INTERNATIONALIZATION OF R&D: THE CASE OF JAPANESE ELECTRONICS FIRMS

by

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(1984)

Submitted to the Alfred P. Sloan
School of Management
in Partial Fulfillment of the Requirements for the
Degree of

MASTER OF SCIENCE
in Management

at the

Massachusetts Institute of Technology

June 1992

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ABSTRACT

The objective of this thesis is to examine the fit between the globalization strategy and internationalization of R&D strategy of the Japanese electronics firms. Chapter 1 summarizes previous academic works on globalization strategy, and surveys the historical evolution and current strategy of the Japanese electronics firms in the fields of globalization. Chapter 2 focuses on the internationalization of R&D, introducing the studies on the internationalization of R&D and the general status and strategy of Japanese firms. Chapter 3 summarizes the findings from the structured interviews. The features of the U.S. R&D centers of the Japanese electronics firms are addressed in terms of two types of R&D facilities: corporate-level laboratories and divisional-level laboratories. Based on the findings in Chapter 3, the fit between the globalization strategy and internationalization of R&D of the Japanese electronics firms is examined in Chapter 4. It is argued that, while most common globalization strategy is to establish a locally autonomous company in each region and the companies have been rigorously creating elements of a value chain in the U.S., these elements are disconnected. In Chapter 5, the transnational model is discussed as a solution to bridge the discrepancy between the strategy and the current status. However, except for the emphasis on the transnational mentality, the way to become a transnational companies differs from company to company, and even from unit to unit. Thus, managing the internationalization of R&D will remain a challenge for Japanese electronics firms, even if they follow this model.

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Acknowledgement

I would like to express my appreciation to all the persons who generously supported me in the completion of this thesis.

I would like to express sincere gratitude to Professor D. Eleanor Westney, my thesis supervisor, for her constructive comments and suggestions on the preparation of the manuscript. She also encouraged me throughout this process. I am also grateful to Professor J. Nicholas Ziegler for his assistance as a thesis reader.

This thesis could not have been completed without the cooperation from several Japanese electronics firms which have R&D centers in the U.S. I am especially indebted to Fujitsu, Ltd., Matsushita Electric Industrial Co., Ltd., and Toshiba Corporation for providing me with valuable information on the internationalization of R&D. I also would like to thank Credit Suisse, my sponsor, for offering me an opportunity to study at the Sloan School of Management at M.I.T.

Finally, I would like to thank my husband, Masahiko, for his support and encouragement throughout this period, and my parents, Shuji and Kyoko Yoda.

Mami Fukasawa
Cambridge, Massachusetts
May 15, 1992

Preface

This thesis is a part of the structured thesis project on the internationalization of R&D led by Professor D. Eleanor Westney. Although each member worked on his or her thesis individually, we shared the information collected through structured interviews as well as other published information. In addition, we discussed the wide range of topics related to the internationalization of R&D at the weekly meetings and occasional brainstorming sessions. I would like to acknowledge my appreciation to each of the members for their cooperation and encouragement throughout this project. Names of the project members and the titles of their theses are listed in Appendix 3.

The companies that participated to our structured interviews are as follows: Canon, Inc., Fujitsu Ltd., Hitachi, Ltd., Mitsubishi Electric Corporation, NEC Corporation, Ricoh Co., Ltd., Sony Corporation, and Toshiba Corporation.

Introduction

Trading across borders has a long history. However, so-called multinational companies -- companies which dispersed its activities as well as resources across borders -- has emerged only in the twentieth century. Following the U.S. and European large corporations by a decade or two, Japanese firms started to join this stream of multinationals in the 1970s. In the name of "globalization", the Japanese firms have been trying to gain from this new challenge of moving value-creating factors.

This thesis examines the internationalization of R&D by Japanese electronics firms. Geographically, the research is focused on the R&D centers in the U.S. The topic was selected for three reasons. First, the internationalization of Japanese firms in the U.S. is expected to be more difficult than that of the European corporations, because of the wider gaps created by geographic distance, language, culture, and management style between the Japanese and Americans. Therefore, lessons from the Japanese case has important implications for the companies from other non-Western nations. Second, among globalized industries, the electronics industry is one of those less affected by politics and government regulations. Although the automobile industry is an important player in the internationalization of R&D, it has been more influenced by the politics and the threat of regulation, and thus less general in its implications for the corporate strategies. Third, R&D is a primary source of long-term competitiveness for electronics firms. Therefore, a corporation's ability to manage R&D has significant implications in understanding a company's competitiveness.

This thesis, however, has some limitations. First, most of the R&D centers we have interviewed have only a few years of history. Therefore, it

might be too soon for us to evaluate their activities, although we believe we allowed for this weakness by interviewing firms about the future direction of R&D centers. Second, the number of the laboratories we could visit was limited, but we did cover R&D centers of the main Japanese electronics companies. Third, the amount of the information we obtained was not standard across the case studies. Especially, in the divisional laboratory category, information from Fujitsu Ltd. and Ricoh Co., Ltd. surpassed those from the other companies.

Chapter 1. Globalization of the Japanese Electronics Firms

In this chapter, the globalization strategy of the Japanese electronics firms will be explored. First, general evolutionary patterns of globalization and categorization of internationalized companies will be presented to give a basis for the analysis. Then, the historical evolution and the current globalization strategy of Japanese electronics firms will be analyzed.

1.1. Patterns of Globalization and Company Categorizations

1.1.1. Globalization and Internationalization

Before discussing the patterns of globalization and company categorizations, I first would like to clarify the definitions of two terminologies -- those of globalization and internationalization. In this thesis, these two words will simply mean "geographical dispersion of value-adding activities into foreign countries," and will be used interchangeably. If certain connotations are implied (e.g., Doz's "globalization" as centralization or integration is contrasted with "fragmentation," and De Meyer and Mizushima use "globalization" to mean dispersion), they will be explained in that context.

1.1.2. Evolutionary Patterns of Globalization

International Product Life Cycle

One of the early studies on business globalization was conducted by Vernon. Based on the pattern of the U.S. multinationals in the 1960s, he

introduced the "International Product Life Cycle." This model assumes that the home country is technologically advanced, but that the factors required for manufacturing are cheaper in the host country. The international product life cycle consists of four steps. The first step is the development and sales of a new product in the home country. As the product matures in the domestic market, the firm starts to export it (Stage 2). Since local manufacturers in the foreign market eventually learn how to produce this product, the original producer starts to establish production facilities abroad to compete against local manufacturers. In the final step, both foreign subsidiary and competitors start exporting the product back to the U.S., taking advantage of the lower prices made possible by the lower factor costs and scale economies.

Other Common Evolutionary Patterns of Globalization

In addition to Vernon's international product life cycle model, the evolutionary level of business globalization is often measured by the portion of the value chain that has been shifted abroad. One example of such models is the categorization by Kikai Shinko Kyokai Keizai Kenkyusho (Economic Research Institute of the Japan Society for the Promotion of Machine Industry). They present four steps of business globalization. The first step is the establishment of a sales function. The second step is the establishment of a manufacturing function. The third step is the establishment of a R&D function. The final step is to establish an autonomous regional headquarters, which integrates all of the functions in the region.

Although these evolutionary models have been helpful in understanding levels of globalization, some of the recent patterns of globalization, especially those of Japanese firms, cannot be explained by these

models. For example, contrary to Vernon's model, companies manufacture locally even in the places where they cannot take advantage of lower costs (e.g., production by Japanese companies in the U.S.). Another example is that there are companies which establish R&D facilities without having a production facility in an area (e.g., some R&D centers established in Europe by Japanese firms). This violates the evolutionary pattern of the second model.

These exceptions suggests the limitations of these two models. The most significant shortcomings of the international product life cycle lie in its assumptions -- technological advantages in the home country and cost advantages in the host country. The main shortcomings of the second model lie in its assumptions that the organization in the host country follows the same organizational evolution process as that of the parent company.

1.1.3. Categorization of Firms Operating Internationally

Given the limits of evolutionary models, there has been an endeavor to understand firms operating internationally by categorizing them into several different organizational patterns.

Categorization by Bartlett and Ghoshal

Bartlett and Ghoshal categorize firms operating internationally into four categories. The first is a "multinational" company, whose organization is decentralized and nationally self-sufficient. In this model, the role of the overseas operation is to sense and exploit local opportunities. Knowledge is developed and retained within each unit in this model. The second category is a "global" company. This is a centralized organization, whose capabilities

are globally scaled. Overseas operations implement parent company strategies, and knowledge is developed and retained at the center. The third is an "international" company, some of whose sources of core competencies are centralized but others decentralized. The role of overseas operations in this model is to adapt and leverage parent company's competencies. Knowledge is developed at the center and transferred to and applied in overseas units. The last model is a "transnational" company, which has a complex asset configuration -- some are centralized and some are decentralized and all of them are integrated by strong interdependencies. The distribution of assets and resources is best represented as an integrated network. Unlike the other three models, the role of the overseas operation in this model is not limited to local. Also, knowledge flows to and from all locations.[1] (Exhibit 1-1: Multinational, Global, International, and Transnational Companies)

[1]Bartlett and Ghoshal, *Managing Across Borders: The Transnational Solution*, (Boston: Harvard Business School Press, 1991), 57-71.

Exhibit 1-1: Organizational Characteristics of Multinational, Global, International, and Transnational Models

Organizational Characteristics	Configuration of assets and capabilities	Role of overseas operations	Development and diffusion of knowledge
Multinational	Decentralized and nationally self-sufficient	Sensing and exploiting local opportunities	Knowledge developed and retained within each unit
Global	Centralized and globally scaled	Implementing parent company strategies	Knowledge developed and retained at the center
International	sources of core competencies centralized, others decentralized	Adapting and leveraging parent company competencies	Knowledge developed at the center and transferred to overseas units
Transnational	Dispersed, interdependent, and specialized	Differentiated contributions by national units to integrated worldwide operations	Knowledge developed jointly and shared worldwide

Source: Bartlett and Ghoshal, *Managing Across Borders: The Transnational Solution*

Categorization by Imai

Imai categorizes firms into three categories. The first and second categories of Imai, which are "multi-domestic" and "global," are similar to Bartlett and Ghoshal's "multinational" and "global," respectively. Imai's third category is called "cross border network". He defines it as an organization which has the strengths of both "multi-domestic" and "global"; that is, each geographical unit is localized and yet exchanges information and human resources. Moreover, these activities are coordinated throughout the company. The most significant difference between this model and the global model is that a cross border network is a self-reinforcing mechanism rather than a centralized control mechanism. Imai attributes the necessity of such a complicated organization to its responsiveness to uncertainty and instability through diversity within an organization.[2]

1.2. Historical Evolution of Globalization by Japanese Electronics Firms

1.2.1. Historical Evolution

The development of globalization of the Japanese electronics firms can be broken down into four periods. The first period is one of export. In the early 1960s, leading electronics firms started direct export. The second period is the late 1960s and the early 1970s, when the Japanese electronics firms established production facilities in other Asian countries in order to take advantage of lower labor costs. The third period from the late 1970s to the early 1980s was when the Japanese electronics firms expanded their overseas

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[2]Imai, *21 Seiki-Gata Kigyo to Netto-wahku* (21st Century Oriented Form of Firms and Networking) (Tokyo: NTT Shuppan, 1992), 26-28.

production in the more advanced countries. This evolutionary pattern is, as discussed before, contrary to the pattern presented by Vernon. The factors inducing such overseas production were increasing trade friction, especially with the U.S., the introduction of floating exchange rate, and slower economic growth in the domestic market. During the fourth period, from 1985 onward, trade friction became more fierce, and the rapid appreciation of the yen after the Plaza Accord in 1985 hurt Japanese electronics firms with high export ratios. To avoid political risks and exchange rate exposures, most firms began to establish the entire value chain in each distinctive region -- America, Asia, and Europe.

1.2.2. Some Indicators of Globalization of the Japanese Firms

Level of Foreign Direct Investment

As a result of such ongoing globalization of business activities, Japan's foreign direct investment increased dramatically from $12.2 billion in 1985 to $73 billion in 1990. Currently, Japan is the third largest foreign direct investor in the world based on the amount of outstanding direct investment, following only the U.S. and the U.K.[3]

Survey Conducted by Kikai Shinko Kyokai Keizai Kenkyusho

Kikai Shinko Kyokai Keizai Kenkyusho conducted a survey on the globalization of the broadly-defined machinery industry in 1991. Although the target of this survey includes not only electric and electronics manufacturers but general machinery, transportation equipment, and

[3]JETRO, *Handy Facts on U.S.-Japan Economic Relations,* 13.

precision instrument manufacturers, the survey helps us to understand the level of internationalization quantitatively.

The overseas production ratio of the broadly-defined machinery industry averaged at 10.9% in 1990, and is expected to increase to 15.5% in 1995. This number is higher than the average of all manufacturing industries, which was 5.7% according to the Ministry of International Trade and Industry. However, it is lower than those of the U.S. (24.9% in 1989) and West Germany (16% in 1989) where multinational companies developed earlier.

