Title: The Comparison of R&D Management Characteristics in the High Tech Industries of U.S. and Japan

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THE COMPARISON OF R&D MANAGEMENT CHARACTERISTICS IN THE HIGH TECH INDUSTRIES OF U.S. AND JAPAN

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ABSTRACT

The objective of this work is to compare the characteristics of Research and Development (R&D) Management strategies of U.S. and Japanese high-tech industries.Both nations are major players in the international high tech market. Throughout the course of this study the major point that has been tried to be determined is either the divergence or the convergence of U.S. and Japanese R&D management structures.

The research paper consists of an introduction, a chapter where R&D and major issues effecting R&D management are presented, four other chapters where collected data is presented in an organized order and a conclusion where the data is analyzed and general conclusions are presented.

The data has been collected through two major sources ; literature search and interviews with PICMET'91 authors. The data gathered through the literature search is analyzed in two streams ; statistical data and structural data.The interviews were conducted by a survey questionnaire in which the questions were based on the conclusions drawn from the literature search conducted

INTRODUCTION

As stated in the abstract this work aims at determining the divergence and convergence of U.S. and Japanese R&D management structures in the high tech industries.

U.S. economic dominance established at the end of WW2 has carried over into the development of the high tech market and to the present. Japan's success in the high tech market has been built from the ground up in the same time period. Through the literature search it has been found that fundamental research is very accessible in corporate Japan and considered more proprietary in corporate America. In Japan, development is based on incremental improvements while U.S. development efforts are concentrated more toward making major breakthrough.

From an aggregate scale Japan and U.S. approaches are very different. Trends in investment show that aggregate savings in Japan have increased dramatically in the last 30 years. In parallel with this trend, Japanese R&D investment has increased significantly in the same period. R&D investment in the U.S. in the last 30 years has increased at a much slower rate.These issues are discussed in details in the following chapters and supported by the gathered data presenting the strengths and weaknesses from these two major contributors to the world market.

GLOBAL RESEARCH AND DEVELOPMENT

DEFINITION OF THE TERMS OF RESEARCH AND DEVELOPMENT

The classification and definition of the research and development terms has always been a topic of discussion and disagreement. Going through the various literature relative to this topic, one can see that most of the publications tend to categorize research and development into three large categories: [11],[55]

I) Basic Research : This type of research is the original investigation whose primary goal is to enhance and advance scientific knowledge. This type of research is not aimed towards any specific practical applications. In pure basic research, it is usually the scientific interest of the investigator which determines the subject researched. In oriented basic research the researcher is directed towards a specific field in an employing organization.

ii) Applied Research : This type of research is the original investigation undertaken in order to gain new scientific and technical knowledge. In contrast with basic research, applied research is directed primarily towards practical goals and objectives.

iii) Experimental Development : This is the use of the scientific and technical knowledge in order to produce new and improved materials, devices, products, processes, systems or services.

Studying the above classification, one can see that most of industry's activities are geared towards applied research and experimental development.

MANAGEMENT OF RESEARCH AND DEVELOPMENT

In every organization the quality of management usually determines the its success. The same rule applies to the research and development organizations. The process of management in such organizations is defined by the following elements: [55]

I) Strategic Planning : The definition of planning could be given as the formulation and statement of the purposes and objectives of research and development and its management. Strategic Planning also includes the determination of the approach methods, the development and selection of projects and programs, and the plans for carrying them out.

ii) Organization : The total coordination of the groups' effort is the main purpose of organization. This coordination includes description of the tasks and functions to

be performed by each individual, the arrangement of jobs into projects, projects into groups, groups into sections, divisions and departments. By coordinating all of these effectively together the operation gets a sense of integration and everybody can strive towards the common goal.

iii) Leadership : The importance of leadership in any organization cannot be stressed enough. This consists of the guidance, training and understanding of people. In research and development it also means developing the lead scientifically and managerially. It must be based on sincere human interest in scientists, engineers, technicians, secretaries and clerks and their individual accomplishments. One of the major goals of leadership is developing the sense of teamwork and harmony among everybody in the organization. Leadership requires the development of a fundamental concept and understanding with reference to research people and their needs. It also involves the selection and placement of scientists, engineers and technicians, the improvement of their managerial and professional skills and the maintenance of good interpersonal relationships, the rewarding of effort, the maintenance of morale and the strengthening of communication.

iv) Performance : This includes the actual work of research and development activities, involving delegation and decentralization and application of scientific method wherever possible.

v) Administration : The executive side of research and development is distinguished from the actual laboratory operations. Administration provides such services as personnel, testing, facilities, laboratories, equipment, materials, workshops, general accounting, cost accounting, financing, contract and patent administration, marketing and public relations.

vi) Coordination : This is the integration of planning, organization, leadership, performance and administration into a dynamic, functioning unity. Coordination also involves the harmonizing of management with the scientists, engineers, technicians and others, the proper disposition and use of facilities and equipment and the adjustment of difficulties. It is the adjustment of all the phases of the phases of research and development into a whole.

vii) Evaluation : This involves the determination of whether or not the purposes of the research and development program have been accomplished, and the quality of the research and development performance and management. The difficulties and deviations from established standards are found and referred to the responsible persons for correction.

ii) Curiosity : this is the fundamental desire and interest in discovering the truth, new knowledge and new improved products or processes.

iii) Concentrated effort : many problems are solved with continuous and enthusiastic hard work.

iv) Freedom of imagination : relaxation or recreation for new knowledge, new products, etc. to evolve from the subconscious, related experiences and development, and from leisure activities.

v) Recognition and reward : human respect, listening, recognition, acceptance, appraisal with non-financial compensation as motivation.

vi) Mental competition and cooperation : stimulation from mental argument, competitive discussions, free thought and cooperation.

[55]

DIFFICULTIES IN MANAGING R&D ORGANIZATIONS

As noted previously, managing creativity is the one of most significant challenges for a manager in an R&D environment. Most of the problems and difficulties that occur, stem from the fact that creativity cannot be ordered and is not easily

manageable. Some of the most frequent special situations and difficulties that occur in R&D will be discussed in the following:

* ***Control of project objectives.*** Frequently, R&D scientists and engineers divert their attention elsewhere than the immediate goal. This happens because with research new topics always come up and questions are asked. So it is quite tempting for a researcher to temporarily "forget" the project objective and devote time to another concept that he/she finds interesting.

* ***Knowledge and authority are inversely proportionate.*** In R&D organizations it is frequent that the higher someone moves in management the less contact he/she has with the technical aspects of any certain project.

* ***Exercise of independent judgement.*** R&D scientists and engineers, being well educated and highly skilled professional people, are permitted to exercise independent judgement to a far greater degree than other workers. Fullest use of their creative talents demands this and the project success frequently depends on it. This has direct effect on the supervisor-scientist relationship.

* ***Freedom of movement.*** Scientists and engineers in R&D organizations have more freedom of movement within the laboratory and the organization than most production or clerical workers. Normally they are unrestricted in this activity because

the movement is required by the project activities.

* ***Frequent reassignment.*** The nature of the explorative, creative, and inventive process is such that there may be frequent reassignment of a scientist or engineer to other related projects. This calls for briefing and orientation to the new project and facilities.

* ***Individual and group communication.*** It is the duty of supervision to keep all the scientists and engineers advised as to the status of his/her part of the project. In some instances when there is lack of individual achievement may have to detail to the scientist his activity status the same way a production supervisor would go over a worker's performance by rating him. Similarly, the supervisor may be required to keep the group posted on the status of the project.

* ***Work plan approval.*** Frequently the supervisor is called upon to monitor a scientist's plan of procedure for a short period of time. This is in contrast to production or clerical activities where the daily activity is pretty much the same and performed in identical fashion.

* ***Varied daily assignments.*** This situation differs from production and clerical departments since there exists a fixed routine of repetitive operations.In R&D this is seldom the case, since activities may vary from day to day and sometimes

In 1986, about half of government-financed research in the U.S. is military, while practically none is in Japan. However, in the US, government money accounts for over half of R&D, whereas in Japan, the figure is only about 20%, most often in projects with little research and much development. In 1990, 70% of Japanese R&D investment was spent by private industries, whereas U.S. industries only consisted 50% of total R&D investment. While U.S. government is spending less in military R&D due to weakening of communism, Japan's R&D investment is playing a catch-up game with the U.S.

INDUSTRIAL R&D EXPENDITURE

While the U.S. government supports R&D only for products associated with defense technology and agency-oriented R&D, Japan places emphasis on gaining advantage in the commercial marketplace. In 1990, U.S. industries were responsible for $74 billion in R&D investment. Japanese industries injected $36 billion in that same year. In the US, while there are already signs of spending cuts, the Japanese industries are pouring even more money into R&D.

In the U.S., the numbers show worrisome trends. R&D spending by U.S. industries in 1989 totaled $65.2 billion, up 10% from 1988 in current dollars, but only 5.6% when adjusted for inflation. That compares with an 11% nominal, 6.6% real gain registered in 1988, and it means that the downward drift in R&D continues. From

engineers than Japan. The U.S. has a substantially higher proportion of scientists than Japan. Both the US and Japan have 18-19 engineers per 1,000 in the labor force.

In the U.S., the number of scientists and engineers engaged in R&D per 10,000 labor force has maintained steady over the period of twenty years. In 1965, the figure is 64 scientists and engineers per 10,000 labor force. In 1985, the number of scientists and engineers engaged in R&D is 67 per 10,000 labor force.

