

# **R&D Strategy of Materials Industry**

- A Case of Mitsubishi Materials -

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Takuo Takeshita, fellow  
Mitsubishi Materials Corp.

## **R&D Strategy of Materials Industry** — A Case of Mitsubishi Materials —

Takuo Takeshita, fellow  
Mitsubishi Materials Corp. Japan

### **Introduction**

This presentation is concerned with a current and future trend of the R&D in the materials industry, which is making a very drastic change. To understand changes in the R&D strategy of the materials industry, it may be worth first to examine socio-economic and technological changes of the past decade and the present status of those of the world. Therefore the current statuses of technological and socio-economical developments are first summarized, and then the R&D strategy of the materials industry is analyzed. The key words to keep in mind are first the Globalization, and Information & Communication Technology, Biotechnology (DNA Coding, etc.), Eco-technology and Nanotechnology-Materials Technology.

In the R&D strategy planning, there are two factors to be considered, that is to say, 1) what is the target(s) of the R&D, and 2) how it should be realized. For the national technological development targets, Japanese government recently selected 4 major technical areas, and these are 1) the information & communication technology, 2) the biological technology, 3) the environmental technology, and 4) the nanotechnology & materials technology. Among these technical areas, three areas are to explore new technological developments, and these are the information & communication, the biological and the nanotechnology & materials technology. And the environmental technology is more to solve the environmental problems caused by the technical progresses of the last century.

The applications & uses of IT technology in the R&D's and the Business Processes are also the keys for the success of any business strategy including the R&D strategy.

### **Current Status of Technology and Socio-Economic Structure**

Since the last decade of the 20<sup>th</sup> century, there have been very rapid technological developments of the information technology (IT) and the communication networking, and they have been utilized by private business sectors, government sectors, universities and private individuals, which can be seen in rapid worldwide growth of Internet. And the developments of IT technologies and the communication networks may change our way of life and social mechanisms, which may be seen in business processes such new business styles as SOHO, e-Commerce, and others

The impacts of the information technologies are two folds, 1) firstly it makes many actions quickly done, which are seen in business transactions, public actions, private deeds, research and developments, scientific & technological simulations by computational methods, and others, and 2) secondly it connects almost all areas of the world making the earth smaller ever. All the results of impacts of IT are not foreseeable, but we have seen developments of new sciences and technologies such as science of chaos, science of complexity, bio-informatics, and others, which are realized only by the applications of computers and computer sciences. And communications technologies have been the motive force of the interconnection between business to business, between business to customers, between university to student, governments to individuals and between individual to individual. These quick exchanges of information among interest groups and individuals make very rapid diffusions of information worldwide including not only information of business matters, cultural information and information of interest groups but also scientific and technological results.

This situation necessitates the planning of new R&D strategies for private enterprises and perhaps governments, NGO and NPO also. And therefore any R&D strategy of a private enterprise (of developed countries) must include the utilization of IT, and also consider collaboration(s) with

foreign partners and global marketing & production locations (either a production of hardware or a development of software).

On the other hand, great advances in the technology and remarkable socio-economical progresses achieved in 20<sup>th</sup> century were mainly based on the mass production technology, and these progresses created serious problems at the same time as seen in the environmental warming and the South-North problems of the unbalanced economical and technological progresses. And therefore, the key word for the 21<sup>st</sup> century is “Sustainable Growth”. In order to realize the sustainable growth, we must solve the tri-lemmas of the conflicts between the economical growth, the natural resources consumption and the environmental protection.

It is now well established that the economical growth can be realized only by the Innovations (either technical innovations or business process innovations), and the technical innovations are the main motive force of the economical growth. And therefore R&D’s for the nanotechnology, biotechnology and information technology are currently being pursued in almost all advanced countries since these technologies will open a new era of vast technological opportunities for the economical progress and the betterment of the humankind. Among these new technologies, the nanotechnology and the information technology are more directly related with the materials technology although the materials technology is the base for all the manufacturing industry.

The restrictions forced on the manufacturing industry particularly on the materials industry by the tri-lemmas solving will give good opportunities and some challenges for the R&D’s in the material industry. As will be discussed in the later section, the materials industry will be in a great demand since it can supply materials of all kinds for the other manufacturing industries and it also can handle the recycling of the used and waste materials and products. In order to maintain the earth environment in a healthy status, it is very important to control and to manage the discharges of hazardous waste at a proper level. A typical example of this can be seen in the Kyoto protocol (COP3, 1999), which requires the decrease of the amount of the carbon dioxide emission to the level of the year of 1990.

