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THE GLOBALIZATION OF INDUSTRIAL R&D AND IMPLICATIONS FOR DEVELOPING COUNTRIES

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INTRODUCTION

The Globalization of Industrial Technology is part of a broader topic of The Management of Technology on a Global Basis that is of increasing concern to R&D executives and managers around the world. Under this broad top are usually included:

1. External Technology Sourcing on a Global Basis;
2. Conducting R&D through International Alliances, Joint Ventures, or Consortia; and
3. The Globalization of Industrial R&D.

The first two topics have already received quite a bit of attention[1] and have some specific implications for developing countries. Particularly for External Technology Sourcing on a Global Basis, if managers of these activities can be taken at their word, their search for desirable technologies today is truly world-wide and not limited to Europe and Japan. Countries such as Brazil, Korea, Israel, India, etc. are sometimes mentioned as sources of technology now, along with more familiar names such as Britain, Germany, Japan, etc.

This paper addresses the third element of Global Technology Management - the Globalization of Industrial R&D. It deals principally with conceptual development and the identification of specific issues and examples involved in the management of globalized, industrial R&D. Future work and papers will attempt to quantify and describe the extent and nature of globalized industrial R&D, to describe how global corporations are attempting to deal with and manage globalized industrial R&D, and to recount their experiences in so doing. Implications for developing countries will be discussed as the work proceeds.

GLOBALISM AND MULTINATIONALISM

In order to understand why the issue of managing global R&D is becoming so important, the distinction between the terms "global" and "multinational" must first be addressed. "Multinational" corporations have been around for some time, and "global" corporations are the more recent buzz word, but in both instances the terms are used to modify corporations, firms,

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[1] See two recent Managers at Work columns by Michael Wolff in Research and Technology Management, for example: "Forging Technology Alliances," May-June 1989, and "Plugging into Overseas Technology: 1990," March-April 1990.

or companies.

Bartlett and Ghoshal, for example, use these terms with the following meanings[2]:

Multinational Companies - that operate as decentralized federations of units able to sense and respond to diverse international needs and opportunities.

Global Companies - that operate from centralized hubs (in the home, headquarters country) on a tightly controlled worldwide basis able to capture the opportunities presented by global forces.

They go on to combine the differing strengths of both multinational and global companies in what they call:

Transnational Companies - that have the ability to manage across national boundaries, retaining local flexibility while achieving global integration; the ability to link local operations to each other and to the center in a flexible way, and in so doing, to leverage both local and central capabilities. Transnational companies maintain interdependence of resources and responsibilities among organizational units, exhibit strong cross unit integrating devices, and have strong corporate identities and a well-developed worldwide management perspective.

The "multinational" and "global" adjectives have also been used by various authors to modify nouns such as industries, competitors, technologies, markets, strategies, products, R&D, customers, businesses, etc. There is, as yet, no generally accepted, single, specific meaning of the terms.

Part of the problem is the level or unit of analysis. Rather than focusing on corporations or industries, it may be more productive to focus on "activities" (technologically and strategically distinct operations that are done by the firm - e.g., inbound material inspection, order processing, personnel recruitment, etc.)[3] This is because, as "global" and "multinational"

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[2] Organizing for Worldwide Effectiveness: The Transnational Solution," California Management Review, Vol 3, No 1, 1988.

[3] See Michael E. Porter's discussion of "value chain activities" in Competitive Advantage, The Free Press, 1985.

are defined below, it is apparent that firms which operate internationally conduct both global and multinational activities.

> Multinational activities then are activities performed in specific countries/regions where the purpose of the outcome or output of those activities is related primarily to those specific countries/regions - i.e., locally - whereas
>
> Global activities are activities where the purpose of the outcome or output of those activities is global in character. Global activities are also performed in specific countries/regions, usually for reasons related to the conduct of the activities, but it is how the outcome/output of those activities are intended to be used - globally rather than locally - that determines their global character.

With these definitions in mind, it should be apparent that some broad functions located in foreign countries, such as sales and after sales service, are likely to be multinational in character; that others, such as production, could be either multinational or global; and that still others, such as research, are likely to be global in character.