In Japan the number of scientists and engineers engaged in R&D per 10,000 labor force has increased substantially over the period of 20 years. in 1965 the figure is 24 per 10,000 labor force. In 1985, the number has increased to 68 per 10,000 labor force.

When comparing the percentage in selected age group among scientists and engineers, the Japanese has a much younger group of scientists and engineers engaged in R&D works. In Japan, according to the 1985 survey, the age group of under 35 is 48.5%; 35-54 is 41%; 55 and over is 11.8%. In US according to a survey conducted in 1986 the age group under 35 is 32.9%; 35-54 is 49% and the figure for 55 and over is 18.1%.

Japan's Top 10 Corporate R&D Spenders

FY 1989	Company	R&D Billions of $	R&D as a % of Sale
1.	Hitachi	2.19	9.9
2.	Matsushita Elect.	2.14	7.9
3.	Toyota	1.90	3.9
4.	NEC	1.78	10.2
5.	Fujitsu	1.74	12.8
6.	NTT	1.52	4.2
7.	Toshiba	1.46	7.6
8.	Nissan	1.36	5.4
9.	Honda	1.13	5.0
10.	Sony	1.01	6.0

(*) Above ratings were taken from Business Week, Innovation 1990, pp 75 [59]

U.S.'s Top 10 Corporate R&D Spenders

FY 1989	Company	R&D Billions of $	R&D as a % of Sale
1.	General Motors	5.25	4.2
2.	IBM	5.20	8.3
3.	Ford Motor	3.17	3.3
4.	AT & T	2.65	8.8
5.	Digital Equipment	1.53	12.0
6.	Du Pont	1.39	4.0
7.	General Electric	1.33	2.5
8.	Hewlett-Packard	1.27	10.7
9.	Eastman Kodak	1.25	6.8
10.	United Technologies	0.96	4.9

(*) Above ratings were taken from the reference # [60]

(*) Below graphs are redrawn or drawn according to the data attained from reference # [52]

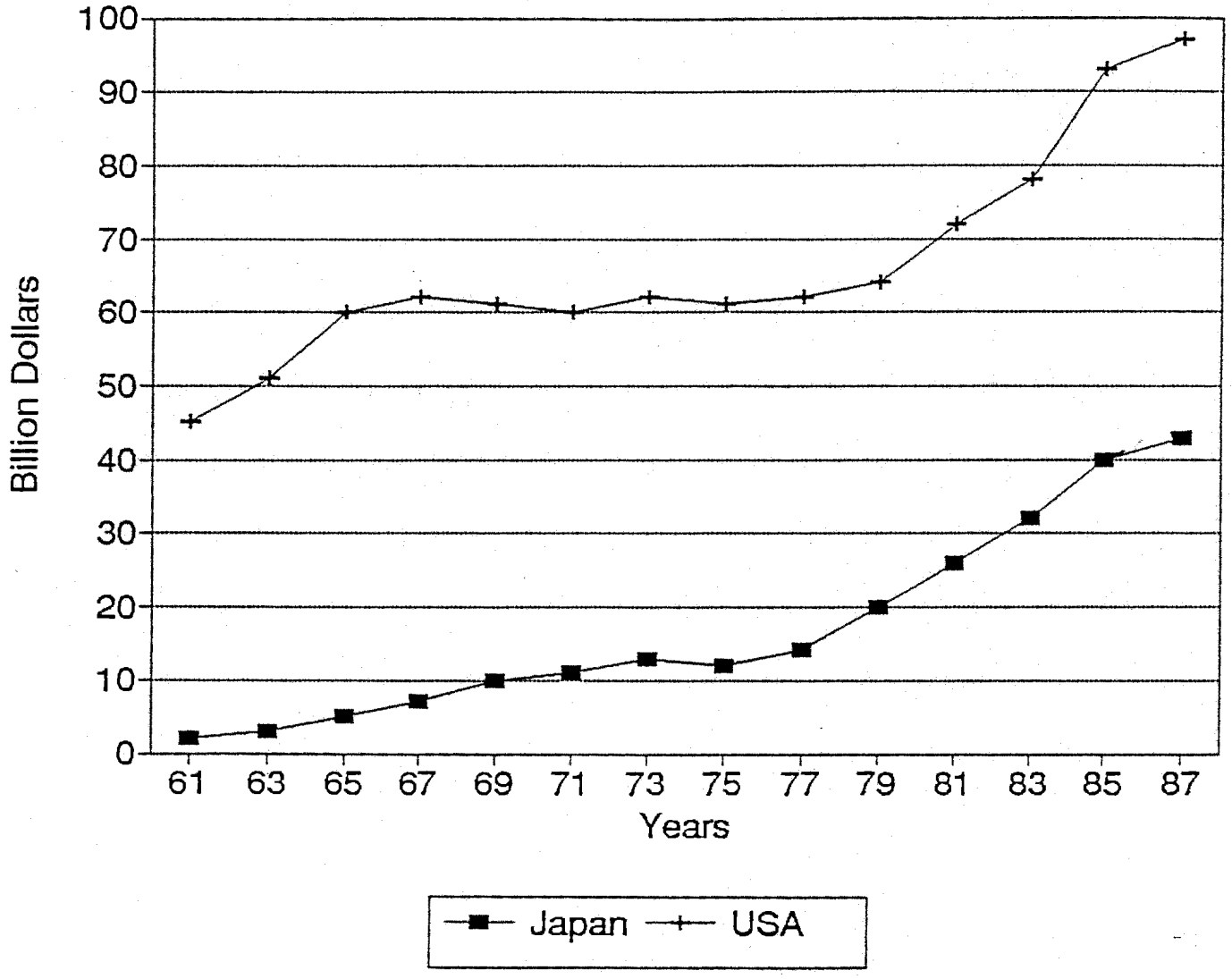


Figure 1.1 NATIONAL R&D EXPENDITURES (Line Graph Type)

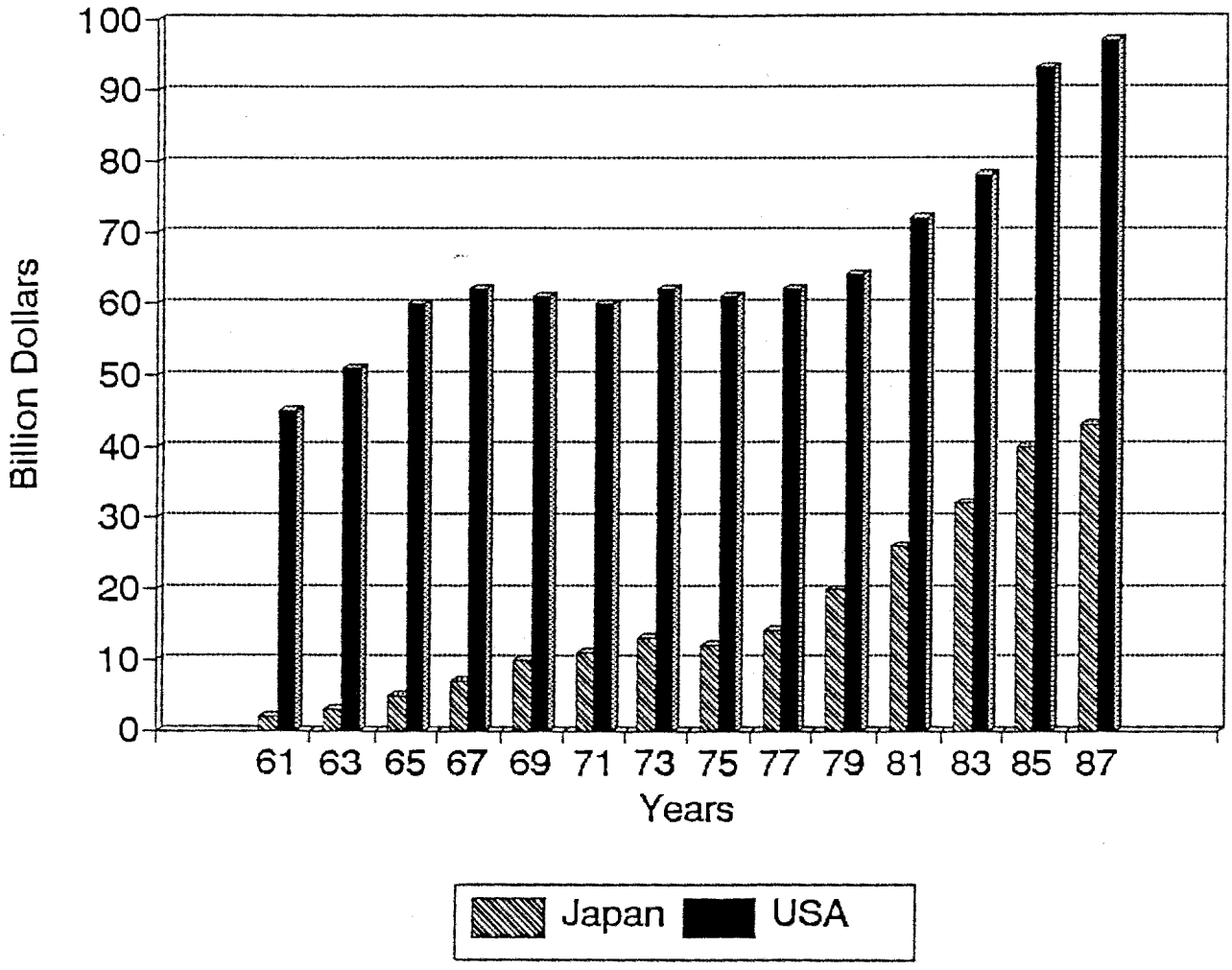


Figure 1.2 NATIONAL R&D EXPENDITURES (Bar Graph Type)

