

# The East China Sea Floor Observatory Network Systems Engineering: Economic Analysis and Prospects

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**Abstract :** As the third observation platform of the earth system, Sea Floor Observatory Network (SFON) completely changes the way of study on ocean and marks a new era in Marine science research. With the increasingly fierce international competition with respect to science, technology and national defense security based on the platform of Sea Floor Observatory Network, our country has made great forward in terms of sea floor observation. This research on the basis of summarizing the current situation of the development of seafloor observation explores the relationship between the East China Sea Floor Observatory Network systems engineering construction and local economic development of Shanghai, as well as puts forward relevant suggestions on the development of seafloor observatory system in our country in the future by analyzing the foundation and advantages of Shanghai .

**Keywords:** Sea Floor Observatory Network (SFON); Current Status; Key Technology; local economic relations in Shanghai; countermeasures and suggestions

## 1. Introduction

In 21 century, the century of ocean, utilization of ocean resources has related to the implementation of the national strategy. Sea Floor Observatory Network

as a kind of new platform which is used to achieve long-term real-time seafloor observation is regarded as the third important platform for explorations in deep water in addition to investigating ships and remote-sensing and telecommunications satellites. Sea Floor Observatory Network consisting of a number of seafloor observatory nodes and shore-based stations based on the connection of all nodes and stations with cables or optical fiber aims for real-time continuous observations on physical, chemical and biological changing processes in ocean, which is the indispensable supporting technology and means of getting information concerning with the environmental protection, resource development, disaster prevention and reduction and national security.

Today, development of seafloor observatory system has been one of the major steps of seizing the commanding height of future marine economy taken by the world's major developed countries. Taking Canadian "Neptune" Sea Floor Observatory Network (see figure 1), American "oo1" Ocean Observatories Initiative, "ESONET" and "ARENA" as examples, Sea Floor Observatory Network has obtained huge governmental investment and developed rapidly in nearly 20 years. Our country has made great forward in

terms of sea floor observation under such an international great background. Shanghai is now taking the lead in actual observation. Shanghai has invested nearly 50 million to support the program in basic research since 2008, and under the support of technological key project “experiment and preliminary application of sea floor observatory networking technology”, the East China Sea floor observatory experimental station at Xiaqushan has successfully been established and run able to gain benthonic real-time information through sensor placed at the bottom of the sea.

Therefore, this paper on the basis of summarizing the current situation of the development of seafloor observation explores the relationship between the East China Sea Floor Observatory Network systems engineering construction

and local economic development of Shanghai, as well as puts forward relevant suggestions on the development of seafloor observatory system in our country in the future by analyzing the foundation and advantages of Shanghai.

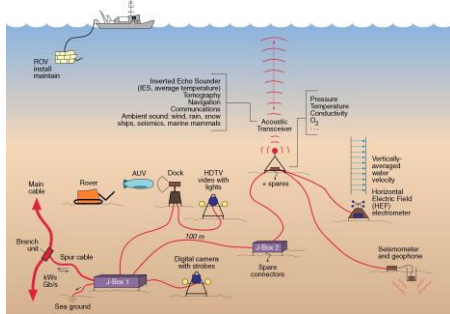


Fig. 1: Sketch of deployment of NEPTUNE node

## 2. Development History and Current Situation of Our Country's Sea Floor Observatory Network

People with visions headed by academician Wang Pinxian have launched a scientific research on seafloor observation and present proposals of “observing” ocean from the bottom of

it which is highly valued by national government. During the “Eleventh Five-Year”, the first East China Sea floor observatory experimental station at Xiaqushan which integrates observation experiment and demonstration system has taken shape initially which helps to improve the marine disaster forecasting ability and emergency handling ability; Six special key technology research is mentioned in the “12th Five-Year” Plan which includes key technologies such as planning and site selection on the research of East China Sea floor observatory system, engineering equipment for East China Sea floor observatory networking and East China Sea floor observatory application system networking etc. Although system research of Sea Floor Observatory Network is developed relatively late, a communication mode that is headed by government, led by the scientific research institutions and actively participated by enterprises has been initially formed aiming to promote the common development of Sea Floor Observatory Network (see figure 1). At present, our Sea Floor Observatory Network construction can be mainly divided into the following three stages:

Stage one refers to the key technologies validation. “Sea Floor Long-term Observatory Network Experimental Key Technology of Nodes” is the major project in the field of marine technology stated in “11th Five-Year Plan” 863 Program. This project aims to research and develop the key technologies for deep sea networking such as junction box and power transmission & communications technology, seabed dynamic environment & chemical monitoring technology, deep sea networking standard techniques & system integration, and lying & testing technique etc., as well as experiment and

connect with international observatory network to gain real-time data by the way of cooperating with MARS.

Stage two refers to the network construction and use to a limited extent with the experimental site of Yangtze River Delta. In 2009, Tongji University led to set up the first East China Sea floor observatory experimental station at Xiaoqushan which integrates observation experiment and demonstration system. Optical cable with the length of 1 km will transmits signal every 15 seconds and the sea temperature, salinity and hydraulic pressure etc. will be recorded. After a magnitude 8.8 earthquake in Chile on 27, February, 2010, Xiaoqushan experimental station successfully collected the data that reveals the sea level altitude of the area is

abnormal. Based on the monitoring results, the researchers in our country will invalidate and improve the tsunami warning model accordingly.

Stage three refers to the ongoing large-scale seafloor observatory network construction. The project of “The East China Sea Floor Observatory Network” with the investment of 40 million yuan from Shanghai has launched and will be scheduled to be built within five years. The central government is expected to invest more than 1 billion yuan to build South China Sea and East China Sea floor observatory networks, as well as do the best to lay sensitive "nervous system" under the sea of China.

Table 2 The development of China’ s SFON

2005	National Guideline on Medium- and Long-Term Program for Science and Technology Development
	The suggestion of constructing SFON
2007	“The third observation platform of earth system” proposed
2009	Chinese first Sea Floor Submarine Integrated Observation Experiment and Demonstration System
2010	Sea surface anomaly captured by Xiaoqushan station after Chili’s 8.8 level earthquake
	“Build devices for sea floor observatory network system” proposed
	Center for marine science and technology established by Tongji University, Jiaotong University, East China Normal University and other institutes.
	Experiments were conducted offshore and successful
2011	“The East China Sea Floor observatory network” initiated

**3. The relationship between East China Sea Seabed Observation Network construction engineering and Shanghai economic development**

**3.1 The foundation and advantages of Shanghai**

As mentioned earlier, in 2011, “Marine environmental monitoring ” was listed

into Shanghai city “Twelfth Five Year” technological development plan, “East China Sea Seabed observation network” project invested 40 million Yuan by Shanghai City is officially initiated and it is expected to be completed in the five years. So why our country’ s first seabed observation network project shall be located in Shanghai and what foundations and advantages in the fields of marine

technology, marine science and marine economy does Shanghai have?

First, Shanghai faces seaward and back hinterland of the Yangtze River. In the modern history, it was famous for sea portal to the world. As to say, in the history of China, Shanghai has a special position. From miles with foreign contended by big powers at that time to remarkable Oriental Pearl today, Shanghai has become proud in the history of China. In the new century, Shanghai not only undertakes the responsibility of “leading in the Yangtze River”, but also shall play its role of “marine window” to take the lead to develop marine industry and marine technology. In recent years, coastal provinces and cities have put forward slogan of “marine XX” to speed up the development of marine economy. Shanghai shall put forward marine plan with high starting point and high target, not only offshore development, but also going to ocean and participating in international frontier competition.

Second, marine development and marine science in modern times are completely based on high technology. Shanghai has abundant science and technology, including more rich intellectual resources, which is the strongest support.

