

Implementation of Information Technology for the Management of R&D and Competitiveness

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Abstract

Information technology allows firms to integrate and coordinate far-flung activities in more and more complex ways. At present, Japanese A/E/C firms are making R&D efforts in diversified fields. Along with the diversification of R&D, complexity in the management of R&D is also increasing significantly. Due to complexity in the management of R&D, firms are becoming increasingly dependant on information technology for real time information, cost effectiveness and also for reliability of information technology for integration and coordination of many of the activities. Shimizu Corporation, one of the largest A/E/C firm in Japan, is involved in R&D activities in diversified fields and implements information technology to integrate and coordinate many of its activities. As the management of R&D and sustaining competitiveness are very important, Shimizu has developed several information systems for the management of R&D and sustaining competitiveness. This paper introduces Shimizu's perspectives on the implementation of information technology for R&D management and competitiveness and introduces the information systems developed by Shimizu, specially for R&D management. Furthermore, this paper also introduces Shimizu's strategic IT planning for the management of R&D and competitiveness.

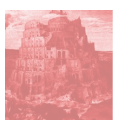
Key Words :

Information Technology, A/E/C firm, R&D Management, Strategic IT Planning, Competitiveness.

Introduction

A firm achieve competitiveness with its cost advantage, uniqueness and closeness to customers. The goal of almost all firms is to be competitive in the market. At present, most of the Japanese A/E/C firms are making their efforts in research and development in diversified fields. Research and development depend upon information of market and technology trends. Information gathering and practical use of the right information at the right time is crucial for a company's R&D strategy. Recently, information technology has developed very significantly. Information technology is now more than just computers and in a broad sense, it may give a firm cost advantage, uniqueness and closeness to customers. Information technology must be conceived of broadly to encompass the information that businesses create and use as well as a wide spectrum of increasingly convergent and linked technologies that process the information.

Information technology is now widely implemented, for the management of R&D and competitiveness, by the Japanese A/E/C firms. At present, alongwith the diversifying of R&D activities, management of R&D is becoming complicated but very important. The basic philosophy of R&D management is to remain informed about the market and technology trends, create human resources for effective research, upgrade productivity, integration of R&D and business strategy to compete in the industry and challenge the future. But the question remains, why are the A/E/C firms of Japan implementing



information technology for R&D management? How is information technology implemented for the management of R&D and competitiveness? What type of information technology is required for the future? This paper explains Shimizu's perspectives on the implementation of information technology and introduces the information systems developed; and furthermore Shimizu's strategic IT planning for the management of R&D and Competitiveness.

State of R&D in the Japanese A/E/C firms

This part of the paper analyses the state of R&D in the Japanese A/E/C firms. Currently, the largest Japanese A/E/C firms spend approximately 1% of total sales for research and development. The main objectives are product innovation, process innovation and business innovation. Product innovation is to develop new types of facilities or materials for various clients. Process innovation is planned to develop a new technology for improving productivity and enhancing working environment. Business innovation is to develop a new business or expand business opportunity based on R&D results by creating new market or enhancing existing market. Japanese A/E/C firms' perspectives on making efforts in R&D are as follows:

- The extent of technology development makes the difference in the level of each company's technology in the long term;
- R&D helps a firm in the fierce competition in the industry;
- R&D helps a firm to cope with the shortage of skilled labor;
- In Japan, university collaboration with private firms for R&D activities is not very common; therefore, each firm has to carry out R&D itself;

A/E/C firms in Japan have several problems in performing R&D. One of the main problems are integration of R&D and business strategy. The pressure for short term profitability on R&D is in conflict with the concept of research as a long term investment. Moreover, business strategies and technology development plans of the Japanese A/E/C firms are mostly to compete in the home market. An international comparison shows that the top Japanese A/E/C firms receive a limited numbers of overseas orders comparing with other overseas firms.(Table-1)