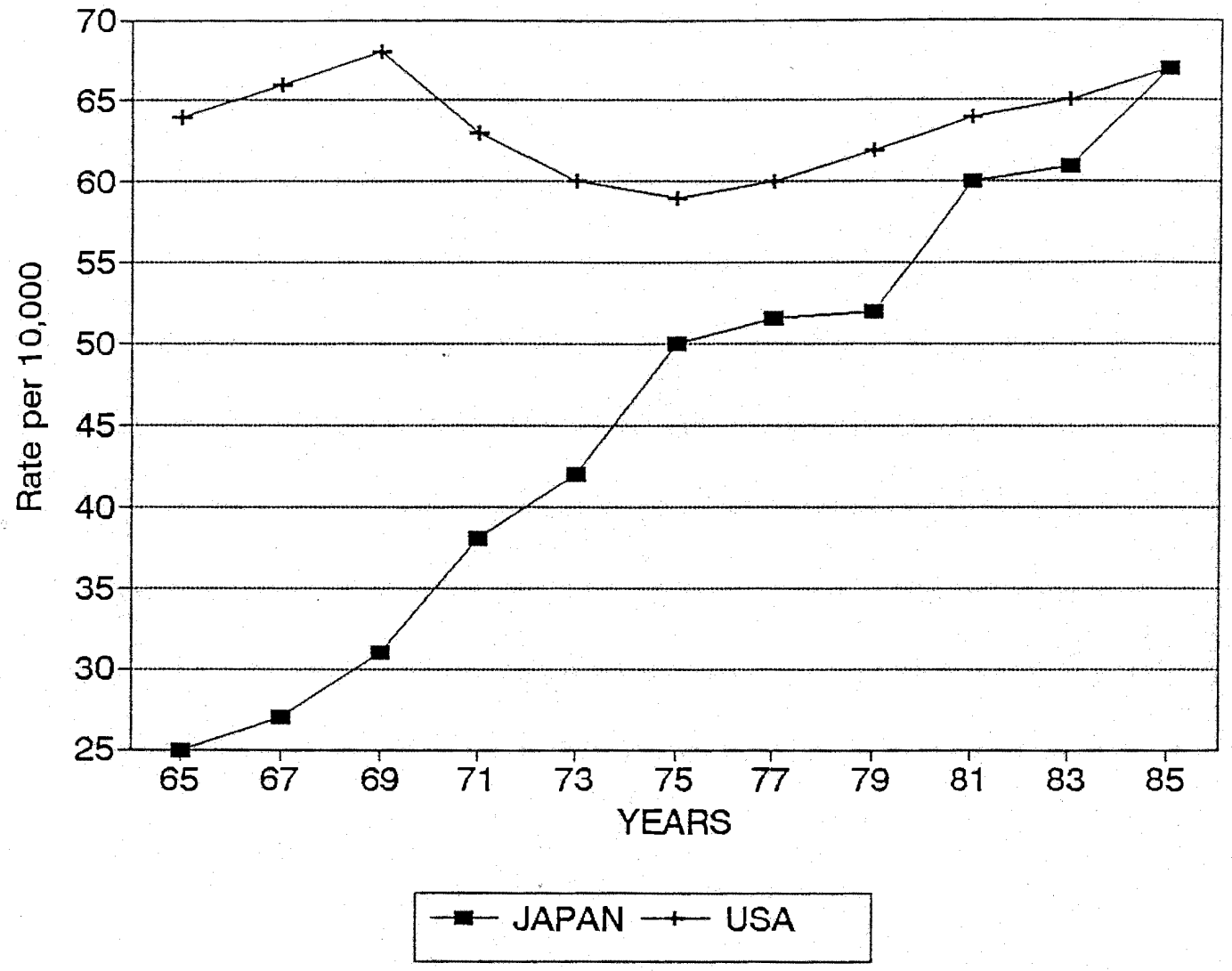


Figure 2.1 SCIENTISTS AND ENGINEERS IN R&D PER 10,000 LABOR FORCE

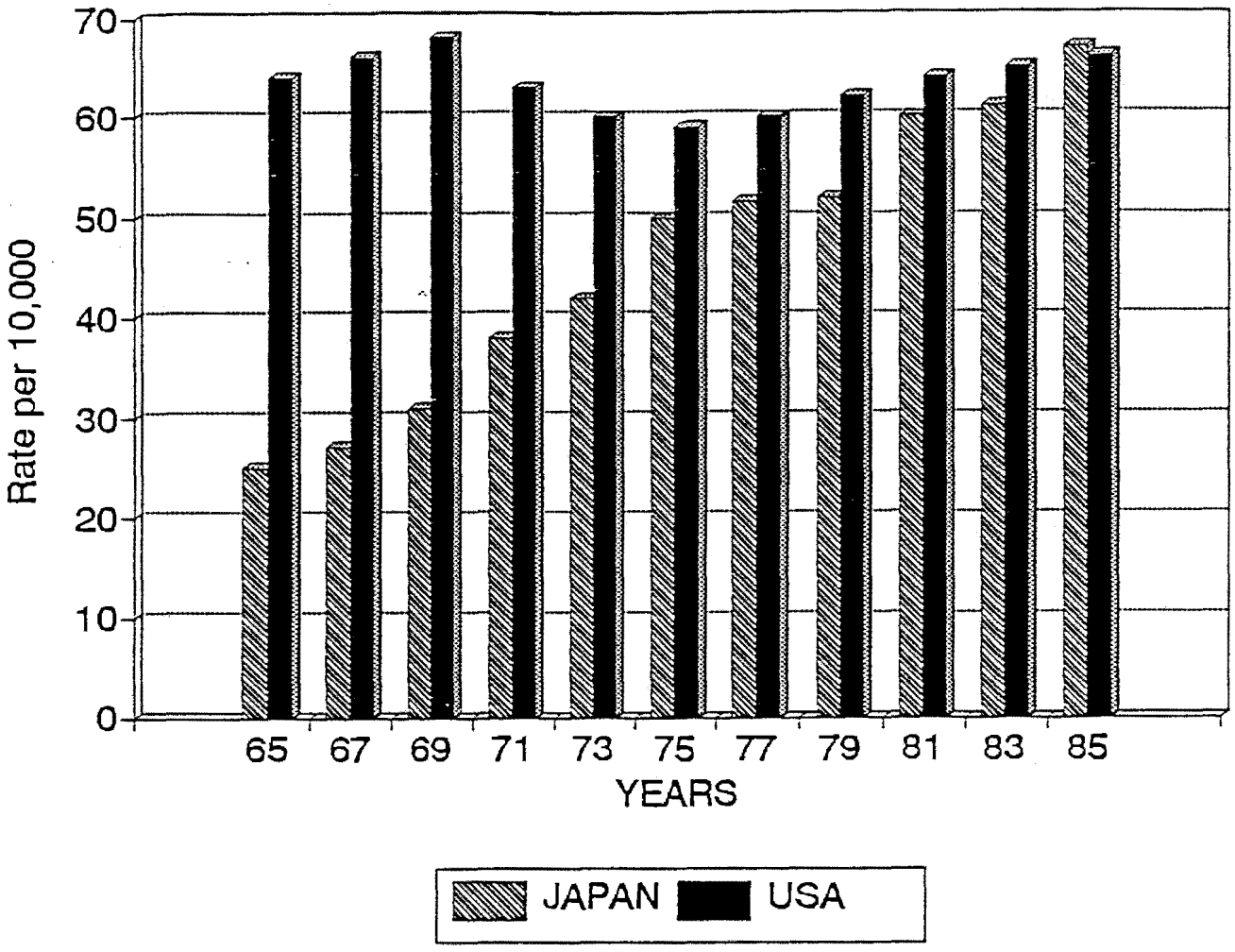


Figure 2.2 SCIENTISTS AND ENGINEERS IN R&D PER 10,000 LABOR FORCE

