recreation, Seawater utilization, Shipping, Transportation, Defense, Marine environment management, Safety, Security, Navy, Observation
From the ocean	Marine bio industry, Marine chemical industry, Seafood processing
To the ocean	Boat building, Cables, Coastal tourism, Communication, High tech marine products and services, Marine applications, Marine business services, Marine equipment manufacturing, Marine engineering, Marine insurance, Marine materials, Marine sensors, Marine technical services, Offshore plant building, OSV building, Port development, Port management, Port operation, Rental, Ship building, Research & Development, Education, License, Navigation, Public administration, Training

'In the ocean' includes marine aggregates, aquaculture, cruise, offshore oil and gas E&P, fisheries and so on. 'From the ocean' includes marine bio industry, marine chemical industry, and seafood processing. 'To the ocean' includes ship and boat building, marine business services, marine equipment manufacturing and so on.

#### 4.2.2. Classification by supply chain and relationship among the ocean economy

Usually, one industry is linked to another in what is called the 'Supply Chain'. We can also find the supply chain in the ocean economy. For example, the fisheries industry is linked to R&D, education, fish ship and gear building, seafood processing, governmental administration and so on. Farmed fisheries and aquaculture may need R&D, education, fish ship and gear building and may be the sources of seafood processing, seafood distribution, and sale. Therefore, we must decide whether or not to merge them into one. If some industries are inside the supply chain, they can be integrated into one industry. But if some industries are outside the supply chain, they must be separated.

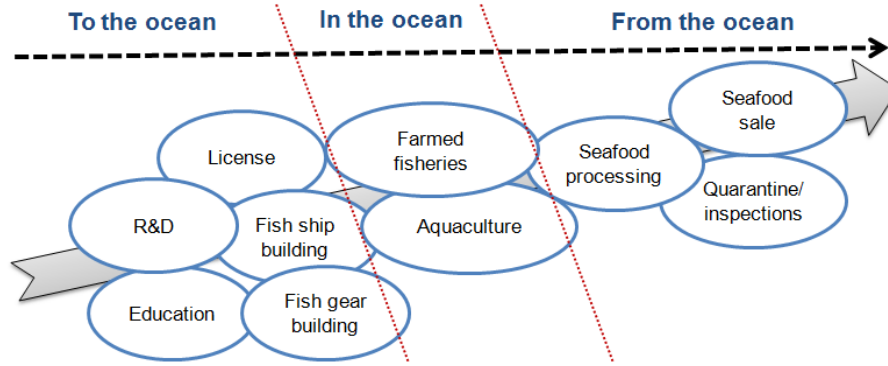


Fig.3. Example of fisheries' supply chain

Although some industries are inside the same supply chain, they cannot be integrated into one industry without causing problems. Because, as Figure 4 shows, there are two cases: multi industries give inputs to one industry or one industry gives inputs to multi industries. Multi industries can be integrated into one industry when they give inputs to one industry. For example, marina, cruise, aquarium, hotels located on the coast, and so on provide goods and services marine and coastal tourism. So they can be merged into marine and coastal tourism.

On the other hand, if one industry gives inputs to multi industries, it can be separated as a different industry. As Figure 3 shows, both R&D and education provide goods and services to fisheries. But they also provide goods and services to other industries, therefore it can be categorized as one industry.

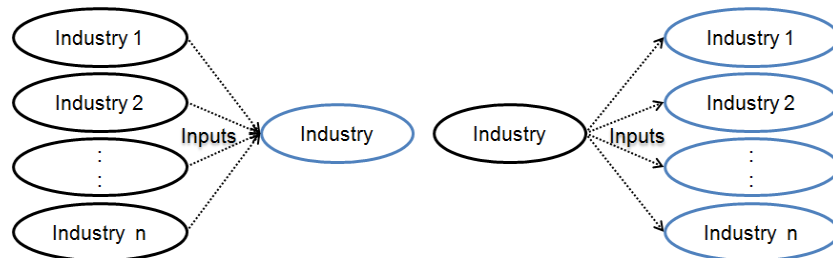


Fig.4. Relationship between the ocean industries

Otherwise, as it appears in chapter 3.2.2, the number of categories for the ocean economy can range from 6 to 33. If the number of categories is at the high end, the ocean economy is detailed but too complex and inaccessible. In contrast, if it is at the low end, the ocean economy is simple, but too general and abstract. The cases by each country remind us that the average number is approximately 15, and that could be a reasonable and acceptable number possibly to strive for.