At the activity level, within the R&D function, and recognizing that R&D organizations might do activities other than R&D, it should be apparent that technology transfer, product adaptation, applications engineering, and technical services activities are likely to be multinational in character (the outcome/output is related to the specific locality); that applied research and new product development could be either multinational or global; and that research activities are likely to be global in character.

It is clear that U.S. and foreign firms operating internationally have had and managed global R&D for many, many years. With some significant exceptions, however, the global R&D has been centralized in the home or headquarters country, in corporate or division R&D organizations.

It is also clear that U.S. and foreign firms operating internationally have been establishing R&D activities in non-headquarter countries for some time. Again, with some significant exceptions, this foreign R&D has tended to be multinational in character. For example:

- to transfer product and/or process technology to foreign manufacturing units of the firm in the same country/region;
- to adapt products to local markets;

- o to do applications engineering for or provide technical services to local customers;
- o to develop new products designed for local markets;
- o to have products comply with local standards/regulatory/testing requirements;
- o to do applied research on a unique local problem/opportunity.

The cause of the recent concern about managing global R&D is not because of the newness of global R&D, but because of the recent trend to decentralize global R&D around the world, outside of the headquarters/home country! This is occurring as a result of conscious corporate policy and as a result of the evolution of foreign R&D units from multinational to global or mixed global-multinational status.

Although global R&D is not new to U.S. corporations with international operations, the extent and scope of it have been rapidly increasing as global markets and global competitors - particularly from Japan - have grown in importance. At the same time, scientific and technical capabilities and resources have also become global. From a position of un-challenged leadership in science and technology following World War II, the United States has become a first among equals in science and technology compared with Europe, Japan, and even some advanced developing countries, and in specific fields is lagging behind other countries. Thus the trend to decentralize global R&D among different countries has paralleled the need to increase and expand it.

Industrial R&D is globalizing and decentralizing internationally for the following reasons:

- o To locate near concentrations of state-of-the-art R&D activity in foreign countries - i.e., to be where the action is, where an R&D infrastructure is in place, where R&D services are present. For example, a diversified British firm has located an electronic gasses R&D unit in Japan because that is where the "maximum excitement" in this field is located. The output of this R&D is not related specifically to Japan, however, but to their global interests in electronic gasses.
- o To achieve efficiencies and create economies of scale in R&D

necessary to compete on a global basis - i.e., to rationalize multinational redundancies in R&D, to achieve critical mass in an R&D area, to be able to carry on R&D that is inherently large in scale and cost. For example, a major U.S. diversified firm is centralizing its biotechnology R&D in a foreign country partly for this reason.

- o To monitor and potentially access foreign sources of technology and technology development. Although this is not "R&D" per se, it is an activity often done by R&D personnel because they are in the best position to evaluate the meaning and significance of foreign technological developments. Many U.S. firms have established R&D organizations in Europe and/or Japan with this as o[illegible] of the explicit or implicit objectives, to obtain both technical and strategic intelligence for global purposes. A major Japanese electronics firm reportedly is establishing a copy of the old Bell Labs in Princeton as an "active window" to access U.S. brains, for example.
- o To take advantage of scientific and technical personnel factor prices and skill surpluses in foreign countries - e.g., to avoid perceived future shortages of scientists and engineers in the U.S. A major U.S. diversified firm is establishing a Technical Center in Japan at least partly to gain access to East Asian scientists and engineers.
- o To meet a unique R&D requirement that is satisfied in a foreign country. For example, to locate R&D on tropical plants with medicinal properties in a tropical country.

There are other reasons why R&D may be decentralized to foreign countries where the character of the R&D could be either multinational or global - e.g., to satisfy local R&D content requirements in foreign countries, to gain access to or prestige in foreign markets, etc.

(There are also other reasons why the globalization of industrial R&D is becoming more

important in the United States. For one, European firms appear to have a longer history and greater experience in locating global R&D activities in other countries - particularly in the U.S. An increasing number of global R&D organizations of European firms appear to be operating in the U.S. - e.g., the Siemens Research Center located near Princeton. For another, more U.S. firms with centralized, global R&D located in the U.S. are being acquired by foreign companies. When this occurs, the U.S. R&D organization suddenly finds itself as only one of several global R&D units being managed from a foreign headquarters.)