Table 1: International Comparison of World's Top Contractors

(Unit: million of U.S. dollar, %)					
Ranking	Name	Country	Orders received (A)	Overseas orders (B)	% of Overseas business (B)/(A)
1	Fluor Daniel, Inc.	U.S.	21,376.0	4,980.0	23.3
2	Shimizu Corporation	Japan	19,165.0	1,279.0	6.7
3	Bechtel Group, Inc.	U.S.	18,339.0	11,630.3	63.4
4	Taisei Corporation	Japan	17,749.7	389.6	2.2
5	Kajima Corporation	Japan	17,883.4	1,029.2	5.8
6	Takenaka Corporation	Japan	16,264.0	812.0	5.0
7	Obayashi Corporation	Japan	14,634.7	1,247.9	8.5
8	John Brown/Davy	U.K.	14,334.0	8,844.0	61.7
9	The M.W. Kellogg Co.	U.S.	13,127.0	9,786.0	74.5
10	The Parsons Corporations	U.S.	13,100.0	5,000.0	38.2

Source: Construction in Japan 1993
Japan Federation of Construction Contractors

The Japanese A/E/C firms have started implementing information technology for R&D activities recently. This does not mean that Japanese A/E/C firms previously ignored about the information technology. Japanese A/E/C firms evaluate the efficiency and effectiveness of any technology before implementation. Information technology is no exception. Japanese A/E/C firms evaluate the necessity and effectiveness of information technology for R&D activities and then implement in the effective areas. Recently, information technology has developed significantly and has been widely implemented in most R&D activities. Japanese A/E/C firms have also implemented information technology companywide. The importance of information technology for the management of R&D is increasing very rapidly.

Information Technology and Management of R&D

The common goal of R&D management is to remain informed about the market and technology trends, to create a better environment for research and development and for development of human resources for better idea and research themes, strategic R&D planning by prioritizing R&D areas and themes through watching market and technology trends, upgrading productivity, integration of R&D and business strategy and to challenge the future through increasing competitiveness of the firm. In general, most of the largest A/E/C firms of Japan maintain research institutes. The research institutes are the focus of basic and applied research and other major efforts such as development and application of results which take place in technology development division(Technology Division). The organization of R&D in a typical Japanese A/E/C firm is shown in figure 1.