#### 4.2. Rebuilding the scope of the ocean economy

##### 4.2.1. Rebuilding the sectors of the ocean economy

On the basis of the previous, the representative words can be extracted from Table 12 in consideration of the supply chain, relationship among the ocean economies, and the number of categories, as shown below;

- 1) Fisheries
- 2) Marine mining
- 3) Offshore oil & gas
- 4) Shipping and port
- 5) Marine leisure & tourism
- 6) Marine construction
- 7) Marine equipment manufacturing
- 8) Ship building & repair



- 9) Marine business services
- 10) Marine R&D and education
- 11) Marine administration
- 12) Others

Figure 5 shows the result of linkage among 12 categories and common words attributed to the ocean economy by each country.

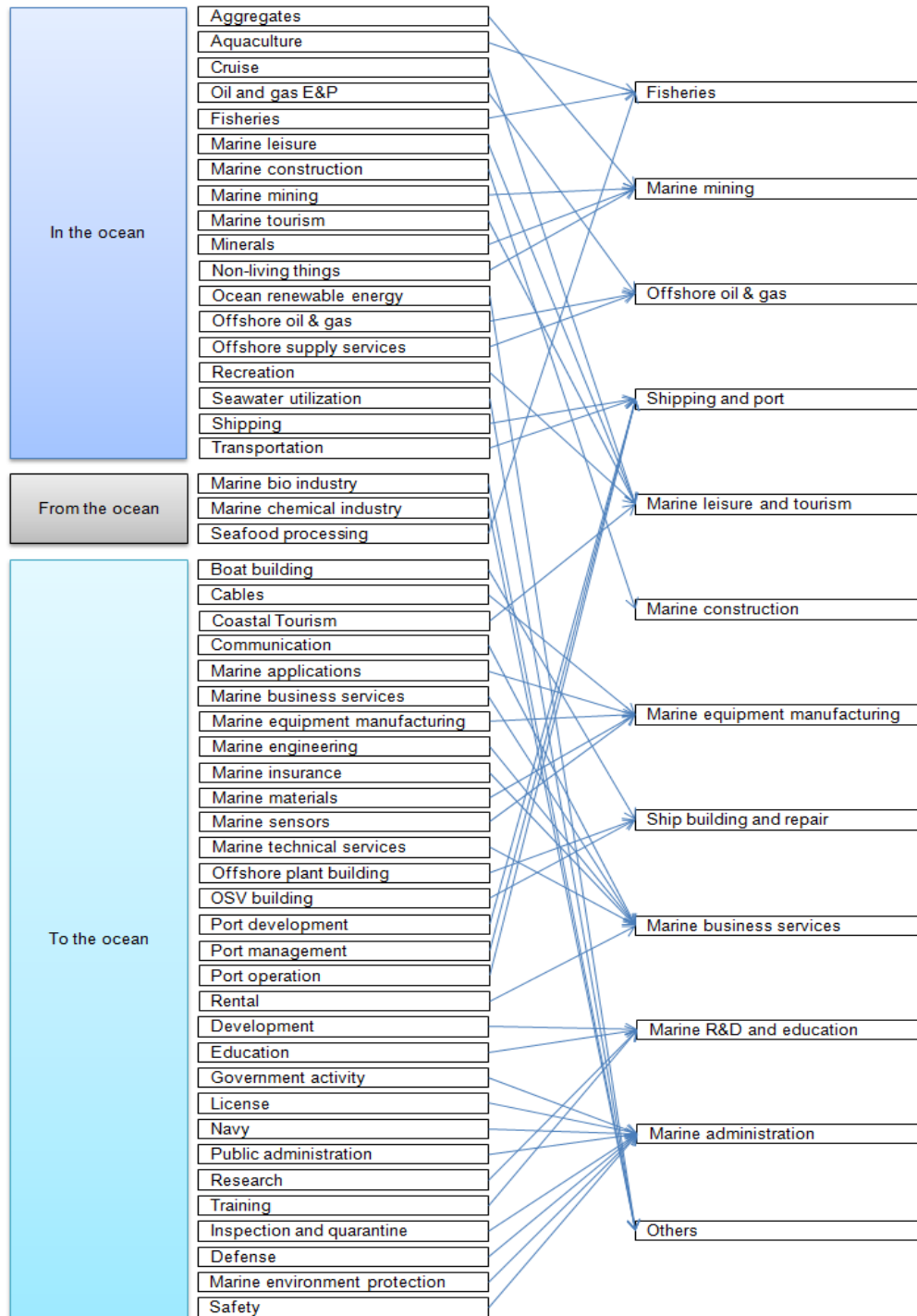


Fig.5. Result of linkage among new proposed categories and common words by country

Fisheries are linked to aquaculture, fisheries, and seafood processing. Marine mining represents aggregates, mineral marine mining, and non-living things. Offshore oil and gas are linked to oil and gas E&P, offshore oil and gas, and offshore supply services. Shipping and port includes shipping, transportation as well as port O&M.

Cruise industry, marine leisure, marine tourism, recreation and coastal tourism are included in marine leisure and tourism. Marine construction is linked to just marine construction. Marine equipment manufacturing includes cables, applications, materials and sensors, etc. Ship building includes the building and repair of ships and boats, offshore platforms, and OSVs.