More than half of the electric/electronics firms have local managers in foreign offices with the title of general manager or higher. Japanese companies operating internationally admit the high turnover of their foreign employees. They attribute high turnover to the following factors: (1) foreign employees are excluded from informal network; (2) the rules for promotion are ambiguous to foreign employees partly because of the differences in appraisal systems; (3) foreign employees are not given the responsibility or authority for making important decisions; and (4) there is discrimination based on race and gender in Japanese firms.

With regard to decision making, about half of the company responded that decisions related to sales, inventory, and materials/parts procurement are made by foreign subsidiaries. However, local management is still strongly dissatisfied with the small authority they have in making important decisions. For example, equipment investment is still largely controlled by headquarters in Japan (decision made mainly in Japan 31.8%; relatively more in Japan, 22.3%). Problems in decision-making also occur in the area of R&D. As for basic research, 76% answered that the final decision is mainly made in

Japan; as for product development, 62.0%; product design, 55.9%; and process technology development, 34.9%.[4]

1.2.3. Local Responses to Japanese Investment

As Japanese foreign investment in the U.S. rose in the 1980s, especially as Japanese firms began investing in landmark real estate and famous companies in the U.S., resistance toward Japanese investment grew. One result was introduction of the Exxon Florio Amendment, which was passed in 1988 and which limits the acquisition of U.S. companies by foreigners if that acquisition influences national security. After 1989, many of similar bills have been submitted to Congress.

On the other hand, there are a group of people who recognize the value of foreign investments in the U.S. Reich argues that the competitiveness of a nation is defined by the competitiveness of the labor in the nation, and that the ownership of a company and the birthplace of the labor does not matter. He concludes that a U.S. firm conducting value-added activities overseas contributes less to the competitiveness of the U.S. than a foreign firm conducting value-added activities in the U.S. Thus, protectionism affects U.S. competitiveness negatively.[5]

1.3. Current Strategy

This section examines the current strategies of the Japanese firms first in general and then on a company basis.

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[4]Kikai Shinko Kyokai Keizai Kenkyusho, *Nihon Kikai Sangyou no Globalization no Genjou to Kadai* (Globalization of Japanese Machinery Industry: Current Status and Perspectives), 1991, 12-16.

[5]Reich, Robert, "Who is Us?," *Harvard Business Review* (January-February 1990), 53-64.

1.3.1. Establishing Regional Headquarters

As mentioned in 1.2.2., a central component of the current strategy of most Japanese electronics firms is to establish regional headquarters. According to the survey conducted by Kikai Shinko Kyokai Keizai Kenkyusho, 25.9% of the respondents answered that they have already established regional headquarters, and 29.3%, that they plan to have one in the future. This trend is more obvious among large scale companies: among 25 firms with capital of ¥10 billion or more, seven have already established regional headquarters and eight answered that they will in the future.

However, the (expected) role of these regional headquarters is far from the traditional meaning of "headquarters". Despite the fact that the Japanese firms' strategy statements often emphasize the importance of independent, self-sufficient local operations integrated under regional headquarters, the (expected) role of the regional headquarters is mere administrative assistance or coordination of the local operations. The five most-supported (expected) role of the regional headquarters are: (1) to process problems common to the operations in that area (indicated by 56.3% of those who have or plan to have regional headquarters); (2) to support local operations in the area of finance (50.0%); (3) to adjust activities of different operating units in the area (43.8%); (5) to localize management (40.6%). To have an entire integrated value chain -- to develop, manufacture, sell, finance, hire autonomously -- was not rated high: it was mentioned by only 15.6%.[6]

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[6]Kikai Shinko Kyokai Keizai Kenkyusho, *Nihon Kikai Sangyou no Globalization no Genjou to Kadai* (Globalization of Japanese Machinery Industry: Current Status and Perspectives), 16-19.

1.3.2. Strategy of Individual Companies

The globalization strategies of Japanese electronics firms can be separated into four different categories, according to the type of organization the companies are attempting to create. The first category is the "locally autonomous," emphasizing the establishment of autonomous and self-sufficient local operations under a regional headquarters. The second category is a "mesh" or "matrix," which localizes operations and, at the same time, links operations by business unit and/or functions. The third category is "transnational," aiming to become a transnational company as defined by Bartlett and Ghoshal. The last category is "other."

Although the globalization strategies of Japanese electronics firms are categorized into four types, the idea of establishing regional headquarters and somehow integrating operations in each region is a common immediate goal for both "locally autonomous" and "mesh" strategies.

Locally Autonomous

The most common type of globalization strategy of Japanese firms is this category. Four out of eight companies we surveyed are in this category. They are Canon Inc., Hitachi, Ltd., Ricoh Co., Ltd., and Sony Corporation.

Canon: For more than a decade, Canon has been expanding its overseas activities by establishing subsidiaries that undertake production and marketing abroad. For example, Canon set up Canon Inc., Taiwan, in 1971 to make cameras; and Canon Business Machines, Inc., in 1974 in the U.S.

The ultimate goal of Canon's globalization strategy is to attain the status of "global corporation," which was defined by President Kaku as follows;

"(A global corporation may be defined as one that) has no national identity and thus generates no international friction. It is a corporation that establishes subsidiaries in countries around the world according to local needs. Fully integrated, these independent entities conduct research and development activities and engage in manufacturing and marketing. Such a corporation creates meaningful employment and does not discriminate on the basis of nationality; all employees work together as members of the same worldwide effort. By paying taxes on locally earned profits and reinvesting capital in host countries, these global corporations contribute to financial stability and export growth. They also endeavor to exist in harmony with their respective communities.[7]"

To attain this goal, Canon started a five-year Global Corporation Plan in 1988.

Hitachi: The company emphasizes contribution to the community. The company has been trying to attain this goal by establishing the whole value chain integrated under regional headquarters in each region.[8] One such example is the reorganization of their operations in the U.S. in April 1987.

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[7]Canon Inc., corporate brochure, *Toward A Global Corporation,* 6-7.
[8]Kikai Shinko Kyokai Keizai Kenkyusho, *Keiei no Guroubaru-ka to Kenkyuukaihatsu Senryaku: R&D Kinou no Kokusai-teki Tenkai* (Globalization of Management and R&D Strategy), 1990, 54.

They consolidated their five major manufacturing subsidiaries in the U.S. under the management of Hitachi America, Ltd. to enhance local autonomy.

Ricoh: Ricoh describes its ultimate goal of a globalization as a"unified, separate Ricoh" in its 1987 Annual Report. In the President's letter to shareholders in the 1989 Annual Report, he stated that:

"I am convinced that the creation of independent operations abroad -- to plan, procure, manufacture and market out products locally -- is the key to long-term international success."

In order to achieve the above goal, Ricoh is trying to transform itself into an organization with three independent and at the same time, complementary headquarters, in Asia, Europe, and the U.S.

Sony: In its 1991 Annual Report, Sony states that one of the company's five medium to long-term policies is to bring all facets of its overseas operations, including procurement of components, R&D, production, and marketing, in closer contact with local communities. Chairman Morita describes this in a phrase "Global Localization."

Mesh or Matrix Type

Matsushita Electric Industrial Co., Ltd. and Toshiba Corporation fall into this category.

Matsushita: Like the companies in the first category, in its corporate brochures, Matsushita also emphasizes having whole value chain managed

under regional headquarters in each region. However, in Matsushita's case, the persistent base for its operations is business units, and the resulting organization will take the form of a matrix. At Matsushita, each business unit is responsible for planning and operating both domestic and foreign activities, while regional headquarters coordinates its operations within the region and takes care of public relations.[9]

Currently, Matsushita manages 117 subsidiary companies outside Japan through three regional headquarters: Matsushita Electric Corporation of America (established in 1988); Panasonic Europe in U.K. (1988), and Asia Matsushita Electric in Singapore (1990).[10]

Toshiba: Currently, Toshiba is making efforts to create a matrix organization by establishing the whole value chain, integrated by the regional headquarters, in each region while continuing to keep the horizontal network with functional departments at headquarters in Japan. To maintain the horizontal network, Toshiba plans to use the division of labor by theme in each area.[11] Its efforts to attain division of labor might allow Toshiba to be categorized as a transnational type. However, because it still lacks "autonomous" interdependence, I categorized the company as a mesh type.

Transnational Type

NEC Corporation falls into this category.

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[9]Imai, *21 Seiki-Gata Kigyo to Netto-wahku* (21st Century Oriented Form of Firms and Networking), (Tokyo: NTT Shuppan, 1992), 133.

[10]Sakamoto,*Global R&D Management in the Electronics Industry: A Comparative Study between U.S. and Japanese Multinationals.*, (MIT Sloan School of Management Thesis), 1991, 68-69.

[11]Kikai Shinko Kyokai Keizai Kenkyusho, *Keiei no Guroubaru-ka to Kenkyuukaihatsu Senryaku: R&D Kinou no Kokusai-teki Tenkai* (Globalization of Management and R&D Strategy), 1990, 49-50.

NEC: The current globalization strategy of NEC is called "Mesh Globalization". However, it is actually a transnational type of strategy because of its emphasis on interdependence among its operational units. In this strategy, NEC is trying to localize its operations and, at the same time, tries to decrease the control by the headquarters in Japan and increase the autonomy of local operations. Through each operation's autonomous efforts to maximize cost-efficiency and productivity, the company expects its worldwide operations to develop into a closely linked network.[12]

Other

Because Fujitsu Ltd. does not mention an ideal type of organization in its global strategy, Fujitsu was categorized as other.

Fujitsu: Globalization is one of the five pillars of Fujitsu's business (the other four are total solution to customers' needs, downsizing, networking, and innovations).[13] In its efforts towards globalization, Fujitsu emphasizes "Existing and Prospering Together" and "Cross Culture". The concept of cross culture means to respect the local culture. One example is the management of ICL in the UK, an acquired company which is completely continued in a British way.

These internationalization strategies of the Japanese electronics firms are expected to have a strong influence on the internationalization of R&D, which will be closely examined in the following chapters.

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[12]Imai, *21 Seiki-Gata Kigyo to Netto-wahku* (21st Century Oriented Form of Firms and Networking), (Tokyo: NTT Shuppan, 1992),138.
[13]*Fujitsu News*, April 1991, 3.

Chapter 2: Strategy of R&D Internationalization by the Japanese Electronics Firms

Chapters 2, 3, and 4 will focus on the internationalization of R&D by Japanese firms. There are two reasons why internationalization of R&D is of importance. Firstly, given that establishing a whole value chain integrated under regional headquarters is an immediate goal, the internationalization of R&D is an unavoidable step for the Japanese electronics firms. Secondly, one of the most important sources of competitiveness in the electronics industry is technology. Therefore, a company's ability to integrate R&D strategy with overall globalization strategy will make a significant difference in the company's performance in the long run.

In this chapter, we first look at previous academic work to provide a basic framework for analysis. Then, the case of Japanese electronics firms in general will be discussed to provide background for the following chapters.

2.1. Previous Academic Works On Internationalization of R&D

2.1.1. Types of R&D Centers and Evolutionary Patterns

Categorization by Rondstadt

The role of R&D centers abroad is not always the same. Based on the early study of internationalization of R&D in the 1970s, Rondstadt describes four types of international R&D activities. The international product life cycle is the basic assumption for his model.

(1) Transfer Technology Units (TTU)

Units established to help certain foreign subsidiaries transfer manufacturing technology from the parent while also providing related technical services for foreign customers.

(2) Indigenous Technology Units (ITU)

Units established to develop new and improved products expressly for foreign markets. These products were not the direct result of new technology supplied by the parent organizations.

(3) Global Technology Units(GTU)

Units established to develop new products and processes for worldwide production and simultaneous application in the company's major world markets.

(4) Corporate Technology Units (CTU)

Units established to generate new technology of a long-term or exploratory nature expressly for the parent.

Rondstadt found that the U.S. companies he studied had started foreign R&D activities in all four categories, however, most began as TTUs or ITUs and followed the evolutionary pattern, from TTU through ITU to GTU.[14]

Categorization by Nemoto

Nemoto categorizes R&D centers into five groups along two dimensions -- the level of market orientation versus technology orientation

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[14] Rondstadt, *Research and Development Abroad by U.S. Multinationals,* (New York: New York Publishers, 1977).

and the level of independence versus integration. The market-oriented R&D centers focus on the modifications and development of the products which meet market needs, while the technology-oriented R&D centers focus on obtaining superior technology. Nemoto's categorization are as follows.

(1) Local Technical Center (LT)

This type of R&D center is responsible for modification of products to meet local market needs. Its linkage with a home country headquarters is strong but that with other R&D facilities in the area is weak. This is equivalent to a technology transfer unit by Rondstadt's definition.

(2) Product Development Center (PD)

This type of R&D center develops products to fit specific market needs.

(3) Technology Development Center (TD)

This type of R&D center focuses on utilizing technological resources in a region to develop new technologies and new products. These R&D centers are very independent. This type was not included in Rondstadt's categorization.