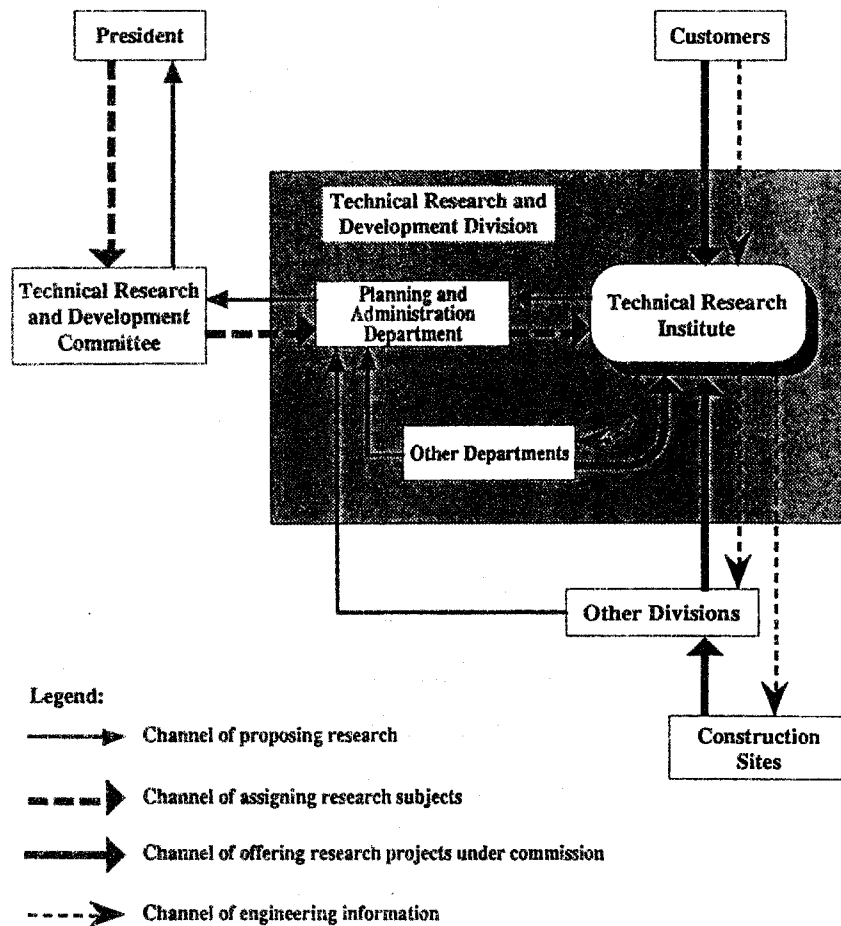


Figure 1: An Organization of R&D in Typical Japanese A/E/C Firm (Source: JTEC Panel Report on Construction Technologies in Japan, 1991)

Most of the largest A/E/C firms make R&D efforts in diversified fields and currently implement IT for the management of R&D. From the stage of market and technology trend watching for planning of R&D areas and themes to the application of research results into practice, management of productivity of R&D, enhancing better working environment and motivation of human resources, A/E/C firms are implementing information technologies in diversified ways.

Information Systems for R&D Management The Shimizu Developments

Shimizu maintains company wide information systems. Before introducing these systems the paper gives a brief introduction of Shimizu's corporate organization, relationship among the R&D divisions, fields where Shimizu is making its R&D efforts, the R&D areas and themes prioritizing process and an outline of the R&D activities.

Shimizu corporation was established in 1804. At present, the number of Shimizu employees is 16,465. Among the permanent employees, 93 hold doctorate degrees in architecture, engineering, applied physics and other subjects. There are also 320 consultant engineers; 2,821 licensed first-class architects and 1,821 licensed first-class civil engineers. Figure 2 shows the corporate organization of Shimizu.