Marine business services include communication, marine business services, marine engineering, marine insurance, marine technical services, and rentals. Marine R&D and education include research, development, training, and education. Marine administration includes government activities such as the navy and defense, licensing, marine environmental management, and so on. Finally, others include activities that may be not be classified elsewhere such as ocean renewable energy, marine bio industry, and sea water utilization.

Otherwise, Figure 6 shows us the relationship among the 12 scopes that are extracted in this article, classification by NOEP [10] and Juan C. Suri's-Regueiro et al. [6]. At first, fisheries, marine leisure and tourism, shipping and port, and marine construction are entirely the same in three articles, even though the terminologies are different among them. In the case of the offshore oil & gas industry, the NOEP and Juan C. Suri's-Regueiro et al. integrated the industry into marine mining. But it is separated from marine mining in the article, because most countries classify offshore oil and gas as one industry, which is separated from marine mining.

In the case of marine equipment manufacturing, it is regarded as one sector that is separated from ship and boat building and repair. But Juan C. Suri's-Regueiro et al. integrated these 2 sectors into 1 and the NOEP integrated it into transportation. Marine R&D and education, and marine administration are exactly the same as in the result of Juan C. Suri's-Regueiro et al., but marine business services and others in this article are integrated into 1 sector. The NOEP includes some of them in the transportation sector.

