U.S. International Firms and R, D & E in Developing Countries

NATIONAL ACADEMY OF SCIENCES
Washington, D.C. 1973

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U.S. International Firms and R,D & E in Developing Countries

A Report of an Ad Hoc Panel of the
Board on Science and Technology for
International Development
With the collaboration of the
National Academy of Engineering

Office of the Foreign Secretary

NATIONAL ACADEMY OF SCIENCES
Washington, D.C. · 1973

This report has been prepared by an ad hoc advisory panel of the Board on Science and Technology for International Development, Office of the Foreign Secretary, National Academy of Sciences, for the Office of Science and Technology, Bureau for Technical Assistance, Agency for International Development, Washington, D.C., under Contract No. csd-2584.

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OFFICE OF THE FOREIGN SECRETARY

May 1973

Dr. Joel Bernstein
Assistant Administrator
Bureau for Technical Assistance
Agency for International Development
Department of State

Dear Dr. Bernstein:

I am pleased to transmit to you the report of the Ad Hoc Advisory Panel on the Role of U.S. Firms in Strengthening Industrial R, D & E Capabilities in Developing Countries, which met under the auspices of the Academy's Board on Science and Technology for International Development. The study was conducted in collaboration with the National Academy of Engineering.

International (or multinational) firms are now receiving attention in many quarters and from many angles. Not least among the issues under study is their impact on developing countries as leading purveyors of private capital and technology.

Some developing countries, believing themselves to be adversely affected by this flow of capital and technology, have introduced measures to bring it under tight control. Others ask whether they are taking maximum advantage of the unique capabilities and resources of the international firms to advance national development objectives. The debate engendered by these concerns has produced a climate of uncertainty and frustration with effects that may well be prejudicial to the interests of both the developing countries and the foreign investor communities.

To set the stage for discussion, the report highlights some of the larger issues in contention; then it focuses on one aspect of the U.S. firm-developing country relationship: its potential for strengthening indigenous research, development, and engineering capabilities. Despite its lack of prominence thus far, the panel believes that this area could significantly help bridge the interests of the international firm and its host country. In seeking to illuminate possibilities for mutually beneficial R, D & E efforts, the panel never lost sight of the imperatives motivating the two sides: the developing countries' determination to achieve technological progress and a measure of self-reliance and the international firm's accountability to its stockholders to operate at a profit. Citing many opportunities for constructive action, the panel stresses

the critical need for sustained dialogue in a spirit of goodwill and mutual accommodation.

We hope this report will contribute to the dialogue—indeed, that it will stimulate discussion in gatherings of corporate and developing-country representatives and interest institutions and consultative bodies in making such discussions possible.

Sincerely,

Harrison Brown
Foreign Secretary

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Introduction

A special panel convened in 1971 under the auspices of the Board on Science and Technology for International Development, Office of the Foreign Secretary, National Academy of Sciences, in collaboration with the National Academy of Engineering, at the request of the U.S. Agency for International Development, has produced this report on R, D & E in developing countries and the U.S. international firm.

Complying with its terms of reference, the panel brought together knowledgeable individuals "to examine the past and potential role of U.S. firms in strengthening the research, development, and engineering [R, D & E] capabilities in developing countries, and to identify the principal factors tending to promote or inhibit such a contribution."

The 15-member panel included 10 from industry—2 from each of five sectors: automotive-farm implements, chemicals, electronics-electrical products, food processing, and pharmaceuticals—and 5 academic members with professional interests in the subject. Petroleum, mining, and other natural-resource industries were not included in this study because of their special characteristics

To provide the panel with the views and experience of a broader cross-section of firms and individuals familiar with private investment and production in low-income countries, and in particular with the associated technological aspects, several advance meetings took place in Washington, Boston, and New York. These meetings brought together persons from industry, universities, foundations, and international agencies. Altogether, some 80 experts took part in the consultations.

Five such meetings were held, one for each of the five industry sectors chosen for attention. Each was built around the two panel members from an industry and at least one academic specialist and was attended by senior executives from leading corporations in the industry sector. Approximately ten firms took part in each industry meeting. At the end of each session participants were requested to submit written contributions. One session was held with members of the management-consulting and technical-advisory community.

The full panel membership then met for 2 days to review the findings and written contributions emanating from these consultations, to establish a format for this report, and to formulate recommendations in general terms.

POINT OF VIEW

The panel approached its task fully aware that the questions before it could not be viewed apart from the increasingly tense relations between the international investor community and the less developed countries. Because these tensions impinge so forcefully on corporate attitudes and plans, both the panel and the consultants gave them careful consideration. Areas of tension are discussed in the chapters that follow.

Because the panel was composed entirely of North Americans, it could be accused of a one-sided view of strongly contended issues. The panel, however, had the benefit of detailed exposition, and frequent reiteration by the chair, of perspectives and attitudes prevalent in less developed countries. Academic members, participants in the consultations, and especially the recent, highly articulate writings of opinion leaders in the less developed countries—all presented the views of the other side. Some of the writings were supplied as briefing materials to all participants before the meetings (see Appendix A). Developing country views on the value, costs, and role of private foreign investment and of their own evolving concerns with scientific and technological development are on record, and that record was on the table.

In its efforts to respond to the demands and aspirations of developing countries, the panel had to be guided by what collective international experience has shown to be achievable and mutually beneficial to host country and investor companies alike. Its insistence on "workability"—a characteristic of successful industry performance—helped ensure realism in assessing the limits of private sector action and, within these limits, the potentials for present and future action.

However sensitive panelists were to commercial and financial realities, they could not be oblivious to the changes overtaking the corporation in U.S. society. In the past decade, especially the last few years, social, political, and economic pressures of growing intensity have induced, often compelled, adjustments in the corporation's relations with local, national, and international communities. The issues of minority rights, consumer preferences, environmental protection, stockholder representation, and other "quality of life" concerns are altering the policies and practices of many corporations. Such adaptability reflects the corporation's character as an ongoing, flexible instrument of production and service. It is doubtful, however, that all the changes in corporate outlook and behavior at home have been conveyed to, let alone adopted by, the many dis-

persed operations of U.S. firms abroad. But the serious response to the gathering pressures at home suggests the same reaction is possible abroad.

TERMINOLOGY

Although this report avoids technical jargon, some terms, as used herein, probably need clarification: *research, development, and engineering (R, D & E); less developed countries (LDCs); U.S. international firms; technology; innovation;* and *diffusion.*

Research, development, and engineering (R, D & E) constitute a spectrum of often overlapping activity associated with the industrial process. In this context, *research* is applied research, which is directed toward practical applications of scientific knowledge—in contrast to basic research directed toward increasing scientific knowledge. *Development* is the systematic use of knowledge gained from research for the production of useful materials, devices, systems, methods, or processes, exclusive of design or production engineering. The *engineering* aspect of development is concerned with actual construction, assembly, layout, and testing of models for pilot processes and procedures—to produce a system that will work. As explained in this report, the experience of developing countries at the individual-enterprise level suggests that the R, D & E sequence is usually reversed; acquisition of capabilities proceeds from E to D to R.

Less developed countries (LDCs) are the low-income, not-yet-industrialized nations of Africa, Asia, and Latin America, often referred to as "low-income" or "developing" countries.

Because a term embracing Brazil and Botswana, India and Upper Volta, Chile and Chad needs further refinement, the panel distinguished three types of LDCs:

1. More advanced LDCs—such as Argentina, Brazil, India, Mexico, and Taiwan—with significant industrial, educational, and technological capabilities. A modern industrial-technological structure, particularly in the major urban centers, may coexist with widespread rural poverty, a situation that results in large-scale rural-urban migration to overcrowded favelas or bustees in and around cities.
2. The largest group of LDCs includes countries such as Morocco and Indonesia, where capital formation, industrialization, education, and technological capacity are rising, but modern industrial establishments are few in number and small in size.

3. The least developed nations are 25 poor countries identified by the U.N. Committee for Development Planning–8 in Asia and Oceania, 16 in Africa, and 1 in Latin America. They are largely rural and virtually without industry or a technological structure.