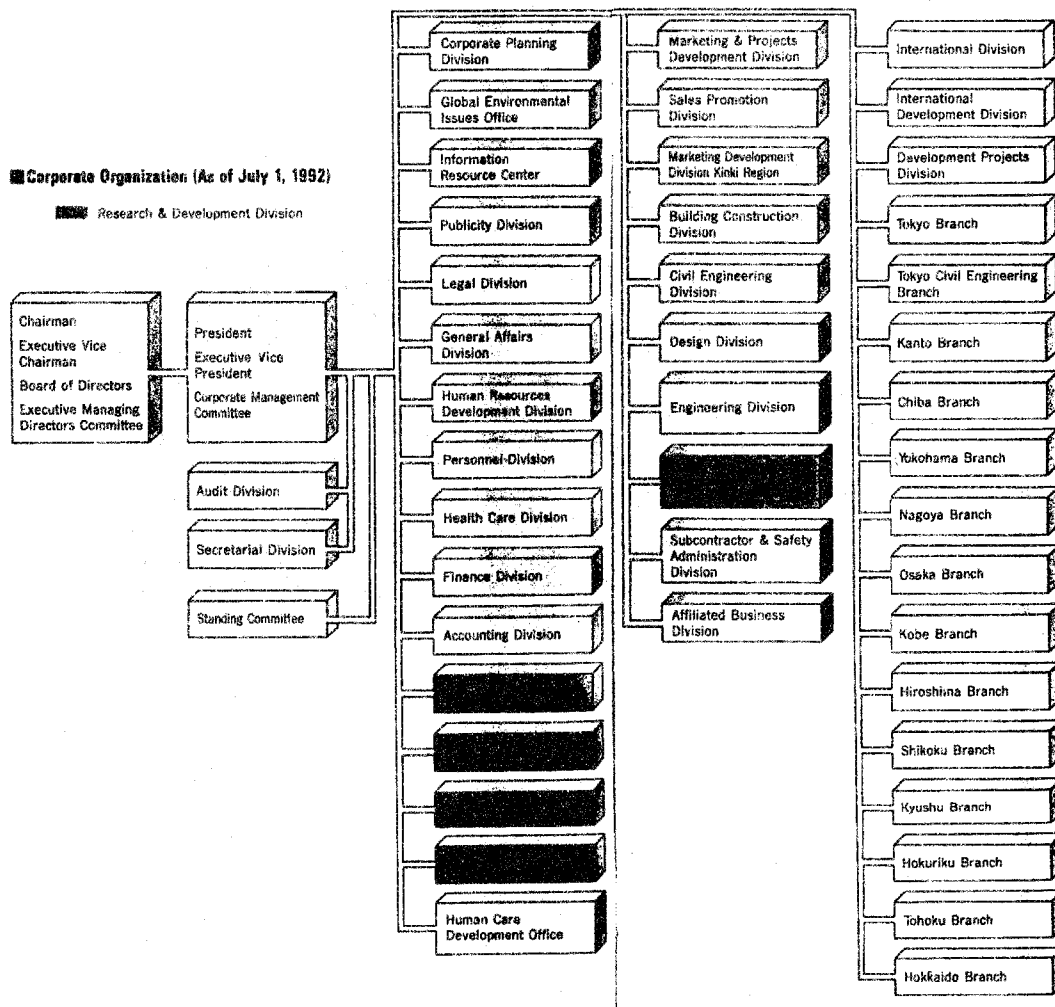


Figure 2: Corporate Organization of Shimizu

Shimizu's main R&D related divisions are the Technology Division, Institute of Technology, Ohsaki Research Institute, Space Project Office and Nuclear Power Division. In addition to these divisions, Shimizu maintains many other domestic and overseas R&D offices and information bases. Figure-3 shows the relations among the R&D related divisions.

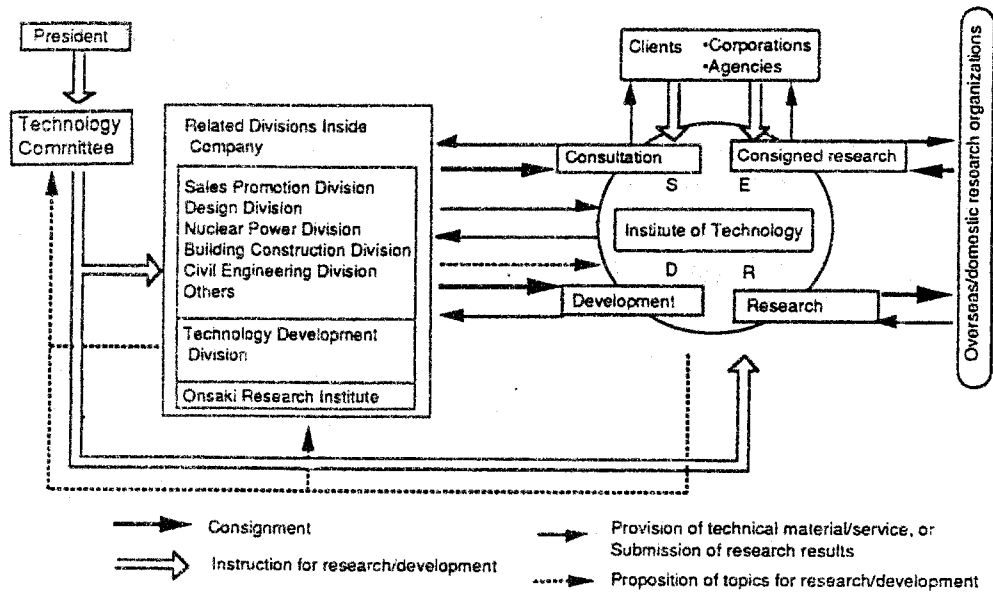


Figure 3: Relations Among the R&D Divisions in Shimizu

At present, Shimizu is making R&D efforts in diversified fields. Figure 4 shows the areas where Shimizu is making its R&D efforts.

