Research on the Direction of Marine Science and Technology R&D Policy in the Fourth Industrial Revolution-The case of Korea

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ABSTRACT
In the fourth industrial revolution environment, it has become an important issue to improve the first-stage R&D planning system of the national research and development business of marine science and technology. Taking South Korea as an example, it is of great practical significance for the development of marine science and technology in China to study the research on the direction of marine science and technology R&D policy in South Korea, analyze its shortcomings and limitations, and find improvement measures for the R&D planning structure.

Keywords: *marine, science, technology, policy, planning system*

1. BACKGROUND

Research and development (R & D) refer to systematic and creative activities in the field of science and technology, including basic research, applied research, and experimental development, in order to increase the total amount of knowledge and use this knowledge to create new applications. Reflecting the synergistic relationship between science and technology innovation and economic development, it plays an important role in high-quality development and is an internationally accepted indicator with consensus and comparability. In 2019, the Korean government and businesses spent $76.4 billion on research and development (R&D), placing them fifth among Organization for Economic Cooperation and Development (OECD) member countries.

2. ANALYSIS OF THE CURRENT SITUATION OF KOREA'S MARINE POLICY

The basic plan of science and technology, based on the Basic Law of Science and Technology, constitutes the basis of the national research and development program. The Basic Plan for Marine Science and Technology Development and the implementation plan are based on the Marine Science and Technology Development Act. The development of the national plan is divided into two parts: "setting the plan should also address matters necessary for the implementation of the proposed policies. The capital master plan also considers the budget, and the financial part is the most difficult part of the planning for the plan.

2.1. Current research and development issues in various fields of marine aquaculture

By analyzing the topic model of the SNS data, the main topics in the marine field, the aquatic field, the maritime and marine field, and the port logistics field are analyzed, and R&D-related topics are proposed（See Table 1.

Table 1. Hot issues related to R&D in various fields of marine aquaculture (overview)

Type	R&D related issues
Ocean	Marine environment/ecosystem damage & response. Climate Change, Marine Litter, Coastal Erosion & Disaster, Marine Tourism, Marine Energy Development, Arctic Waterways & Resource Development, Marine Environmental Technology & Equipment Development, Marine Safety & Illegal Fisheries, Green Ship
Aquatic	Impact of marine environmental changes on aquatic resources, illegal fishing & indiscriminate fishing response technology, intelligent aquaculture technology development, aquatic product quarantine
Marine	Develop logistics systems using light ships, autonomous pilot ships, and block-chain, and develop maritime safety accident response systems to cope with Arctic shipping lane development and the cruise industry
Port Logistics	Development of logistics systems using block-chain, etc., unmanned automation in ports, technology development for environmental regulation response in ships, and technology development for green ships

2.2. Policy Trends in Marine Science and Technology R&D

Korea's Ministry of Maritime Affairs and Fisheries (MMAF) released the "2050 Carbon Neutral Plan for the Marine Aquaculture Sector."In order to successfully implement the 2050 Carbon Neutral Plan and effectively reduce carbon emissions from maritime and aquaculture production, the Ministry of Maritime Affairs and Fisheries (MMAF) released the "[1]2050 Carbon Neutral Plan for the Marine Fisheries Sector" on the 16th, setting out the "2050 Carbon Neutral Roadmap" that includes policy directions for promoting carbon reduction in the marine fisheries sector. "Carbon Neutral Roadmap." First, the marine sector plans to reduce carbon emissions by 307,000 tons by 2050 through a phased conversion of diesel-fueled ships to low-carbon, carbon-free ships. Secondly, in the field of fishing and fishing villages, we plan to reduce carbon emissions by 115,000 tons by 2050 by replacing and reducing aging fishing vessels and expanding the spread of energy-efficient equipment. At the same time, we plan to reduce greenhouse gas emissions by 2.297 million tons by 2050 by expanding the use of wave, tidal, and other marine energy sources through the construction of a foundation for the use of various renewable energy sources such as solar energy, small hydropower, and wave power on idle land and water such as fish farms and national fishing harbors; and we will also develop hydrogen production technologies based on marine organisms and implement the Hydrogen Port Construction Program as scheduled. In addition, it will develop and utilize marine biology-based hydrogen production technology and will fulfill the "Hydrogen Port Construction Program" by 2040, supplying 13 million tons of hydrogen through the port every year. The Minister of Maritime Affairs and Fisheries of Korea, Moon Sung-hyuk, said that climate change and carbon neutrality are irreversible trends, which are both a crisis and an opportunity, and that the policy of promoting carbon neutrality in the field of marine fisheries will be implemented to the maximum extent.

3. DEVELOPMENT TRENDS

The Ministry of Marine Fisheries has developed and published a marine aquaculture R & D roadmap to make strategic R & D investments in the marine aquaculture sector to achieve sustainable development in the marine aquaculture sector. The roadmap outlines the direction of marine aquatic research and development as well as emerging industries by 2025, as well as specific safeguards.(2016, Korea Institute for the Promotion of Marine Science and Technology, Ministry of Maritime Affairs and Fisheries, Korea) The roadmap divides marine aquatic R & D into three categories: public innovation, technology-led, and industrial innovation. The technology-led part will be analyzed.