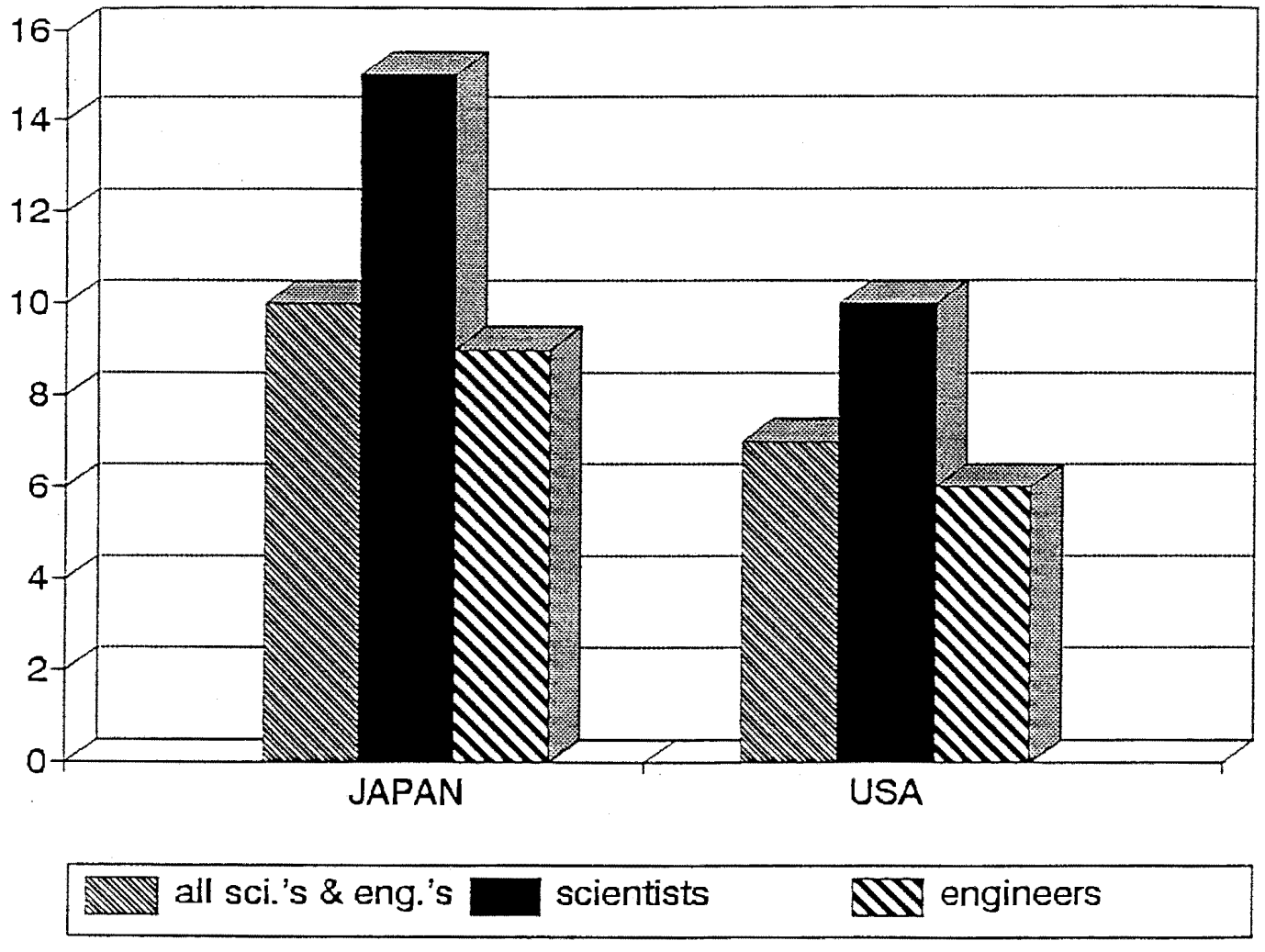


Figure 3 AVERAGE ANNUAL GROWTH IN NO OF SCIENTISTS AND ENGINEERS

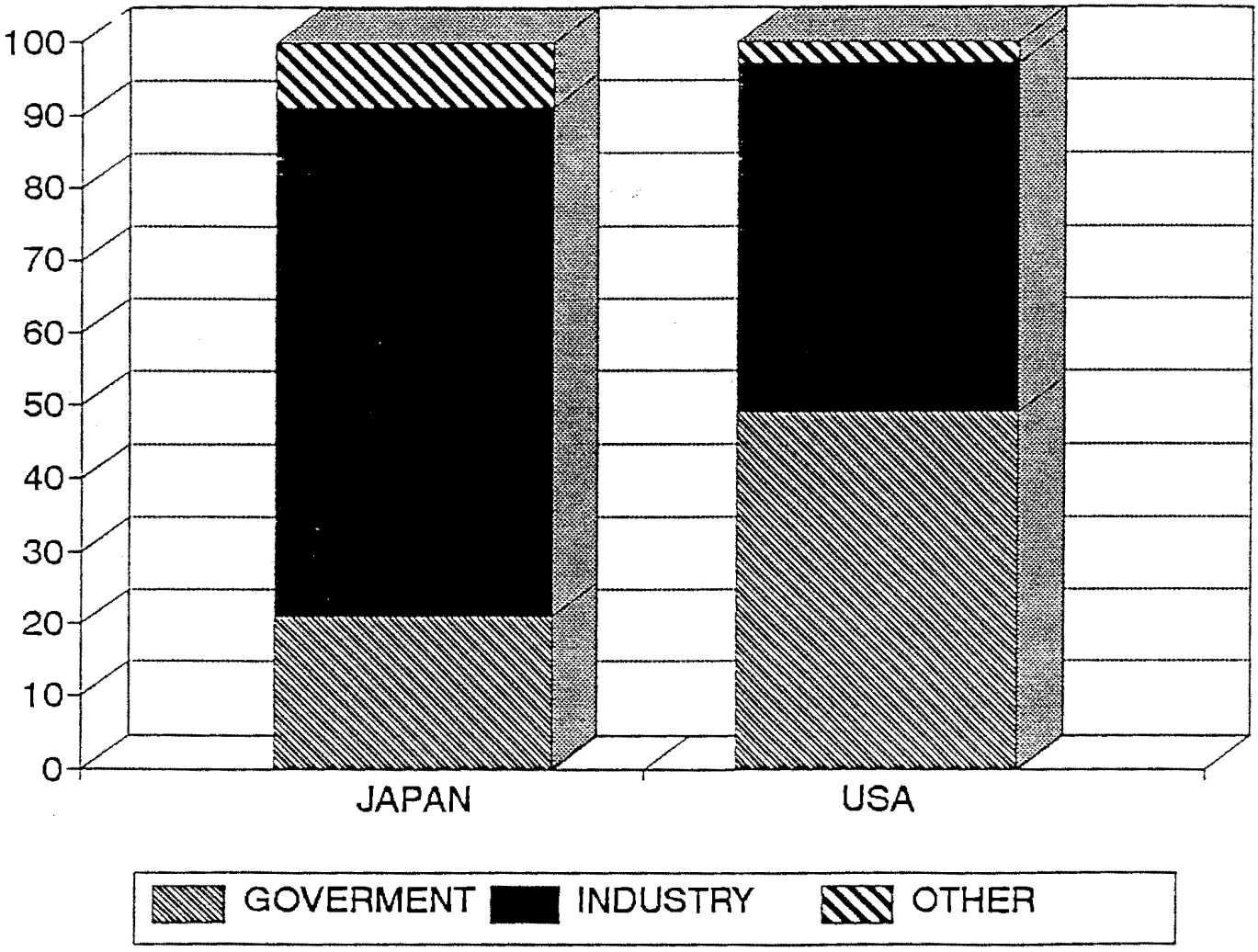


Figure 4 DISTRIBUTION OF R&D EXPENDITURES BY SOURCE OF FUNDS (1986)