(4) Global Technology Research Center (GT)

Like a technology development center, this type of R&D center also focuses on acquiring technologies. However, the difference is that this type of R&D center not only focuses on local markets but also plays an assigned role in the company's worldwide R&D activities. Therefore, this type of R&D center communicates more often with other R&D centers.

(5) Global R&D Network

Integrated R&D activities are conducted under a global network. He categorizes IBM, which was categorized by Rondstadt as a GPU, in this group.

Although Rondstadt showed the single evolution model of R&D centers, which is TTUs-ITTs-GPUs, Nemoto argues that R&D centers can evolve in two ways; LT-PD-GP or LT-TD-GT.[15]

Doubts About Evolutionary Models

Although both Rondstadt and Nemoto suggested evolutionary models of R&D centers, there are some questions about these models. For example, De Meyer and Mizushima argue that globalization of competition has brought some doubts about the validity of Rondstadt's evolutionary model. In recent years, foreign laboratories with new product responsibilities (GTUs) including exploratory research (CTUs) are more likely to be established through direct placement as the result of global strategic decision-making by the parent companies rather than evolution of their existing foreign R&D activities.[16]

Also, the complexity of the factors influencing internationalization of R&D, which has been increasingly observed in recent years, is not acounted for in the evolutionary model.

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[15]Nemoto, *Guroubaru Gijutsu Senryaku-ron* (A Study of Strategy of Global Technology), (Tokyo: Doubunkan, 1990), 38-43.

[16] De Meyer and Mizushima, "Global R&D Management," *R&D Management*, Vol. 19, No.2, 1989, 135-146.

2.1.2. Factors Influencing Internationalization of R&D

Although the internationalization of R&D is an unavoidable step to achieve their globalization strategy, that is not convincing enough to explain these firms' decision to internationalize R&D. The factors influencing the internationalization of R&D can be identified as follows.

Doz points out the three key forces driving toward decentralization or internationalization of R&D. They are: (1) the dispersion of lead users around the world, (2) the dispersion of scientists around the world, and (3) the host country's government's desire for more highly skilled jobs through the location of R&D. The third factor can also make a firm eligible for national R&D subsidies or provide access to national collaborative projects.

He also argues that the forces driving centralization of R&D in the home country is strong because (1) the needs for specific local product adaptation is lessened as the world market becomes increasingly homogeneous, (2) the benefits for having researchers in close proximity to one another are greater, (3) there are often economies of scope in R&D, and (4) home countries are unwilling to be dependent on technologies developed abroad because of political risks.

Reasons (2) and (3) are often mentioned as the main reason for R&D centers to maintain "critical mass." In companies that require research by multi-disciplinary teams, it is said that at least 50-100 employees are needed to reach an efficient scale.[17]

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[17]Perrino and Tipping, "Global management of Technology," *Research Technology Management* May-June (1989), 12-19.

Doz's conclusion is that there will be many trade-offs between centralization and decentralization, and which factors prevail will be dependent on types of function, country, and business.[18]

Westney points out eight factors influencing globalization of R&D. They are:

(1) The Science/Technology Factor

(a) Equilibrium of the scientific/technological level between industrialized societies

(b) Complementary strength of nations in science/technology

(2) The Nation/Regional Factor

(a) Setting standards - national and international standards

(b) Access to national R&D subsidy

(3) The Market Factor

(a) Global dispersion of lead users

(b) Customization of products for national markets

(4) The Competition factor

(a) Global distribution of major competitors

(b) Improving the company image through full commitment to the national market.[19]

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[18]"International Industries: Fragmentation Versus Globalization." In: B.R. Guile and H. Brooks (eds.), *Technology and Global Industry: Companies and Nations in the World Economy,* (Washington DC: National Academu Press, 1987).

[19] Westney, "The Globalization of Technology and the Internationalization of R&D," *Business Review*, Vol. 37, No.2, 1990, 30-40.

Another explanation on internationalization of R&D is provided by Nemoto (1990). He identifies six costs and eight benefit of overseas R&D activities.[20]

Costs:

(1) Initial investment for establishment of a R&D center

(2) Duplication of investment

(3) Communications costs (Includes culture and language gaps)

(4) Duplication of projects

(5) Linkage of technology

(6) PR costs

Benefits:

(1) Faster access to technology trends

(2) Better understanding of local market's needs

(3) Access to local R&D networks

(4) Exposure to new ideas and concepts

(5) Faster development of products for local and/or global markets

(6) R&D activities which cannot be done in Japan (due to legal restrictions; language-related researches)

(7) Exposure to world-class researchers

(8) Accumulation of R&D management know-how.

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[20]Nemoto, *Guroubaru Gijutsu Senryaku-ron* (A Study of Strategy of Global Technology), (Tokyo: Doubunkan, 1990), 84-86.

2.1.3. Types of R&D Strategy

Once a firm decides to internationalize its R&D activities, there are different strategies it can pursue. Westney describes three different types of global R&D strategy. They are:

(1) enhanced global research for foreign technology,
(2) cooperation with foreign companies through strategic alliance, and
(3) internationalization of R&D functions.

She suggests that internationalization of R&D is the final stage of a global R&D strategy to cope with globalization of technology.[21]

2.1.4. Central, Local, and Transnational Innovation

Bartlett and Ghoshal describes four different types of innovations, which influences a corporation's R&D strategy. These four types correspond to multinational, global, international, and transnational corporations discussed in the previous chapter.

Global and international companies have depended on a central process for creating and exploiting innovations: sensing a new opportunity in the home country, using the centralized development resources of the parent company to create a new product or process, and then adopting the innovation in appropriate locations around the world. The risk of central innovation is market insensitivity.

On the other hand, multinational companies relied heavily on local innovations: their autonomous, self-contained national subsidiaries used

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[21] Westney, "The Globalization of Technology and the Internationalization of R&D," *Business Review*, Vol. 37, No.2, 1990, 30-40.

their own resources to create new products or processes that meet the needs of their local environments. The risk of local innovation is needless differentiation.

In the transnational model, knowledge is developed jointly and shared worldwide. In this model, centrally designed products and processes still play an important global role. But innovations are created by the subsidiaries as well. The transnational will pool the resources of central facilities and many national subsidiaries to develop a worldwide solution for its dispersed organization. The risk of locally leveraged innovations is NIH (not invented here) risk, and that of globally linked innovation is coordination cost.[22]

2.2. Case of the Japanese Firms

This section explores the Japanese firms' progress in internationalization of R&D to date. Internationalization of R&D by the Japanese firms, in fact, started only in the late 1980s, led by the electronics firms. In 1987, Hitachi, Fujitsu, NEC, Sony, and Ricoh established overseas R&D centers, and Matsushita followed in 1988.[23]

2.2.1. Current Status

The JETRO survey on Japanese R&D in the U.S. (139 Electric and electronic manufacturers replied) shows that 43.9% of them have some form of R&D function in the U.S.: 5.0% of the 139 companies have joint R&D programs, and 7.9% have independent R&D firms.[24]

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[22]Bartlett and Ghoshal, *Managing Across Borders: The Transnational Solution*, (Boston: Harvard Business School Press, 1991), 64.
[23]Kikai Shinko Kyokai Keizai Kenkyusho, *Keiei no Guroubaru-ka to Kenkyuukaihatsu Senryaku: R&D Kinou no Kokusai-teki Tenkai* (Globalization of Management and R&D Strategy), 1990, 44.
[24]JETRO, JETRO Survey 1990.

Other surveys shows that about 10% of the large scale Japanese firms have overseas R&D facilities. According to a survey by the Science and Technology Agency of Japan in 1989, 9.7% of Japanese firms with the capital of ¥10 billion or larger (including all industries) have already established R&D centers abroad.[25] Another survey by the Ministry of International Trade and Industry shows that 11% or fewer Japanese firms with foreign subsidiaries/affiliates with 10% or larger ownership in all industries have established R&D centers abroad[26].

The MITI survey shows that 37.8% of the 119 Japanese firms' overseas R&D centers were located in the United States, followed by 36.1% in Asia, 13.4% in the EC, and 12.7% elsewhere. Based on R&D expenditures, the U.S. share surges to 49.0% of the ¥57.7 billion total, followed by 28.9% in the EC, 17.6% in Asia, and 4.5% elsewhere. This difference in shares based on the number of R&D centers and R&D expenditures suggests that R&D centers in Asian countries include many technical service centers which support marketing, and modification centers attached to manufacturing facilities while R&D centers in the U.S. and EC are more focused on higher value-added research and development activities. This corresponds to the result of MITI survey which shows that most the overseas basic and applied research centers and new product development centers are located in the U.S. (Exhibit 2-1: Overseas R&D Centers of the Japanese Firms)

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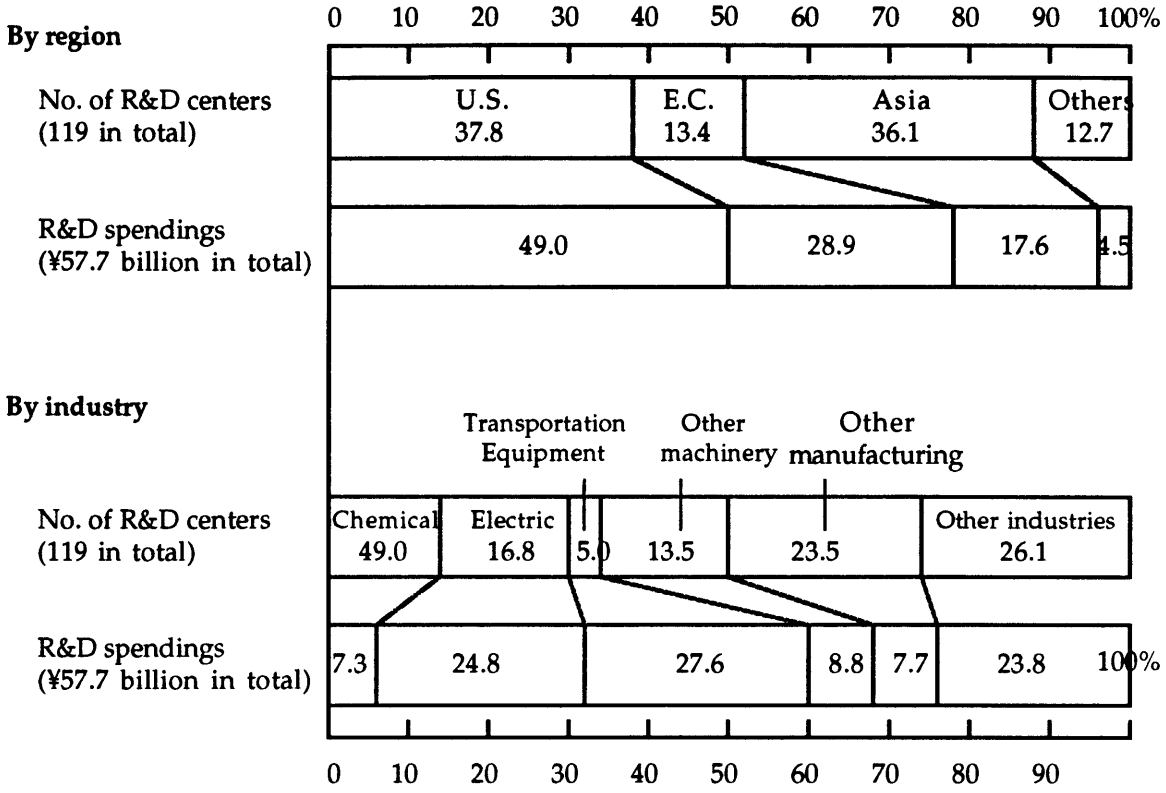
[25] Science and Technology Agency of Japan, *Minkan-kigyo no Kenkyu-katsudo ni Kansuru Chosa (Heisei Gan-nen Do)*, (Research on R&D Activities by the Private Entities: 1989 Edition), 1989.
[26] Ministry of International Trade and Industry, *Dai San-Kai Kaigai Toshi Tokei Soran*, (The Third Survey on Foreign Investment).

Exhibit 2-1: Overseas R&D Centers of the Japanese Firms



Source: Ministry of International Trade and Industry, *Dai San Kai Kaigai Toshi Tokei Soran* (The Third Survey on Overseas Investment)

By industry, electric/electronics equipment manufacturers account for 16.8% of the total number of R&D centers, followed by 15.1% for chemical product manufacturers, and 5.0% for transportation equipment manufacturers. Based on R&D expenditures, transportation equipment manufacturers are first with 27.6%, followed by 24.8% for electric/electronics equipment manufacturers, and 7.3% for chemical product manufacturers.

2.2.2. Factors Inducing Internationalization of R&D

The purpose for establishing overseas R&D facilities changes over time. According to a survey conducted by the Seisaku Kagaku Kenkyujo (Policy Science Research Center), the main purposes at the time of the establishment of R&D centers are "to strengthen technologies" and "to support production and marketing" (Exhibit 2-2: Reasons to have Overseas R&D Centers at the Establishment and in the Future).[27] As in Exhibit 2-3, "to collect advanced overseas R&D information" (indicated by 13.8% of the respondents) is recognized as the most important reason at the establishment, followed by "to enhance product development based on overseas technology" (10.8%), "to learn superior technologies and knowledge" (9.2%), "to catch up to the top competitors" (6.9%), and "to techologically respond to competitors" (6.7%). A second important group of reasons are related to the support of other facilities in the region. Included in this category are: "to technically facilities in the region. Included in this category are: "to technically support facilities in the region. Included in this category are: "to technically support overseas production facilities" (5.5%), and "to respond to local market's needs" (5.3%).