### **R&D Strategy for Private Enterprises**

The word of Strategy is originally for the planning of military actions, however, recently this word is being applied to the business planning and to any plan makings by almost all organization including national governments, NPO and NGO. Therefore it may be worth to define the strategy we use in the business world. A definition of the business strategy can be summarized as follows: **“A set of Integrated Actions to Attain the Corporate Objective Sustainably Through Competitive Advantages”** (by Ryo Hatoh). The key words are therefore the choice of a right objective(s), the sustaining the business and the utilization of the competitive advantages (core-competences). In order to establish the R&D strategy, therefore, we should understand the position of the materials industry in the social and the industrial system. The Structure of the all Industry can be summarized as follows: it contains the base materials, the parts and the production systems (materials and parts = the base of all manufacturing industry), the mass production consumer products, the mass production machine products and the social systems products (consumer products = the final products). Since the last decades, all industry and the public and the private sectors are using and developing IT for the efficiency and the creations of new frontiers. In this sense, IT is also the base of all industry and the human activities. From this brief analysis of the industry world, we can see that the materials industry is supporting the other disciplines of the industry and it also will be utilized for maintaining the earth in the healthy status. In my analyses of the R&D strategy of the materials industry, the materials industry includes the base materials industry (the fabricated materials included) and some activities of the parts industry also.

As pointed out at the beginning, the speeds of the changes of technology and the social structure, and the international propagation of almost all information (technologies transfer and

manufacturing facilities included) are unbelievably fast (effects of the globalization and IT technology). For example, I had an opportunity to visit a factory in a rural area in China in the year before last year, and found that it had an ISO certificate for the environments (ISO 14001). This is my personal experience in China based on visiting few locations and few times and these may be very limited observations, however, it indicates that changes are really occurring in the countries like China also. Many private enterprises of the developed countries are facing (or will face) rather severe competition from companies in China and in other developing countries who have large population and educated people. In order to solve this problem, the approaches we can take will be either to move production facilities to these countries and produce the products for the exportation to the world or think that they will be the markets for our products and produce them in the market locality. Depending on the strategy we choose, the emphasis of the type(s) of collaboration and R&D planning will differ.

Therefore each corporate must take these facts into considerations for the establishment of the R&D strategy. What do we choose as products, and where do we select production location(s), whom do we choose as a partner(s) for production and as a collaborator(s) of R&D's, when and how do we proceed these actions? Do we choose the public partner(s) or the private partner(s) or universities? Do we move into a new location(s) without any collaborator(s), and establish a new business in that area? And so on. These are very challenging and important questions, and the answers to them may vary depending on the kinds of the industry. However, the choice(s) of the production items and R&D target(s), and the timing of the move must at least meet the demands and the situation.

### **R&D Strategy of Materials Industry**

There are two approaches to meet the situation above, one is to make our business more competitive through reconstructing the business scheme and processes; to do business on the core business area(s) by the selection and the concentration of business activities (**reconstructing**), and the other is to proceed into new area(s) of technical activities (**technological innovations**).

For the restructuring the business, many corporations are concentrating on their core business, and making alliances and/or merging with others in their core business. These alliances and mergers are being made internationally even by Japanese corporations which had (have?) traditionally more inward nationalistic mentality. For example, Nippon Steel Corp. is making alliances with Korean, Chinese, and European companies. And other Japanese steel companies are also working on alliances and mergers with each other and foreign partners also. Similar moves by the companies in a different industry are also seen, for example electronics companies like Fujitsu, Hitachi, Toshiba and others are separating their home electric products division from their main businesses, which are related with so called Solution Business (more emphasis on software business).

As to new technology development, the nanotechnology will be the choice for the future technology, and very many companies worldwide are working its development in their own technical areas. For the private enterprises, it will be wise to classify the technical areas in the nanotechnology depending on their time schedule for realization of profitable businesses. This is because that the nanotechnology covers almost all technical areas and some of them may take longer than 20 years to become real businesses. For those long-term targets, the governments should invest their fund in their research and development efforts, which is now being made by many governments. US initiated National Nanotechnology Initiative in the year 2000, and Europe and Japan are also started similar developmental projects in the year 2001.