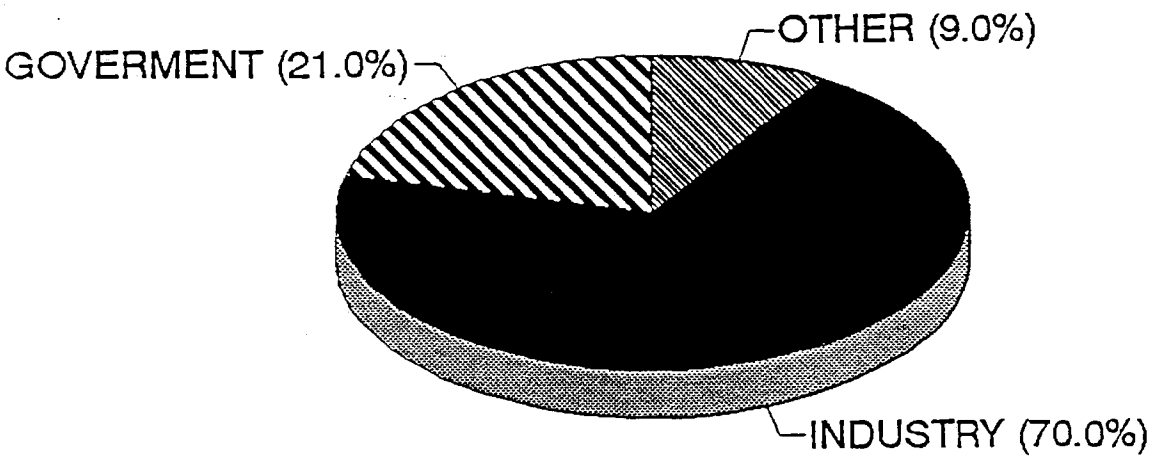


Figure 5 JAPAN'S R&D EXPENDITURE BY SOURCES

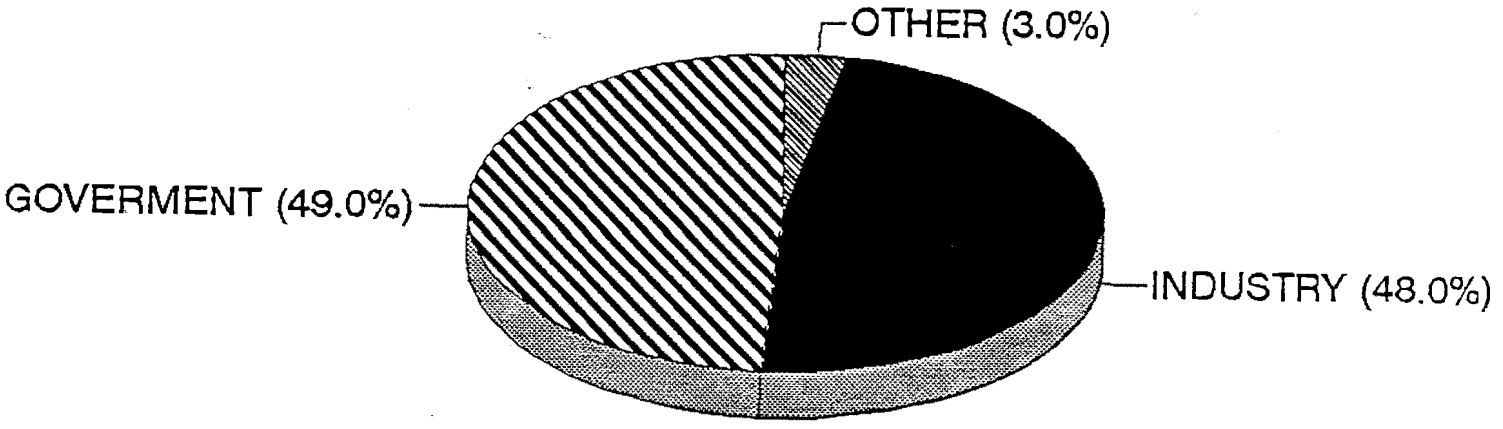


Figure 6 US' R&D EXPENDITURE BY SOURCE

STRUCTURAL DATA OF US R&D

INTRODUCTION

The U.S. R & D programs, in general, have only been in existence for the past 35 years. There are some exceptions, however. Dupont, founded in 1802, became involved in formalized R & D 100 years later and by 1920 had 3000 people involved in that activity. Dow Chemical was involved in R & D by 1909. Bell Telephone Laboratories was incorporated for R & D in 1925. In this time of evolution of the R & D programs, management has been looking at the best way to manage to meet the companies' mission. The following seven areas of the U. S. R & D management are generalities common to many programs but are not inclusive to all programs. [11]

1. Role Specialization and Training - Specialists are trained by outside institutions for occupational careers which are affected by professional communities outside the company. This training consists usually of graduate levels of education.

2. Employee Orientation - R & D employees often have individualistic, careerist orientation, sometimes augmented by professional father than company norms.

3. Structure - R & D is either in centralized labs segregated from bureaucratic-

mechanistic factories or in small, high tech ventures organized organically.

4. Interfunctional Integration - R & D is loosely coordinated with other functions, as liaison personnel handle contract through bureaucratic channels. Inventions are translated into new products stage-by-stage, specialist-by-specialist.

5. Teamwork and Participation - Teamwork is more common for special projects which occasionally require employees to perform tasks outside of their job descriptions.

6. Technology Transfer - Interorganizational teamwork between suppliers and end market producers is moderately low and joint ventures between large corporations and small business units are few. Many inventions are never successfully commercialized and remain dormant.

7. Performance - Product innovations are made occasionally involving radically new discoveries. Commercialization opportunities are sometimes inadequately exploited because inter functional integration is lacing between R & D, manufacturing and marketing.

THE ORGANIZATION OF R & D IN MULTINATIONALS

In order to understand why a firm pursues R & D abroad it is necessary to examine the orientation of the company to the international market. Companies with a primary orientation to their home market would be expected to have little overseas commitments. Host-market firms have an orientation towards the national markets where they are located. A third category of companies is that in which the firms have an international market orientation. These organizations are more likely to set up overseas R & D to look after new product research.

The Behrman and Fischer study found that there was no one generally accepted pattern of organizing foreign R & D activities. Five different styles could be identified: absolute centralization, participative centralization, cooperation, supervised freedom, and total freedom. However, these styles were developed for the relationship between a parent and subsidiary company.[3]

FACTORS INFLUENCING THE STRUCTURE OF R&D

There are many factors that can influence the way in which the R&D effort of a company is organized. Some of the factors are as follows:

Size

Position in life cycle

Product diversity

Market diversity

Geography

Environmental factors

Management philosophy

The size of the firm influences R & D directly. Small companies are usually organized on functional lines which gives rise to the functional organization of R & D. Growth of the company usually leads to decentralization. Thus different product lines may require different R & D organizations and perhaps different emphasis on research or on development depending on the rate if change of the particular technology. Market diversity may also give rise to the need for different R & D structures. Geography may require the decentralization of R & D to address the particular needs of different areas such as the United States, Europe, and the Far East. It may even be politically wise to locate R & D units in different geographical areas because of favorable grants, tax treatment, or favorable treatment of the company.

The location of R & D also depends on the nature of the business. Process research requires that laboratories be placed adjacent to manufacturing facilities or the expenditure of sizable amounts for pilot plant facilities.

Environmental factors that influence R & D are often those that influence the company as a whole. These factors include diversity, dynamicism, and other elements such as the influence of governmental regulation. New technology may effect the restructuring of R & D well before its effects are felt by the rest of the organization.

Management philosophy is of overriding importance on the R & D structure. Philosophy dictates the amount to spend on R & D. An emphasis on long range research by management will lead to the establishment of a central laboratory while product introductions on a frequent basis with incremental improvements requires decentralized R & D.[11]

INCENTIVES FOR COOPERATIVE R&D IN THE U. S.

After legislation had been passed in the Federal government, encouragement of cooperation in R & D efforts in the past decade represent a fundamentally different approach to the U.S. R & D policy. To encourage domestic R & D cooperation, governmental policies have lowered antitrust restrictions, increased incentives for the transfer of technology from government to industry, eased the stringent patent procedure for technologies developed in government owned or operated laboratories, and provided funds for university-industry technology start-up companies as well as multi-corporation sponsored limited R&D partnerships.

The results of this legislation was the development of the U.S. research consortia, MCC (the Microelectronics and Computer Technology Corporation). This research consortia represent a new organizational form which clarifies and highlights barriers and solutions to efficient and timely technology transfer.

As dicussed before, there are five styles of management identified: absolute centralization, participative centralization, cooperation, supervised freedom, and total freedom.

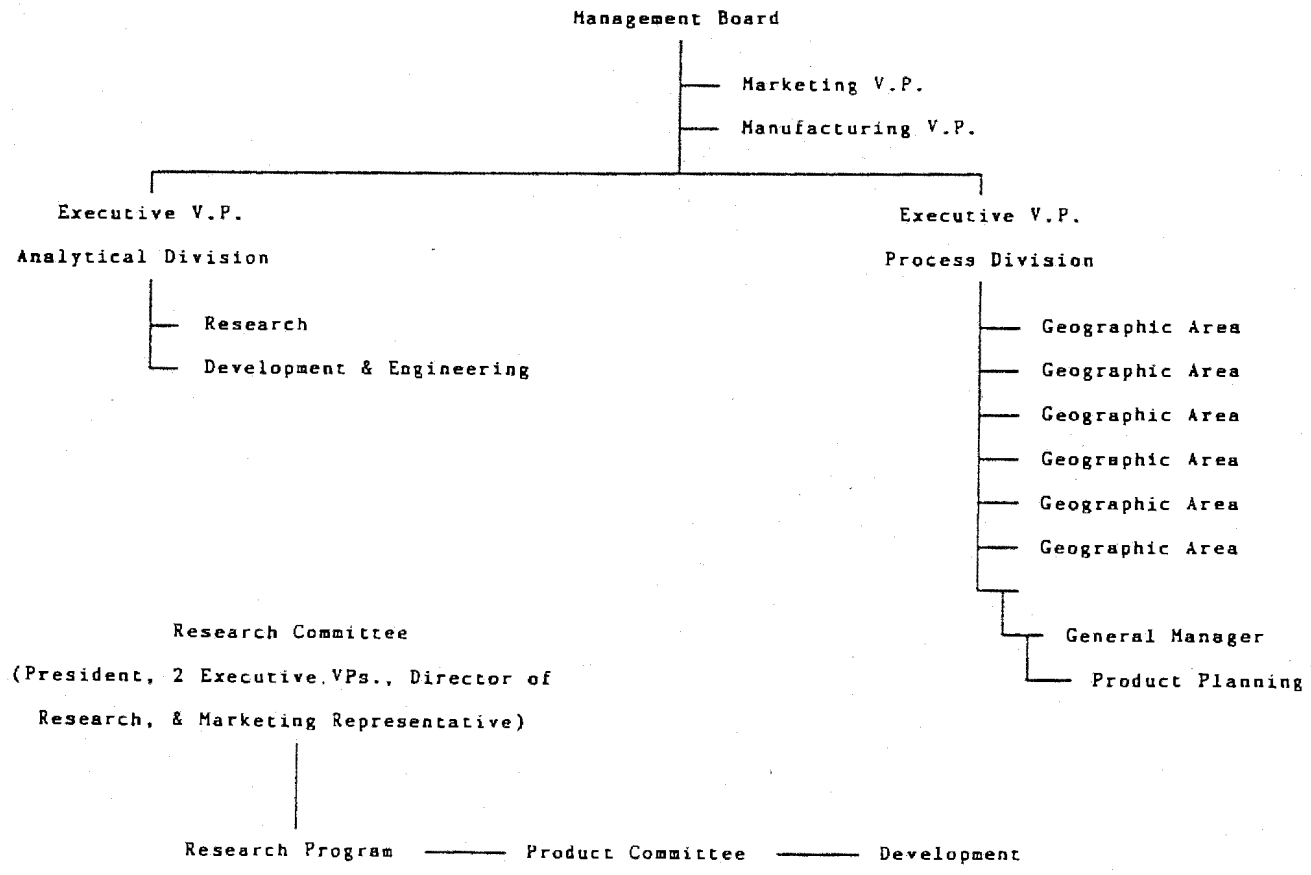


Figure 7 CENTRALIZED MANAGEMENT OF R&D [11,pp 108]