U.S. international firms–often called "multinational corporations (MNCs)"–are U.S. firms that operate transnationally, in marketing and in manufacturing industrial products. Most corporations engaging in manufacturing and R, D & E abroad are large in terms of sales ($100 million or more annually) and worldwide in spread. However, this report is concerned not only with corporations that are large in terms of sales, but also with many smaller ones.

Raymond Vernon says:

> . . . As a rule multinational enterprises exude an aura of strength and flexibility. These attributes seem to come partly from the fact that the constituent parts of the multinational enterprise generally consist of corporations, that those corporations are of different nationalities, and that their assets are located in a number of national jurisdictions.
>
> They sprawl across national boundaries, linking the assets and activities of different national jurisdictions with an intimacy that seems to threaten the concept of the nation as an integral unit. Accordingly, they stir uneasy questions in the minds of men. Is the multinational enterprise undermining the capacity of nations to work for the welfare of their people? Is the multinational enterprise being used by a dominant power (read "United States") as a means of penetrating and controlling the economies of other countries?[1]

Technology is the application of knowledge to new ways of doing things. It is distinguishable from science, which produces new knowledge, although science and technology form part of a single system interacting with other systems in national and international frameworks. The two principal sources of technical knowledge are invention through discovery or experiment, and innovation or adaptation to meet new needs or modified conditions. The interdependence of science and technology requires, among other things, links between industrial firms and universities.

Innovation is the act or process of giving a new idea or an invention an economic impact. Because the proof of innovation lies in successful economic application, innovation is directly related to economic growth and development, the central concerns of the LDCs. Technical innovation can save resources, time, or costs. The same industrial good may be produced at different scales and by different production techniques. Implicit in alternative tech-

[1] Raymond Vernon. *Sovereignty at Bay: The Multinational Spread of U.S. Enterprises.* New York/London: Basic Books, Inc., 1971. pp. 4-5.

niques are varying combinations of labor, management, equipment, materials, and land. Qualitative differences in labor skills, industrial management, available materials and other producers' goods influence the relative cost and efficiency of a particular technology.

The Organisation for Economic Co-operation and Development (OECD) uses *innovation* in a similar way:

> Technological innovation is defined as the first application of science and technology in a new way, with commercial success. It always requires the existence of three factors: scientific and technological capability, market demand and an agent to transform this capability into goods and services which satisfy the demand. In the OECD countries, this agent is the industrial firm, whose incentives are competition and the quest for profit. Innovations may lead either to the creation of a new product or to a reduction in the manufacturing costs of an existing product.[2]

Diffusion is the process whereby a technical innovation is transferred from one nation, section, or industrial enterprise to another. In considering problems of technological transfer, a basic distinction needs to be drawn between the transfer of technology embodied in products and equipment and the transfer of the capacity to adapt and absorb technology, especially engineering and design capabilities. In the transfer of usable technology, the role of the technical entrepreneur is critical, along with a market opportunity at a particular time.

[2] *The OECD Observer.* Paris. No. 54. Oct. 1971. p. 10.

I

Summary

Improving the efficiency and effectiveness of industrialization programs has become of increasing concern not only to economic planning authorities in less developed countries (LDCs) but to political and opinion leaders as well. The reasons for this heightened concern with types and techniques of production include

- The desire to save foreign exchange and other scarce resources by developing a more efficient range of industries that produce, primarily for sale in the domestic market, goods that would otherwise be imported;
- The desire to earn more foreign exchange by producing with the requisite efficiency goods that can be sold on world markets;
- Greater sensitivity than ever before to the need for reducing unemployment and underemployment, upgrading skills, distributing income more equitably, and having available an array of products suitable for purchase by low-income groups as well as the more affluent citizens of the country.

The implications of these developments for U.S. firms interested in selling to, or manufacturing in, LDCs are far reaching. Governments of LDCs want foreign enterprise to assist them in (1) implanting indigenous capability to adapt technology to their particular needs, (2) training research and engineering personnel to perform a wider range of adaptive engineering, and (3) enabling enterprises in LDCs to acquire, control, and use more industrial technology.

The actual role U.S. firms have played in strengthening research, development, and engineering (R, D & E) in LDCs has varied greatly, depending on corporate philosophy, the "systems dependence" of the corporation's product or products, and the hospitality of the local environment for R, D & E work. Size of market and stage of industrial development of the host country are also important elements.

Except for the engineering involved in scaling down production techniques for markets of more limited size and in making modest adjustments to consumer tastes, little R, D & E has actually been carried out in the LDCs. In regard to any immediate expansion, most corporations consulted were skeptical

either of the existence of many remunerative opportunities or of the readiness of the environment for undertaking R & D efforts beyond the required engineering (E) phase. A few firms (particularly in the pharmaceutical industry and, to a lesser extent, in the food-processing and automotive industries) felt there was room for a considerable increase in current R & D activities in LDCs.

Most U.S. firms listed certain preconditions for any significant expansion of R & D efforts by their foreign affiliates. A foundation of mutual respect and understanding between foreign corporation and host country is an essential base for undertaking pilot projects and developing programs that would be advantageous to both parties. Reasonable stability and predictability in the economic environment—or at least an absence of zigzags in policy that make forward planning futile—are essential if U.S. firms are to make long-term investments and commitments in R, D & E in LDCs. An adequate patent system was also emphasized as a precondition, especially by the pharmaceutical industry and, to a lesser extent, by the chemical and the electronics-and-electrical-products industries. Almost all panelists stressed the need for a system of industrial standards, particularly if products manufactured in LDCs are to compete in world markets.

If host countries insist on licensing and permit little or no foreign equity, they must be prepared to move forward with less advanced, or "open-market," technology and perform for themselves many of the services a foreign partner normally provides. Moreover, if they intend to imitate the Japanese system of limiting foreign investments in favor of licensing arrangements, they must first reach the threshold of absorptive capacity for new technology from which the Japanese were able to launch their spectacular forward thrust of the last 20 years.

Industry must go through certain evolutionary phases before it is ready to make commercial use of R & D efforts. As in the United States, so in the LDCs, the development of basic engineering capabilities—the ability to manage quality-control systems, introduce materials specifications and standards, maintain tool shops, and establish other production-support activities—normally must precede more ambitious developmental and applied research on product design, new materials, equipment design, and other changes in production or processing techniques. In other words, the logical and chronological sequence is E, D & R rather than R, D & E.

Just as there are facts of life that LDCs must recognize if they wish to speed up their industrialization, so there are facts of life to be recognized by foreign investors. LDCs are determined to process more of their own raw materials; to decrease their dependence on foreign technology and their extreme vulnerability to minor changes in the economic situation or the consumer preferences of the already-industrialized nations; and to assert their sovereignty

in a variety of ways that cause difficulty for traditionally minded foreign enterprises.

The panel recognized that although the policies of each LDC will determine its relationship with the outside world, forward-looking behavior on the part of U.S. international firms could influence and help shape the policies that are ultimately adopted. Believing confidently that U.S. international firms in some cases already have played, and in more cases can play, a major role in the transfer to, and improvement of, technological capabilities in LDCs, the panel recommended measures designed to reduce tensions and improve working relations. Following are the key recommendations:

- All concerned should recognize that R, D & E is a complex, time-consuming, and costly activity that requires a stable, long-term, and open relationship between the host nation and the investor.
- U.S. firms should relate their affiliates' activities to host countries' development goals, priorities, and strategies.
- Host countries should encourage this process and establish mechanisms that foster consultation and interaction among the government, the scientific sector, and the productive sector.
- Governments of LDCs are urged to improve the ties between their local research services, including universities and institutes, and the private productive sector.
- U.S. firms are urged to explore a range of activities that could be undertaken within the limits of a profit-making, local enterprise—such as close analysis of local development needs and resources as a guide for selective R, D & E activities; an active collaboration with local universities and research institutions; strengthening of local affiliates' personnel in R, D & E; deliberate programs to implant technological capability; and expansion of programs in adaptive technology.
- The panel recommended further actions that U.S. firms could take, if externally funded, in applying their resources to joint R & D efforts with local governments and with other industries, foreign or domestic; projects for training local research personnel; and the gathering and dissemination of technological information useful to the LDC.
- To facilitate these and other R, D & E activities, the panel recommended that international organizations and agencies of developed countries provide a range of financial incentives and forms of funding.