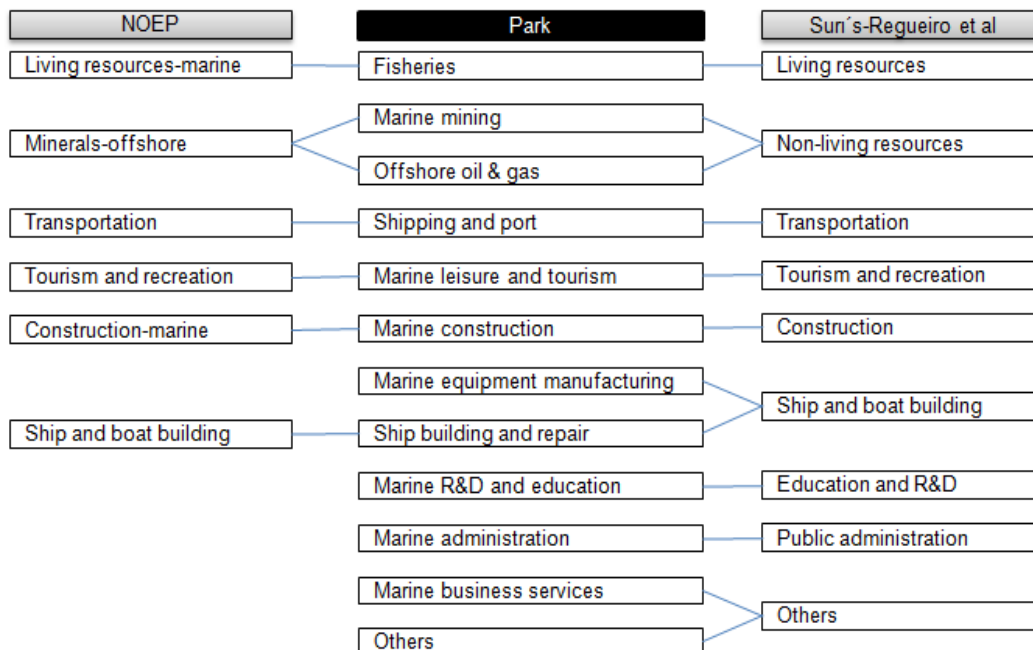


Fig.6. Comparison of the scope of the ocean economy among three studies

#### 4.2.2. Rebuilding the definition and categories by sector

As can be seen in Table 13, each sector that is proposed by the new classification standard can be defined and categorized as follows. First, 'Fisheries' can be defined as the economic activity related to the production, processing, and distribution of seafood. And the scope of fisheries can be categorized by fishing, aquaculture, seafood processing, seafood distribution, and sale. Even though the marine bio industry is the activity that uses marine living things, it is excluded from fisheries because the purpose of this industry is different from fisheries.

'Marine mining' is the economic activity related to the production, extraction, and processing of non-living resources in seabed or seawater. The sub sectors in marine mining are marine aggregates like limestone, sand and gravel, seabed resources, salt, and seawater dissolved minerals extraction. But it doesn't include offshore oil & gas because most countries separate it from marine mining.

'Offshore oil & gas' is the economic activity related to the exploration and production of offshore oil and gas, and includes the operation and maintenance of equipment related to this activity. It just includes the activity related to oil and gas E&P, and offshore service business. So the building of facilities for oil and gas E&P such as offshore platforms and OSVs is excluded from this scope according to cases by each country. They are included in the ship and boat building industry.

'Shipping and port' means the economic activity related to the transportation of freight and passengers through the ocean and river, and the economic activity related to the O&M of port. In particular, the port industry is included in the shipping industry according to cases by each country. However, it doesn't include the building and repair of vessels. Three sub sectors under shipping are passenger transportation, freight transportation, and shipping business services. The port industry includes port development to O&M such as storage, load and unload, etc.

For the 'Marine leisure and tourism', it is defined as the economic activity related to marine and coastal leisure and tourism, which includes eating & drinking places, hotels & lodging places, marinas, marine sporting goods retailers, zoos, aquarium, recreational vehicle parks & campgrounds, and so on. Fishing for amusement is also included in this sector. The sub sectors of the marine leisure and tourism include all the tangible facilities (such as hotel, marina, aquarium) and (or) intangible activities (such as marine sports and leisure, marine festival) intangible. Otherwise, to be classified as a part of marine leisure and tourism, these activities should take place in, and these facilities should be located in a place near or adjoining the coast with regard to geographical criteria.

'Marine construction' means economic activities that include construction in the ocean, and related to the sea. It can be divided into 2 sub sectors, which are marine construction (seabed cable, pipeline, waterway, etc.) and marine-related construction (ports, bridges, etc.). Like marine leisure and tourism, it is important for marine construction to take place in, and near or adjoining the coast to meet the geographical criteria.

