1. Introduction

“Economic Development”, “Resource Limitation”, and “Global Environment” consist of the so-called tri-lemma the difficulty of which we face and could not be solved in the straightforward way. The only possible way to solve this difficulty may be the sustainable development, which corresponds to the holonic path as the hybrid of hard and soft system.

There is no frontier land left on the earth, while the ocean, which covers 70% of the surface of the earth, is still new frontier left on the earth. In order to carry out the sustainable development, we have to utilize the ocean. From the standpoint of food, resources, energy and space, the ocean is left still in a new frontier.

The life style in the 21st century requires to introduce a new concept on all sociological condition for safety, environment, health, product design etc, in which it is the most important to do anything in fully rational way. ISO 9000 and ISO 14000 are the examples of this concept. The rational safety includes safety engineering, risk analysis, estimation of cost of human life ISO9000 and so on. The rational environment includes ISO14000, global conservation etc. The rational design of system and production is based on the life cycle engineering which considers life cycle cost, safety and environmental assessment through the consistent way from material selection, design, production, operation, maintenance management, recycling to scrapping.

It is important to generate needs in order to succeed in the ocean development. It is important to match the conditions among technology, sociology and economics in order to realize the needs. If the objectives are made clear, it is not impossible to develop the technology, to improve regulations and systems in order to realize the objectives.

In the following, just look over the brief history of the ocean development in the 20th century, and predict the marine and ocean development in the 21st century and outlook the long-range development the ocean in future.

2. Marine and ocean development in the 20th century

The relationship between human being and the ocean started in the oldest history of the fishery activities. In the beginning of the 20th century, the technology of fishing boats, and the fishing methods were greatly progressed, and the fish catch was tremendously improved. The excessive catch of fishes is the today's big issue. In order to maintain the sustainable development, nowadays the management of fish resources becomes a big issue. The total allowable catch is one of the examples of the today's issue. The aquaculture is getting
important from the standpoint of the sustainable development.

The ocean surface transportation has had the long historical since olden days, while the ocean surface transportation has pursued the scale merit and high-speed merit to the present. Nowadays super large-scale container ships require a very deeper water port, then the existing ports could not afford this situation in Japan.

The most successful example of the ocean development in the 20th century is the offshore oil development as in the Gulf of Mexico or in the North Sea. The today's energy problem could not be solved without the offshore oil, while the offshore oil development is progressing into the deeper water, ultra deep water area more than 3,000m deep that requires the breakthrough of the underwater technology.

The ocean technology has been improved very much by the development of the underwater submarine cable networks. This submarine cable laying technology has been accompanied with development of the technology on the ocean measurement and deepwater exploration.

In the following paragraphs two examples are introduced which realized the needs of the ocean development. At first, a twin hull ferry boat is shown which connects the downtown of Vancouver and the residential area of the North Vancouver and belongs to the Transportation Bureau of the British Columbia in Canada. The ferry is far from the ordinary ferry. The ferry has the same configuration of bow as that of stern part, carry 400 passengers who can get out and get on only in less than 90 seconds, adopting the unique design and utilizing improved floating terminal. A special consideration is paid to the connection with the bus lines at the North Vancouver in which the passenger can transfer a ferry to a bus without worrying the miss of the bus. They have operated two twin hull ferries every 15 minutes from 6 am till midnight with only 3 accidents in 20 years. The maintenance has been kept from midnight till 6 am every night with 6 persons. This ferry is one of the examples of the success of the ocean development in which technical, sociological and economical conditions are improved in order to fulfill the needs.

Next example is a floating platform for the space rocket launching. The equator is the most appropriate place to launch a space rocket for a stationary satellite, which is used for a meteorology observation. The launching cost of a space rocket is around US$70M in USA, and US$50M in EU. If we use a floating platform for a rocket launching, then the launching cost may be around US$30M. In the coming 10 years, the joint industry group from USA, UK, Ukline and Russia may expect to receive orders of US$1B and they organized the Sea Launch Project. The IS company was mainly responsible for the finance and Ukline and Russian companies were in charge of the technology. This project is one of the successful examples of an ocean development, which looks like a fusion of demand, and supply with technology and finance.