The panel considers this report only a first step in a continuing process of consultation and analysis involving U.S. firms, other private producers, and public authorities in LDCs.

II

The Setting: Conflicts and Possibilities for Cooperation

The panel took up its task confident in the belief that U.S. international firms play a significant role in the transfer, diffusion, and growth of technology in the less developed world. This role is difficult to portray quantitatively since few of its characteristics lend themselves to statistical definition or data collection. The pool of technology in any given country is fed from many streams; it is virtually impossible to separate the technological impact of U.S. firms from that of firms of other nationalities. Therefore, what is said of U.S. firms may apply to other corporate purveyors of technology.

There is a natural inclination to treat questions of economic development and the practices of aid-giving and aid-using countries from a public-sector perspective, that is, as responsibilities and concerns of government. The public transactions involved are often large, and subject to considerable scrutiny. Flowing through official channels as grants, loans, and technical assistance, they are programmed to meet specific development problems that have been identified and agreed upon by donors (bilateral and multilateral) and recipient governments.

Although private foreign investment is known to bring vital, complementary resources to the LDCs, it usually enters the development calculation only in terms of total capital flows. Having a logic and motive of its own, it is generally thought unsusceptible to being oriented, much less fine-tuned, to serve specific public needs of the LDCs.

In sum, public aid is "administered"; private investment, at best, is "encouraged."

The panel has tried to learn to what extent and in what ways private foreign investment in the developing world, beyond its immediate reasons for being

there, can assist host countries to realize developmental goals that call for competences foreign firms are uniquely able to contribute.

The question has been made timely by the conjuncture of several historic trends and movements that have made relationships between industrialized countries and LDCs, and the place of private foreign investment in such relationships, increasingly sensitive and controversial. Indeed, the panel's charge acquires its true significance only when viewed against this background.

UNDERLYING TRENDS

Briefly stated:

- The role of science and technology in nation building is now recognized by leaders in most LDCs. But emphasis on science and technology will not of itself contribute significantly to economic and social development; science, government policy, and effective production methods must be integrated.
- The pace of scientific and technological advance is accelerating in the industrial or "postindustrial" world, thus widening the gap between the more developed countries and the pre-industrial, or less developed, countries. The LDCs must establish links with technologically advanced societies, even though their technological requirements are vastly different from those of the societies to which links must be forged.
- Environmental concerns are injecting new unknowns into the technological and economic equations of both the industrialized and the less developed countries. In the industrialized nations, the problems of resource conservation, waste, and degradation of the environment have raised subtle and complex questions about the direction and control of technology, the social costs, and the growth limits of a highly industrialized society. The results will affect the pattern of world trade, the availability of capital, the international distribution of industry, the competitive position of different countries, and the comparative costs of production. All will directly affect the LDCs.
- The growing international corporate system with its transnational capabilities, resources, and markets is at odds with traditional concepts of the sovereignty and the regulatory powers of nation-states. At home and abroad, the related tendencies to examine, criticize, and in some cases restrict the activities of U.S. international firms—the so-called multinational corporations—create a climate of uncertainty for these firms.
- Political and economic relations of all kinds between the rich industrialized nations and the far more populous, less affluent pre-industrial nations have become more difficult. Two expressions of the change are reduced real levels of official development assistance and great hesitation on the part of the United States to make its domestic markets readily accessible to manufactured products from poor countries.

• Until quite recently, poor countries expressed their development goals almost entirely in terms of growth in gross national product (GNP), overall or per capita. Now they are much more concerned about reducing unemployment and underemployment, distributing income more equitably, and generally increasing social justice.

• Nationalism appears to be increasing in the less developed world, expressed in part by demands for a greater indigenous scientific and technological capability and a rapid decline in dependence on the already-industrialized nations.

Of greatest importance for this study are the divergent interests and attitudes of LDCs and international investors, the latter represented significantly, but not wholly, by U.S. firms. The full range of differences, however, is beyond the scope of this report; moreover, the differences vary widely among countries and companies. But it will be necessary to examine specifically certain issues that have set LDCs and international firms at odds, if the later discussion of R, D & E is to be relevant and contemporary.

LDCs are determined to strengthen their capabilities in R, D & E for two reasons: (1) to become better able to evaluate, select, and absorb incoming technologies; and (2) to achieve enough self-reliance to innovate on their own, thus lessening their dependence on imported technology. In many LDCs, foreign firms account for a significant portion of industrial output, generally the major part of capital and intermediate goods. They are seen, therefore, as vital to the dynamic interactions of industry, government, and the universities that are necessary to build the scientific and technological foundations of an LDC. The expectation that U.S. international firms can aid their host countries in this objective puts the issue of R, D & E in a strategically sensitive spot, which can influence the outcome of the larger contest between foreign investors and host governments.

DIVERGENT INTERESTS AND ATTITUDES

In the world economy U.S. international firms represent an exceptional assembly and integration of resources: managerial, technical, market-building, and problem-solving. Operating largely under the discipline of profitable performance, they are a powerful instrument for innovation and economic growth. The rigorous tests engendered by competition ensure a level of competence and even excellence in the execution of their industrial and commercial functions. Exacting methods of control and accountability usually identify error, waste, and substandard performance.

These firms have demonstrated their ability to carry scientific discovery through the time-consuming, complex, risky, and expensive process of successful, profitable innovation. This unique capacity enables such corporations to serve effectively as agents of capital formation and self-generating economic

growth. Frequently, the corporations' foreign investments have complementary backward and forward linkages to supplying firms and to consumers, which multiply their innovative impact on the economy.[3]

International corporations are important agents of change in the developing world, but they are not customarily concerned, let alone accomplished, in analyzing and measuring the social and developmental consequences of what they do or what they produce. Assuming such monitoring to be the function of the host country's citizenry and various levels of government, they tend to let market forces or economic regulations determine their behavior.

The LDCs are in the process of redefining development theory and practice in the face of severe internal problems and tensions. In broadening development goals to embrace more than increases in GNP, they are giving priority attention to alleviating mass poverty and its symptoms—hunger, malnutrition, disease, illiteracy, squalor, urban blight, rural stagnation, and massive unemployment. Confronted by rising numbers of people unaffected by the development process and therefore worse off when compared to those who have benefited, governments must seek ways to provide "a minimum bundle of goods and services . . . to the common man."[4]

These social and political imperatives have given new strength to the LDCs' demands for

- Increased technical assistance and development financing,
- Easier access to the industrial world's markets,
- A higher share of income from the natural resources supplied by LDCs,
- Improved efficiency in their industrialization through expanded export production and better selection of import-substitution industries, and
- Greater self-reliance in using science and technology for development.

[3]International firms are . . . increasingly being used as instruments to create markets of a dimension and complexity that would be unattainable by operating or exporting from a single country only. By operating on a world scale, the company enjoys a volume of international demand that is not only greater in itself but also less liable to wide fluctuations.

An increasing part of industrial R and D in the member countries [of the OECD] is carried out by international firms. These firms are becoming an important and effective instrument for transferring and diffusing technology throughout the world. The efficiency of the transfer process is due largely to the complex network of relations linking parent company to its subsidiaries, including the movement of people from one activity to another within the firm . . . .

The importance of these transfer mechanisms cannot be overrated. They have been a powerful factor in the world wide diffusion of technology and have brought important benefits to the recipient countries in economic growth, greater efficiency and new consumer products . . . .

(*Science, Growth and Society: A New Perspective.* The "Brooks Report." Paris: Organisation for Economic Co-operation and Development, March 1971. p. 75.)

[4]Mahbub ul Haq. "Employment in the 1970's: A New Perspective." *International Development Review.* Washington, 1971/4. p. 12.

In reassessing their development goals, many LDCs are concluding that multinational corporations do not meet, or do not meet adequately, some of their overriding needs. For example, the technologies of international firms tend to be capital-intensive and labor-saving. The companies provide costly consumer goods for the affluent but fail to meet the simpler needs of the masses. They are said to keep key jobs in the hands of foreigners. As development policies shift toward the promotion of employment and more equitable income distribution, both governments and industrial firms will need to gain new understanding of the technical and economic potentials, as well as the constraints, inherent in the adaptation of technology to such objectives.

THE POTENTIAL FOR CONFLICT

In the extreme view, the interests and objectives dividing foreign investors and LDCs seem irreconcilable.