'Marine equipment manufacturing' is the representative industry that provides goods to multi sectors. It can be defined as the economic activity which includes the manufacturing of marine equipment and materials, such as various machinery, valve, cable, sensor, ship materials and so on. But it doesn't include the building, repair and/or conversion and supply of services. It is difficult to decide what to include and what to exclude in marine equipment because there are such a variety of equipment.

'Ship building and repair' is the economic activity related to the building, repair, and maintenance of ships, boats, offshore platforms, and OSVs. Offshore platforms are the facilities that explore and develop oil and gas in the ocean, such as FPSO, fixed platform, Spars, TLPs, and so on. OSVs, which are offshore support vessels, are special vessels to support offshore oil and gas E&P. The reason that offshore platforms and OSVs are included in this sector is that offshore platforms are similar to a ship and OSVs are a kind of ship. Besides, ship builders produce these facilities as well as ships.

'Marine business services' are the economic activities related to services to support the ocean industry. The sub sectors under it are marine insurance & finance, marine consulting, rental, technical services, inspection and survey, SW services, labor supply services, and others related to this activity.



Table 13. Rebuilding the classification system of the ocean economy

Sectors	Definition	Categories
1. Fisheries	The economic activity related to the production, processing and distribution of seafood.	1) Fishing 2) Aquaculture 3) Seafood processing 4) Seafood distribution and wholesale
2. Marine mining	The economic activity related to the production, extraction and processing of non-living resources in seabed or seawater. But it doesn't include offshore oil & gas.	1) Marine aggregates (limestone, sand, gravel) 2) Seabed resources 3) Salt 4) Seawater dissolved minerals extraction
3. Offshore oil & gas	The economic activity related to the exploration and production of offshore oil and gas, includes operating and maintaining equipment related to this activity. It doesn't include building offshore platforms, equipment, and OSVs.	1) Oil and gas E&P 2) Offshore supply services
4. Shipping and Port	The economic activity related to the transportation of freight and passengers through the ocean and river, and related to operation and management of port.	1) Passenger transportation 2) Freight transportation 3) Shipping business services 4) Port development 5) Port O&M (storage, load and unload, trucking, etc.)
5. Marine leisure & tourism	The economic activity related to the marine and coastal leisure and tourism, which includes eating & drinking places, hotels & lodging places, marinas, marine sporting goods retailers, zoos, aquarium, recreational vehicle parks & campgrounds and so on.	1) Eating & drinking places 2) Hotels & lodging places 3) Marinas, marine sporting goods retailers, zoos, aquarium, recreational vehicle parks & campgrounds 4) Marine festival, etc.
6. Marine construction	The economic activity which includes construction in the ocean and related to the sea.	1) Marine construction (seabed cable, pipeline) 2) Marine related to construction (ports, bridges, etc.)
7. Marine equipment manufacturing	The economic activity which includes manufacturing of marine equipment and materials, such as various machinery, valve, cable, sensor, ship materials and so on (no building, repair and/or conversion and supply services).	1) Machinery, valve, cable, sensor, ship components 2) Research equipment 3) Others
8. Ship building & repair	The economic activity related to the building, repair and maintenance of ships, boats, offshore platforms, and OSVs.	1) Ship & boat building 2) Ship & boat repair and maintenance 3) Offshore platform & OSV building 4) Offshore platform & OSV repair and maintenance
9. Marine business services	The economic activity related to services to support ocean industry like finance, consulting, technical services, and so on.	1) Finance & Insurance, marine consulting 2) Rental 3) Technical services 4) Inspection 5) Ocean engineering, S/W service 6) Labor supply services 7) Others
10. Marine R&D and education	The economic activity which is related to research and development, education, training.	1) Research and development 2) Education and training
11. Marine administration	The economic activity related to defense, coast guard, security, navigation and safety, coastal & marine environmental protection by government and public or private organization.	1) Defense, coast guard, security 2) Navigation and safety 3) Coastal & marine environmental protection 4) Organization (government, public organization, NGO)
12. Others	The economic activity which is not classified elsewhere. It also includes economic activity related to development of the ocean resources, which are ocean renewable energy, marine living resources, seawater and spatial, but just enter into the early commercial stage.	1) Ocean energy (tidal, wave, OTEC, offshore wind) industry 2) Marine bio industry 3) Seawater desalination 4) Marine CCS 5) Others which are not classified elsewhere

'Marine R&D and education' means the economic activity, which relates to research and development, education, and training. Even though R&D and education are different from each other, they are integrated into one sector. That's because in general the same organizations such as a university and research institute perform these activities.