MANAGING GLOBAL R&D

The reason for the concern about the expansion of decentralized global R&D around the world is that the requirements for managing this new, evolving corporate R&D organization are much more difficult and complex. Figure 1 depicts what generically might be called the traditional structure of global-multinational R&D for a U.S. corporation with international operations.

In this traditional structure, global R&D is carried out exclusively in the home/headquarters country, either at centralized corporate or divisional R&D centers. Recognized problems involving the corporate-divisional interface when both are working in the same global R&D area notwithstanding, this structure is well known and R&D managers are relatively comfortable with it. The flow of information and technology outside of these centralized centers is generally vertical and down, to either global or multinational downstream activities. There may be some feed back flows going back up on a specific problem in Australia and there may be some attempts to transfer technology or know-how horizontally among multinational activities, but the primary flow is vertical and down.

Figure 2 depicts what the new/evolving structure of global-multinational R&D might look like when global R&D is decentralized outside the United states - in this example, to the UK, Korea, the USSR, and Germany. Although the U.S. global R&D unit situated at corporate headquarters will still probably be at the center of the global network, the new managerial challenge is to create the horizontal linkages among all global R&D units that are necessary to bring about integrated multi-disciplinary global research or global new product development, and then to be able to coherently transfer information and technology from the many points of this decentralized network vertically to global or multinational downstream operations.

Figure 1

Traditional Structure of Global-Multinational R&D
for a US Corporation with International Operations

