

# Economies of Combination Innovation from Group Operation in Petrochemical Complex\*

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**Abstract:** The circumstances in the oil and petrochemical industry recently have been severe. Under such a severe competitive situation, oil and petrochemical companies come up with the idea of business cooperation in the same region in order to acquire global competitiveness. In this paper, the approach and ways of the high-level integration for group operation in petrochemical complex are analyzed. The author explains the case in business cooperation, and introduces the advanced projects in Japan. And economies arising from group operation are considered. Cooperation with some businesses would be effective for energy conservation and environmental measures, and would advance to pursue some social interests. The paper proposes that economies in group operation have made possible simultaneous implementation of two strategies, Cost Leadership and Product Differentiation.

**Key words:** Petrochemical complex; Oil and petrochemical industry; Group operation; Pursuit of social interests; Economies of combination; Management of sustainability

## 1 Introduction

The circumstances in the oil and petrochemical industry recently have been severe. Oil and petrochemical companies are in the situation where they should deal with various problems. These subjects are global competitiveness, sudden rise of price of raw material, response to environmental issues, minimization of resource energy consumption, security of safety technology, employment and economical contribution to the region, requirement to satisfy severe product quality standard, further upgrade and cost reduction in system of production, and construction of system of production for sustainable development etc.. In Japan, oil and petrochemical companies have taken up matters of energy saving measure, actions on environmental problems, security of global competitiveness, and restructuring of system of production etc.

In Europe, America, the Middle East, and East Asia (China, Taiwan, and South Korea), one company usually builds a large-scale factory, and consistently produces oil and petrochemical goods in the system of one company. Differently from it, two or more companies are concentrated in the coast landfills in Japan, and generally manufacture in the system of groups. The system of production in a petrochemical complex would be a medium-scale level if it sees worldwide.

In severe competitive situation, oil and petrochemical companies came up with the idea of business cooperation in the same region in order to acquire global competitiveness. In this paper, the approach to and ways of the high-level integration for group operation in petrochemical complex are analyzed, the meaning of the plan is declared, and the economy arising from the group operation business is considered. Cooperation with some businesses would be effective for energy conservation and environmental measures, and would advance to pursue some social interests. Also, group operation would break the stoppage and promote innovations of manufacturing technology in petrochemical industry one after another.

## 2 Change of Oil and Petrochemical Industry in the World

In the 1990's, oil and chemical companies of Europe and America have reorganized and consolidated their businesses based on the strategy of selection and focus. Extending

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\* This paper is written, based on my presentation paper in ICIM2009 and the 25<sup>th</sup> International Conference on Korea-Japanese Economy and Management, and I added retouches and corrections to it.

strong fields further, they had been improving global competitiveness. In the petroleum industry, British Petroleum and Amoco Corporation had a plan to merge between 1998 and 2001, and became BP Amoco Chemical Corporation. Afterwards, ARCO was purchased. In oil companies in France and Belgium, TotalFinaElf was born. In the United States, there were two large scale merges of Exxon Mobile and Chevron Texaco Inc. As a result of having repeated merges and integrations, oil companies were integrated into mainly four companies, Exxon Mobile, Chevron (changed from Chevron Texaco Inc. in 2005.) , BP, Royal Dutch Shell.

In the oil industry of Europe and America, these integrations don't only mean the efficiency, but also improvement and consolidation of oil refinement. Many oil companies have petrochemical industries downstream. If they could construct a consistent system of production from oil refinement to petrochemistry, the effect by integration would be larger. And the operation of supplying material to petrochemical sectors has occupied a big part of the profit in the oil refining industry. In the 1990's, the petrochemical section had changed for oil companies from a supplementary section to the section in which the profit is secured and growth will be expected in the future.

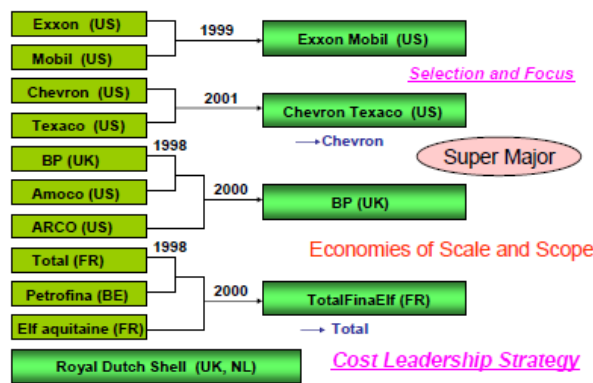


Figure 1 - Reorganization of the Major “Big Oil” Companies

Meanwhile, petrochemical companies of chemistry origin also have attempted to reorganize and consolidate. Large mergers, alliances, and business integrations were done actively. However, diferente from petroleum industry, the integration of petrochemical companies of chemistry origin has another meaning.