Generally speaking, the ocean development requires the technology development to solve the typical ocean problems which are oscillation of a floating structure in waves, corrosion on steel materials, degradation, bio-fauling, on-site inspection/repair/maintenance etc as the new/old technical issues. Recently, the technology for the ultra deep water development is focused.

3. Marine and ocean development in 21st century

Everybody can expect that the ocean which covers 70% of the surface of the earth will be becoming more
important from the standpoint of the global environment, energy, bio resources, economic development, security. Especially, the sustainable development for the EEZ (Exclusive Economic Zone) may become the fundamental strategy for the national interest.

Among the ocean developments, important issues, which may be realized in 30 years, are listed in the following section from each standpoint.

3.1 Standpoint for the global marine environment

To put the technology for submarine storage of carbon dioxide (CO2) to practical use is one of the important issues from the standpoint of the prevention of the global warming. There are several methods proposed for submarine storage of carbon dioxide (CO2) which are the method to discharge liquefied CO2 as weak solution to underwater, the method to sink dry iced CO2 to underwater, the method to store hydrate of CO2 on sea bottom, etc. Those technologies are under development in the various wide ranges. It is also important to explain the effect of CO2 discharge to surrounding of the site of storage of CO2, which is obviously important research subject.

Nowadays most advanced countries worry about disposal of industrial waste. In Japan industrial waste has been disposed in an artificial island as the main material for a reclaimed land, while natural environmental preservation/conservation has been getting worse due to the reduction of lagoons. It is very difficult nowadays to continue to dispose of industrial waste in an artificial island. Then the utilization of subduction zone of ocean floor plate as plate tectonics occurs as a long-range strategy for the disposal of industrial waste. The feasibility study on industrial waste disposed in a subduction zone of an ocean floor plate may be an important issue in future.

According to the increment of global population, ocean cities will be used with higher desire on which energy utilization based on fossil fuel and wastewater may become heavily environmental load. In order to solve this problem, a very large floating structure will be expected as “Ecofloat” which installs facilities of disposal of industrial waste and natural (renewable) energy utilization.

3.2 Standpoint of energy

The following important issues are listed from the standpoint of energy. Since the oil resources may have the limitation in near future, the development of methane hydrate is getting important as one of most expected energy resources. At present, the Japan National Oil Corporation just started to investigate the reserves of methane hydrate around Japan. The national project for the development of practical technology on utilization of methane hydrate will start in 2002 as 15-year project. The practical use of methane hydrate will be one of the most important issues in 30 years, considering economic condition.

From the standpoint of reduction of CO2 disposal, the increment of consumption of natural gas is desired. At that time, transportation cost of natural gas should be reasonable. Submarine pipeline and hydrated natural gas carrier may be key technologies as transportation. Submarine pipeline can be used not only for fuel and gas transportation, but also solid material transportation, which corresponds to a submarine tunnel, both in unilateral and bilateral. Coexistence of communication cable line and power cable line with submarine pipe line can be available which indicates the possibility of fusion of material, energy and information
transportation.

Since a very large floating structure such as “Mega-Float” will be used widely in future, a huge area of deck of a Mega-Float can be utilized as the power station base of natural (renewable) energy utilization, as one of alternatives of solutions for the energy problem.

3.3 Stand point of ocean biological resource

Rational management of fishery resources as food and conservation of ocean ecosystem will be important issues in this category. In detail, establishment of monitoring technology for ecology of migrating fishes, and on-site observation technology for deep water biology including those under ocean floor will become important. The total allowable catch is not always rational for fishery management, while we have to consider regime shift for some kind of fishes.

From the point of view on fishery revolution as creative destruction, realization of marine ranching in midpoint of a large ocean such as Pacific Ocean where nutrient is very poor may become important, utilizing deep ocean water.

3.4 Stand point of economy

Sea surface transportation is a main issue on this standpoint. In order to reduce sea surface transportation cost, the size of container vessels are getting larger and larger which means the draft of a vessel is getting deeper and deeper. At present the largest container vessel carries 15,000 TEU containers, while 30,000 TEU container vessel may be an important issue in future, which may require more than 20 m water depth in the harbor.