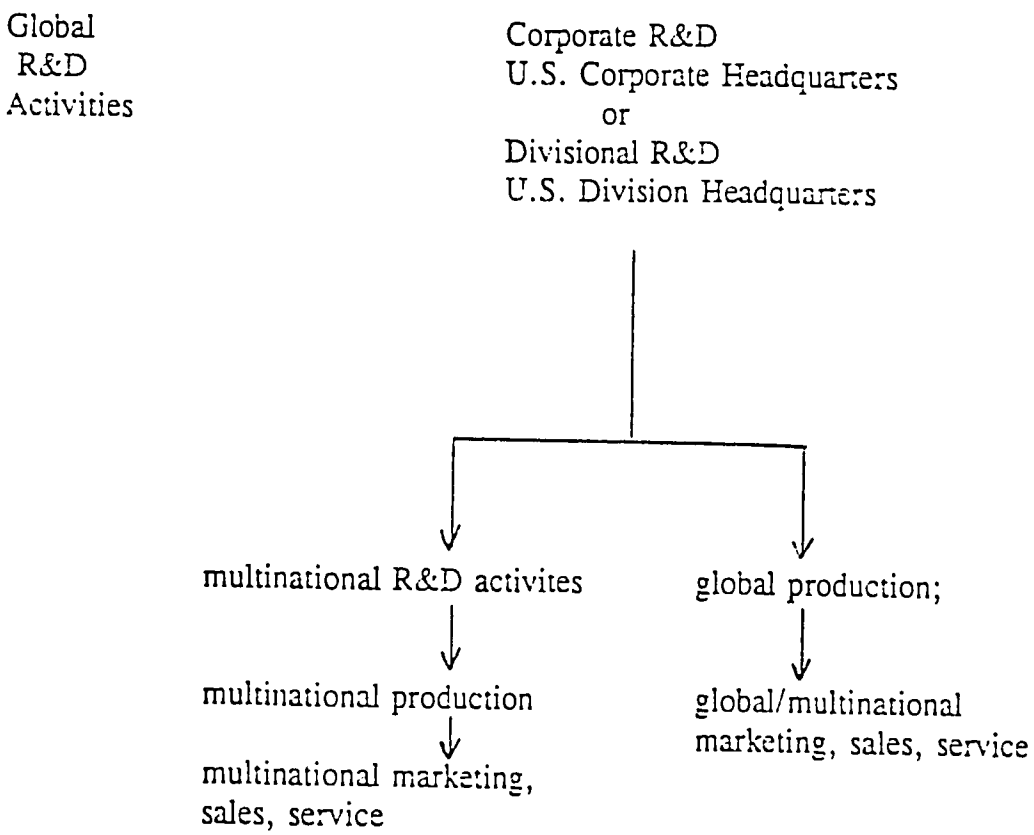
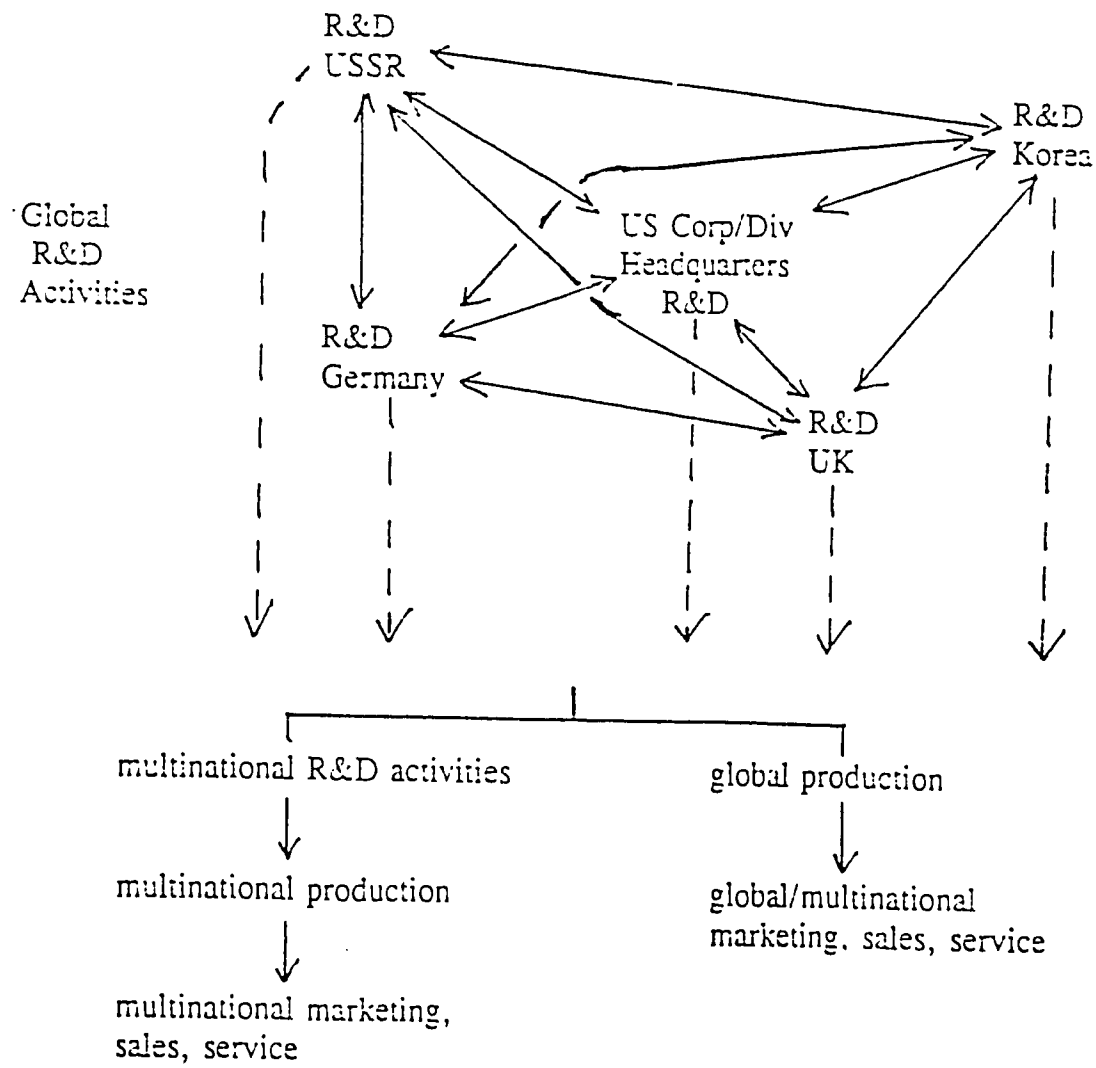


Figure 2

New/Evolving Structure of Global-Multinational R&D
for a U.S. Corporation with International Operations



The situation in Figure 2 is further complicated by the fact that, as has been discussed earlier, some foreign R&D units very possibly may have both global and local (multinational) R&D activities going on simultaneously (have both global and local missions/objectives) and other foreign R&D units may be only local (multi-national) in character. Therefore, the questions being raised are how to manage decentralized global R&D activities horizontally, decentralized global-decentralized multinational R&D activities vertically, and decentralized global R&D - production, marketing, service activities vertically.