On the one hand, the integration of oil companies which have petrochemical divisions have accomplished large plants in scale, consolidation, vertical integration, and possession of a lot of derivatives. They have adopted the strategy to pursue economies of scale and economies of scope. On the other hand, the integration of petrochemical companies of chemistry origin has consolidated their business into strong sectors in order to have global competitiveness. They have adopted the differentiation strategy. Changing from the strategy that possessed many sections and aimed at the general chemical company in the past, they have concentrated firm resources on strong businesses, separated weak departments with low share, and sold them off.

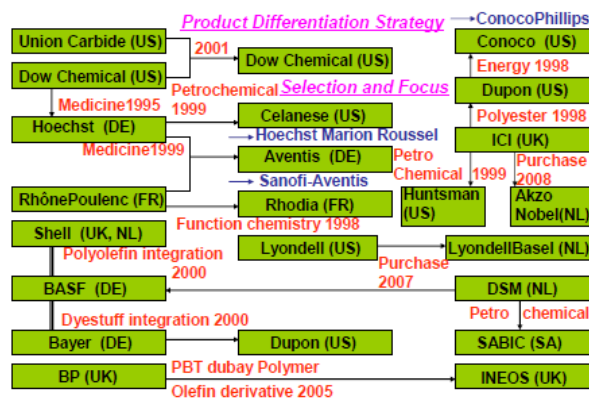


Figure 2 - Reorganization of Chemical Industry

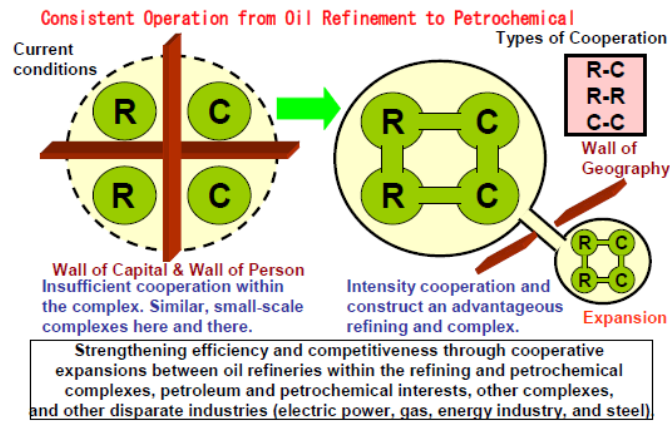
As well as the trend of reorganization and integration of European and American oil companies, a new movement has happened in Asian nations and the Middle East oil-producing countries. Especially, in the Middle East and China, there were movements to raise oil and petrochemical industry to a new industry in order to contribute to the region. It is expected that the promotion of oil and petrochemical industry would be able to produce employment in the region and contribute to the regional economy. They have intended to secure cheap raw materials, use the plentiful labor, establish competitive advantage in factor conditions. They are planning on large-scale construction with the latest equipment to have cost competitiveness internationally. They are going to manufacture ethylene and general-purpose petrochemical products.

### 3 Strengthening Competitiveness of Petrochemical Complex and Establishment of RING

Strengthening cost competitiveness is requested in oil and petrochemical enterprises in Japan. In the latter half of the 1990's, the merge and reorganization had advanced, and cost reduction had been attempted with efficiency improvement of production facilities. They had pulled out of unprofitable businesses. Positive investments in core business and growth business and participation in foreign complexes had made the business integration and competition stronger. However, the reorganization and integration of oil and petrochemical companies in Japan, if it is seen in the scale, is internationally the medium-scale one. It has faults that many operational companies are independent and production facilities have been distributed to many places. The equipment of oil and petrochemical companies in petrochemical complexes are widely distributed to eight places in the whole country. One company has production facilities in some complexes. The consolidation and expansion of manufacturing scale, efficiency improvement in manufacturing process, and reduction in cost of manufacturing are more necessary to obtain global competitiveness. But one company can't do them alone.