A leading western economist puts the contribution of foreign direct investment to development in the following unequivocal terms:

> The corporation's concern in establishing branch operations in a particular developing economy is not to promote the development of that economy according to any political conception of what development is, but to make satisfactory profits for its management and shareholders. Its capacity to make profits derives essentially from its possession of productive knowledge, which includes management methods and marketing skills as well as production technology. It has no commercial interest in diffusing its knowledge to potential local competitors, nor has it any real interest in investing more than it has to in acquiring knowledge of local conditions and investigating ways of adapting its own productive knowledge to local factor-price ratios and market conditions. Its purpose is not to transform the economy by exploiting its potentialities–especially its human potentialities–for development, but to exploit the existing situation to its own profit by utilization of the knowledge it already possesses, at minimum cost of adaptation and adjustment to itself.
>
> The corporation cannot be expected to invest in the development of new technologies appropriate to the typical developing country situation of scarcity of capital and abundance of unskilled, uneducated, illiterate labor and in the mass training of blue collar, white-collar and especially executive local personnel. It has at its disposal an effective technology appropriate to the capital and skilled-labor-abundant circumstances of the developed countries. Hence, it will invest in technological research on the adaptation of its technology and in the development of local skills only to the extent that such investments hold forth a clear prospect of profit.[5]

[5]Harry G. Johnson. "The Multinational Corporation as a Development Agent." *Columbia Journal of World Business.* May-June, 1970. p. 26. Compare Johnson's views with the more sanguine outlook of the "Pearson Report." (*Partners in Development.* Re-

Increasingly critical spokesmen for the developing world demand adjustments in the present system of international economic relations. For example:

> Whatever the case, the era of "creating favorable business conditions for direct foreign investment" as a general policy seems to be coming to an end. But even then, as is seen more and more with the socialist countries, possible cooperation with foreign firms is not totally excluded, even though there will certainly be little place for wholly owned subsidiaries of foreign firms or private foreign investment of the traditional kind. What is opening up is a new era of hard bargaining and negotiations, of pragmatic and detailed considerations of specific cases, of weighing the conditions offered by Japan, Europe, the socialist countries and the United States, of building up alliances with countries with similar interests (the Andean Pact, the Special Co-ordination Commission of Latin America, the Organization of the Petroleum Exporting Countries), etc. In short, what we are seeing is the assertion of interest of our countries in their international economic relations. The aim is greater autonomy, in order to achieve development without "dependencia" and without marginalization. To achieve this goal, the asymmetrical nature of the present system of international economic relations must first undergo a thorough reform.[6]

To obtain a clearer understanding of the potential for collaboration and beneficial relationships, it is useful to examine carefully the factors making for conflict, as well as the possible courses toward resolution. Both are summarized in Table 1, "LDCs and MNCs: Conflicts and Conflict Resolution."

In the short term, multinational corporations (MNCs) seek to maximize revenues and minimize costs on a global scale. This involves questions of tax incidence, allocation of overhead expense items, transfer pricing, and flows of credit and currency. LDCs are concerned with the net social profitability of the activities of foreign enterprises, and this includes effects on national income, employment, balance of payments, and consumer welfare.

In the longer term, the LDCs' development objectives and strategies often conflict with global corporate strategies and operational modes. LDCs, on the one hand, seek to (1) increase the productivity and competitiveness of domestic industry; (2) develop capabilities and skills of their human resources; (3) acquire appropriate technology and an indigenous R, D and E capability; and (4) decrease dependence on foreign technology and related industrial-support activities. Corporations, on the other hand, are interested in selling goods and services at a profit and maintaining equity ownership, managerial

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port of the Commission on International Development. New York, Washington, D.C.: Praeger, 1969. pp. 16, 99-123.)

[6]Osvaldo Sunkel. "Big Business and 'Dependencia'–A Latin American View." *Foreign Affairs.* April, 1972. p. 531. The Specialized Conference on the Application of Science and Technology to Latin American Development (CACTAL) in Brasilia, Brazil, May 12-19, 1972, continued the dialogue along these lines. Excerpts from CACTAL's Final Report are in Appendix C.

controls, and flexibility. (This includes patent and other industrial proprietary rights.) The corporations also have a vital interest in the long-term development of the global corporation's human resources and physical assets.

Implicit in these different sets of objectives are two major categories of potential controversy that if unresolved could lead to confrontation or even conflict. First, the issue of social benefit versus corporate profitability: LDC efforts to maximize employment may add to corporate production costs, or the production of luxury goods by corporations may neglect the need for mass-produced goods for low-income groups. Second, the potential conflict between national sovereignty and corporate ownership and control: at issue are governmental controls over foreign investment and screening of acquired technology in terms of decreasing dependence on foreign enterprise and developing indigenous technical and entrepreneurial capabilities. LDCs want foreign investors to provide stimulus and technical assistance to local enterprise instead of stifling local enterprise and preempting its inputs and markets.

MITIGATING THE CONFLICT: TOWARD MUTUAL UNDERSTANDING AND ACCOMMODATION

The wide disparities between market performance and social needs in LDCs suggest that corporations must find ways to anticipate and then to monitor the effects of their operations and their products on national populations. Prudent self-adjustment by corporations, using management methods in which they excel, should avoid costly collisions with local authority. Such probing, problem-anticipating styles of operation, aided by the R, D & E function, may ease the built-in conflict between a profit-maximizing foreign investor and a government seeking economic growth with social justice.

International corporations are likely to find that LDCs will (1) continue to seek to enhance their bargaining power vis-a-vis foreign enterprise, (2) seek to maximize the benefits derived from MNCs without becoming dominated by MNCs or permitting disruption of their societies or economies, and (3) continue to look for alternatives to foreign private investment to provide a continuing flow of industrial technology and an expanding access to world markets. LDCs, on their part, should understand and expect that the management of a corporation has a basic responsibility to its stockholders to maximize long-term profits within a reasonable concept of international social responsibility. Much of what corporations are able to contribute will depend also (1) on the LDC's stage of industrial development, including its absorptive capabilities for technology in various industrial fields, and (2) its government's competence and expertise in managing the economy and in bargaining with foreign enterprise.

LDCs also must recognize that reductions in the flow of foreign private investments will not necessarily be offset by increases in public resource transfers.[7] At the same time, the international firms must realize that if and when more LDCs are able to mobilize their collective bargaining power, as the petroleum-exporting countries have done in negotiating over oil prices, the low-income world may exact similar levies for other raw materials and commodities.

If potential conflicts are to be avoided, or at least mitigated, the starting point must be understanding of and respect for the other's objectives and operational constraints. LDCs are understandably resentful of "tokenism" in meeting their social and economic needs and aspirations. A willingness on the part of both sides to explore and experiment should prove helpful.

One important path for this exploratory effort is for both parties, given the needs and goals of the host country, to consider their relationship not merely in terms of the character of investments now in place, but also in terms of the character of further investments to be made. This focus on the future is required by the accelerating rate of change and the need for time to solve problems. It will give both host countries and foreign investors the opportunity to explore new modes of operating. The very commitment to joint consideration of problems implies mutual adjustment and continuity.

The LDC's current concerns with unemployment, burgeoning urban centers, rural stagnation, poverty, and malnutrition suggest some broad fields in which the foreign investor might make a positive contribution. Many U.S. international corporations face these or analogous problems at home or in other countries in which they operate. Their willingness and ability to join with local agencies, investors, and institutions in addressing these problems, particularly through the application of their R, D and E resources, could have a significant bearing on their future relations with host countries.

OBJECTIVES OF THE HOST COUNTRY

Specific objectives of the host countries to which some U.S. firms are contributing through R, D and E and other supporting activities, and to which more firms could contribute, include the following:

- Additional processing in the host country of indigenous raw materials;
- Manufacture of components and parts for the world market;

[7]Robert S. McNamara, President of the World Bank, in his "Address to the U.N. Conference on Trade and Development" (Santiago, Chile, April 14, 1972) indicated that the total "official development assistance" was likely to average 0.35 percent of donor-country GNP, rather than 0.7 percent, the widely publicized target for the 1970s.