The first of these questions, how to manage decentralized global R&D activities horizontally, appears to be of primary interest to many U.S. R&D executives. To put it another way, the question is how to create and maintain horizontal integration or horizontal linkages among decentralized global R&D activities.

The degree and nature of the complexity/difficulty of managing this horizontal integration of global R&D would appear to vary based on the degree of specialization of the foreign R&D organizations. At the two extremes of a spectrum there could be:

1. Narrow, disciplinary-or field-specific R&D activities located in foreign countries to be near concentrations of state-of-the-art R&D existing in those disciplines/fields, to achieve efficiencies and scale in those disciplines/fields, etc. The previously mentioned R&D unit on electronic gasses in Japan would appear to be of this type; and
2. Broad based, general purpose multi-disciplinary/field R&D activities located in foreign countries that appear to be organizational re-creations of centralized corporate/divisional R&D centers at home. These might have been located to establish a general R&D presence in a foreign country/region, to monitor the range of R&D/technology development going on in a foreign country/region, etc.

Managing the horizontal integration of decentralized global R&D activities of the one extreme can perhaps best be envisioned from the perspective of new product development - i.e., the conscious and systematic division of labor among specialized R&D units from around the

world and subsequent reintegration of effort along new product/new process lines.

For example, a global company establishes a software development and testing laboratory in India, a solar cell/battery R&D organization in France, an electronics R&D organization in Japan,a materials research center in the U.S., and a product/process engineering design center in Italy - and then has multi-development projects going on in each organization that must be horizontally integrated to create the latest new running shoes with continuous heart and blood pressure monitoring and early warning technology built in, plus a micro-pager that automatically notifies the nearest Emergency Room in case of a heart attack.

Managing the horizontal integration of broad-based, general purpose decentralized global R&D activities of the other extreme can perhaps be best envisioned from the perspective of R&D results/technical information sharing and coordination. For example, keeping the relevant people worldwide in the firm informed on the latest technical/strategic developments in a foreign country or region; or coordinating a research project among several biochemistry R&D units located in different countries/regions.

(A global "Skunk Works" team is an example of one way to attempt to achieve horizontal integration. By "Skunk Works," is meant any attempt to form a separate independent group, organized around the development of a specific product/process, given a budget and freed from normal organization or bureaucratic reporting requirements or "red tape." R&D project teams are similar in character, but are subject to normal R&D organizational/bureaucratic reporting requirements and red tape. Global skunk works teams would be made up of scientists/engineers from the different global R&D activities of the firm, worldwide. The team could be located anywhere in the world. Location criteria include the desirability for a skunk works to be separated from the normal R&D structure, and at the same time for its output to be able to be integrated back into the mainstream operations of the organization when the time comes.)

Managing multi-national R&D activities in foreign countries involves primarily managing each individual unit effectively within the context of its national and cultural environment in order to achieve its localized objectives. Secondarily, multi-national R&D management may also seek to transfer technology and know-how to other multi-national units.

Managing global R&D activities in foreign countries also involves managing each individual unit effectively within the context of its national and cultural environment, but in

addition involves aspects of cooperation, coordination, and communication with other global R&D units located in different places and working in other national/cultural contexts. The integration of the individual global R&D units and the subsequent transfer of results from this decentralized network to downstream operations poses significant new issues and problems for global R&D management. Technology can help, particularly computer and telecommunications technologies to download and transfer databases, have interactive CAD product design exercises, do video conferencing, etc. Still, this presents a significant cross cultural, across space challenge.