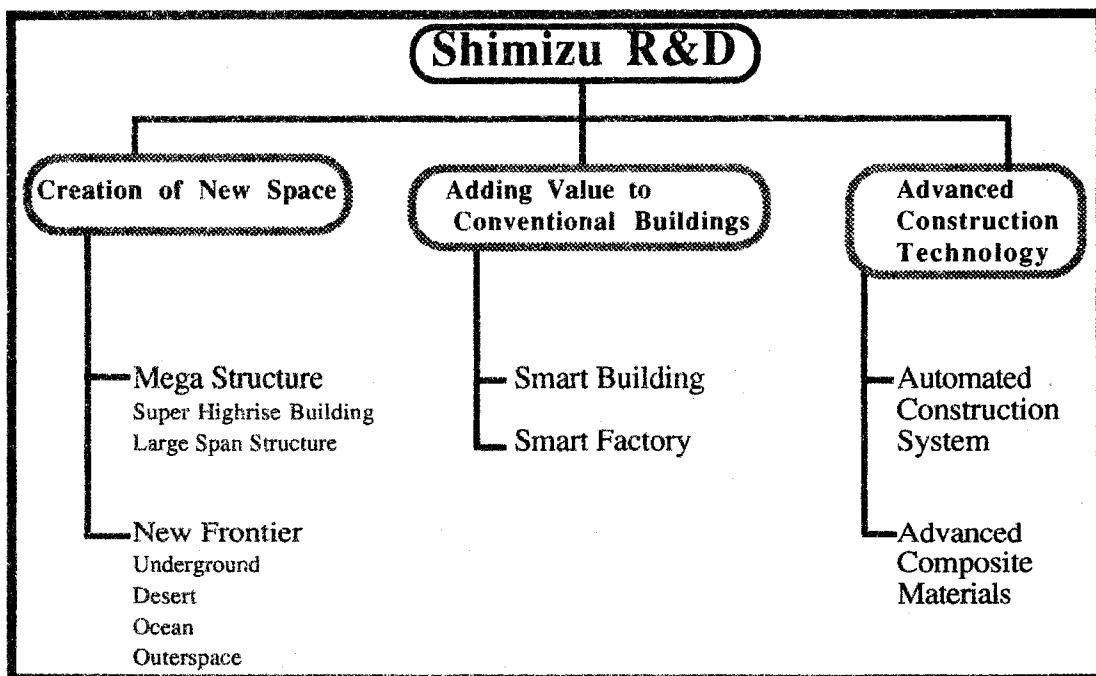


Figure 4: Shimizu's Main R&D Areas

Shimizu perspectives on R&D are based on the market and technology trends. Shimizu considers strategic cost advantage, uniqueness and closeness to the customers. Figure-5 Shows Shimizu's strategic R&D areas and themes prioritizing process.