As to the future role of these R&D centers, science/technology factors become much less important while support of local operations increases in importance. Also, the relaxation of trade and technology friction and access to an excellent labor force drastically increases in importance. This shift can be confirmed by the changes in the rate in Exhibit 2-3. "To collect advanced overseas R&D information", the top reason to establish overseas R&D, dropped its ratio most drastically by 7.8% points from 13.8% to 6.0%. The first

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[27]Kikai Shinko Kyokai Keizai Kenkyusho, *Keiei no Guroubaru-ka to Kenkyuukaihatsu Senryaku: R&D Kinou no Kokusai-teki Tenkai* (Globalization of Management and R&D Strategy), 1990, 22-26.

Exhibit 2-3: Reasons to Have Overseas R&D Centers at the Establishment and in the Future

(%)

Reasons	At establishment	In the future	Changes in % points
<Strengthen technologies>			
-Enhance product development based on overseas technology	10.8	7.7	-3.1
-Learn superior technologies and knowledge	9.2	2.4	-6.8
-Catch up to the top competitors	6.9	2.4	-4.5
-Technologically respond to competitors	6.7	5.4	-1.3
-To have an access to top-level foreign researchers	4.5	7.5	+3.0
-Conduct R&D under the free atmosphere in foreign labs	3.1	5.5	+2.4
-Activate domestic R&D by opening labs overseas	3.9	4.2	+0.3
-Shorten R&D period by utilizing overseas R&D resources	3.7	5.4	+1.7
-Reduce R&D investment by diversifying the risk	2.2	2.2	0.0
-Reduce R&D costs by conducting R&D abroad	1.2	1.3	+0.1
<Collect advanced overseas R&D information>	13.8	6.0	-7.8
<Support production and marketing>			
-Technical support to overseas production facilities	5.5	6.3	+0.8
-Strategic necessity in medium-/long-term	2.6	6.6	+4.0
-Respond to local market's needs	5.3	7.3	+2.0
-Strengthen globalized strategy	4.1	9.1	+5.0
<Others>			
-Supplement weak/new areas at HQ	5.1	6.1	+1.0
-Legislative and other restrictions forcing the establishment of R&D	4.5	5.1	+0.6
-Improve company's trust and image as a internationalized company	3.3	4.0	+0.7
-Request from foreign countries	2.0	0.2	-1.8
-Respond to international trade/technological conflicts	0.1	4.2	+4.1
-Others	0.0	0.1	+0.1

Source: Seisaku Kagaku Kenkyujo. Arranged by the author.

four reasons in the category of "to strengthen technologies" also decreased their ratios. On the other hand, all of the four reasons in the category of "to support production and marketing" increased their ratios. Of the four, the most outstanding growth was shown in "strengthen globalized strategy", which gained 5.0% points from 4.1% to 9.1%, followed by "strategic necessity in medium to long-term", which increased by 4.0% points from 2.6% to 6.6%. "To respond to international trade/technological conflicts" increased its ratio by 4.1% points from almost nothing (0.1%) to 4.2%, and "to have an access to top-level foreign researchers" increased by 3.0% points from 4.5% to 7.5%.

A study by Kikai Shinko Kyokai Keizai Kenkyusho summarizes the factors inducing overseas R&D in the electronics firms as follows: (1) to support production facilities in the region, (2) to design products responsive to the market's needs, (3) to develop products which satisfies national/regional standards (i.e., HDTV), (4) to look for scarce engineers (i.e., software engineers) (5) to reduce technological friction, and (6) to pursue strategic alliance with foreign firms.[28]

As these surveys indicate, one of the increasingly important factors inducing the internationalization of R&D is to avoid technology friction. According to *Science and Technology White Paper (1991)*, the Japanese trade balance for technology in 1988 is such that technology exports totaled $1,785 million and technology imports amounted to $2,263 million. Imports come mostly from the United States and Europe, and the U.S. has about one half of these. The share of the U.S. increased form 57% in 1984 to 60% in 1988. The

[28]Kikai Shinko Kyokai Keizai Kenkyusho, *Keiei no Guroubaru-ka to Kenkyuukaihatsu Senryaku: R&D Kinou no Kokusai-teki Tenkai* (Globalization of Management and R&D Strategy), 1990, 44-45.

items of technology which are imported are concentrated in the field of electronics.[29]

2.2.3. Reactions in the Host Country

There have been both negative and positive reactions to the Japanese companies' establishing R&D centers abroad. An example of positive reaction is the argument by Reich, which was discussed in the previous chapter. An example of negative reactions is the argument by Clyde Prestowitz, a former U.S. trade negotiator for Washington. He argues that stronger Japanese research capabilities will continue to erode the competitive position of Corporate America by enabling Japan to tap into new technology at the earliest stages. He anticipates that the Japanese companies can put more resources into commercialization since they feel less pressure to show short-term profits as compared to U.S. firms. Therefore, he concludes that likely the new technologies that come out of the lab will benefit the Japanese first.[30]

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[29]Science and Technology Agency of Japan, *Science and Technology White Paper. (1991)*

[30]_____., "Follow That Brain Wave; Avid for new ideas and short of engineers, the Japanese are moving their R and D labs to the U.S.", *Time*, August 12, 1991, 48.

Chapter 3: Data Analysis

This chapter summarizes the results of the structured interviews conducted by the structured thesis members. The structured thesis group visited 20 R&D centers of eight Japanese electronics firms, namely, Canon, Fujitsu, Hitachi, Mitsubishi, NEC, Ricoh, Sony, and Toshiba.

3.1. Definition of Corporate and Divisional Laboratories

In this chapter, interview findings will be summarized in two different groups, corporate laboratories and divisional laboratories. Such grouping is adopted to match distinctions in the nature of different laboratories: although the definition of corporate laboratories and divisional laboratories varies by company, corporate laboratories are usually involved in more basic research with a target of five years or longer while divisional laboratories are involved in research closer to commercialization (e.g., product development) with a target of five years or fewer. In addition to these two types of laboratories, engineering centers are often categorized as R&D centers. Engineering centers are usually attached to manufacturing facilities and are involved in modification of products. Thus, their targets are usually less than one year. In our structured interviews, we did not have a chance to interview at engineering centers.

When categorizing laboratories, we basically followed the definition provided by the company. Whenever the definition was not provided by the company, we categorized laboratories based on the level of corporate organization it belonged to; that is, a laboratory will be categorized as a corporate laboratory unless it belongs to a business unit (e.g. divisions and regional headquarters).

3.2. Corporate Laboratories

The structured thesis group members interviewed six corporate laboratories of Japanese electronics firms in the U.S. They are:

Canon Research Center America, Inc.,

Ricoh California Research Center,

Mitsubishi Electric Research Laboratory,

NEC Research Institute, Inc.,

Advanced Computer Architecture Laboratory (Sony), and

New Jersey Telecommunications Laboratory (Sony).

In addition, some information on Matsushita's Panasonic Technologies, Inc. was available.

Establishment

The six laboratories at which we had interviews are all relatively new with only a few years of operation. The oldest is the NEC Research Institute which was established in 1989, followed by Canon Research Center America, Ricoh California Research Center and Sony's New Jersey Telecommunications Laboratory which were established in 1990. The newest are Mitsubishi Electric Research Laboratory and Sony's Advanced Computer Architecture Laboratory which were established in 1991.

Size

All six laboratories, except the NEC Research Institute, are still small, and far from achieving critical mass. The only laboratory to have achieved the critical mass, NEC Research Institute, currently has 50 full time scientists and plans to staff a total of 60. The size of the other laboratories are (from

smallest to largest): Sony's Advanced Computer Architecture Laboratory has 2, Sony's New Jersey Telecommunications Laboratory (5), Mitsubishi's MERL (10), and Ricoh California Research Center (16). The exact number of the researchers at Canon Research Center America was not available, though it is known that the size of the laboratory has not reached critical mass. (Exhibit 3-1: Interview Summary - Corporate-level Laboratories)

Efforts to achieve critical mass have been ongoing. Firstly, almost all of the R&D centers are planning to expand staffing levels. Canon Research Center America plans to expand the staffing of its technical professionals to 25 in the near future; Mitsubishi's MERL plans to hire 25 people by the end of 1992 and 50 people over the next five years. Another approach is to locate different R&D centers close to one another. For example, Ricoh moved its formerly dispersed R&D centers to the Silicon Valley to have a total number of researchers of about 200 at the establishment of Ricoh California Research Center.

Funding

All of these laboratories are funded by the headquarters in Japan, and no facility receives funds from local operations. This is because these laboratories are "corporate laboratories" and belong directly to the headquarters in Japan on organizational charts. For example, the NEC Research Institute is funded fully with corporate basic research funds, and Sony's New Jersey Telecommunications Laboratory is fully funded by corporate R&D in Japan.

However, local managers have influence on the budgeting processes. Ricoh California Research Center is funded by Japan, but local managers have

Exhibit 3-1: Interview Summary - Corporate-level Laboratories

Company/Laboratory	Size	Funding	Mandate	Manage-ment style	Communications with home country	Communications with local operations	External Technology Links
Canon:							
Canon Research Center America, Inc.	<50	Corporate	Basic	US	Loose	Loose	Stanford
Matsushita:							
Panasonic Technologies, Inc.	<50	Corporate	Basic	US	Loose	Not available	
Mitsubishi:							
Mitsubishi Electric Research Laboratory	<50	Corporate	Basic	US	Loose	Loose	
NEC:							
NEC Research Institute, Inc.	<50	Corporate	Basic	US	Loose	Loose	Bell Lab.
Ricoh:							
California Research Center	<50	Corporate	Applied	US	Dense	Loose	
Sony:							
Advanced Computer Architecture Laboratory	<50	Corporate	Dev.	US	Not available	Not available	
New Jersey Telecommunications Laboratory	<50	Corporate	Dev.	US	Not available	Not available	

Notes: Dev. stands for product development.

Sources: Interviews and publicly available information.

significant amounts of discretion and responsibility in guiding the work of the laboratory.

Mandate

There are two important elements in terms of mandates. One aspect is how much freedom local laboratories have to define their mandates, and the other is the content of the mandate itself.

As for the freedom given to the local laboratories to define the mandate, there are four patterns. The first is that the mandate of the laboratory was already narrowly set by headquarters at the time of establishment. The second is that the headquarters define the mission of the laboratories very broadly, and the local management plans more detailed research topics. The third is that headquarters in Japan and local management jointly select the research topics. The last pattern is that the local management is totally responsible for selecting the mandate of the laboratory.

Sony's two laboratories seem to fall into the first category. They are given very specific mandates compared to the other corporate laboratories; namely, software development for specific products.

Included in the second category are Mitsubishi's MERL, and NEC Research Institute. At MERL, the broader theme of research, which is "basic research on computers," has been set by the headquarters in Japan. However, the local director, who had directed software engineering at IBM's Watson Research Institute for over 20 years, is given full authority over the research management. At NEC Research Institute, the area of focus -- technology for unconventional computing environments -- was selected by the headquarters

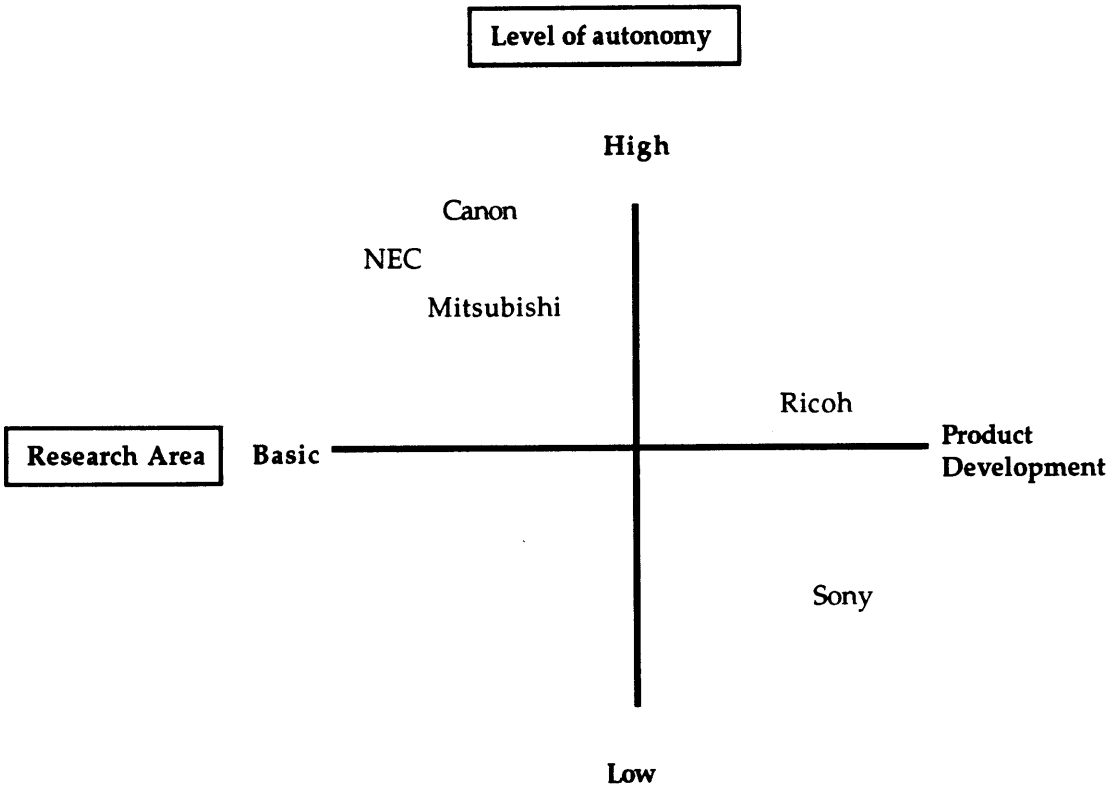
in Japan. However, as long as the research topics stay within the larger framework, topic selection is autonomous.