'Marine administration' means the economic activity related to defense, coast guard, security, navigation and safety, coastal & marine environmental protection by government and public or private organization.

'Others' mean the economic activity which is not classified elsewhere. It also includes economic activity related to the development of the ocean resources, which are ocean renewable energy, marine living resources, seawater, and ocean spatial. These industries usually enter into the early stage of industrial development.

## 5. Conclusion

### 5.1. Summary

Economic activities related to the ocean are developing significantly around the world. However, as Kildow and McIlgorm (2010) [5] pointed out, in studies by other countries, different definitions or delimitations appear in which it is understood to be the ocean economy or industry. As can be seen in chapter 2 and chapter 3, classification standards and scope as well as terminology and definition for the ocean economy are different among countries. So it is difficult to compare the ocean economy among countries, even though it is important to decision-makers related to ocean policy. The goal of this study is to provide concrete practical proposals on the definition, classification standards and scope of the ocean economy. To achieve this goal, the definition of the ocean economy is rebuilt, and characteristics are extracted from the ocean countries. The classification standards and scope of the ocean economy by each country is also analyzed.

For the terminology, 'Ocean Economy' is selected as a representative terminology for this article. 'Ocean' can be replaced with 'Marine', but 'Economy' cannot be used interchangeably with 'Industry' because economy includes much more than industry. If the ocean economy just deals with the private sector and it does not include the public sector, it can be called as just 'Ocean Industry'. Additionally, non-market value is excluded from the ocean economy in this article even though non-market value of the ocean should also be an important part of the ocean economy.

With regard to the definition of the ocean economy, common words are extracted by each country, and a combination of industrial and geographical perspectives is considered. As a result, the ocean economy is defined as follows: a) the economic activities that take place in the ocean, receive outputs from the ocean, and provide goods and services to the ocean, or b) the economic activities that directly or indirectly take place in the ocean, use the ocean's outputs, and contribute to inputs to ocean's activities.

To determine the scope of the ocean economy, nearly 50 common words are extracted from the case of 10 ocean countries, and 3 characteristics of the scope of the ocean economy are inferred from them. These are 'in the ocean', 'from the ocean', and 'to the ocean'. With the cases by each country, supply chain and the relationship among the ocean economies are also considered. According to the newly proposed classification standard, 12 sectors of the ocean economy are rebuilt and they are linked to common words. In conclusion, 12 sectors are newly rebuilt reflecting the ocean economy in this study.

### 5.2. Limits and suggestions

This study has two limits. First, there is no trial to compare among nations according to this study's result, because this study is solely focused on rebuilding the definition, classification standard and scope of the ocean economy. So it would be better to conduct a follow-up study. Second, even though non-market value must be included in the ocean economy, it is excluded from this article at present. It also should have a follow-up study.

Furthermore, we can consider the methodology of estimating ocean economy. Most countries have no statistical classification system for the ocean economy as a distinct category. To estimate the size of the ocean economy, these countries usually use SIC (Standard Industrial Classification) or inputs-outputs table, which are produced by their own

country's statistical bureau. Therefore, one might consider linking to the International Standard Industrial Classification (ISIC), which is created and issued by the UN. Most countries adopt the ISIC as a national statistical system. If each country established the statistical classification system for the ocean economy linked to ISCI, it helps to compare the ocean economy among countries more easily.

Although this study aims to provide concrete practical proposals for the definition, classification standard, and scope of the ocean economy, there still might be various and different opinions related to this study result. Therefore, there should be more lively discussion about this topic around the world.

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