TABLE 1. LDCs and MNCs: Conflicts and Conflict Resolution

LDCs	Potential Conflict	MNCs
1. *Social cost-benefit*	vs.	*Profit-maximizing strategies*
- national - employment - balance of payments - consumer welfare		- global revenues & costs - allocation of overhead - tax incidence - credit and currency flows - transfer pricing
2. *Long-term development goals*	vs.	*Global strategies & operational modes*
- increased productivity & competitiveness of domestic industry - development of human-resource - skills - environmental preservation & resource conservation		- selling packages of goods & services that will maximize long-term corporate earnings - develop corporate resources & capability to support long-term goals and strategies
3. *Sovereignty & economic independence*	vs.	*Corporate ownership & managerial control*
- controls over foreign investment - screening of acquired technology - develop local enterprise & technological capabilities		- maintain proprietary rights over industrial assets & capabilities - maintain managerial control & flexibility in allocating corporate resources on global basis

Conflict Resolution

Mutual respect and understanding for each other's objectives and constraints.
Exploration and experimentation in new modes of organization and operation.

MNC should expect	LDC will continue to seek ways and means to enhance its bargaining position vis-a-vis MNC.
	LDC will seek to maximize derived benefits from MNC without being dominated by MNC or permitting undersired distortions in its economy.
	LDC will seek alternatives to foreign private investments to provide a continuing flow of industrial technology and expanding access to world markets.
LDC should understand	MNC managers have a basic obligation to the corporation's stockholders to maximize long-term profits while exhibiting reasonable social responsibility.
	MNC's contribution to LDC development depends largely on LDC's stage of industrial development and technological absorptive capabilities.

- Development of integrated industry patterns involving linkage between U.S. firms manufacturing in the host country and local suppliers of all kinds of inputs;
- Raising local industrial activity to higher levels of technology;
- Adjustment of technology to serve not just export markets but also local markets of predominantly low-income consumers, and to serve them adequately.

Such joint activities are discussed later in this report. Another pervasive problem concerns the conditions that host countries are willing to provide to encourage socially responsible behavior by U.S. firms. In light of the range of corporate objectives, short-term and long-term, set forth in Table 1, these conditions call for mutual understanding, for cooperation rather than hostility, and for agreed-upon mechanisms for negotiating changes in the ground rules.

III

Problems in Strengthening R,D & E in LDCs

The LDCs rely heavily on imported technology,[8] but much of the technology they have received has been ill suited to their needs and conditions. Either product designs or production techniques, or both, have been inappropriate. Even countries such as Brazil and India, though much farther along the road to industrial development than the average LDC, have limited ability to adapt or convert acquired technology.[9]

Adaptation to local requirements is also hampered by the cultural biases of U.S. managers and technicians. Attuned to high-volume production systems and to product designs suitable for more affluent societies, they are unfamiliar with and disdainful of any other techniques.

DISTINCTIVE FEATURES OF LDCs

Programs of adaptive technology must also take into account many special physical, cultural, and economic features of LDCs.

[8]In one estimate barely 1/8th of 1 percent of India's industrial technology is derived from indigenous sources; the rest is acquired and purchased from foreign sources. (J. Dubashi. *Research and Industry: Seven Case Histories.* New Delhi: Economic and Scientific Research Council, 1966. p. 1.)

[9]See, for example, Victor L. Urquidi. "Technology, Planning and Latin American Development." *International Development Review.* Vol. 13, No. 1, 1971.

> To sum up, in order to accelerate Latin America's economic development it is not enough to undertake processes of economic planning as they have been understood until now, allowing the transference of technology to remain implicit or dormant in the required investments. Technological change must be planned consciously and its self-sustained growth must be assisted with the help of an adequate

CLIMATE AND CULTURE

Most LDCs are located outside the temperate zones. Consequently, agricultural systems, patterns of food consumption, clothing, housing, and health needs differ markedly from those of the developed countries. These differences are reinforced by patterns of consumer preference determined by different cultural, religious, and economic backgrounds. Because all these factors affect either production processes or products, opportunities to apply R, D & E to develop processes and products suitable for the host countries are many and challenging.

PHYSICAL RESOURCES

LDCs may lack the minerals or other natural resources currently purchased and used by an international corporation in its operations. But they may have an abundance of usable substitute materials not found in other nations where the corporation now does its manufacturing. Also, LDCs may possess some of the materials customarily used by a producer but in a different natural form that could be satisfactorily adapted by appropriate processing. In either situation, R, D & E may find ways to exploit the host country's indigenous resources for use as inputs. R, D & E can also improve extraction and utilization processes with a view to conserving the resources and protecting the environment of the LDCs.

MARKET SIZE

More than 60 LDCs have populations under 5 million. Their markets, as well as those of the more populous LDCs, are further limited by the small proportion of the population that is part of the money economy (in contrast to the subsistence economy) and by the low incomes of many who are in the money economy. Small countries have sometimes become the site of ill-adapted, uneconomical production facilities based on product designs developed for larger, richer markets. Frequently, this has been the result of their desire to locate heavy, as well as light, industry within their borders, rather than the result of misguided profit-seeking on the part of U.S. international firms. In some types of manufacturing, it may be feasible to scale down operations with only minor adjustments in the basic production unit. More often, "miniaturiz-

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institutional infrastructure in order to reduce dependence on technology that is controlled by private foreign interests. (p. 12)

ing" operations will require a fresh design and engineering approach if the latest production techniques are to be used efficiently for a reduced level of output.

The small size of the markets and other handicaps of small countries in the world today lead to sporadic efforts to form regional groupings or common markets among neighboring LDCs. Such efforts to date have not been notably successful.

ABUNDANCE OF UNSKILLED LABOR

Large reserves of unemployed, unskilled labor in LDCs have focused attention on the need for labor-intensive techniques of production. The extent to which it is feasible to incorporate such techniques in modern industrial activity depends heavily on the degree to which machine precision and pacing can be replaced by muscle power and new patterns for organizing it. In any event, the transfer of materials and supplies into and out of company warehouses, the building and maintenance of access roads to factories, and the production of locally purchased components can be organized to use far more manual labor (and less machinery) than would be appropriate in a capital-rich, labor-scarce economy.[10]

PRICE DISTORTIONS

In most LDCs factor prices of labor, materials, and capital are distorted to varying degrees. Capital is often underpriced because of tax concessions, subsidies, and artificially low rates of interest for purchases of capital equipment. High protective tariffs and quantitative restrictions on imports may make both imported and domestically produced inputs extremely expensive. Overvalued exchange rates discourage exports. Labor may be cheap because of its abundance and because of lax enforcement of whatever minimum-wage regulations may have been enacted. Often, however, labor unions, social security systems, and regulations concerning minimum wages and severance pay combine to make unskilled labor a costly factor. The degree to which the international corporation will have to live with price distortions in the host country will vary significantly from country to country.

[10]Multinational enterprises have also in a few cases discovered that rare types of labor, such as skilled artisans, could be found in the LDCs at a cost and in a quantity not available in the United States. This discovery has led a few automobile and aircraft companies to assign fairly difficult manufacturing tasks, such as the making of jigs and forms and the hand-finishing of complex engine parts, to their subsidiaries in LDCs. (See Raymond Vernon, op. cit., p. 105.)

LDC STRATEGIES FOR INDUSTRIALIZATION

Since the end of World War II, LDCs have employed various strategies of industrialization. Their many-pronged efforts are often described by analysts (with gross but pardonable oversimplification) as "import substitution" followed by "export promotion."

IMPORT SUBSTITUTION AND EXPORT PROMOTION

The principal industrialization strategy of most LDCs during the early postwar years is said to have been import substitution: domestic production, under the shelter of a high tariff wall and usually under monopoly conditions, of goods that were formerly imported. All too often, this strategy has resulted in high prices and inferior products. A well-protected, seller's market provides little incentive to utilize technological innovation, for either market penetration or cost-saving production processes. In this sense, the industrialization strategy adopted by many LDCs is partly responsible for their failure to develop their own R, D & E; a noncompetitive, protected environment generates little demand for the economies and advances that R, D & E can contribute.