It has been said that weak points of oil and petrochemical companies in Japan are halfway of cost reduction in medium-scale production, excessive competition, surplus of production scale, low degree of rate of profit. Petrochemical complexes of Japan have production facilities at a medium-scale level. It is in the situation in which economies of scale cannot be requested. And the equipment of one company is distributed to two or more districts. It is also difficult to consolidate these in one place. Many enterprises, concentrated in the same district, often belong to different capital groups. There are examples of producing same products by different manufacturing methods in the same district, too. In such a system, each company respectively has continued to conduct business actions, making decisions independently. Unfortunately, if the company is different, the organizational culture is also different and the spoken jargon tends to be dissimilar. There was an assumption not to

communicate with each other easily in the situation. They have called these things "Wall of person", "Wall of capital", and "Wall of geography".



To solve the problems, 20 companies in oil industry and chemical industry gathered round at first. Under the Research Association of Technology Law, Research Association of Refinery Integration for Group-Operation (RING) was established in 2000. RING has acted group-operation programs in complex, which the Ministry of Economy, Trade and Industry has supported since 2000. In RING projects, they have tried to find new methods of integrated management, exceeding types of business and a frame of capital, developing some latest technologies, aiming at efficiency improvement and optimization. It is important that one complex is thought of as virtual one factory. If it is so, the integrated management could be practiced. As a result, new effects, economies and innovations by new technological development would be achieved. These practices are difficult for one company to do alone.

In RING, the research and development business, related to advanced united management, has been done between different types of business such as oil and petrochemical factory, etc. The first R&D project (RING 1) had got good results of the proof of R&D in the each district. It had resulted that strong unity was caused among complex enterprises through these activities. Following this, the second R&D project (RING 2) was executed in 2003. Development of advanced, highly integrated technologies for reducing environmental burdens was performed there. In addition, the action to optimize entire petrochemical complex and carry out advanced function unification was executed in the third R&D project (RING 3) in 2006. At present, such a business has been accomplished in most complexes in Japan, that is, in Kashima, Chiba, Kawasaki, Chita, Sakai Senboku, Mizushima, and Shunan.

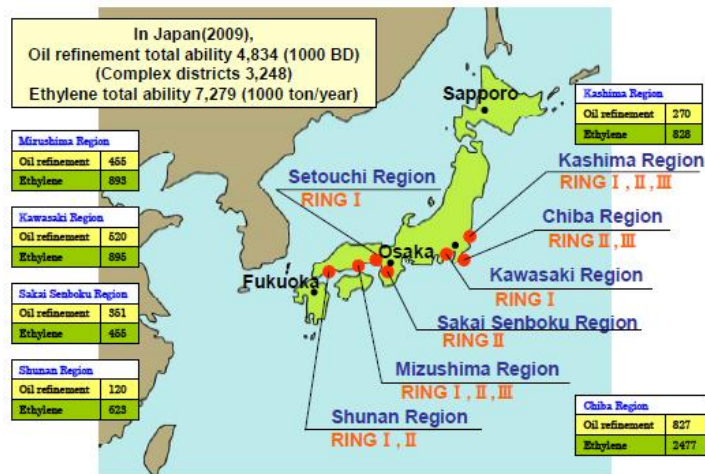


Figure 4 - Development of RING 1,2,3 Projects

One company perhaps tends to attempt single survival and optimization. Even if it notices the importance of cooperation, the priority level might be low. There are only two choices whether to execute it or not in one enterprise. Therefore, the government needs to put out a subsidy at first as a trigger, and it is necessary to establish the third-party institution in order to give the motivation to business cooperation. It is important to build the organization to adjust common interest. The support of the government for RING projects is a pump-priming policy. And the enterprises have recognized new possibilities in business cooperation. They would begin to mix well with them, and come to analyze a system of production with each other. They would examine construction of system of production and technological development accommodating wasted gas, heat, and energy etc. And profits between enterprises, which one company cannot conceive, would begin to be recognized, and their interest would spread various contents such as treatment of waste, contribution to the region, joint power generation etc. Innovations have progressed in an upward spiral through cooperation between enterprises beyond the limit of single company business. The new idea of business cooperation has arisen one after another.