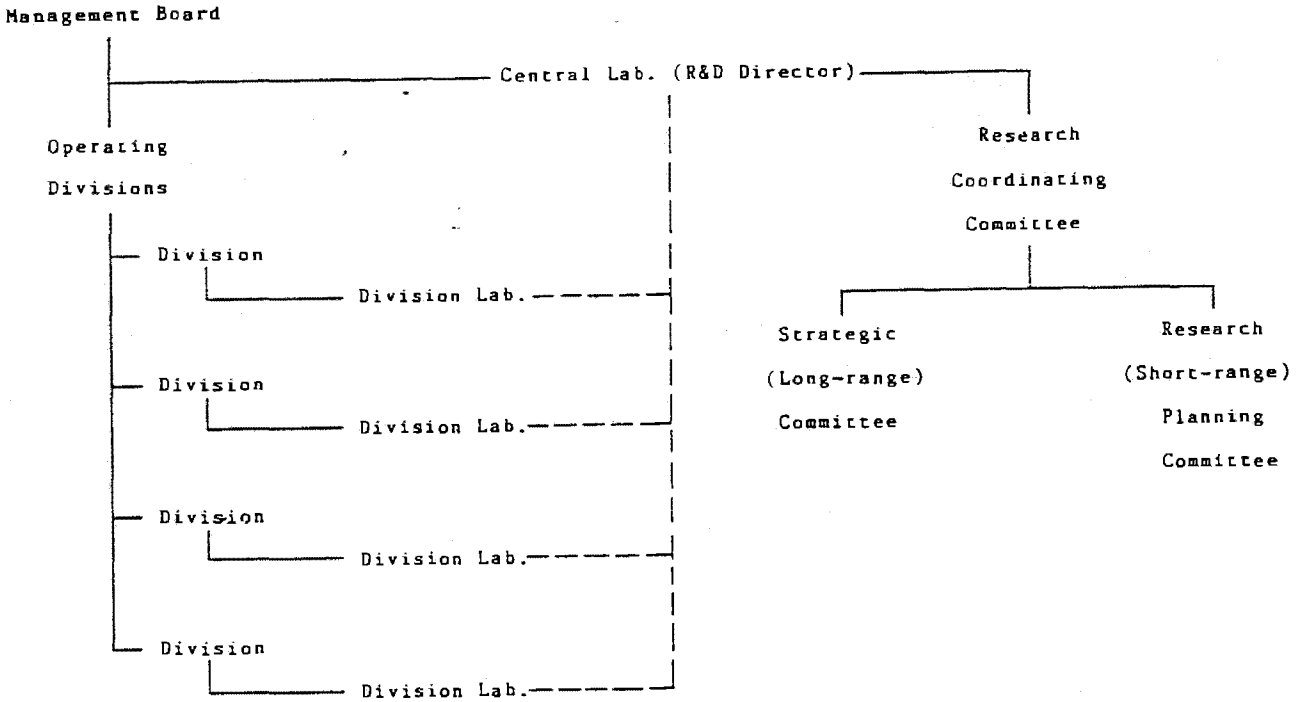


Figure 8 CENTRALIZED CONTROL AND COORDINATION [11,pp 113]

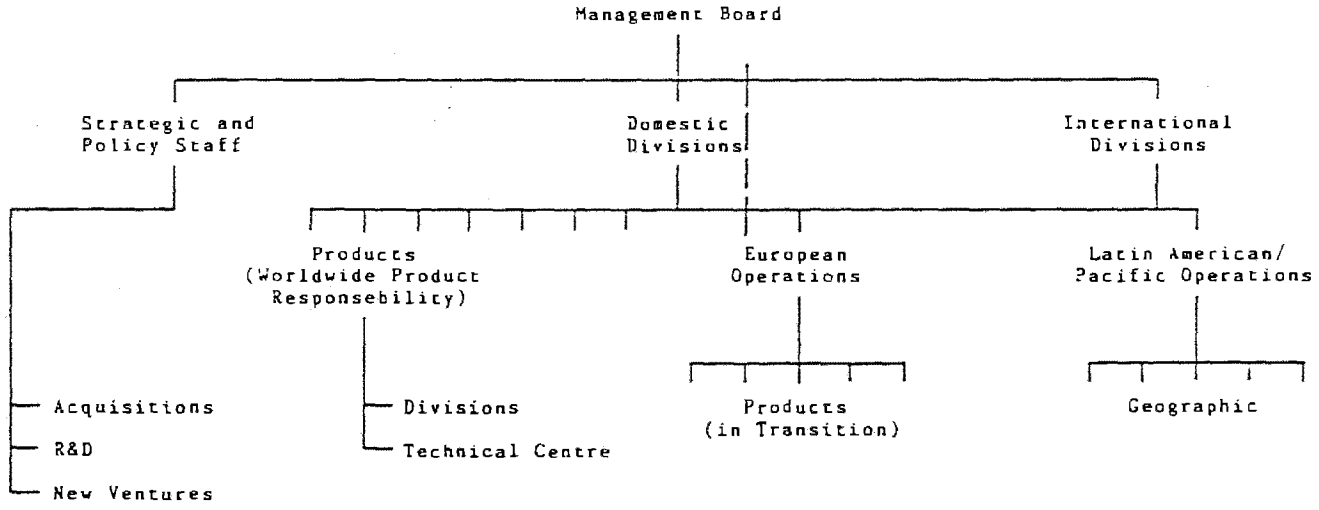


Figure 9 DOMESTIC PRODUCT LINE MGMT & FOREIGN GEOGRAPHIC MGMT [11,pp 115]

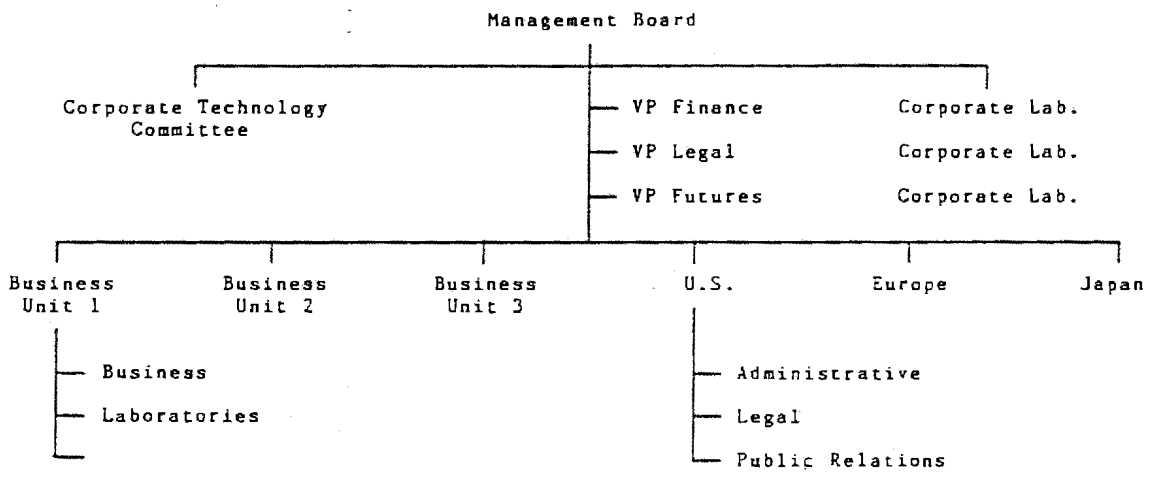


Figure 10 DECENTRALIZED R&D WITH CORPORATE SUPERVISION [11,pp 118]

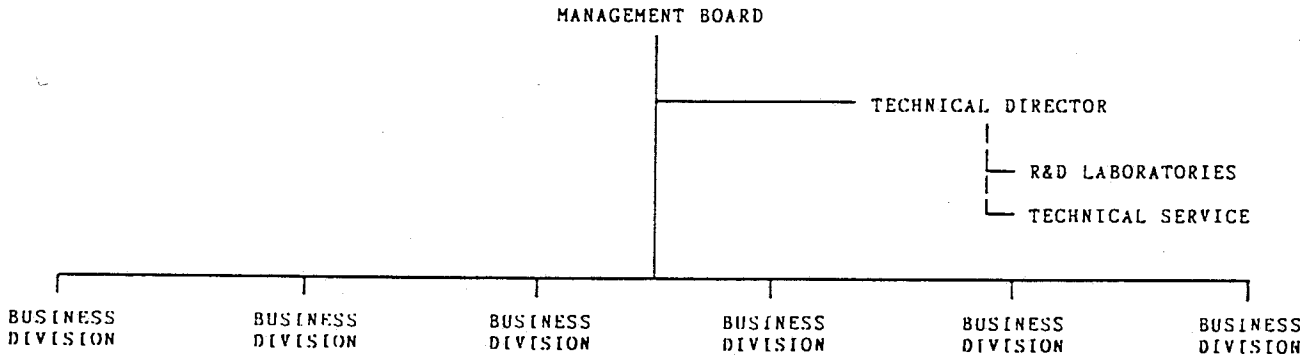


Figure 11 DECENTRALIZED R&D [11,pp 120]

Above figures display the R&D structures generally employed by the US companies

Figure 5 shows the absolute centralization of R&D management. All R&D is conducted at one place, normally at the corporate headquarters. The link between the divisions and corporate R&D is the research committee consisting of the President, the two Executive Vice Presidents, the Director of Research, and a marketing representative.

Figure 6 shows the participative centralization of R&D management. Here all of the affiliates have inputs into the R&D program, but the R&D group has the final say on whether or not that program is followed up.