By the end of the 1960s, export promotion as a strategy for development had become a full partner of, if not a replacement for, import substitution. This change increased LDC interest in strengthening the technological capabilities of local enterprise—exporters must sell at competitive prices. A basic reason for fostering indigenous R, D & E is to combine engineering skills, which are becoming more plentiful in the LDCs, with first-hand knowledge of local productive capabilities and social customs and both local and foreign product requirements. Delicate but necessary blending of cultural values with machine operations, quality-control systems, and demands of workers' organizations can best be shaped by persons born and raised in the area, though they may have obtained their education in industrial engineering and management elsewhere. A comparative advantage of one nation or group of nations in competition with others will not be fully realized until considerable indigenous capacity to adapt or design industrial systems has been developed. The controversial Andean Code is clearly aimed at strengthening technological capabilities in the countries of the Andean market.[11]

[11]Proposed by the Andean Group countries (Colombia, Ecuador, Bolivia, Peru, Chile), the Andean Code has been partially ratified under the Treaty of Cartagena (1969). The proposed set of regulations deals, inter alia, with the conditions under which existing and new foreign, private investment may operate, e.g., access to local and external credit, limitations on repatriation of profits and capital, participation of nationals in management, conditions for access to benefits of trade liberalization within the Andean market group, and the screening of acquired technology (patents, trademarks, licensing, and royalties). (See Appendix D.)

Although LDC planners were primarily responsible for import substitution as a strategy for industrialization, LDCs now often blame "foreigners"—foreign enterprise, foreign governments, foreign technology—for some of the inefficiency, built-in obsolescence, and other inadequacies of their industries. The prominence of foreign-owned industry has been equated with colonialism and labeled a detrimental form of "technological imperialism."[12]

ADDITIONAL PROCESSING OF INDIGENOUS RAW MATERIALS

However the policy may be classified as an industrialization strategy, LDCs are determined to expand their technical, managerial, and manufacturing capacities to process indigenous raw materials. Earning 80-90 percent of all foreign exchange from exports of raw materials—tin, copper, rubber, jute, coffee, cocoa, etc.—is regarded with some justification by an LDC as a hallmark of its underdevelopment.

LDCs may realize that the success of multinational corporations such as Nestlé and Unilever was based on international marketing and research facilities that enabled the companies to adapt product mixes and designs and raw material sources to changes in the world structure of supply and demand. In some cases, product and process innovation (for example, instant coffee and frozen foods) gave them a competitive edge in world markets.

Whatever the situation in the past, however, the cocoa-producing country today is much less willing to export beans and import chocolate bars, the rubber producer to export latex and import tires, the possessor of coal and iron to import steel. International corporations often can profitably locate processing facilities closer than heretofore to the sources of supply of their raw materials.

MANUFACTURE OF COMPONENTS AND PARTS FOR LIGHT INDUSTRIES

A second area in which LDCs are seeking to expand their technological and industrial base (and one in which U.S. firms can, and often do, play a vital role) is in the manufacture of components and end products with a high labor content. Illustrative of the expansion that has already occurred is the

[12]Felip Pazos. "Should the External Financing of Latin America Be Progressively Increased or Gradually Reduced?" *El Trimestre Economico.* April-June 1971 (in Spanish).

Two other prominent Latin American economists have dealt with this theme of economic and technological dependence:

movement of parts of electronics, precision instrument, and other light industries from the United States to Hong Kong, Singapore, South Korea, and Mexico.

Certain European electronic and camera equipment firms—Plessy (United Kingdom), Rollei (West Germany), and Phillips (Netherlands)—are each investing substantial amounts in facilities in Singapore to manufacture for world markets. The new facilities will produce components and end products that require increasing percentages of higher-level skills and will use locally procured materials in increasing volume. The Singapore planning authorities are paying special attention to training industrial manpower for the middle and upper ranges of technical and managerial skills. The foreign firms (funded in part by the Singapore government) have agreed to train double their manpower requirements in specified categories as a further contribution to the development of a national pool of skilled manpower. Within the next decade, Rollei will transfer a large portion of its camera-manufacturing operations to Singapore and make it the major source for supplying Rollei's world markets. To do this, Rollei will have to develop local sources for intermediate industrial materials and parts, as well as help train the indispensable local cadres of technical and managerial personnel.

OTHER TYPES OF MANUFACTURING

The automobile industry may be at the center of a second wave of industries to emigrate, or partly emigrate, from high-cost production centers. Certain automobile components with a high labor content are obvious candidates for manufacture abroad. In the host country, producing a high volume of these components for export would make more sense than producing complete cars for its domestic market at high cost because of low volume and burdensome requirements for the proportion of materials of local origin to be incorporated in the finished product.

LDCs are interested in more than the employment of low-wage, low-skilled labor for simple assembly and fabrication operations. They are looking toward the transfer of segments of manufacturing operations that will upgrade labor's technical and managerial skills, broaden the industrial base with

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Celso Furtado. *Development and Underdevelopment.* University of California Press, 1964.

Victor Urquidi, who uses the term "technological imperialism" in his article "Latin American Development, Foreign Capital and the Transfer of Technology." *El Trimestre Economico.* Jan.-March, 1962 (in Spanish).

See also Albert O. Hirschman. "How to Divest in Latin America and Why." *Essays in International Finance.* No. 76. Princeton University, November 1969.

backward linkages into local supplier industries, and develop indigenous research and industrial systems.[13]

IMPLICATIONS FOR U.S. INTERNATIONAL FIRMS

Except for scaling down plant size to lower-volume markets, most international firms appear to have done little to adapt product designs or production techniques to local conditions. They have made little effort to implant indigenous research and engineering capability that is innovative enough to adapt imported technology to local needs and resources. Industrial technologies generally have been held on a close proprietary basis, especially if they have involved advanced technologies with valuable competitive advantages.

Of course, there are exceptions. Some large corporations have redesigned output or manufacturing techniques to fit local conditions in LDCs.

Widespread among LDCs is the need to adapt products and equipment to local laws, physical environments, and customer usages. Such adaptations are not unknown to multinational corporations when they license the manufacture of their products in other industrially advanced economies. In the United Kingdom and Japan, engines and transmissions had to be adapted to a 5-gear system (compared with a 10-gear in the United States) as an accommodation to truck driver habits. Differences in road conditions (average steepness of slopes, road widths for passing, and road surface conditions) and in legal requirements (maintenance of minimum speeds on uphill traffic and maximum load-carrying limitations) were additional constraints that had to be met for the Japanese market.[14]

In areas where repairmen and even hardware stores are rare, ruggedness of farm equipment (tractors or water pumps), standardization or interchangeability of parts, and ease of part replacements with available tools are particularly advantageous design features. The work habits of the local labor force constitute another set of design parameters to which equipment and manufacturing techniques can be adjusted. For example, workers in India are accustomed to stooping at their work stations. Theoretically, machine-operator control systems could be adapted for these workers—particularly where production volumes warrant the change or a new product design is going to be used.

[13]The labor movement in the United States, which is far stronger than the consumer movement, will not accept with equanimity the transfer out of the country of production previously carried on within its borders. Note the Burke-Hartke Bill introduced in the Ninety-Second U.S. Congress.

[14]See Jack Baranson. "Equipment and Products for Developing Countries." *Industrial Technologies for Developing Economies.* New York and Washington: Praeger, 1969. pp. 54-71.

TABLE 2. Changing Role of MNCs in Technological Development of LDCs, 1950s-1970s

	1950s and 1960s		Challenges for 1970s	
	Conditions	Deficiencies	New Demands	New Requirements
Products	-Protected sellers' market -Limited effective demand—largely in upper-10-percent-of-income groups	-Design lags and obsolescence -High prices and/or inferior quality -Limited range of products for low-income groups	-For domestic demand, wider range of more functional products to fit low-income needs -For external markets, development of products and components that can compete in world markets	-More corporate efforts and resources to be channeled into LDC needs and requirements -Emphasis on exportable products
Production techniques	-Protected markets -Limited size of domestic market -Moderate demand for quality control and production efficiencies (by world standards)	-High costs of production due to proliferation of brands and models in markets of limited effective demand -Little adaptation of production techniques to size of internal markets and available production factors	-For internal markets, techniques better adapted to local market sizes and factor availabilities -For external markets, moving onto an "escalator" of emerging industrial capabilities	-MNCs to adapt production techniques (and ultimately product designs) to better fit factor endowments and emerging productive capabilities -Emphasis on environmental safeguards using best available technology
Managerial systems	-Moderate requirements to train middle management and provide technical support to supplier industries	-Heavy dependence on MNCs for R & D, top production management, and access to foreign markets -The more sophisticated range of technologies usually owned and managed by MNCs.	-Expanding emphasis on indigenous ownership and managerial control of industry in the full range of production, marketing, and engineering, design capabilities	-MNCs to help develop indigenous R, D & E capabilities to adapt technology and design world-competitive industrial systems -MNCs to train new generation of transfer agents to implant R, D & E capabilities -Shifting emphasis to licensing arrangements and training of indigenous top level technical & managerial personnel.