This kind of port and harbor is no more practical. Then a floating type harbor may be realized in future similar to Mega-Float. Combination of airport and container yard can be called as a “Dual Port”.

The technology on completely unmanned vessel from one port to another port may be an attractive issue.

Submarine tunnel is also an attractive issue. The project of Japan-Korea submarine tunnel may be important issue in future, which will be connected to the Siberia railway.

New Orient Express from London to Tokyo would come in sight. Then there must be an intermediate station located on Tsushima Island between Korea and Japan. If a Mega-Float as a dual port is installed at the intermediate station, this station must be very important as the connection of railway, ship and airplane, and this port would be called as a Triport.

3.5 Stand point of security

The concept of security covers everything, which is related to national profit in the broad sense. Seals, regulations against pirates, emergency management, disaster prevention, energy crisis, food crisis, and environment problems are all covered by the concept of security. The security except the concept of all the previous sections is treated in this section.

At first, the establishment of submarine cable line network system will be the most important issue in order to monitor the EEZ (Exclusive Economic Zone). Various monitoring sensors will be installed on submarine cable lines, while among them hydrophone network system must be important.

After that, not only EEZ monitoring but also global ocean observation system will be urgent issue, using a combination of large floating platforms, floating buoys and AUVs as a point and line observation system. This
kind of system may be called as Global Ocean Observation Platform System (GOOPS). Corresponding to GOOPS, the development of an earth simulator will be big issue, which will predict meteorological, climatological variations, and variation of biological resources with high precision. We can call the global ocean observation as a real experiment, while we can call the earth simulation as a virtual experiment.

Next to deepwater exploration, the earth’s depths exploitation will be a frontier left on the earth as the last one. In order to fulfill this objective, more than 4,000m deepwater drilling technology will be urgently required.

Under the ultra severe environmental conditions, development of on-site physical, chemical and biological measurement system will be important.

The underwater GPS (Global Positioning System) may be big issue in near future, while the underwater GIS (Geographical Information System), which covers all ocean information in the EEZ and sea floor geographical information, must be important.

From the casualty prevention stand point, technology to prevent earthquake, which occur in the subduction zone of the plate tectonics, may be available, digging many holes on the subduction zone and injecting lubrication material into the holes.

4. Marine and ocean development after 21st century

The global warming affects seriously sea level rising, reduction of residential areas, reduction of farmland and living of human life. In order to prevent the global warming, the restraint of CO2 discharge are being discussed globally, while it is still not clear that the Kyoto protocol will be approved globally. Then we should consider the second best to solve the problems due to the sea level rising. The proposed solution is that very large floating structures (Mega-Floats) will be deployed as present Noah’s Arcs in the Pacific, Atlantic and Indian Oceans. Those Mega-Floats will function as a huge floating city, which will supply sufficient residential area and farmland. We can install facilities for renewable energy deployed on a huge area of a deck. Then we need not worry about the food crisis nor energy crisis. We can call this floating city as “Eco-Float”. The Interglacial period lasts only about 20,000 years in which the global warming is worried.

Comparing with the Interglacial period, the Glacier period lasts longer about 80,000 years. The sea level lowering is 120 m, and most of the cities in the world will cover with glacier, that is to say, very little residential area left. It is more severe to secure the residential area on the earth in the glacier period than in the global warming period. We still have the possibility to utilize a Mega-Float deployed along the equator in order to secure the residential area. We can use the deck of the Mega-Float to absorb the renewable energy such as solar energy, which may provide the power to drive the great ocean current and may change the glacier period to the inter-glacier period. This Mega-Float can be called as the Ocean Great Wall. Prof. Emeritus Noriyuki Nasu of the University of Tokyo proposed this idea.

5. Concluding remarks

The marine and ocean development is the most important for the global sustainable development with regard to global economics, food, energy, and space utilization. At the same time, the ocean environmental conservation is also very important. However, if we worry about failure and become too conservative not to
make failure, we could not expect rational and sound sustainable development. Every failure is a stepping to success. If we want to develop rationally marine and ocean, we need creative failure and creative destruction.

I point out one more thing at the last moment. Since the beginning of the human history, there have been neither food crisis nor energy crisis globally. Of course there had been some local food crisis and energy crisis. Uneven distribution is always a problem.