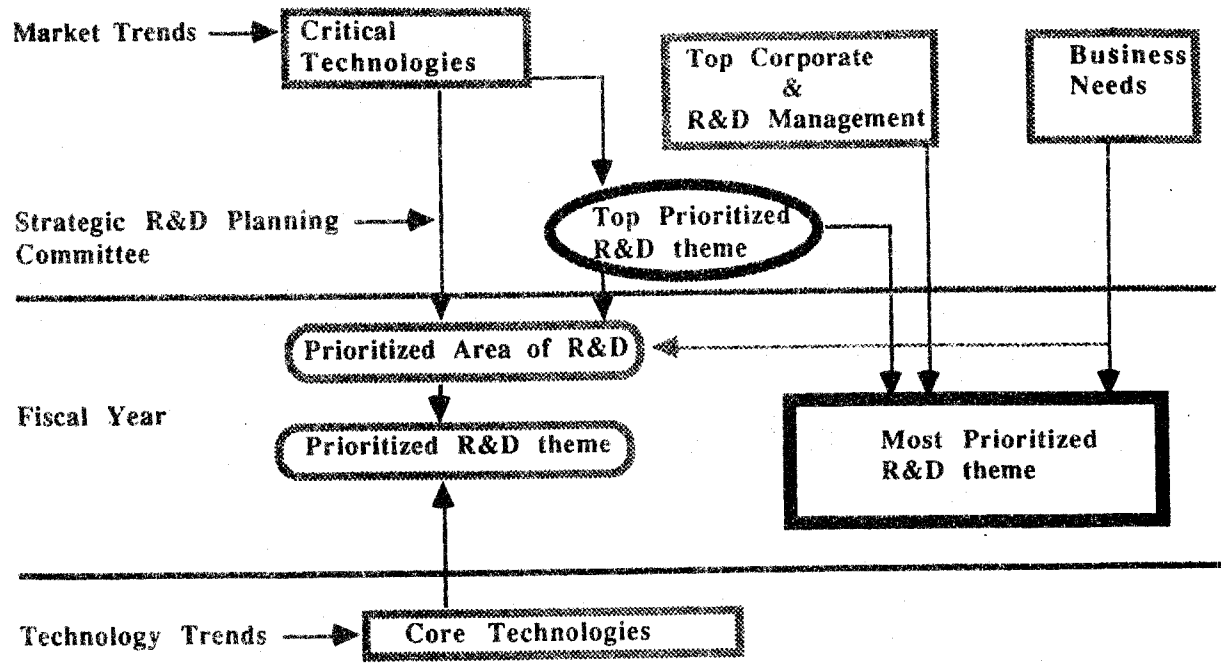


Figure 5: Strategic R&D Area and Theme Prioritizing Process in Shimizu

Shimizu has developed a remarkable number of advanced technologies and also advanced materials. Recently, Shimizu is making its R&D efforts in Computer Integrated Construction (CIC) and has already developed a fully computer integrated construction system, SMART (Shimizu Manufacturing System with Advanced Robotics Technology) system as a step towards CIC. The SMART system allows fully automated building construction. The SMART system is now used at a construction site of a bank building in Japan. Recently, Shimizu has developed two advanced composite materials, called NEFMAC and NESTEM, which are reinforcing materials to ensure longer life for concrete structures.

Shimizu has developed several information systems for its R&D activities as it is moving toward the full implementation of CIC. All these information systems could be divided into four types. These systems are integrated with company wide information systems. Figure-6 shows how the information systems are integrated with the company wide information systems.

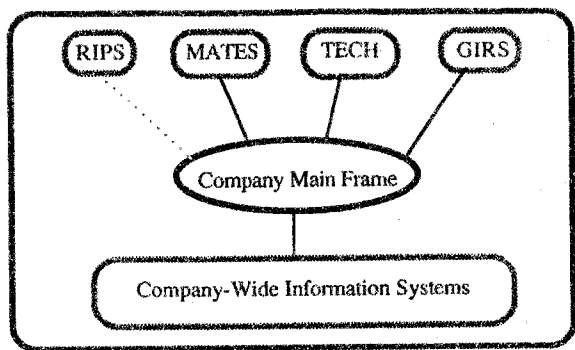


Figure 6: Integration of Shimizu's Information Systems Developed for R&D Management

For information gathering, Shimizu uses commercial data bases and an in-house information system, named RIPS(Rapid Information Processing System). This data base is still in the development stage. This information system can be used to rapidly obtain information on global technology and market trends.

For the management of research results, Shimizu Institute of Technology maintains an in-house information system, which is named as MATES(Research Management and Assistant For Technology Evaluation System); this data base maintains information for the Shimizu Institute of Technology; The characteristics of this system are as follows:

- Information on research projects and research results are managed with this system;
- This system reduces cost and time;
- It improves the working environment with real time information;
- This system is integrated with the company wide information systems.

To upgrade productivity of R&D, Shimizu has developed an in-house information system which is named as TECH(Technology Development Evaluation System); This information system maintains the required information of the technologies which are in the developing process; The characteristics of this system are as follows:

- This information system allows information on the cost and time required for the development of a technology to be obtained;
- It allows real time information on the technologies which are at the developing stage to be obtained;
- This system is integrated with other company wide information systems;

For the management of developed technologies, Shimizu has developed another in-house information system, which is named as GIRS(*Gijutsu* Information Retrieval System). GIRS has been developed for the management of information on developed technologies. The characteristics of this system are as follows:

- This system allows real time information on the developed technologies to be obtained;
- It allows technologies which are applied significantly in construction site to be evaluated;
- This system allows construction sites to know about the developed technologies;
- This system is also integrated with other company wide information systems.