In summary, the distinctive features of LDCs stressed in this chapter call for varied actions by international corporations. "Flexibility" rather than "adhere to the tried and true" should become the slogan. (See Table 2.) Whether the purpose is domestic sale in the host country or export from that country, production techniques should be adjusted to use the unskilled and semiskilled labor so abundant in LDCs. Consumer goods intended for sale within the host country or in other LDCs should be designed to meet a range of tastes, including those of the low-income masses as well as the elite. Plants whose products are designed primarily for sale in world markets will usually be welcome because they earn much-needed foreign exchange, but such enterprises will be more welcome if they use production techniques that maximize employment and include generous possibilities for upgrading the skills of employees. The choice of location of new manufacturing enterprises will be determined by several factors, which usually place new industries in already overcrowded cities. Decisions to locate elsewhere will help meet the host country's concerns for equitable regional development, broader income distribution, and greater opportunity for disadvantaged groups.

IV

The Role of U.S. Firms in Strengthening R,D & E in LDCs

The five industry sectors represented on the panel include an assortment of products ranging from simple foods to complex electronic products. The research effort required for these different industries to function in LDCs varies widely. For certain vehicles and standard food items, relatively simple adaptations to local materials or patterns of consumption and use may suffice. For new drugs, fundamental research in the physical sciences or in the life sciences may be needed. According to the firms surveyed, only a small fraction of the necessary research has been performed in LDCs. This chapter examines the general motivations and constraints that govern U.S. affiliates in the five industry sectors, as reported by panel participants and the consultative groups. The next chapter looks at the situation from the viewpoint of each industry sector.

SPECTRUM OF CORPORATE VIEWS

The panel and consultative discussions revealed a wide divergence of views on R, D & E performance by U.S. firms and affiliates in LDCs. At one end were firms satisfied that they had made important contributions in training local technicians and in adapting products to conditions in the host country. They considered their current role "adequate" and their progress in fostering R, D & E reasonable and sound. By and large, they saw little need to expand their efforts. Some did not consider it in their own interest to reduce the LDCs' technological dependence on them. For others, major deficiencies in the LDC environment appeared to prevent an expansion of their R, D & E

commitment. They referred to the LDCs' undiscriminating appetite for advanced technology, their inability to make necessary choices, the lack of appreciation for technical assistance received, the unfavorable economic and political environment. In general, these firms believed that LDCs exhibited an unrealistic desire to leapfrog the evolutionary stages of industrial development that gradually bring in the R, D & E capabilities required for innovation and self-generating growth.

At the opposite end were firms that took an expansive view of the prospects for enlarging and extending R, D & E in LDCs. They tended to regard the current efforts of international firms as "inadequate" and recognized a need for new corporate policies and roles. Such firms felt it was both desirable and feasible to sponsor high-quality research in LDCs, to make better use of existing R, D & E facilities and to expand them. Regarding the LDC environment, they described conditions as "often difficult, but manageable." They saw constraints as primarily political and psychological rather than technical and managerial. These firms felt that existing obstacles could and should be overcome gradually but in a "near future" time frame. The key words in these firms' assessments of prospects were "experiment" and "mutual respect and understanding" for the other's responsibilities and needs. According to this group, the scope and pace of transfer were constrained chiefly by (1) the technical complexities of the specific industry, (2) the overall technological stage of industry in the LDC, and (3) the negotiating abilities and the bargaining power of industry and government in the host country vis-a-vis foreign enterprise.

All participants agreed that the prospect for R, D & E work in a country depends on the viability of the total enterprise in the country. The enterprise must be permitted to acquire the dynamism that will enable it, overall, to operate profitably, to enlarge its production and sales, and to serve the needs of the community appropriately.

PRIME CORPORATE CONCERNS

Throughout the discussions, corporate participants emphasized four themes:

- The sequence of activity implied in the term R, D & E does not reflect actual practice, which is E, D & R.
- An effective patent system is required to provide impetus to the transfer of technology and especially to the commitment of local resources to innovative research.
- A well-articulated and properly enforced standards program is an indispensable adjunct to innovation and industrial growth.

• The economic and political atmosphere and longer-term prospects have decisive effects on the willingness of entrepreneurs to take the risks that are characteristic of investment in research and development.

THE E & D & R SEQUENCE

The problem of sequence was well stated by a participant:

> . . . the sequence of R, D & E should be applied *in reverse* in less developed countries. It is well known that the transition from R to D to E to production and successful commercial sale is difficult, risky, time-consuming, and expensive even in highly developed countries.
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> *The LDC's should attempt to proceed in the reverse order. i.e.: start by learning the technology required for making some products that are already relatively mature; then experiment with engineering and design modification; then evolve into developmental programs that make use of the enormous amount of published research; and then, after they become competent and financially successful, they may be able to afford to venture into research.*
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> I stress this point, because I know that many well-educated technical personnel in LDCs . . . are unduly fascinated by the glamour of research, and unwittingly do their countries a disservice by concentrating on research, without giving enough thought and effort to achieving the practical outcomes that their countrymen need and desire. The United States went through the R, D & E sequence in reverse order, starting with practical technology imported from Europe, and then slowly evolving into our present position of being able to afford substantial research. The LDC's would profit by emulating our example.[15]

The experience of industry in developed countries suggests that most firms develop a capacity for innovation only after achieving a mature command of their technology. A firm goes through certain evolutionary phases before it becomes ready to make commercial use of research and development efforts. The acquisition of basic engineering capabilities (for instance, ability to manage quality-control systems, to introduce materials specifications and standards, to operate tool shops, and to establish other production-support activities) normally precedes the more ambitious work leading to new product or equipment design, utilization of new materials, and adaptations of production or processing techniques. In short, this is the hierarchy of technical development whose steps are quality control; product improvement; process improvement; product development; process development; new-product research; industrially oriented, university-based research. A firm must fully

[15]Electronics manufacturer. Italics added.

assimilate the capacity to copy, adapt, and improve existing technology before it can safely venture into the creation of wholly new technology. Having acquired technical self-confidence and determined marketing prospects for new product lines, the firm can then engage in research to whatever depth its resources and prospects permit.

PATENTS

The existence of an effective patent system was cited by U.S. corporate participants as an extremely important factor in a U.S. firm's decision to transfer technology or invest in R, D & E in LDCs. To the corporate participants, patents are granted not to reward the inventor but to encourage investment and entrepreneurship, to create new industries, or to modernize and expand existing ones. The exclusive privilege conveyed by the patent induces speculative capital to back the introduction of a new invention, to work it out as a marketable product, and to bring it into commerce on a large scale. For certain industries, such as pharmaceuticals, the stronger the monopoly granted by a patent, the greater is the incentive to undertake R, D & E and to incur the heavy costs of production engineering and marketing.

Patents issued to foreign firms in LDCs are only a small fraction of those issued to them in their home countries. In the past, firms sought patents in LDCs mainly for two reasons: first, to favor and protect the production and domestic sale in an LDC of something the country previously imported—the "import substitution" long encouraged by LDC governments and local capital; second, to provide "defensive" protection for the export of finished products to these markets.

As long as LDCs did not have the technical capabilities and the capital to exploit a technology themselves, they saw no disadvantage in granting this type of privilege. But to the extent that finished products (especially those easily copied) can now be made and sold domestically at reasonable prices, LDCs consider granting what amounts to a commercial monopoly to foreign patentees to be highly prejudicial to their interests.