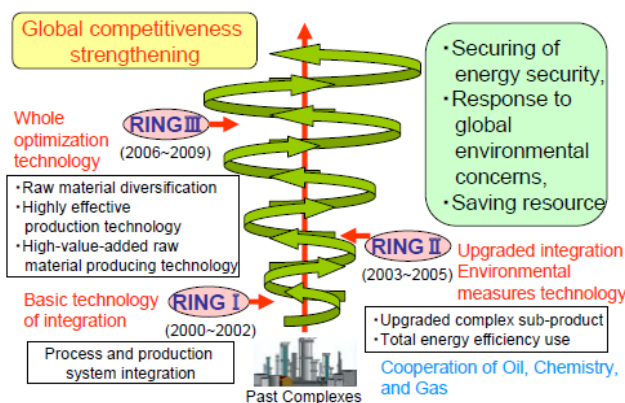


Figure 5 - The Spiral-up Innovation in Group Operation

#### 4 Conclusion

The RING project began from easy business collaborations. It is said that participating companies had not expected the result to joint operation too much at first. However, as RING projects have advanced, most enterprises have come to notice potentiality in the effect of group operation and business cooperation. The circle of RING extends through RING 1, 2, and 3. The speed of technological development in cooperating businesses has increased with

acceleration. Innovations have occurred in an upward spiral. And, as time passes, reduction of CO<sub>2</sub>, energy conservation, and environmental measures have been paid attention to, and they have been involved in RING projects. If one company does it by itself, only the optimization for one company would be realized. Actions on these problems would be postponed when thinking from the priority level. However, in group operation and business cooperation, these would be problems to undertake first of all.

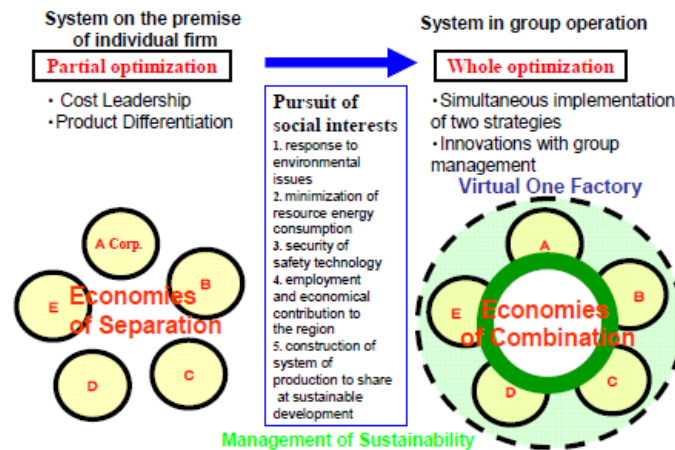


Figure 6 - Economies in Group Operation

The RING project is an attempt of joint operation and business cooperation in oil and petrochemical business. The project assumes current production facilities, capital tie, and business activities. On that assumption, it is necessary for two or more enterprises to cooperate and work on reduction of environmental burdens facing the world. Different from the strategy that one company pursues productivity and efficiency, same kind of effects may be achieved by cooperation between enterprises and different types of business. Whole optimization will be achieved by the system in group operation. And they can implement simultaneously two strategies, Cost Leadership and Product Differentiation.

In addition to economies of scale and economies of scope, some social interests will be pursued. When collaboration with many enterprises is achieved, 'justice' will be necessary for cooperation. Therefore, the aspects to social interest will arise: joint energy use, efficiency improvement, regional contribution, establishment of safety technology, positive commitment to environmental measures, and cooperative treatment of waste etc. And enterprises will pay more attention to practices of social activities: greening of the complex, ownership of joint power generating equipment, security cooperative relationship etc. In this paper, economies of combination is defined as some economic effects which group operation produces; whole optimization and efficiency, simultaneous implementation of two strategies, pursuit of social interests, innovations with group management, management of sustainability.



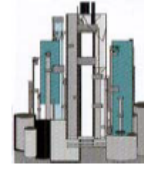
The results of business based on the premise of one company

- Partial optimization and efficiency
- Alternative strategies; Cost Leadership or Product Differentiation

The results of business in cooperation with two or more companies

- Whole optimization and efficiency
- Simultaneous implementation of two strategies
- Pursuit of social interests
- Innovations with group management
- Management of sustainability

“Kombinat” is a Russian word, means “combination”, and is used instead of “complex” in Japan



**Figure 7 - Economies of Combination (KOM6NHat)**

The goal of the RING project is to obtain global competitiveness in oil and petrochemical companies. When all technological developments are completed, much of reduction of energy use amount in oil refinement equipment etc. will be achieved, and it will be expected to increase production efficiency by the best flexibility of raw material and semi-finished products between oil refinery plants and different type of factories. And it is forecasted that they greatly contribute to reduction of CO<sub>2</sub> exhaust. As a result of experimental studies that have been done up to now in RING projects, the amount of CO<sub>2</sub> exhaust reduction is expected to reach 500,000 tons/year or more. In addition, the developed technology will be applied to other domestic industrial complexes, and therefore reduce CO<sub>2</sub> further.

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