### **A Case of Mitsubishi Materials Corp.**

My company, Mitsubishi Materials Cop., recently reorganized its business structure and made business divisions into more independent and autonomous organizations, and they are now called a

Company instead of a business division, and we have now 8 Companies within Mitsubishi Materials Corp (MMTL). These are Copper Smelting Company, Cement Company, Non-ferrous Metals Products Company, Fabricated Metal Products Company, Silicon Products Company, Advanced Materials Products Company, and Energy-Environment Related Operations Company. The business size of each Company is larger than 1b\$ and up to around 2b\$, and the MMTL's total sale is about 6b\$. This order of the list of the Companies of MMTL reflects the evolution of MMTL, i.e., MMTL started as a mining company of non-ferrous minerals more than 100years ago, and moved into the copper smelting, the fabricated metal products, the advanced materials products, the silicon business, and the environment energy related operations. The cement business was started in an effort to utilize the coal mining technology since the coal was not competitive with the oil, and the coalmines were to be closed. This evolution of MMTL shows that MMTL has been meeting the socio-economic changes so far. For example, there are very few metal mines or coalmines in Japan. However, the structure of MMTL has a strong feature and a weak feature, i.e., MMTL can meet almost any requests on materials related matters, on the other hand, each business is not necessarily the top in the industry. Based on this observation, we are taking two directions, that is, retargeting new technology areas and reconstructing the established businesses.

New technology areas we will invest our resources for their development are the environment technology, electronics materials and parts, and nanotechnology. Needless to say that the improvements of conventional products and customer's requests are to be developed and handled by each Company's laboratory. These three new areas above have quite different characteristics. The environmental technology requires the integration of more of the conventional techniques of many technology areas including even the social sciences and the sociological technologies also. On the other hand, the electronics industry requires very specialized and advanced knowledge and techniques, and quick turnovers (dog year speed). And in the case of the nanotechnology, it is a very new concept and covers very large areas of the technology. It can be said that the nanotechnology encompasses all the manufacturing industry, and we must select desired and profitable developmental targets in the nanotechnology.

The environmental technology includes the recycling of used materials and scraps, and the control and the reduction of the pollutants emission including the discharges of carbon dioxide and others. We will be working first on the materials recycling business in the environmental area.

For **recycling** of used materials and treatments of waste materials, we can utilize our smelting furnaces and cement production kilns, and their operation know-how's together with energy related operational skills and materials handling techniques of fabricated materials and advanced materials companies. Currently we are building the recycling business of used home appliances and other used goods in collaboration with electronics companies and engineering companies. For this business, we introduced a technique developed by a German company in order to speed up the establishment of this business. Since we have almost all techniques and facilities for the recycling used materials, it may appear that the building the recycling business is a straightforward matter for us. However, the integration and collaboration of all parties (companies and R&D division) are needed since different companies and individuals possess techniques, information, knowledge and know-how's of the environmental technology. For this reason, the headquarter R&D division is promoting knowledge sharing and information exchange among involved parties.

For the **electronics** area, we have many related businesses, for example, the silicon wafer business (fourth in the world), the electronics materials and ceramic parts business, tools for production of IC tips, and others. In order to make the silicon wafer business more competitive, we established a JV with Sumitomo Metals Corp. for the 300mm wafer production and this will initiate further collaboration with Sumitomo Metals Corp. Other electronics products are produced in many different companies within MMTL, and the headquarter R&D division organizes the regular conference for the information sharing and the technology exchange. By the collaboration between the R&D division and the fabricated metal products company, we have developed a ultra-

violet laser system for drilling very small holes in a IC board (less than 100  $\mu$  m diameter).

For the **nanotechnology**, we will first strengthen the nanoparticle businesses exploring new applications and new functional particle productions. The nanoparticle business has been one of our core-technologies-based businesses. For the technologies that may take longer time for the development, we joined (and will join) the national R&D projects and will collaborate with universities, national laboratories and private corporations.

On the **reconstructing** of the corporate, we made the business divisions more independent and autonomous (call them Company) as mentioned before. And each Company is now working to become more competitive in their own business area. The Cement Company in MMTL established a JV with Ube Industry Corp. And the Silicon Company also established a JV with Sumitomo Metals Corp. as mentioned before. And they aim to be in the top league of the field. The Fabricated Metals Products Company acquired the tool division of Kobe Steel Corp. and aims to be world leader of hard tool tips business (GLOBAL TEN).

### **Conclusion**

MMTL is like a reduced drawing of the materials industry as you can see in the description of MMTL above. And this short summary of MMTL may show that the materials industry has many potential business opportunities including the eco-business, electronics related business, and energy related business, and almost all real world businesses. This is because that the materials industry is the base of all manufacturing industry.