Ricoh California Research Center falls into the third category. At this laboratory, projects comes both from within the California Research Center and the Research and Development Center in Yokohama, Japan.

Included in the last pattern is Canon. Before specific goals and strategies were formulated, the globalization of R&D was decided according to Canon's globalization program. Therefore, it was the local management who was given the responsibility for selecting the research focus and goals for the center. Although the local managers need to report to the headquarters in Japan, the local management has felt a reasonably complete sense of autonomy in defining the strategic goals and the organizational structure for the center. To date, Canon headquarters has not directed that any specific projects be undertaken at the center.

As far as the contents of the research is concerned, it varies from very basic research to product development. However, even the most product development-oriented laboratories are more inclined toward basic research than the offshore divisional laboratories of their own companies. Among the six laboratories discussed here, NEC Research Institute seems to be at the extreme end of the basic-product development continuum, followed by Mitsubishi's MERL and Canon Research Center America. Relatively closer to the product development side are Ricoh California Research Center and Sony's two laboratories. (Exhibit 3-2: Mandate of Corporate Laboratories)

Exhibit 3-2: Mandate of Corporate Laboratories



Source: Created by the author

In addition to the scientific/technological mandate in their respective areas of research, some of these laboratories serve headquarters as a place to learn American style R&D management. For example, Ricoh has been consciously making efforts to learn from its R&D centers in the U.S. about how to realize a more creative environment for its researchers. One of the resulting changes in its R&D centers in Japan is less emphasis on the seniority system. Also, the director of the Canon Research Center America states that:

"Canon is best served by tapping into the American model of R&D rather than using the Japanese cultural and management approach in the U.S. The U.S. model offers Canon something different and unique which might be rendered ineffective by attempts to import Japanese management practices."

Management Style

All of the six laboratories have adopted American style management. In other words, at all six facilities, there have been no attempts to introduce typical Japanese style management, such as life time employment, or the seniority system. Also, recruiting and compensation plans are done in the American style. This is a natural consequence, considering that most of the laboratories have U.S. citizens as managers, and almost all of the researchers at these facilities are U.S. citizens. For example, the NEC Research Institute has no Japanese researchers. The Canon Research Center America and the Ricoh California Research Center have only one Japanese each. In addition, if one of the mandates of the laboratory is to give headquarters in Japan a chance to learn about the American style R&D management as mentioned, headquarters in Japan might make efforts consciously not to intervene in its R&D centers in the U.S.

Communications with Home Country

These facilities' communications with operations in Japan are characterized by the interviewers to be loose with the one exception of Ricoh. In the case of the Canon Research Center America, the only Japanese employee serves as the interface between the center and Japan. The center sends monthly and semi-annual reports to Japan and conducts informational meetings with the operating divisions to share information about research

projects and results. Also, the center depends on headquarters for patent strategy and legal support. In the case of the NEC Research Institute, the majority of communication is with divisions in Japan. There is little formal linkage with the Japanese based R&D organizations. Communications through electronics mail is most common. Also, communications with business managers are done through "R&D exhibits," where heads of the business units and the technology sponsors gather to discuss R&D needs. In the case of Sony, the project conducted by the Advanced Computer Architecture Laboratory is not directly linked to a project in Japan. Thus, the need for communication is not so strong. The project conducted by Sony's New Jersey Telecommunications Laboratory is more related to a prototype development project in Japan. Thus, the need for communication with Japan is relatively stronger.

Ricoh California Research Center is the only laboratory for which communications with operations in Japan can be characterized as dense. The center is directly controlled from Japan, and there seems to be a lot of technology transfer, both formal and informal, between the Center and Japan.

Communications with Other Local Operations

All of the facilities' communications with the company's other operations in the region are characterized by the interviewers to be loose. The most significant communications with other local operations are often those with the regional headquarters. For example, the director of the Canon Research Center America reports to the president of Canon USA. The other type of communications are those enhanced by the geographical proximity. For example, the NEC Research Institute is housed at the same site with an applied research group, the C&C Research Laboratory, which is owned by NEC

U.S.A. This keeps the Institute from becoming an "ivory tower" and provides access for the applied group to the basic research scientists.

External Technology Links

Most of the laboratories have strong links with an external center of excellence, such as top-ranked universities and first-rate laboratories. In most cases, these external links were brought about and have been kept by employing top-notch researchers. The other side of the coin is that keeping an external technology linkage is one of the key factors in choosing the location of the laboratory. For example, the two founders of the Canon Research Center America served as the faculty members at Stanford University. The location of the facility was chosen so that these two people would not lose their interaction with Stanford and other area professional networks. Sony also mentioned that proximity to Rutgers University, which has an important wireless communication laboratory, was an important criterion for deciding on the location of its New Jersey Telecommunications Laboratory.

Other types of efforts to maintain external technology links include using the laboratory as a distribution point for ex gratia donations to professors in U.S. universities (Ricoh), hosting some symposia and allowing some thesis students to work under the direction of the laboratory's scientists (NEC).

3.3. Divisional Laboratories

Members of the structured thesis group interviewed 14 divisional laboratories of Japanese electronics firms in the U.S. They are:

Fujitsu:	Fujitsu Network Switching of America, Inc. (FNSA),
	Fujitsu Network Transmission Systems, Inc. (FNTS),
	Fujitsu Business Communication Systems, Inc. (FBCS),
	Fujitsu Microelectronics, Inc. (FMI),
	Fujitsu Computer Packaging Technologies, Inc. (FCPT),
	Open Systems Solutions, Inc.,
	Fujitsu Computer Products of America, Inc. (FCPA),
Ricoh:	Strategic Technology and Applied Research Division,
	FAX R&D Division,
	Image Communications Systems Division,
	Software Research Center,
Toshiba:	Toshiba America MRI, Inc., (TAMI)
	Vertex Semiconductor, and
Hitachi:	Semiconductor Research Laboratory (SRL).

In addition to the above laboratories, the structured thesis members collected information on U.S. divisional laboratories of Matsushita and Sony.

Establishment

Just like corporate laboratories, divisional laboratories of the Japanese electronics firms have only a short history. Among the laboratories we interviewed, the oldest is the R&D facility of Fujitsu Network Transmission Systems, which was established in 1984. The rest of the laboratories were established between 1988 and 1991.

One significant difference between corporate and divisional laboratories at the establishment is that some of the divisional laboratories have their roots in U.S. companies which were later acquired by Japanese

companies. For example, Fujitsu's Open System Solutions, a former Unisoft Corporation, was acquired in 1991; Toshiba America MRI, a former Diasonics Corporation, was acquired in 1989; and another of Toshiba's R&D centers, Vertex Semiconductor with its origin in 1974 as STC Research, was fully acquired in 1991. On the other hand, all of the corporate laboratories were established by the Japanese companies themselves.

Size

The size of the laboratories, measured by the number of researchers and engineers, varies from 10 to 150. Fujitsu Computer Packaging Technologies and Open Systems Solutions, Ricoh's four divisional laboratories, and Hitachi's Semiconductor Research Laboratory each have 10-25 researchers/engineers. The middle-sized groups are Fujitsu Business Communications systems with 40, Fujitsu Network Transmission Systems with 41, Toshiba's Vertex Semiconductor with 65, and Fujitsu Microelectronics with 70. Laboratories with over 100 engineers are Toshiba America MRI which has 110, Fujitsu Network Switching of America (130), and Fujitsu Computer Products of America (150). (Exhibit 3-3: Interview Summary - Divisional Laboratories)

Exhibit 3-3: Interview Summary - Divisional Laboratories

Company/Laboratory	Size	Funding	Mandate	Manage-ment Style	Communications with home country	Communications with local operations	External Technology Links
Fujitsu:							
Fujitsu Network Switching of America	>50	Corp+BU	Dev., mod	Japanese	Dense	Dense	Customer, consultant
Fujitsu Network Transmission Systems	<50	Jap+Local	Dev., mod	US	Loose	Dense	Suppliers
Fujitsu Business Comm. Systems	<50	Corp+BU	Dev., mod	Japanese	Dense	Dense	Customers
Fujitsu Microelectronics	>50	Corp+BU	Dev., mod	Japanese	Dense	Dense	Sun Microsystems
Fujitsu Computer Packaging Technologies	<50	Corp	Applied	US	Dense	Loose	Customers, suppliers
Open Systems Solutions	<50	Japan	Dev	US	Dense	Loose	
Fujitsu Computer Products of America	>50	BU	Dev	US	Dense	Loose	
Ricoh:							
Strategic Tech and Applied Research Div.	<50	Contract	Mod	Japanese	Loose	Dense	
FAX R&D Division	<50	Contract	Mod	Japanese	Loose	Dense	
Image Communications Systems Div.	<50	Contract	Dev	Japanese	Loose	Dense	
Software Research Center	<50	Contract	Dev	Japanese	Loose	Dense	
Toshiba:							
Toshiba America MRI	>50	BU	Basic-Dev	US	Loose	Loose	UCSF
Vertex Semiconductor	>50	Japan	Dev	US	Loose	Loose	
Hitachi:							
Semiconductor Research Laboratory	<50	Corp	Dev., mod	US	Loose	Dense	Stanford, Berkeley
Matsushita:							
Panasonic Advanced TV-Video Lab	<50	Local	Dev	N.A.	N.A.	N.A.	
Sony:							
(in general)		Corp	N.A.	N.A.	N.A.	N.A.	

Corp.: corporate-level BU: business unit Dev.: product development Mod: product modification
Sources: Interviews and publicly available information.

Funding

In most cases, funding for the divisional laboratories comes from their parent company in Japan, some from the corporate-level budget and some from the business unit or division level budget. In the case of Fujitsu, all of the divisional laboratories except Fujitsu Network Transmission Systems are fully funded from Japan. Fujitsu Network Transmission Systems is partly funded by the local operations. Fujitsu is trying to increase the local funding for its overseas divisional laboratories.

In the case of Panasonic Advanced TV-Video Laboratory of Matsushita, its funding comes from the regional headquarters, Matsushita Electric Corporation of America. This is because the laboratory belongs to the regional headquarters but not to a product-line sector, as most of the divisional laboratories do.

Another unique case is Ricoh. Ricoh's divisional laboratories receive funds on a contractual basis.

Mandate

At division level laboratories, mandates are determined jointly with headquarters in Japan and the laboratories. No divisional laboratories enjoy as high degrees of autonomy as some of the corporate laboratories do. Considering the nature of mandates -- much closer to commercialization compared to those of corporate laboratories, this is probably to be expected.

All of the laboratories have partial or entire product development and/or modification as their mandates. Involved in both product development and modifications are Fujitsu Network Switching of America, Fujitsu Network Transmission Systems, Fujitsu Business Communications Systems, Fujitsu Microeclectronics, Toshiba America MRI, Hitachi's

Semiconductor Research Laboratory. In addition to product development and modification, Toshiba America MRI also conducts some basic research. Involved mainly in product development are Fujitsu's Open Systems Solutions, Fujitsu Computer Products of America, Ricoh's Image Communications Systems Division and Software Research Center, Toshiba's Vertex Semiconductor, and Sony's four divisional laboratories. Involved mainly in product modification are Ricoh's R&D centers at Strategic Technology and Applied Research Division and FAX R&D Division. Fujitsu Computer Packaging Technologies defines its mandate as applied research, and Matsushita's Panasonic Advanced TV-Video Laboratory undertakes long-term R&D to provide advanced technologies critical to future regional market.