Third, in fact, Shanghai has had strong ocean scientific research strength and marine industry force. Its researches for shipbuilding, navigation, seafood, river mouth and coast are at the top of list in our country and have international reputation. Shanghai also is a petroleum exploration and development base in East China Sea. Shanghai's marine

geological ability has passed international ocean drilling held in South China Sea in the spring of 1999. Shanghai has also entered into international frontier in the deep sea research; therefore, Shanghai is a competitive big city for marine scientific research and marine industry in western pacific.

Therefore, Shanghai is a big city in the western pacific, no matter from geographic position, historical mission to science and technology force and economic base, Shanghai has various advantages to develop marine science and marine industry.

### **3.2 The Relationship between the Construction Project of Seafloor Observatory Network in East China Sea and the Marine Economy Development in Shanghai**

#### **3.2.1 Shanghai Provides the Supports on various aspects for the Construction of Seafloor Observatory Network in East China Sea**

Seafloor observatory network in east china sea is the first seafloor observatory network in China, so its construction will face many difficulties that need to overcome. The project has the distinctive characteristics due to the special spatial location of its operation, those characteristics present as follows: complicated construction conditions, huge construction scale, various technological contents, high requirement for anticorrosion, large demand on engineering equipments and investment, high pressure on project schedule, large-span on management, high level difficulty and so on. Shanghai has the strong

technological strength and financial strength, rich intellectual resources and the relatively formal business environment and market mechanism, which can provide the good support for the construction of seafloor observatory network. Since the beginning of construction in April of 2011, the construction has being proceeded in an orderly way with the cooperation of Shanghai government, Shanghai science and technology association, relevant construction headquarters offices as well as the colleges and science research institutes.

### 3.2.2 The impact of East China Sea underwater observational network on Shanghai's economy

Firstly, it may become a new power of Shanghai Marine economy development. This “ sea-crossing action” which beyond administrative divisions contains systematic breakthrough, maybe have more profound significance. In today's international society is all pay attention to marine economy market. In this fierce competition, Shanghai as an international metropolis, one of the challenges is the transformation of marine economy. The very important part of economic transformation is to accelerate the manufacturing industry upgrade and enhance the core competitiveness. And the key technology introduction, innovation and independent research and development of East China Sea underwater observational network, and technology localization will drive the upgrade and development of the Shanghai marine engineering equipment manufacturing industry. On the other hand, according to benefit analysis of the construction of the underwater observation network of the developed

countries, they have the accurate forecast of climate, weather, and sea conditions, once they are used by producers and consumers to improve their economic activities and decision-making, will produce significant economic value and interests(11). For many years, Shanghai has attached a great importance to the development of marine economy and the construction of marine engineering, for instance marine construction projects of “ Donghai Bridge ” and Yangshan Deep-Water Port has promoted the development of marine economy in Shanghai. For many people, the magnificent Donghai Bridge has the certain symbolic significance, it connects the Shanghai and Suzhou, so it can be regarded as the epitome that the economic development breaks the restriction of administrative division. The construction and further application of seafloor observatory network in east china sea will bring renewed energy to the development of marine economy in Shanghai.

Secondly, it may promote economic agglomeration effect. Someone says, the underwater observational network of East China Sea is just the beginning. Because of the distant sea around it and the underwater observation network of South China Sea is under discussion. It is not difficult to see that marine science and technology innovation plays a role as vanguard in the economic integration process of region and even the whole country. Today, the national government, and local governments have realized that the construction of large Marine engineering has immeasurable giant power to regional economic integration. More importantly, urban agglomeration effect and market aggregation function which brought in by it can help to complete some difficult tasks, for

instance, the adjustment of industrial structure, repeated construction, etc.

#### **4. Suggestions for the development of seafloor observatory network**

The development of seafloor observatory network does not only closely related to technology, but also involves with the overall reform of the observatory system, state ' s maritime strategies, operational mechanisms and policies, huge amount of investments and other issues.