Figure 7 shows the cooperation of R&D management. This hybrid management type has no relationship with existing businesses and concentrates on trying to take the firm into new fields. Each division has its own product-directed R&D activities.

Figure 8 illustrates the supervised freedom of R&D management. The situation allows for decentralized R&D with corporate supervision. The R&D program determination is the responsibility of each business unit. Interaction with the R&D efforts of the business unit is effected through a Corporate Technology Committee with members drawn from each corporate laboratory and the business unit R&D group. This committee governs the sponsoring of work by the business units at the

corporate laboratories.

Totally decentralized within the business units is the R&D organization in Figure 9. The technical director has no direct responsibility for the company's R&D activities but serves as the liaison between the laboratories. He is also to review the plans and capabilities of the business unit's R&D and to manage their performance.[11]

JAPANESE R&D STRUCTURE

HISTORY OF R&D IN JAPAN

Historically, the Japanese government has never taken a great interest in devoting public funds to R & D spending. Before World War I,the primary intent of university research was to "absorb Western knowledge and teach it to students." [13]. Testing laboratories and experiment stations did exist but basic research institutes weren't established until after World War I. All were funded privately.

In the early 1930's, economic depression stifled private R & D efforts . This helped set the stage for the military to become a leader in Japan's R & D efforts. (At war with Manchuria in 1931, the Japanese defense budget jumped from 30% to 70% of national spending in the preceding six years.) The military's role in R & D continued through World War II and halted at war's end.[13]

After World War II, financial resources were tight and the Japanese government was reluctant to fund non-military R & D for fear that it would be unsuccessful. In the 1950's, recognition that large projects like nuclear power and space projects would dominate much of the R & D resources of other major countries, Japanese skepticism of publicly funded R & D grew. Yet, the Japanese realized that to be competitive in international markets, private industry R & D had to be promoted.

In the early 1950's, the Japanese government established the Ministry of Trade and Industry (MITI) as the agency responsible for shaping the structure of Japanese industry. In R & D, the MITI's strength is not in public funding, but in working with large national corporations and the Zaikai, a branch of the federal government that is composed of corporate leaders. The MITI's purpose within R & D is to establish a business environment that makes it advantageous for Japanese corporations to coordinate their R & D efforts so that the primary R & D needs of the nation's economy are met while each of the investing corporations receive a return in knowledge that exceeds what would have been gained if the research wasn't coordinated.

In the last 30 years, the MITI and its industrial policy has been instrumental in the success of Japanese R & D efforts. Since 1970, the MITI's success in working to coordinate R & D within the computer and automobile industries has been particularly successful for Japanese companies in both their domestic and foreign markets. In some specific industries, the MITI has taken an active role in funding R & D efforts. Today, its primary role in R & D remains that of a policy maker and organizer for the economy as a whole and the Japanese corporations within it.

ROLE OF MITI

In comparison to the R & D structure in the United States, the U.S. has no counterpart to the MITI. In Japan, the MITI's authority is extensive. In addition to shaping the structure of Japanese industry, the MITI controls international trade and regulates overall production and distribution of goods in Japan. The MITI has 6 primary functions, all of which it uses to assist in its authority to direct and coordinate corporate R & D efforts. These functions include promoting an orderly expansion of exports; insuring that Japanese industry is adequately supplied with essential imported resources; managing the overall flow of trade in the domestic economy; regulating manufacturing, distribution and energy industries, and administering patents and trademarks.

Over the years, the MITI has used a variety of policy instruments to implement its industrial policy which includes coordinating R & D. Its establishment of cartels and mergers have put it in conflict with Japan's Fair Trade Commission (FTC) and anti-monopoly laws. In most of these conflicts, the MITI prevails. The same applies to conflicts related to patent infringement. As for tax policy, the MITI maintains a fairly consistent approach of granting a 20% tax credit on all R & D expenditure that exceeds a corporations highest annual rate in the past. [40]

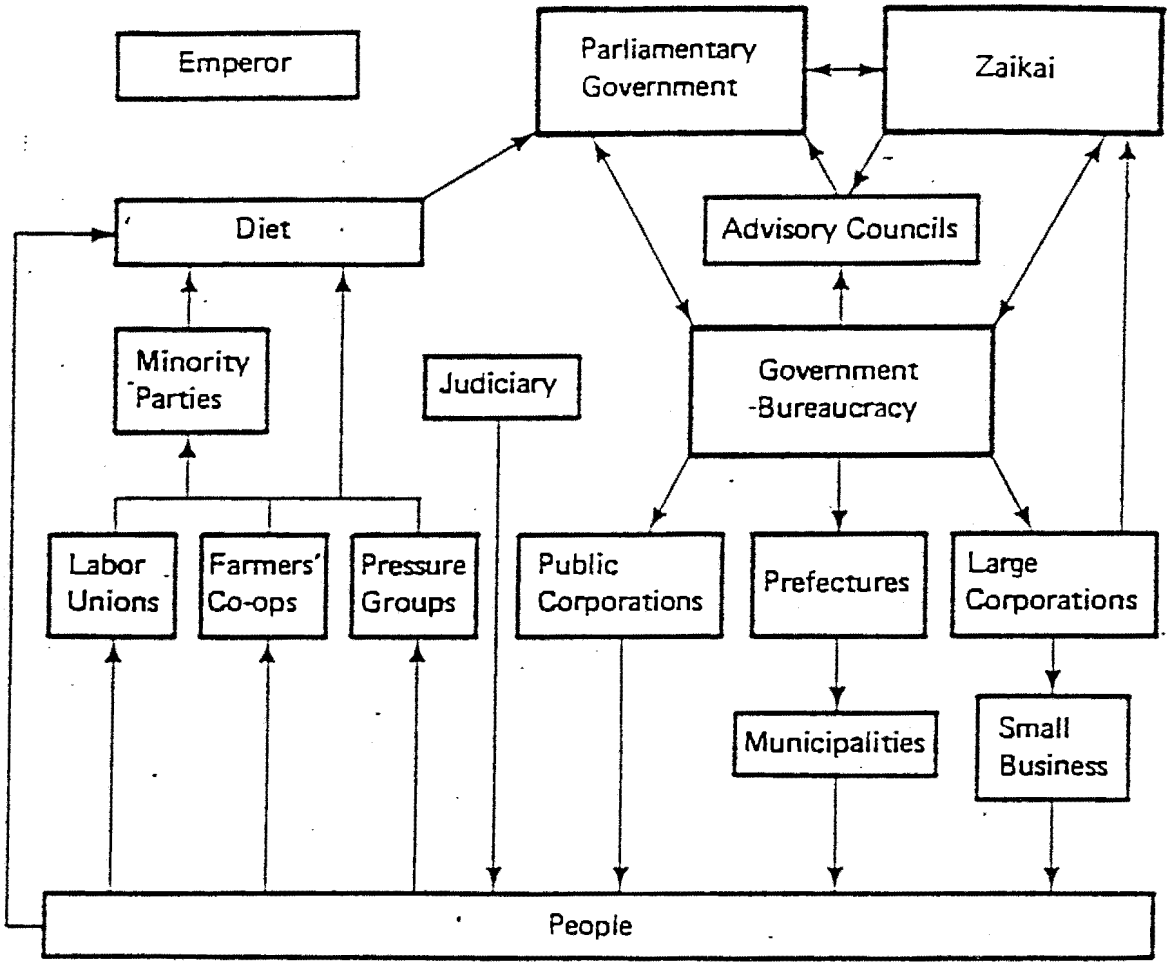
In cases where corporations refuse or ignore MITI's industrial policy goals, the

ministry uses numerous tactics to enforce its authority. Among positive measures, the MITI may use subsidies, preferential tax treatment, or mediate in public or private loans. As for negative enforcement measures, the MITI has the authority to withhold licenses for foreign exchanges needed to pay for imported materials and technology. One such case of conflict arose with Sumitomo Metal in 1965. In view of a market oversupply of steel, the MITI suggested that the industry curtail output by each producer cutting output of the previous year by 10%. Sumitomo Metal refused and the MITI retaliated by withholding Sumitomo's license to import the coal necessary to produce its steel.[13]

As for enforcement of coordinated R & D efforts among Japanese corporations, the MITI generally avoids extreme measures as were taken against Sumitomo Steel for defying authority. However, the MITI's goals to coordinate Japanese corporate R & D are just as important as its goals to direct the production in large industries such as steel. The MITI's authority, in itself, encourages Japanese corporations to work with the MITI to establish cooperative R & D efforts with each other.

To conclude, Japanese R & D structure is established by the Ministry of International Trade and Industry. Its primary function is to shape the structure of Japanese industry. The MITI's legal authority is extensive. Its fiscal authority is not. Its primary strength in directing R & D expenditure is in its ability to work within the Japanese corporate establishment to promote efficient use of Japan's R & D

resources and meet Japan's national economic goals.



Note: The direction of the arrows indicates the direction of influence.

Figure 12 Organization of the House of Japan [20,pp40]

INTERVIEWS & SURVEY

In this section the nature, contents, responses and the analysis of these responses of the interviews and the survey that was conducted during the PICMET conference, are presented. The backgrounds and other related research of the authors that were interviewed are also introduced in this section. Also a conclusion according to the responses from the authors , is presented. Other similar and extended survey and research examples are included at the end of this section

THE PURPOSE OF A QUESTIONNAIRE

In the beginning of the research, the issues that would be focused on were determined. And according to these a list of questions was prepared for the authors attending PICMET , so that they could state their inspections about US and Japanese R&D's and their differences.