Management Style

Although none of the divisional laboratories are transformed into the genuine Japanese style management, some of them have adopted more aspects of their parent company in management than the corporate laboratories. Included in this group are Fujitsu Network Switching of America, Fujitsu Business Communications Systems, Fujitsu Microelectronics, and Ricoh's four divisional laboratories. One common factor for these seven facilities are that they work closely with the local operations, especially with manufacturing, whose management style is more Japanese in an effort to adopt competitive Japanese manufacturing methods. Also, these seven R&D centers often have Japanese managers as a corporate head and/or as a financial officer. Based on the interview results, it seems that such Japanization of the divisional laboratories was not intentionally planned. A manager at Fujitsu Network Switching of America stated that

they wanted to keep the proportion of Japanese assignees to less than 10% to show that FNSA is an American company and that it is Americans that are doing R&D.

While there is an attempt to keep "America" in these R&D centers on one hand, there also are efforts to reduce cultural conflict with the Japanese expatriates and the headquarters in Japan on the other hand. For example, all of the employees at Fujitsu Network Switching of America have to take some cross-cultural training. A similar training is also available at Fujitsu Network Transmission Systems.

Communications with Home Country

Communications with the home country headquarters from divisional R&D centers seem to be denser than those of corporate laboratories. Six laboratories were perceived by interviewers to have dense communications with the home country. Those six laboratories all belong to Fujitsu; namely, Fujitsu Network Switching of America, Fujitsu Business Communications Systems, Fujitsu Microelectronics, Fujitsu Computer Packaging Technologies, Open Systems Solutions, Fujitsu Computer Products of America. Those which have loose communications are Fujitsu Network Transmission Systems, Ricoh's four laboratories, and Hitachi's Semiconductor Research Laboratory. Classification for Toshiba, Matsushita, and Sony was not possible.

There are two main reasons for divisional laboratories' denser communications with the home country. Firstly, some of the products developed in these divisional laboratories are commercialized back in Japan (e.g., Fujitsu Business Communication Systems, Ricoh's four laboratories, and Sony's two laboratories). Therefore, to those laboratories, communications with the Japanese counterpart are critical to carry out their

mandates. Secondly, unlike corporate laboratories, there are some Japanese expatriates in most of these divisional laboratories. It is those Japanese assignees who play important role in communications with Japan.

Popular modes of communications include electronics mail and face-to-face meetings.

As the frequency of the communication increases, problems related to cross-Pacific communications also rise. The most common problems are language and cultural gaps and the difference in approach in project management. There are some examples for the latter type of problems: the Japanese are less concerned about the total system when they develop a subunit[31]; the Japanese do not use project management tools (e.g., systems planning) which the Americans are used to; and the Japanese are organized by project while the Americans are organized by specialty.

Communications with Other Local Operations

Communications with other local operations are significantly denser than those of corporate laboratories. Four out of seven Fujitsu's laboratories (Fujitsu Network Switching of America, Fujitsu Network Transmission Systems, Fujitsu Business Communications Systems, and Fujitsu Microelectronics), all the four Ricoh's laboratories, and Hitachi's Semiconductor Research Laboratory are categorized as having dense communications. Also, Toshiba's Vertex is reported to be increasing the communications with the local operations. Those which were categorized to have loose communications are Fujitsu Computer Packaging Technologies,

[31]The Americans are often characterized as a specialist, who lacks overall view, and the Japanese as a generalist, who can have an overall picture. However, we received the opposite observation from one of our interviewees.

Open Systems Solutions, Fujitsu Computer Products of America, and Toshiba America MRI.

As the communication density increases among the local operations, problems also increase. For example, Fujitsu Network Transmission Systems has difficulty in communications between manufacturing and R&D. This difficulty is due not to the differences in "manufacturing" and "R&D" but to the cultural and language differences between the Japanese and the Americans: many of the manufacturing managers are Japanese and almost all of the R&D managers are American. The company expects a new American director, who was a professor at Carnegie Mellon University and spent two and a half years in one of Fujitsu's main factories, to address the communication problem.

Another interesting example of communications problems within the local operation is that within Toshiba America MRI. They claim that there is a strong cultural difference between the academic group staying at the University of California San Francisco and the engineers which makes communications between the two groups very difficult.

External Technological Links

While most of the external technological links of the corporate laboratories are limited to top-notch universities, laboratories, and professional societies, those of the divisional laboratories include suppliers and customers as well. This reflects the more product oriented nature of mandates of these divisional laboratories.

Links with academics were claimed by Toshiba America MRI (with University of California San Francisco) and Hitachi Semiconductor Research Laboratory (with Stanford University and University of California Berkeley).

In the case of Toshiba, the company had relations with UCSF before the acquisition of Diasonic. Toshiba maintained the relationship by having 13 of its 110 engineers stationed at UCSF. Fourteen more people, who are UCSF employees, are also assisting this team, which is working on the new generation MRI technology. UCSF is located one mile away from Toshiba America MRI. In the case of Hitachi, it has an advisory board that meets every 4-6 months with a panel of academics to discuss the key thrusts of the research and brainstorm new ideas.

The importance of strong links with customers was mentioned especially by R&D centers in the telecommunications industry. Location of Fujitsu Network Transmission Systems shows its strong link with a customer. The current location of Fujitsu Network Transmission Systems was decided on the request of MCI, who then had a plan to come to Dallas, Texas. Currently, MCI has a large facility nearby. Fujitsu Network Switching of America also expressed the importance of communications with lead users, regional bell companies, to develop marketable products.

Other types of external technological links are: Fujitsu Computer Packaging Technologies' alliance with material companies, such as Du Pont or Dow Chemical; and Open Systems Solutions relations with Sun Microsystems in the area of ASICs.

Chapter 4: Fit Between Globalization Strategy and Internationalization of R&D

The purpose of this chapter is to examine the fit between the globalization strategy and the direction of internationalization of R&D in Japanese electronics firms. First, the expected patterns of internationalization of R&D based on Chapters 1 and 2 are discussed. Then, the actual patterns of internationalization of R&D are discussed based on the data provided in Chapter 3.

4.1. Expected Patterns of Internationalization of R&D

In Section 1.3.2., the current globalization strategies of the eight Japanese electronics firms were categorized into four different groups. The expected patterns of internationalization of R&D based on that categorization are presented in Exhibit 4-1, and discussed type by type in the following pages.

Locally Autonomous

This type of strategy puts strong emphasis on the completeness of a value chain in each region. Therefore, the expected pattern of R&D centers is that overseas R&D centers are strongly connected to local manufacturing and sales operations. The relations among R&D centers in the region are also expected to be strong. Ideally, the technology level of R&D centers should be high enough to develop products sold in the region without help from other part of the company.

Mesh/Matrix

This type of strategy tries to maintain both product-line and regional links. Therefore, the expected pattern of R&D is that overseas R&D centers are both well connected to local operations and their counterpart R&D centers in their respective research areas.

Transnational

This type of strategy tries to utilize innovations occurring at both parent company headquarters and local subsidiaries. This purpose is achieved through the transnational's self-reinforcing network mechanism, which is based on interdependence among different operations. Therefore, the roles of each R&D centers would be expected to be designed to enhance interdependence. Because of the flexibility of a transnational, the density of linkages with the home country and local operations varies according to the role of each R&D center as long as the R&D center is included in the network in some way.

Others

Fujitsu was not categorized into any of the above groups. It is not clear what type of internationalized R&D organization will be created based on the company's emphasis on "existing and prospering together" and "cross culture". However, it is clear that Fujitsu should adopt a local style of management in its R&D facilities to realize what it refers to as "cross culture".

Exhibit 4-1: Patterns of Internationalization of R&D

Types of strategy	Characteristics of Overseas R&D
Locally autonomous	• Strongly connected within the different level of R&D and to the rest of the value chain in the region • Self-sufficient
Mesh/Matrix	• Strongly connected to both product- and regional line
Transnational	• Interdependent among different units • Included in the corporate-wide network, but the density of communication varies
Others (cross culture)	• Respect local way of management

4.2. Actual Patterns of Internationalization of R&D: Observation from R&D Centers in the U.S.

4.2.1. Disconnected Value Chain

Stand-alone Corporate Laboratories

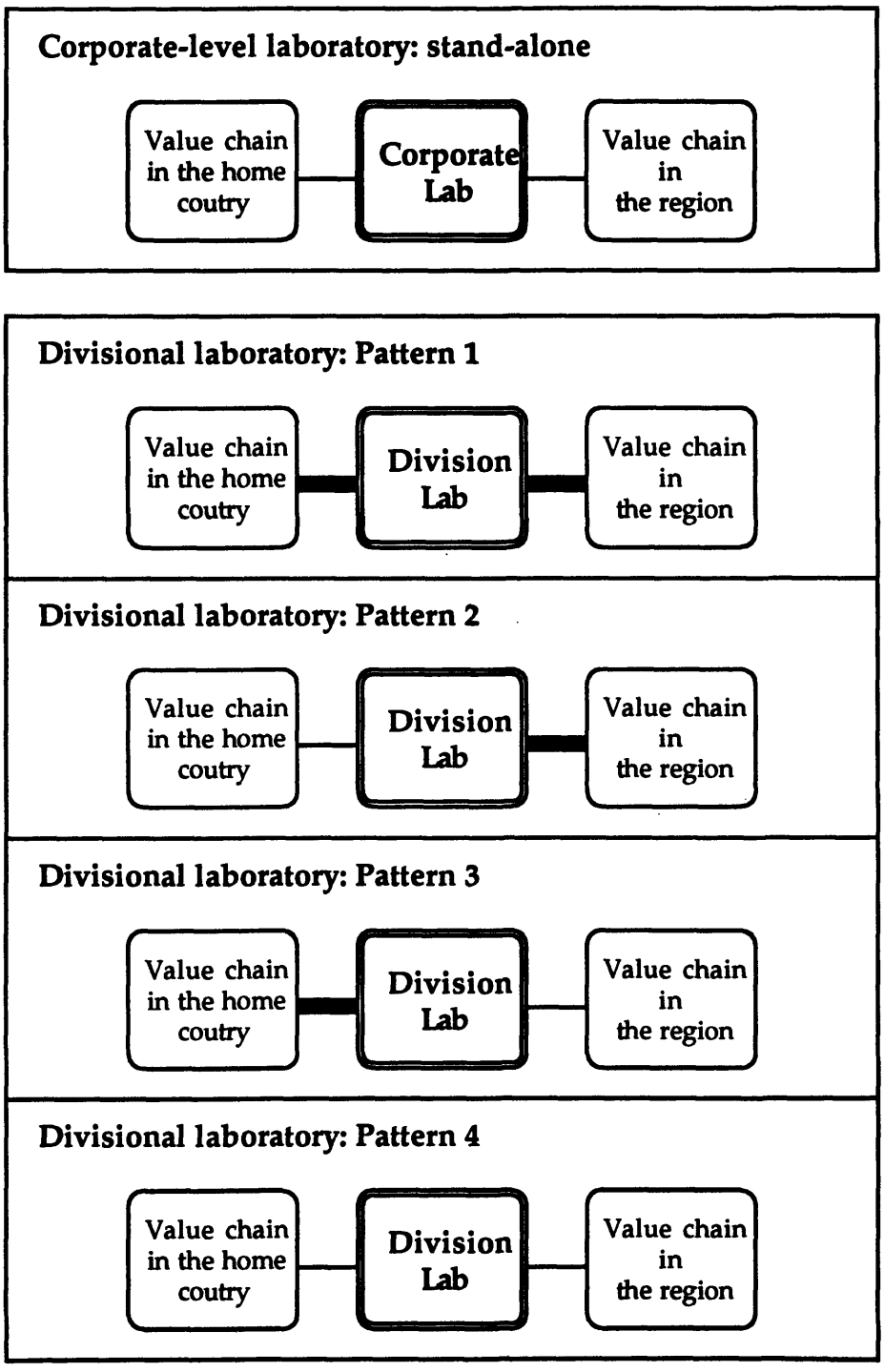
It was noticeable that all of the corporate laboratories are characterized by the interviewers as having loose communications with both the home country and the local operations, regardless of the type of globalization strategy. Corporate laboratories are described as a "stand-alone" type. This does not fit any of the expected internationalized R&D organizations discussed in Section 4.1. (Exhibit 4-2: Observed Pattern of Internationalization of R&D)

Divisional Laboratories Developing Links with Home Country and Local Operations

Internal linkages at the 14 laboratories, which were observed by the structured thesis members, are broken down into four different patterns. The first pattern is that the laboratory has linkages with both the home country and the local operations. Three Fujitsu R&D centers in charge of product modifications are in this group. The second is that the laboratory has linkages only with local operations. This is the most commonly observed pattern: six laboratories, in charge of product development and/or modifications are categorized into this group. However, these facilities do not have dense connections with the regional corporate laboratories (when applicable). Therefore, their linkages with the local facilities are one-sided. The third

group is that of the laboratory which has linkages only with the home

Exhibit 4-2: Disconnected Observed Pattern of Internationalization



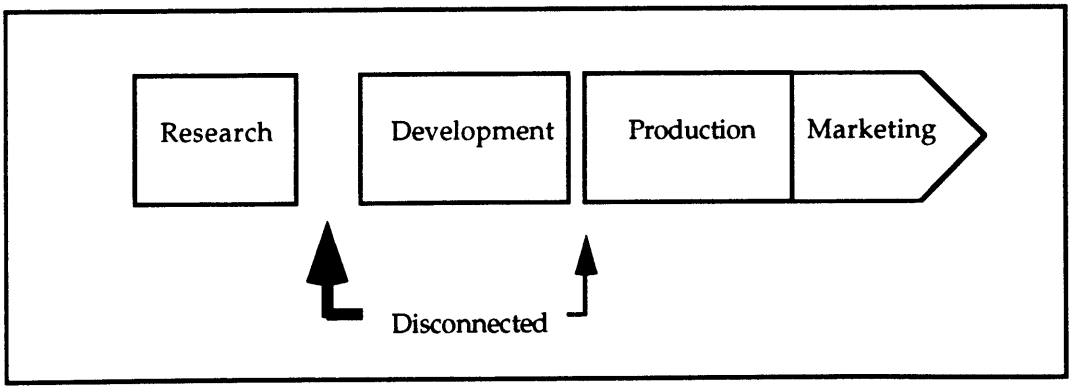
Source: Created by the author

country. Three R&D centers in charge of product development or applied research are in this category. The last category is that of the laboratory which has only loose linkages with both the home country and local operations. Two laboratories are categorized in this pattern.