##### **4.1 Formulate, develop and make state plan for our ocean observing system**

As it has been mentioned that many marine powers such as U.S., Japan and EU etc have formulated and made plans for developing ocean observing technologies and seafloor observatory system, and have set corresponding stage and long-term targets, and in view of the needs and demands on seafloor observatory system due to and necessary for China ' s social and economic development and national defense construction, it is in urgent need to make national plan for guiding the development of China ' s seafloor observatory system. Although there ' re some certain disparities and differences exist in level when comparing China ' s conditions with that of these marine powers, the nature of such causes as caused existed problems are basically the same except for the degree. If we can formulate and develop authoritative plans according to which to guide relevant divisions to construct and develop the state integrated seafloor observatory

system, a great number of troubles can be eliminated which is benefit for concentrating the limited funds to support the continuous operation of the permanent observation system.

##### **4.2 Increase investment and perform supervision and management efficiently**

China ' s seafloor observatory network industry is still in initial development phase, thus, it is in need to formulate and provide systematic and supporting policies, especially that it is necessary to provide policy supports and incentive guidance in terms of the investments on, approval for, standards and mechanism formulated for and taxes levied on relevant major science and technology projects, so as to facilitate the overall development of the industry. It is worthy to draw on Canadian and Japanese government ' s practical experience of making huge investments on developing seafloor observatory network, on the other hand, the long-term maintenance of seafloor observatory network is one of the difficulties which needs huge amount of funds, besides, state must supervise the investments on seafloor observatory network, attach importance to the economical efficiency, and consider capacity of the national and local economy, therefore, analyses should be made on such benefits as may be brought and generated from the costs caused by developing seafloor observatory network, and the investment should be restrained, supervise and managed.

#### **4.3 Perform exchange and cooperation, and draw on foreign experience**

Although some certain differences may exist in various countries' key points and ways used for making development, it is necessary to follow the development trend of international seafloor observatory network closely, therefore, it is important for Chinese government to promote related international cooperation, performs technological exchange and cooperation with developed countries such as America, Canada and Japan etc according to plan, introduce and grasp new technologies related to the design of key parts, and contribute and share seafloor observation data, which are essential for developing China's seafloor observatory network and can get twice result with half efforts.

#### **4.4 Organize and integrate resources, tackle key technological problems**

China's conditions are similar with that of America that marine divisions (but except for these with administrative system), some cross-sector organizations, research institutions and many other organizations always and often, for their own business needs, support a certain scientific plan or project, which result in the current status of dispersed research efforts and small-sized research project, caused the conditions of repeat development and investment and lead to that "data-sharing" can not be realized on resource platform, which are disadvantageous for establishing Chinese's international position in researching industry, especially bring about great resources wastes, therefore, the state divisions which are in charge should

formulate some certain mechanism, organize and integrate relevant team, concentrate state funds, labor and resources to form high-level research team, so as to avoid making repeat researches, investments and developments.

#### **4.5 Improve people's knowledge to seafloor observatory system**

Speak of the four major ancient civilizations, Chinese civilization originated from and in mainland, while, the content of marine culture is rather limited in traditional culture that our sense and knowledge to ocean are still weak till now. In the past few decades, both government and people lack of sensitive ocean sense for a long-term, although, with the economic development, Chinese business activities, energy safety and state benefits have involved global oceans, the ocean sense and spirit have not followed. Thus, it is necessary to advocate by formulating policies and promote pilot projects to make the concept of seafloor observatory network being deep in people's mind, so as to lay solid foundations for promoting the development and construction of seafloor observatory network in the future.

All in all, it is a tremendous technology-intensive project to develop and construct seafloor observatory network which needs huge funds, well design and organization and involves with a great number of organizations, and , it should be cooperated by such government division as is responsible for maritime affairs, the R&D divisions which have strong technical powers and various social people from all walks of life who cares about environment and resources to

establish an efficient and integrated observation system. We believe that, Shanghai, as the pilot city endowed with the above-mentioned advantages, will play a demonstration and leading role in developing seafloor observatory network. In future, with the guidance of general, efficient and scientific state plan, the integrated and permanent state seafloor observatory network will be developed and established by the efforts made by various sectors together for the same goal.

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