3.1Marine energy technology field

Marine energy technology refers to various technologies that investigate and analyze the physical energy in the ocean and convert it into electrical energy or energy that can be easily used. As a new renewable energy source that can solve the problems of climate change and resource depletion, ocean energy is actively promoting technology development and practicalization under the leadership of developed countries, especially the European Union and the United States, which regard ocean energy as a major energy source in the future and are expanding investment in technology development and strengthening policy support. The EU plans to replace 15% of electricity demand with ocean energy by 2050, and the US plans to provide 7% of electricity demand by 2050 through the utility of wave power. Korea's technology development centered on development along the sea is expanding to the deep sea, and the direction of technology development is changing from unitary modular technology development to large-scale campus and composite development.[2] There is a trend of accelerating research and development in the early stages of technology development or competing to seize the technology for composite power generation.

3.2.Field of marine equipment technology

The marine equipment technology field includes a variety of fields such as instruments, equipment, and facilities based on the development of marine science and technology. Here, we have studied technology development trends centered on marine robots, ship communication equipment, and ship integrated navigation devices. After developing the Near Range Mine Search System (NMRS) unmanned submarine in the late 1990s, the U.S. completed the development of the Long Range Mine Search System (LMRS) and the MRUUV with higher functions than the LMRS in the mid-21st century, and has been operating them on board submarines and combat ships. Underwater glider utilization technologies are broadly classified into three types: mechanical electric buoyancy change method, seawater temperature difference energy drive method, wave energy drive method, and composite method, which combines a standard propulsion system and a gliding system..

3.3 Marine traffic and safety technology fields

In the field of marine transportation and safety technology, the key technologies are divided into environmentally friendly ships and autonomous operation ships. Environmentally friendly ships generally reduce atmospheric and marine pollutant emissions while significantly improving fuel efficiency over conventional ships. They are ships that meet the new international environmental limits for ships, including LNG ships, electric propulsion ships, fuel cell ships, hydrogen ships, etc.(see Figure 1)

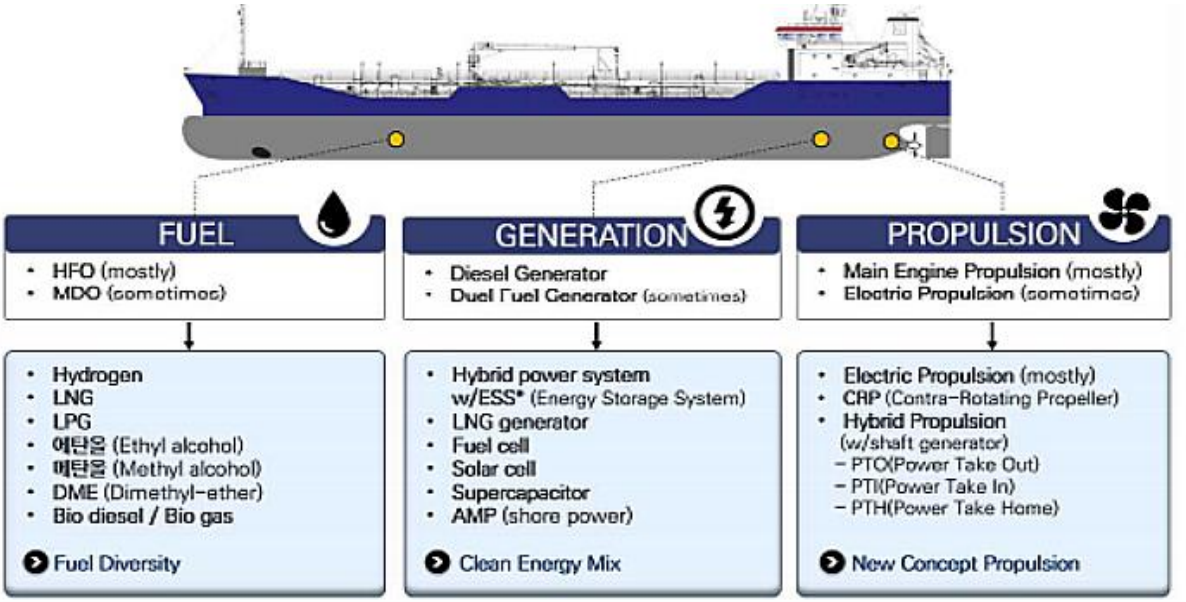

Figure 1. Korea Ocean and Fisheries Development Institute (2019) Report on the Survey of Overseas Cases in Major Marine Science and Technology Fields

With the rapid development of the global LNG market, the development of LNG carrier technology is also accelerating, especially the ice-breaking LNG carriers that are attracting attention. LNG storage tanks that can maintain the appropriate temperature are a key technology for LNG carriers. Currently, most of them are stand-alone type C for coastal shipping purposes, but the demand for stand-alone type B or membrane type will increase if transport vessels become larger in the future. In addition to environmentally friendly ships, other areas where R & D is accelerating are autonomous operation ships. The key technology elements are advanced sensor modules, autonomous navigation systems, remote control support systems, engine monitoring and control systems, maintenance interaction systems, energy efficiency systems, and coastal control centers. The autonomous piloting concept is to apply autonomous piloting systems in distant seas where the risk of ship collision is low, and to control the ship from a coastal control center in complex situations such as ports.

4. CONCLUSION

Strengthen R & D planning capabilities and develop specialists with a wide range of experience in technology forecasting topics, project evaluation, budget adjustment, etc. Analysis of global trends (PEST analysis: political, economic, social, and technological), analysis of domestic trends (PEST analysis), and development of strategies.He is able to carry out differentiated R & D planning according to the nature of the R & D planning projects that meet the characteristics of marine science and technology.Guidance for national marine science and technology innovation policies

ACKNOWLEDGMENTS

* This work was supported by a grant from Brain Korea 21 Program for Leading Universities and Students (BK21 FOUR) MADEC Marine Designeering Education Research Group.

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