The biggest issue that U.S. R&D executives seem to focus on in this decentralized, global R&D conundrum is how to effectively cooperate, coordinate, and communicate across nationalities and cultures. (Since the U.S. technical work force is increasingly becoming multi-national, multi-cultural due to an increasing proportion of immigrants in scientific and technical fields, this aspect of global R&D is occurring to some extent within a U.S. context as well.) Some firms look at this issue as a problem to be resolved; others have an explicit corporate philosophy that looks at this issue as an opportunity to take advantage of the strengths that different cultures can bring to R&D.

MECHANISMS, BARRIERS, ASSUMPTIONS, AND QUESTIONS IN MANAGING GLOBAL R&D

Firms have attempted a number of cross-cultural linkage mechanisms to bridge these perceived gaps within the decentralized global R&D organization. Some of those cited include[1]:

- Promoting cross cultural networks at all levels
- Electronic communications systems - e.g., computer conferencing, electronic mail
- Education/training in foreign cultures or international topics
- Cross cultural composition of training classes in any subject - "It may be inefficient to do it this way, but there's a greater objective involved."

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[1] These examples are derived from the literature and taken from an R&D Executives Workshop on The Globalization of Industrial R&D in which this author participated.

- o Embed and emphasize social communications skills within other cross cultural integrating activities
- o Formally establishing English as the official language of the firm worldwide
- o Providing travel support for many kinds of cross cultural R&D meetings, face-to-face (committees, panels, task forces, etc.)
- o Cross national video conferencing
- o Rotating R&D personnel to new, foreign locations (length of assignment is key decision)
- o Making international experience an evaluation criteria in promotion decisions
- o Consciously forming multi-institute, cross cultural R&D project teams
- o Creating "Centers of Excellence" that do global R&D in areas of core competency of the firm
- o Picking members and managers of cross cultural R&D teams very carefully
- o Emphasizing the formal and structured aspects of cross national networking and assignments - e.g., explicit charters, regular meetings, specific agendas, specific assignments and due dates, etc. "If we do the formal aspects of cross cultural organization, the informal or social aspects will follow naturally."

The assumption underlying this perceived need for cross cultural, cross national linkage mechanisms is that there are cultural differences which act as barriers to horizontally integrating global R&D; barriers or issues or problems that must be resolved. As one R&D executive expressed it, outside of Anglo - U.S. interrelationships, there is a lack of "cultural comfort" in global R&D. Some specific barriers, problems, or issues that are frequently mentioned include:

- o R&D leadership in U.S. firms is too U.S. - it's up to other nationalities/cultures to think and act like Americans to make it work (a "national bias" in favor of headquarters)
- o Disputes about who's going to pay for global R&D
- o Government tax treatment of R&D in foreign and home/headquarters countries - how to do accounting and finance for global R&D
- o Difficulties in sorting out roles and responsibility for global R&D - who champions it? who decides who does what in a global allocation of effort? who

decides priorities and sets objectives?

- Who in the organization are the winners and losers in global R&D, and what will the losers do to stop/delay it?
- What are U.S. Governmental policy/political implications of industrial global R&D? (International competitiveness is the other side of globalization)
- How do we globally cooperate and nationally compete?
- Do we have R&D management job descriptions - and R&D managers - for global R&D?
- Will global R&D create new barriers to vertical transfer technology to downstream operations?
- How will global R&D affect universities? Will there be new tensions and problems? At the moment there's a large perceived imbalance in what foreign firms are getting from U.S. universities as opposed to what U.S. firms are getting from foreign universities.

In discussing these issues, problems in working with the Japanese are brought up time and time again. A number of frequently held stereotypical perceptions of working with Japanese scientists and engineers in a global R&D context include:

- The Japanese do R&D in a different way than we do - in thinking about R&D work, in the way things get done
- Japanese tend to maintain an appearance of order and tranquility in the laboratory, and let arguments and messes surface when drinking at night
- Japanese are reluctant to be up front with conflict, even when it obviously exists
- Japanese have a problem with eye contact - they won't look you in the eye and that causes problems for Americans
- Japanese will lie if it serves a higher order purpose, and they won't consider it wrong
- No matter how good they are in English, and vice versa, there will always be language problems in communicating with the Japanese
- Differences between Americans and the Japanese won't go away entirely, but if each side could come part way many problems would go away