Disconnected Linkages

In summary, most of the R&D centers of the Japanese electronics firms are described as having disconnected linkages. Aside from Fujitsu, which does not have a clear picture for the linkages of its internationalized organizations, and NEC, whose target is to become a transnational corporation, this does not fit into the companies' immediate goal of globalization to establish a whole value chain in the region. Even though the companies establish elements of the value chain, if these elements are not connected to create a value, that can not be called a value chain. (Exhibit 4-3: Disconnected Value Chain)

Exhibit 4-3: Disconnected Value Chain



Note: There are such cases that produciton and marketing in a same region are disconnected.
Source: Created by the author

4.2.2. Reasons for the disconnected value chain

There are a number of explanations for the disconnected value chain. They are the relatively short history of these R&D centers, difficulties in communications, and little need for linkages.

1. R&D centers are still new.

One strong explanation for the disconnected linkages is that these R&D centers have only a few years of history, and therefore, are still in the process of building linkages. For example, Toshiba's Vertex Semiconductor is reported to have been witnessing an increase in its communications with both the home country and the local operations.

2. Communication difficulties.

Another possible reason for loose linkages is the difficulty in communications. Two types of communications difficulties among the local operations were pointed out in the previous chapter. One is the difficulty in communication between the Japanese and Americans. This difficulty is attributable to the differences in language and culture. The other type of difficulty is attributable to the differences between academic type of researchers and more product oriented researchers. With these difficulties in communications, linkages will not develop unless there is a strong necessity or force to create them.

3. Little need for intra-country linkages.

Despite the first reason, there are some R&D centers whose linkages with local operations are unlikely to strengthen in the foreseeable future. This is especially true among corporate-level laboratories whose research is

more basic. Unless the product development capability of the local operations is fully developed, it is difficult for a local product development function to exploit the research findings by the basic research laboratory. In order to have a fully developed product development capability, a strong local production function is required in turn. Thus, as long as each of the local functions lacks a reasonable level of self-sufficiency and breadth of technologies, there is no incentive for basic research centers and product-development centers to strengthen the linkages between them. If we also consider the cultural and language differences discussed above, it is sometimes more efficient and reasonable for the company to link elements of a local value chain via headquarters.

This last explanation for the disconnected value chain suggests a fundamental question about the idea of creating an autonomous whole value chain in each region. Are the locally autonomous operations and the matrix type of organization the optimal direction for the Japanese firms? Based on the insights from the current status of the linkages provided by R&D centers, the following chapter re-examines global strategy of the Japanese electronics firms.

Chapter 5: Toward A Transnational Corporation

Observations of the Japanese electronics firms' R&D centers in the U.S. throw up a fundamental question about the firms' globalization strategy of building a self-sufficient autonomous regional value chain. In this chapter, we will re-examine the globalization strategy of these firms, which was described in Chapter 1.

5.1. Globalization Strategy Re-examined

In this section, the most common strategies among the Japanese electronics firms -- "locally autonomous" type and "matrix" type, will be examined. Then, a transnational strategy will be suggested as a solution to some of the problems the Japanese electronics firms are facing.

Bartlett and Ghoshal break down a company's competitiveness into three types of capabilities -- efficiency, responsiveness, and learning capabilities. They argue that the successful companies in the past are those who could match the organization's capability with the key needs of the industry (e.g., efficiency in consumer electronics, responsiveness in toiletry products, and learning in switching industry). However, changes in those business environments mean that more and more businesses being driven by simultaneous demands for global efficiency, national responsiveness, and worldwide leveraging of innovations and learning.

5.1.1. Locally Autonomous Strategy Re-examined

The "locally autonomous strategy" is the "multinational" strategy of Bartlett and Ghoshal's definition. The strength of this strategy is national responsiveness. In addition, having the whole value chain in one area makes it easier to be recognized as a local player. Thus, this strategy helps to obtain subsidies from the local government and to avoid political friction and foreign exchange risks. The weaknesses of this strategy is the difficulty to achieve efficiency because of each regional operation's relatively small size and the difficulty in learning across borders.

Considering the characteristics of the industry (scale economy is still more important than national responsiveness) and the historical evolution of the Japanese electronics firms' overseas operations discussed in Chapter 1, the main reason for these companies to stress a locally autonomous strategy in the advanced countries seems to be to avoid increasing trade friction and currency exchange risks. Since establishment of R&D centers do not directly help in reducing the foreign exchange risk, the main reason for establishing R&D centers as a part of the value chain can be summarized as creating an image as a local player in order to reduce political frictions, which is addressed by Westney as one of the two competition factors.

5.1.2. Matrix Strategy Re-examined

In theory, the matrix organization is the organization which can enable a company to maintain balance among centralized efficiency, local responsiveness, and the building and leveraging of functional competencies.[32] However, this ideal type of organization has turned out to

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[32]Bartlett and Ghoshal, *Managing Across Borders: The Transnational Solution*, (Boston: Harvard Business School Press, 1991), 31.

be unsuccessful in history. The problems with this organization are (1) amplification of the differences in perspectives and interests by forcing all issues through the dual chains of command, (2) barriers of distance, time, language, and culture, and (3) consequent slow, acrimonious, and costly management processes. The aim of the Japanese firms' adopting this strategy seems to be to combine the strength of their divisional organization, which is designed based on product lines to exploit global efficiency with the need to become a local player.

5.1.3. Danger With These Two Strategies

After re-examination of the Japanese electronics firms' globalization strategy, it becomes clear that one of the main reasons for R&D globalization is to create the image of a local player. However, it is apparent that the current status of intra-country linkages between R&D centers is far from contributing to a value chain in that country. In addition, at the end of Chapter 4, it is pointed out that it might not be optimal to create a self-sufficient autonomous value chain in each region. With such a weak incentive for creating linkages, the progress toward perfecting a whole value chain must be very slow.

The current status and expected slowness in the progress of localization may jeopardize each strategy's original goal -- to create the image of a local player. If the Japanese companies continue to state their immediate goal as establishing a self-sufficient autonomous regional company but cannot get closer to that goal, it will be addressed by the mass media and/or the academics at some time. Then, the Japanese companies will be labeled as deceiving the locals. That will ruin the Japanese electronics firms' original

goal to enhance their image as local players. Indeed, it will result in a worse image.

5..2. Transnational Model as a Solution to Image Problem

The transnational model by Bartlett and Ghoshal discussed in Chapter 1 could become a solution to the above image problem because the model can justify what the Japanese companies have been doing.

Instead of centralizing or decentralizing assets, the transnational makes selective decisions. The resource configuration of the transnational is summarized as follows:

(1) Certain resources and capabilities are best centralized within the home country operation, not only to realize scale economies, but also to protect certain core competencies and to provide the necessary supervision of corporate management.

(2) Certain other resources are also centralized by the transnational, but not necessarily in the home country.

(3) Some other resources may be best decentralized, on a local-for-local basis.[33]

Based on this model, the Japanese companies can claim that their disconnected linkages are due to selective decisions on centralization and decentralization. For example, currently-observable linkages between product development, modification functions and manufacturing functions can be explained as decentralization of a certain product line whose benefit from being located in a certain country is large. The same company's disconnected

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[33] Bartlett and Ghoshal, *Managing Across Borders: The Transnational Solution*, (Boston: Harvard Business School Press, 1991), 60.

linkages with the corporate laboratory can be also explained in the selective decisions on centralization and decentralization. In this case, the company can claim that the corporate laboratory function is decentralized for a reason other than the localization of production and development facilities, which is often true.

In this way, adopting a transnational model enables the Japanese companies to maintain their public image. The transnational model can explain without using the vision of "establishing a self-sufficient autonomous company" why a company has various elements of a value chain, including high-value added activities like R&D, in the U.S. and yet these elements are not always connected to one another.

5.3. Transnational Model as a Solution to Management Problems?

The transnational strategy could be very effective for protecting the Japanese companies from damaging their public image. But, that is not the only thing the transnational model can do: the concept of the transnational model may enable a more practical and solid way of building a globalization strategy. However, the problem is that even in the descriptions by Bartlett and Ghoshal, it is not clear how to build a transnational corporation.

5.3.1. Essence of Transnational

In addition to its flexibility in resource configuration and interdependence among different units, the transnational model has different change process from those of the multinational and the matrix strategies. It emphasizes transnational mentality and administrative heritage.

Transnational mentality

Central to the transnational model is the "transnational mentality" -- a shared understanding of the company's purposes and values, an identification with broader goals, and commitment to the overall corporate agenda by individual managers. This is the global glue, which works against enormous forces of fragmentation and dissipation emerged from built-in flexibility of the transnational model.[34] Bartlett and Ghoshal argues that a change in mentality should come first and a change in formal organizations should follow, while in the traditional strategies changes in structure comes first and mentality of the managers can not follow such changes, resulting in disharmony in the organization. (Exhibit 5-1: Traditional and Emerging Change Processes) This view on the importance of shared vision is also supported by Kenichi Ohmae. He states in *The Borderless World*: "Formal systems and organizational structures can help, but only to the extent that they nurture and support intangible ties."[35]

Importance of administrative heritage

Another important element of the transnational model is its emphasis on administrative heritage, which is defined by Bartlett and Ghoshal as "where the companies come from." They argue that successful transformation to a transnational company can be brought about by building on the company's current strengths and supplementing its current weaknesses. Although, in conceptual terms, different companies are gradually transforming into a similar transnational form, the different

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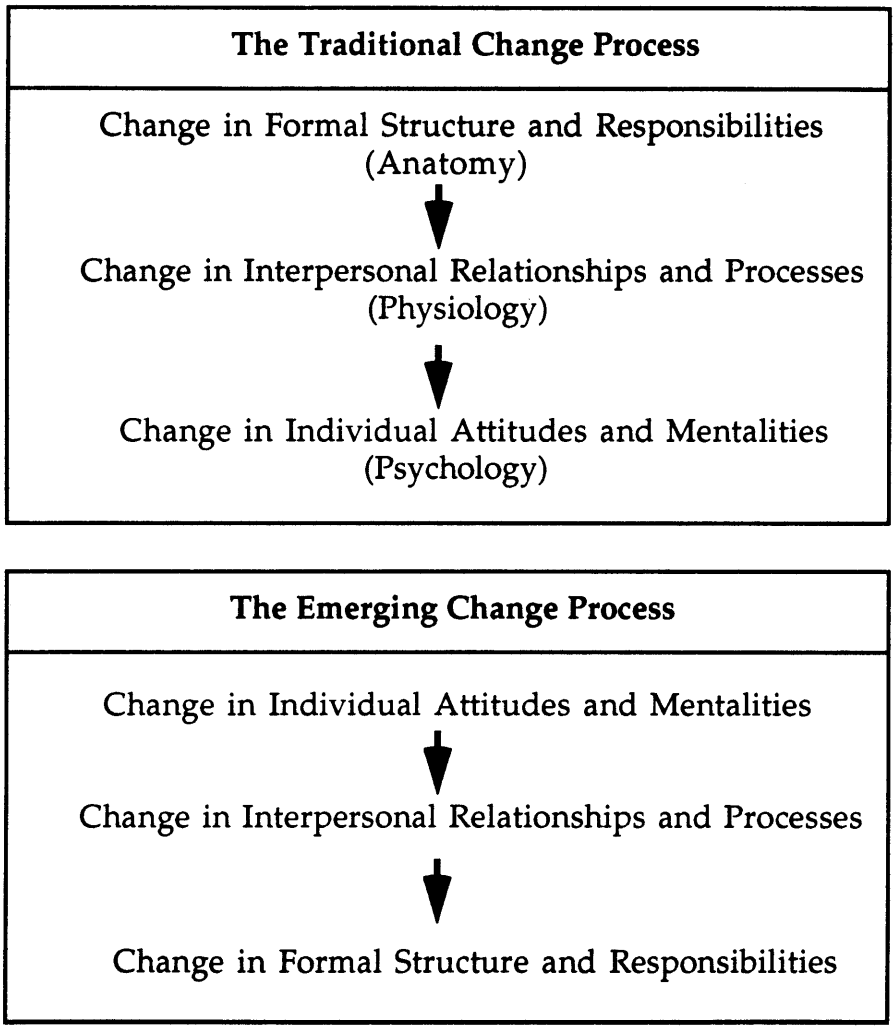
[34]Bartlett and Ghoshal, *Managing Across Borders: The Transnational Solution*, (Boston: Harvard Business School Press, 1991), 175.
[35]Ohmae, *The Borderless World*, (New York: Harper Business, 1990), 89

administrative heritage of each company makes the adaptation process very different in operative terms.[36]

Exhibit 5-1: Traditional and Emerging Change Processes



Source: Bartlett and Ghoshal, *Managing Across Borders: The Transnational Solution*

[36]Ohmae, *The Borderless World,* (New York: Harper Business, 1990), 55.