Rather than asking authors to compare US and Japanese R&D strategies, asking them to comment on the differences and similarities that were inspected through the literature search, complemented the research.

The issues that were focused in this survey are ;

- The primary differences between Japan and US corporate R&D strategies

- Example products whose success is primarily due to a particular R&D strategy
- The share of defense spending in US R&D expenditure
- R&D cooperative efforts in both countries

THE NATURE AND IMPORTANCE OF PICMET

As it is stated in the preface of the proceedings of PICMET'91 by the Program Chair Dundar F. Kocaoglu, ' PICMET was developed as an international forum to bring together top researchers, educators and practitioners for authoritative discussions on management of engineering and technology. About four hundred papers were submitted to PICMET from more than thirty countries.'

THE RELATED RESEARCH TITLES PRESENTED AT PICMET

Related research at PICMET was collected under the title R&D Management.
The related research titles are presented below ;

- 'Global R&D activities of US multinational corporations: Some empirical results' Masazumi Sone, Nissan R&D Inc , George A. Fulton, Univ of Michigan

This research was focused on corporations that conduct R&D in facilities which are in foreign countries. These R&D facilities were expected to be involved in different tasks and issues.The authors based their research on a survey conducted among US multinational corporations.

- 'Characteristics of Japanese R&D management excellence ' Fujio Niwa, Univ of Tsukuba

This paper compares R&D management between corporations whose R&D activities were evaluated as outstanding and the ones that were not chosen as outstanding. The author based his research on a survey which was conducted among Japanese manufacturing corporations.

THE QUESTIONS, THE STRATEGY APPLIED IN PREPARING THE QUESTIONS

In order to get more organized and complementary data the following list of questions was prepared to be asked to the authors during the PICMET'91 conference.

- What do you think are the primary differences between Japan and US Corporate R&D strategies ?

- In the last 10 years have these strategies converged or diverged?

- What are examples of products whose success is primarily due to a particular R&D strategy ?

- Defense spending accounts for a major portion of US R&D expenditure.Would a decrease in Defense spending help or hinder US R&D ?

- What are major differences between US and Japanese R&D cooperative efforts ?

The above questions are all based on the main issues that differentiate the R&D management in these two countries and those are the ones that are determined through the literature search.

One major issue in the allocation of resources is that the US government accounts for a much higher percentage of R&D funding in the United States than the Japanese government does in Japan. In 1981, the US government funded 72% of research undertakings by US private industry. In contrast, the Japanese government funded only 2% of same in Japan's private industry. Most of the US government support is defense industry related. Even today, Japan's support to defense is negligible in comparison. Excluding US defense industry support; the US

government funds 7.7%.

Other issues in R&D allocation include just how research is supported by government. Much of federal R&D spending in the US is via the university level. In Japan funding places more emphasis on subsidizing R&D projects that are cooperative efforts by two or more corporations. For the most part, Japanese cooperative R&D efforts concentrate on generic research so that corporations have more incentive to contribute. Tax subsidies are used by both US and Japanese governments to encourage corporate ventures in R&D.

THE INTERVIEWEES AND THE SURVEY RESPONDENTS

In choosing the authors that would be interviewed or asked to answer the survey questionnaire , the backgrounds and their research interests were evaluated. At the end the ones that do have related research or that were believed to have inspections about the US Japan competitiveness , were asked to contribute to the research .The names, affiliations and the related research of these authors with a summary of their responses are presented below :

- Belinda H. Adams NASA Langley Research Center

Related Research : ' A study of the impact of the growing international dimensions

of technology on career development at a national aerospace laboratory' PICMET'91 Proceedings.' Career Development in the High Technology Environment : A study from the Perspective of A National Aerospace Laboratory' MIT Thesis

Response to the questions : 'Japan's research is focused by national policy . US corporate R&D strategy is independently chosen by each corporation in response to market force or predicted market forces. Japan focuses on small practical improvements. The US R&D goal is usually a breakthrough.' 'In the last 10 years the corporate R&D strategies of US and Japan has perhaps converged a bit but neither has changed substantially.' 'US will create the technology, Japan will improve and apply the technology. japan is in continuous improvement (eg. the automobile , the TV)whereas US is looking for a breakthrough (eg. superconductivity) .' ' A decrease in US defense spending will hinder R&D unless similar funding is redirected to other national R&D institutions.' ' US anti trust law inhibits many opportunities for cooperative effort. Japanese government policy promotes cooperative effort.'

- Jan Osterlund Stockholm University

Related Research : 'Informatics for project structuring' PICMET'91 Proceedings

Response to the Questions 'The US Home Market is enough in size to bear its own strategy and have hope for the government to hinder attacks on it. Japanese

companies are looking for export from the beginning.' 'A decrease in US R&D will cause some front line research to be missed . The results of the military research is often used in non-military products in one or other form.'

' The japanese are more for cooperation in contrary to the US culture of competition.'

- Ryo Hirasawa University of Tokyo

Related Research : ' Ascertaining the relation between Advanced technology and Basic science' ' Competition and cooperation in Japanese manufacturers-A case in VCR manufacturers-'Co-author; K.Yanagishta, PICMET'91 Proceedings ' Organizational Flexibility in the Japanese corporate R&D setting ' Co-authors; S.Boluda, H.Asamitsu, T.Ijichi PICMET'91 Proceedings ' Inclusive-Interactive approach for R&D management-A new scheme for the global enterprise' Co-author; Y.Kuwahara, PICMET'91

Response to the questions: 'Japanese corporations aim at long-time planning unlike US. Japan has "one-set"ism: they make up R&D organization from basic research to the development stage. US prefer alignments with other companies whereas japanese make more intimate relations within the company. Hitachi and Toshiba have each around 10 R&D institutions, and they make alignments with either with each other or with the universities.' 'The R&D strategies of US and Japan diverge. The social system, culture and thus the hiring system is different.'

'Japanese manufacturing companies aim at incremental innovation. They reduce the cycle time ; believing in that imagining near-future is easier and less risky than imagining 6 or 10 years from now.' 'In japanese companies making up human-wear is important. Hitachi hires 800 new engineers every year. ' 'In japan even the development stage includes basic-research'

- C. Carl Pegels SUNY - Buffalo

Related Research : ' Research and Development Intensity and Performance' , PICMET'91 proceedings

Response to the questions: 'US aims Basic R&D whereas Japan is aiming at Development oriented R&D. In US R&D activities are directed by individual decisions, but in Japan, these are MITI guided.'

- Kiyoshi Niwa Hitachi Ltd.

Related Research : ' Knowledge-based technology transfer' Co-author; D.Gibson, PICMET'91 proceedings ' Engineering applications of knowledge sharing systems' PICMET'91 proceedings

Responses to the questions: ' Japanese companies aim at long-range targets whereas US companies aim at extremely short-range targets.'

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Responses to the questions: ' Japanese companies aim at long-range targets whereas US companies aim at extremely short-range targets.'

' Decrease in US defense spending in the short range will hinder US R&D but in the long range it will help US R&D.'

RESULTS

All the responses given agree that the US companies aim at short-range targets whereas japanese companies aim at long-range targets. Another agreed point is that Japanese corporations are in continuous improvement and do have shorter cycle times. US companies are after breakthroughs and they do have long cycle times.All responses state that a decrease in US defense spending will hinder US R&D. But this may turn out to be better in the long range as stated by Dr Niwa. As a conclusion it can be stated that US and Japan have totally different cultures and social system and therefore their corporate R&D strategies should diverge. However some convergence is inspected in multinational companies from either country. Since corporations from either side want to have share in growing markets that are tending to be global, they should adjust their systems so that a convergence can be attained.

CONCLUSION

After analyzing the data the following conclusions are drawn :

Managing creativity is an important aspect of R&D management ; which is supported by both countries.

The statistical data shows that increase in R&D expenditures of both countries in the last 20 years are in the same amount.But the R&D expenditure of Japan was only one tenth of the R&D expenditure of US in 1961, whereas in 1987 this ratio became 1 to 2. Another inspection done from statistical data that the percentage of the engineers and scientists has been increasing very rapidly in Japan but has been constant in US in the last 30 years. These percentages are same today.

The interviews conducted support the idea that Japan is in continuous improvement whereas US is after major breakthroughs like superconductivity.

Cooperative effort is supported by government in Japan (MITI).But the companies in US are in continuous competition which hinders cooperation.

Although government support has the highest share in R&D expenditure in US most of this goes to defense industry. Reducing this defense spending may hinder US

R&D in the short run but in the long run it can help.Available resources can be allocated in abetter way in the long run.In Japan government support is in the way to urge the cooperative effort by supplying tax subsidies.

The cultures of both countries are different therefore the hiring systems differ too. Structural difference of R&D organizations occur because of that.Japanese companies tend to hire people for nearly life-time periods whereas US companies keep employees as long as they are profitable to the company.Also the R&D labs in US are centralized in one central lab. In Japan the companies have more than one R&D organizations which do alignments with each other all the time ; which therefore increases the efficiency.

All those inspections give signals of a future Japanese dominance in the high tech market. To avoid that non-military R&D expenditure of US should be increased. Government support similar to the one applied by MITI in Japan should be applied in US. Corporations should be urged to cooperate and they should be given tax subsidies by the government. Although the characteristics of R&D managements in US and Japan diverge structurally as inspected from the issues discussed above, it seems that a future convergence will occur and actually it is necessary for US.

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