Several research questions emerge from the above discussions. The high priority questions, when put in the proper sequence, form a logical progression of thought as shown below:

1. Under what circumstances and for what reasons does decentralized, global R&D become preferable to multi-national R&D? (How much of decentralized global R&D is a conscious policy decision of the firm as opposed to evolutionary developments of multi-national R&D?)
2. When decentralized global R&D is a conscious policy decision of the firm, how are decisions made as to where in the world to locate these global R&D activities? How should these decisions be made?
3. What are the major difficulties in managing decentralized global R&D?
4. What organizational structures, approaches, tools, systems, policies, mechanisms, values, etc. have proven to be effective in managing decentralized global R&D, and under what conditions? What Human Resource practices have proven to be effective?
5. How do differences among Basic R, Applied R, New Product Development, etc. affect the above questions?
6. How does global R&D relate to other aspects of Managing Technology on a Global Basis - i.e., to global external technology sourcing and global R&D joint ventures/consortia membership?

IMPLICATIONS FOR DEVELOPING COUNTRIES

Although global corporations have not yet established global R&D activities in developing countries in significant numbers, the trend toward the Globalization of Industrial R&D does present some potential opportunities for at least some developing countries. These opportunities are based on the following set of assumptions about attitudes and trends in U.S. R&D management:

- U.S. R&D managers/executives have discarded the presumption that foreign R&D was useful only for locally-oriented reasons or tasks. They have now accepted the prospect of establishing globally-oriented R&D activities elsewhere in the world.

- o U.S. R&D managers/executives are recognizing that an increasing number of state-of-the-art clusters of R&D activity are located outside of the United States.
- o U.S. R&D managers/executives are increasingly worried about the future supply (and price) of qualified scientists and engineers from the United States.
- o U.S. R&D managers/executives are under increasing pressure to rationalize their R&D organizations worldwide, to reduce R&D costs, and to raise R&D productivity.
- o U.S. R&D managers/executives already recognize certain specific developing countries as potential (or actual) locations for global R&D activities.

The developing country that is most frequently mentioned in this regard is India. Some of the features that attract U.S. R&D managers/executives to India include a surplus of well trained scientists and engineers, relatively low wage rates, English language in wide spread use, and an acceptable communications/transportation/political infrastructure.

There is now the opportunity for developing countries to decouple foreign industrial R&D investments in their countries from local industrial or agricultural development or markets - i.e., developing countries may be able to attract foreign industrial R&D investments simply by virture of national investments in educating and training R&D personnel and in creating an R&D infrastructure in specialized fields. Consciously attempting to create the conditions that would attract global industrial R&D to a country would obviously require significant and long-term commitment on the part of most developing countries. Attempts to assist in the evolution of locally located multinational R&D activities to a global R&D status might bring positive results more swiftly and less expensively.

SUMMARY AND CONCLUSIONS

This paper has outlined a new way to look at The Globalization of Industrial R&D. One way to approach "globalization" and "multinationalism" is from the level of the firm or corporation, as do Bartlett and Ghoshal and many others. Using this approach, firms are characterized as global or multinational according to a management structure that emphasizes

centralization, operating on a worldwide basis, or decentralization (worldwide), operating on a local basis. A third type of firm/corporation is then proposed, which combines the best features and advantages of the two management structures, which in Bartlett and Ghoshal's vocabulary is called the "transnational" firm.

In this paper, however, another way to approach globalization and multinationalism is proposed - from the level or unit of analysis of the activity. Using this approach, firms that operate internationally are seen to be conducting both multinational (locally oriented activity outputs/outcomes) and global (globally oriented activity outputs/outcomes) activities. Viewed from this perspective, it is not the existence of global R&D per se that is attracting management attention, but the fact that global R&D activities are being decentralized from the home/headquarters country of the firm around the world! Managing this decentralized, global R&D presents a more challenging management problem (or opportunity) than existed for either centralized, global R&D or multinational R&D - i.e., the development of horizontal integration among decentralized global R&D activities and the subsequent transfer of information or results from this decentralized global network to downstream operations. Whatever the firm which operates internationally may be called, it must recognize and manage both global and multinational R&D activities well. There are potential opportunities for developing countries to participate in this worldwide decentralization of global industrial R&D.