5.3.2. Implications to Internationalization of R&D by the Japanese Electronics Firms

The most important implication of the transnational model is that the Japanese electronics firms' R&D centers in the U.S. will continue to play an important strategic role. Even in the transnational model, the assumption is that a major market country like the U.S. will be a "strategic leader" in at least some product or major technology. This means that expansion of technology capabilities in the U.S. by Japanese firms, which started a few years ago, will continue in the future.

Then, what are the implications of the transnational model in the actual process of developing R&D centers in the U.S.? Unfortunately, the transnational model does not say much about how a company can become a transnational. Due to differing administrative heritage, the way to become a transnational varies from company to company, and even from unit to unit. Each company should evaluate their strengths and weaknesses, and implement incremental changes. There is no single formula for everyone.

However, there is one clear starting point. The transnational model can link the disconnected units without major re-organization nor re-configuration of assets: the suggestion is linking the disconnected units through a transnational mentality. This approach works even for the stand-alone corporate laboratory. For example, as mentioned in Chapter 3, the NEC Research Institute defines its mandate based on the C&C philosophy of NEC.[37] Even though communications at the NEC Research Institute are characterized as loose, a vision commonly shared by the rest of the corporation prevents the researchers at the Institute from "deviation." If there is no strong vision shared between the company as a whole and the

[37]C&C stands for computer and communication.

managers of the very autonomous corporate laboratories, the freedom these managers are enjoying could provoke envy from the rest of the company. Also, the chance for the company to fail in leveraging the research findings will increase. In this way, creating a "transnational mentality" in each individual manager can be a significant element of managing even R&D centers with a strong preference toward autonomy and a lack of culture fit with the rest of the company.

Conclusion

A few years ago, induced by the marketing, political, and science/ technology factors, increasing number of the Japanese electronics firms started to locate R&D functions in the U.S. Structured interviews at these R&D centers revealed that the corporate-level laboratories tend to have loose communications with both the home country and the local operations, and are characterized as stand-alone facilities. The divisional laboratories are observed to have more linkages with the rest of the company, though the linkages are much weaker and more difficult to keep than those observed in the home country. Such a weak intra-country linkage does not fit the Japanese companies' globalization strategy, which often emphasizes establishing locally autonomous operations. This mismatch creates a threat that works against protecting a "good local player" image of the Japanese firms, one of their most important reasons for locating high-value added activities in the U.S.

The transnational model, a new model of a corporation operating internationally, is suggested as a solution to potential loss of image. Also, the transnational model implies the importance of having R&D centers in the U.S. Finally, a transnational mentality can be presented as a measure to integrate R&D centers.

Although adoption of a transnational model sounds like a perfect solution to managing internationalization of R&D, the model by itself hardly suggests any concrete formula for success. Because of its emphasis on building on administrative heritage, the way to reach transnational status differs from company to company, and from unit to unit. The one clear thing is that the transformation toward becoming a transnational company starts in

each manager's mind through developing a "transnational mentality." As put in Bartlett and Ghoshal's words:

"Fundamentally, they are evolving a common vision about managing across borders. This vision recognizes the importance of administrative heritage both as an asset to protect and as a constraint to overcome. Another central belief is that the first step toward developing the multidimensional strategic competencies needed in transnational businesses is to build organizational capabilities. **Such a management mentality, more than any particular organizational form or strategic posture, is at the heart of what we call the transnational organization.**"[38] (emphasis by the author)

For those interested in the evolution of internationalization of R&D, the transnational model suggests a new challenge for approaching the internationalization of R&D; that is, to measure the level of "internationalization" by the level of the "transnational mentality" rather than the development in visible organization or actual level of communications as examined in this thesis. Although examining the invisible is a difficult task, this approach might more clearly reveal strengths and weaknesses of the internationalization of R&D, or globalization in general, by Japanese electronics firms.

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[38]Bartlett and Ghoshal, *Managing Across Borders: The Transnational Solution*, (Boston: Harvard Business School Press, 1991), 55.

Appendix 1: Company Profiles

Canon, Inc.

Company Description:
Major manufacturer of copiers, cameras and computer peripherals. Known around the world for its cameras and copiers, Cannon has expanded its product lines to become a comprehensive producer of OA and computer equipment. While enjoying expanding overseas sales across all product categories, the company has moved aggressively to increase its foreign production capacity with new plants in Asia and expanded capacity in the U.S. and Europe.

Main Products:
Copiers and copier supplies, computer peripherals, image systems, computer and information systems, cameras and video equipment, medical equipment, and others.

Incorporation: January 1, 1937

(Consolidated, in ¥million)

	3/1991	3/1990	3/1989
Net sales	1,727,948	1,350,917	1,106,010
Net Income	61,408	38,293	37,100

Fujitsu Ltd.

Company Description:
Engaged in the manufacture and sale of computers, communications equipment and electronics components. Japan's leading computer manufacturer, Fujitsu also enjoys a strong presence in domestic semiconductor and telecommunications markets. R&D expenditure, which has exceeded 10% of total sales in recent years, continues to stress mainline products with 64 megabyte DRAMs and 64 kilobyte SRAMs utilizing HEMTs receiving special attention.

Main Products:
Computer equipment, telephone and telegraph apparatus, and electronic components.

Incorporation: June 20, 1935

(Consolidated, in ¥million)

	3/1991	3/1990	3/1989
Net sales	2,971,462	2,549,773	2,387,442
Net Income	82,673	86,758	69,948

Hitachi, Ltd.

Company Description:
Nation's largest comprehensive manufacturer of heavy electric plant and equipment. The company has many promising subsidiaries in varied fields, including chemicals, wire and cable manufacturing and shipbuilding. The company is also expanding into the aerospace field.

Main Products:
Heavy electric plant, consumer electronics, communications and electronic equipment, industrial machinery and plants, traffic equipment, and aerospace equipment.

Incorporation: January 1, 1920

(Consolidated, in ¥million)

	3/1991	3/1990	3/1989
Net sales	7,736,961	7,077,855	6,401,417
Net Income	230,185	210,963	185,587

Matsushita Electric Industrial Co., Ltd.

Company Description:
One of the world's largest consumer electronics manufacturers, the company is the nucleus of the Matsushita group. The company has about 75 overseas manufacturing subsidiaries and 26 sales companies worldwide. The company exports its products under the 'National', 'Panasonic', 'Technics', and 'Quasar' brands.

Main Products:
Consumer electronics, communications equipment, industrial equipment, electronic components, semiconductors, and laser equipment.

Incorporation: January 1, 1918

(Consolidated, in ¥million)

	3/1991	3/1990	3/1989
Net sales	6,599,306	6,002,786	5,504,250
Net Income	258,914	235,561	213,462

Mitsubishi Electric Corp.

Company Description:
Ranks third among comprehensive electric machinery makers. Top in defense electronics. Has tieup with Westinghouse (U.S.) in nuclear power. Friendly with Sperry Ranc (U.S.) in computers, but actually oriented toward compatibility with IBM. Bolstering semiconductors to catch up in field of electronics.

Main Products:
Industrial machinery, turbine generators, electronic equipment, programmable controllers, and semiconductors.

(Consolidated, in ¥million)

	3/1991	3/1990	3/1989
Net sales	3,316,243	2,976,420	2,716,818
Net Income	79,760	76,796	53,236

NEC Corporation

Company Description:
Manufacturer of computers, communications equipment and various electronics products. The world's largest producer of semiconductors and a recognized leader among Japan's high-tech industries, NEC Corp. relies heavily upon the sale of personal computer products, a product category in which the company enjoys a commanding market share and which has continued to exhibit strong growth. Systems integrating computers and communications equipment have been targeted for development as part of long range corporate strategy.

Main Products:
Computers & computer components, and communications equipment.

Incorporation: January 1, 1909

(Consolidated, in ¥million)

	3/1991	3/1990	3/1989
Net sales	3,316,243	3,444,177	3,082,800
Net Income	79,760	85,219	64,477

Ricoh Co., Ltd.

Company Description:
A leading supplier of office automation equipment, including copiers, facsimile equipment and data processing systems. The company is also involved in electronic devices and components, and is also known for its cameras. In fiscal 1991, copiers and related supplies provided 53.2% of net sales, communications and information systems, 33.6%, and other products, 13.2%.

Main Products:
Copiers and related supplies, facsimile equipment, data processing equipment, and other products.

Incorporation: February 6, 1936

(Consolidated, in ¥million)

	3/1991	3/1990	3/1989
Net sales	1,003,263	835,464	729,411
Net Income	13,557	15,871	17,795

Sony Corporation

Company Description:
Comprehensive electronics maker with a worldwide network of distributions outlets. The company's audio equipment still yields the largest percentage of sales but the company is moving into higher value-added lines of business including optical discs and materials for the communications industry. Sony made headlines with the multi-million dollar acquisition of CBS Records and is pursuing market share in the movie and home entertainment industries. Has recently developed a final version for the mini disc music recording format, and has entered licensing negotiations with EMI and Warner Music.

Main Products:
Household audio and video equipment, and electronic data storage media.

Incorporation: May 1, 1946

(Consolidated, in ¥million)

	3/1991	3/1990	3/1989
Net sales	3,690,776	2,945,242	2,201,472
Net Income	116,925	102,808	72,469

Toshiba Corporation

Company Description:
Toshiba is a major world electronics producer ranking second in Japan behind Hitachi. Through extensive R&D the company is advancing into high value-added information-related products. Expanding into communications field with overseas tie-ups with major foreign firms including Siemens, Olivetti, AT&T, and recently, IBM. The company will be a major competitor in the development and marketing of HDTV and broadcast satellites.

Main Products:
Information processing equipment and systems, Telecommunications equipment, Control systems, medical systems, semiconductors, automated equipment, electric tubes, other electronic components, power plant systems, industrial electrical apparatus, transportation equipment, machinery, household products, and lighting equipment.

Incorporation: July 1, 1875

(Consolidated, in ¥million)

	3/1991	3/1990	3/1989
Net sales	4,695,394	4,251,953	3,800,857
Net Income	120,852	131,836	119,402

Sources: COMLINE Corporate Directory, Japan Company Handbook, and S&P Corporate Descriptions

Appendix 2: Structured Interview Questionnaire

1. How are the general strategies and goals for overseas centers formulated? Do the overseas lab heads participate in strategy formation with the headquarters R&D organization?

2. How are budgets decided for overseas R&D expenditures? What, in general terms, are the expectations for changes over the coming five to ten years?

3. What are the criteria for assessing the performance of overseas R&D centers?

4. To whom do the directors of overseas labs report? What is the formal relationship between the central R&D centers and the overseas centers?

5. One of the major themes of current research in corporate strategy is the importance of strategic groups: that is, the set of companies that your own company uses to benchmark or assess its competitive strength and its performance. What companies are important points of reference for your company as you develop R&D strategies outside Japan?

Appendix 3: Structured Thesis Members and Thesis Titles

Cooper, Simon	"The Strategic Development of Offshore R&D Facilities by High Technology companies: TI and Hitachi - A Comparative Study"
Dewar, Bruce	"Internationalization of Research & Development: Identification of Trends and Issues"
Horowitz, Eduardo	"Technology Strategy and the Internationalization of R&D in the Japanese Electronics Industry"
Ijiri, Haruhisa	"Japanese R&D Centers in the United States: Their Role in the Evolution of Global Management"
Izquierdo, Armando	"Internationalization of Technology in the Oil Industry"
Jordan, John R.	"The Internationalization of R&D: Alignment of Strategy and Human Resource Management Practices"
Otterstatter, Jonathan	"Strategic Alliances: The Challenge of a Necessity"
Shryock, Richard S.	"The Internationalization of Japanese Research and Development: Strategy and Implementation"
Sommer, Robert W.	"Building Internal Knowledge Networks in the Multinational Corporation: A Study of International R&D"
Voisey, Christopher	"Issues in the Internationalization of Research and Development in High Technology Companies"
Wojciehowski, Bart	"Staffing Strategies for the Internationalization of R&D"
Yasseen, Fareed	"European R&D Efforts in the United States: The Case of Swiss Pharmaceuticals"

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