At present, Shimizu is making efforts in R&D in diversified fields. As information technology is developed significantly and as it is cost effective and efficient for the management of R&D, Shimizu has developed several in-house information systems and is also developing the systems as it is becoming necessary. Shimizu has future plans to develop more information systems for the information network and for the management of R&D. Further development of graphics, visual simulation, virtual reality may increase the importance of information technology for the R&D activities of A/E/C firms as the firms are heading towards CIC.

Corporate Philosophy of Shimizu on R&D and Implementation of Information Technology

This part of the paper introduces the basic corporate philosophy of Shimizu for R&D and the implementation of information technology. Corporate philosophy of Shimizu on R&D is integrated with the company's overall philosophy. The goal of Shimizu is to serve its customers with the best quality buildings and other structures worldwide, keeping social, cultural and environmental concerns in mind; R&D efforts are made to develop technology to achieve the corporate goal.

The main goal of Shimizu R&D is as follows:

1. Challenge the future
2. Upgrade productivity and improve working environment
3. Innovate new technology to create new markets and also to revitalize existing markets

In the long term, upgrading productivity is the top priority of Shimizu's R&D management. But at present, the Japanese economy is in down turn, all the Japanese firms are making efforts to remain

competitive in the market. To revitalize the existing market and remain competitive is the top priority of Shimizu's R&D management at this time.

In the long term, to upgrade productivity, Shimizu is concerned with the following:

1. Prioritize the best areas and themes for R&D
2. Productive development of technology
3. Application of research results and diffusion of the developed technology
4. Development of the human resources and better working environment

Information technology is playing a very important role to upgrade productivity. To prioritize the best area and theme for R&D, it is necessary to watch the market and technology trends and information technology enables us to perform the market and technology trend watching activities. Information technology reduces time and labor significantly. To develop human resources and better working environment, Shimizu has implemented information technology. The information systems developed by Shimizu for the management of R&D are integrated with company wide information systems. Shimizu has a strategic plan for the globalization of the systems developed for the management of R&D and competitiveness.

There are still some difficulties in the implementation of information technology. Maintenance is still complicated and data input is very time consuming and know-how is essential for most effective application of the systems. In this busy corporate world, visual images are more appreciated than lengthy written documents. The existing graphics, visual simulation and related technology require further development for further implementation. Because of these remaining difficulties in the application of information technology, in some sectors, information technology is not fully effective yet. Shimizu has already implemented information technology in the fields where it is most effective.

Conclusion

Information technology is now widely implemented by the companies seeking to upgrade productivity and gain competitiveness. To remain competitive, along with differentiation and cost effectiveness of technology, a very high quality of human resources is required - who are always ready in body and spirit to set out on the long and lonely voyages of adventure. Information technology is providing courage to the people to set out for adventure and to the firms for strategic planning for winning in competition. As the importance of R&D and complexity in the management of R&D is increasing significantly, firms are implementing information technology increasingly.

Shimizu has developed several information systems, for company wide information exchange and also for the management of R&D and competitiveness. Shimizu has implemented information technology in the fields where it has become essential and effective. Shimizu has strategic planning for further implementation of information technology as it is heading towards the implementation of CIC. Shimizu has plans for globalization of its R&D activities and management of R&D and competitiveness

At present, A/E/C firms are heading towards computer integrated construction(CIC) and making R&D efforts in diversified fields, computer graphics, virtual reality and visual simulation are very effective. Further development of the multimedia systems may contribute to the R&D activities of the A/E/C firms. It will also be very effective for the management of R&D and competitiveness. Further development of the information technology will certainly increase its importance and implementation by the A/E/C firms' for the management of R&D and competitiveness.

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