Bibliography

Christopher A. Bartlett and Sumantra Ghoshal, "Managing Across Borders: The Transnational Solution, Harvard University Press, 1989.

Christopher A. Bartlett and Sumantra Ghoshal, "Organizing for Worldwide Effectiveness: The Transnational Solution," California Management Review, Vol. 31, No. 1, 1988.

Christopher A. Bartlett and Sumantra Ghoshal, "Managing Across Borders: New Strategic Requirements," Sloan Management Review, Summer 1987.

Jack N. Behrman and William A. Fischer, Overseas R&D Activities of Transnational Companies, Fund for Multinational Management Education, Oelgeschlager, Gunn & Hain Publishers, 1980.

D. B. Creamer, Overseas Research and Development by U.S. Multinationals 1966-1975, The Conference Board, 1976.

Yves Doz, "International Industries: Fragmentation Versus Globalization," in Technology and Global Industry, Bruce R. Guile and Harvey Brooks (ed), National Academy Press, 1987.

Herbert I. Fusfeld, The Technical Enterprise: Present and Future Patterns, Ballinger Publishing, 1986.

Sumantra Ghoshal and Christopher A. Bartlett, "The Multinational Corporation as an Interorganizational Network," Academy of Management Review, Vol. 15, No. 4, 1990.

Sumantra Ghoshal and Christopher A. Bartlett, "Creation, Adoption and Diffusion of Innovations by Subsidiaries of Multinational Corporations," Jounral of International Business Studies, Fall 1988.

Sumantra Ghoshal and Christopher A. Bartlett, "Innovation Processes in Multinational Corporations," in Readings in the Management of Innovation, Michael L. Tushman and William L. Moore (ed), Ballinger Publishing Company, 1988.

Ernest R. Gilmont and Santhanam C. Shekar, "R&D in Europe: Linking Corporate Strategies with Technology Strategies," The Journal of European Business, September/October 1990.

G. Hamel and C. K. Prahalad, "Do You Really Have a Global Strategy?", Harvard Business Review, July-August 1985.

T. Levitt, "The Globalization of Markets," Harvard Business Review, Vol. 61, No. 3, 1983.

OECD, "Technology and the Process of Internationalization-Globalization," Chapter 9 of the Background Report resulting from the Technology Economy Programme, 17 September 1990.

Maurice Papo, "How to Establish and Operate Multinational Labs," Research Management, January 1971.

Michael E. Porter, The Competitive Advantage of Nations, The Free Press, 1990.

Bibliography (continued)

Michael E. Porter, "Competition in Global Industries: A Conceptual Framework," in Competition in Global Industries, Michael E. Porter (ed), Harvard University Press, 1986.

C. K. Prahalad and Yves L. Doz, The Multinational Mission, The Free Press, 1987.

Robert Ronstadt and Robert J. Kramer, "Getting the Most Out of Innovation Abroad," Harvard Business Review, March-April 1982.

Robert Ronstadt, "International R&D: The Establishment and Evolution of Research and Development Abroad by Seven U.S. Multinationals," Journal of International Business Studies, Spring/Summer 1978.

Robert C. Ronstadt, Research and Development Abroad by U.S. Multinationals, Praeger Books, 1977.

Candace Stevens, "The Restructuring of Europe: Regionalization vs. Globalization of Industrial Research," speech given at Semi Annual Meeting of the Industrial Research Institute, November 1990.

Vern Terpstra, "International Product Policy: The Role of Foreign R&D," Columbia Journal of World Business, Winter 1977.

Henry Wendt, "In a Transnational World, Restructuring Can Stimulate R&D," Research Management, March-April 1990.

D. Eleanor Westney and Kiyonori Sakakibara, "The Role of Japan-Based R&D in Global Technology Strategy," in Technology in the Modern Corporation, Mel Horwitch (ed), Pergamon Press, 1986.

"Multinational R&D In Practice - Two Case Studies," Research Management, January 1971.

"The Stateless Corporation," Business Week, May 14, 1990.