The primitiveness of their own patent procedures and their inability to safeguard themselves from what they perceive to be abuses by the international investor community are causing LDCs to become disenchanted with the international patent system. A growing number of LDCs see the patents they have granted concentrated in the hands of a small number of multinational firms and oriented largely to maintaining preemptive control of the local market. Only a small fraction of these patents are seen to be exploited in the countries of issuance. Meanwhile, they prevent competition by other foreign or local companies. In addition to price increases and adverse affects

on balance of payments, the consequence of not utilizing patents is to restrict the flow of technology and distort the flow of foreign investment.

A frequent source of confusion in discussions of the patent problem is failure to recognize the close relationship of patented to unpatented know-how. To obtain the latter on favorable terms, an LDC should adhere to the international patent system, as one writer explains:

> . . . It is sometimes argued that a developing country has little to gain from adhering to an international patent system, since patents invariably emanate from the developed countries. It is even suggested that one form of development aid might be to exempt developing countries from the obligations of such a system. Patented know-how is, however, only part of total technological knowledge; by itself, it is inadequate for the introduction of new products and processes. Without unpatented know-how, a developing country may be unable to work a patented process, and a unilateral abrogation of patents may merely result in its being denied almost all access to advanced technology. The experience of countries which have not adhered to international patent systems indicates that they are often forced to accept relatively stringent licensing agreements in order to import unpatented know-how. The unfavorable legal and economic effects of these agreements may, in fact, prove more costly than would the payment of patent fees.[16]

A number of proposals for adjustments in patent legislation and simplification in patent practice to provide mutually acceptable protection to investors and developing countries alike have been under discussion in the international community. Accommodation is imperative, for in its absence both LDCs and foreign firms deny themselves some of the advantages of international trade.

STANDARDS

The need for LDCs to establish systems of standards and methods of securing compliance with those standards also received strong emphasis in panel deliberations. Almost all R, D & E must eventually be translated into the language of standards to have an economic effect.

The basic purposes of industrial standards are (1) to prescribe the qualities of manufactured products and (2) to set the limits of quality control of those products. Products intended for international trade must meet internationally accepted standards. National and international standards for a given product may differ in accordance with demand differences in the two market areas. There may also be various degrees of tolerance within any standard according to the intended levels of performance required by the expected users of the products. But the manufacture of lower grades of a given product does not

[16]Savak S. Tarapore. "Transmission of Technology to Developing Countries." *Finance and Development.* Vol. 9, No. 2, June 1972. pp. 16-17.

necessarily imply the use of simpler standards or of less rigorous quality control than does the production of a higher grade of the same product.

Like R, D & E, standardization must become associated with the production process and evolve with it. On a continuing basis, the main body of economic-technological expertise necessary to the most effective development of standards is to be found in manufacturing organizations, where the application of standards is a daily and necessary experience.

But a national standards laboratory quickly becomes essential as a training center and as a source of operative standards developed initially in the laboratory or acquired from international standards organizations. Metrology (the science of physical measurement) and standardization form a scientific-technological continuum in which the national standards laboratory serves as the ultimate reference authority. It must be equipped for both in-house laboratory research and for continuous consultation and cooperation with research institutes and the R, D & E and production facilities of industrial establishments.

In addition to a national standards laboratory, a national standards institute will need to be established at some stage of a country's technological development, preferably as a self-governing body having legal sanction and assigned authority. Under its auspices, a national system of standards should be formulated and maintained. Normally, such institutes should include in their active membership representatives of private industry, research institutes, universities, and government. This diversity of sources for an informed membership should give the institute the objectivity and perspective to solve national problems in accordance with the national interest, broadly construed, and to represent the nation in international standards organizations.

It will be to the advantage of public authorities and industrial firms, both domestic and foreign, to promote and participate actively in standarization activities because they are a vital component in the technological and industrial development of a nation. Where a group of nations have joined together to form a common market or free trade area, standardization laboratories and institutes might be organized more economically at a regional level.

INVESTMENT CLIMATE

To reiterate here because, if for no other reason, it recurred as a leitmotif in the panel and industry-consultant discussions, the stability and predictability of the economic and political climate are the most critical determinants in a foreign firm's decisions on operations in LDCs. Corporations are expected to make a profit, not always immediately but certainly before long. Whether engaged in deciding to expand productive capacity, to invest in R, D & E that

will pay off only in the long term, or to allocate corporate resources to activities of general community benefit, the outcome will be governed by the corporation's judgment concerning its future returns in money and goodwill.

The investment climate, however, is usually neither immutable nor subject to improvement only by action of the LDC. The actions that foreign investors take, the understanding and confidence they exhibit, the potential benefits they can provide in meeting local development needs, and the ingenuity they exercise within existing constraints can affect the climate for future operations.

OTHER CORPORATE CONCERNS

Patents, standards, investment climate, and inversion of the R, D & E sequence in LDCs are not the only areas of corporate concern. The level and volume of R, D & E undertaken by U.S. firms in LDCs will depend also on (1) the nature of the products the U.S. firm manufactures and sells, (2) the market situation in the host country, and (3) the U.S. firm's world market position and earnings strategy.

"SYSTEMS DEPENDENCE" OF THE PRODUCT

Systems dependence—the need for, and the possibilities of, adapting product designs and production techniques to local market conditions—varies with the industrial product. Physical environments (climate, geography, natural resources), government regulations (product designs, performance standards), and consumer characteristics (income levels, cultural affinities and idiosyncrasies) all bear on production designs and production processes. So do market size, raw materials base, and cost and quality of local employees.

In the food-processing industry, products have to be adapted to the taste preferences of domestic consumers. In pharmaceuticals, the adaptation of drugs, which requires biological and clinical testing, presents special problems. Foods, pharmaceuticals, and chemicals generally require some adaptations to the cost and quality of raw materials that are available locally. Production costs of electronic products and electrical equipment, automotive products, and chemicals are particularly sensitive to the diseconomies of small-scale production; unit costs can increase sharply when output is insufficient to realize economies of scale. These three industries may also have abnormally difficult problems in maintaining quality control and materials standards—especially with variations in the scale of production and in sources of raw materials.

OPPORTUNITY AS PERCEIVED BY MANAGEMENT

Whether to locate elements of R, D & E in affiliates overseas obviously depends on the advantages and disadvantages as seen by individual managements. Decentralization inevitably has costs as well as benefits; the resultant fragmentation of activity or absence of the critical mass of expertise believed to be necessary may present themselves as major barriers. Decisions on where to locate R, D & E activities will also be influenced by estimates of the gestation time required before benefits can be realized. That perceptions of opportunity differ even within a single industry will be evident from the following statements by two participants from the pharmaceutical industry:

[1] While I firmly believe we in the pharmaceutical industry must encourage and participate wherever we can in the technological development of LDCs, I cannot as a practical matter see the U.S. pharmaceutical industry spending significant funds in the immediate future to create R & D laboratories in these countries.

Again, if a company decides to initiate R & D activities in an LDC, the availability of trained personnel will be a plus factor. However, most of the activities of a drug research laboratory are such that it is nearly out of the question that scientists and technicians will be available locally who do not require extra training on the job. Thus R & D in LDCs demands generally far more efforts in the area of education than it does in advanced countries.

[2] There are several reasons for a company to want to do research in a foreign country:

1. To become a total part of a country in which there are other divisions such as sales and manufacturing. A company should contribute to, as well as take profits from, a country. Sponsoring high-class research is definitely a contribution.
2. To take advantage of skills available locally that could not be attracted to the United States.
3. To take advantage of the knowledge of local problems.
4. To use funds that cannot be transferred without major tax implications. The results of research are easily transferred to any place in the world.

The willingness to share equity, ownership, and managerial control in manufacturing and related research operations is particularly low in pharmaceutical and electronics work, and moderately low among manufacturers of chemical and automotive products. The pharmaceutical, chemical, and electronics industries have a high degree of concern over infringement of patent rights. For products with an ephemeral product cycle (many electronics and pharmaceutical products), the urge to earn corporate returns through licensing and overseas manufacturing is strong; at the same time there is concern over a too rapid diffusion of proprietary technology.[17]

[17]See John Tilton. *Diffusion of Semi-Conductor Technology*. Washington, D.C.: Brookings Institution, 1971. According to Raymond Vernon, op. cit., and others, indus-

The instances in which U.S. firms have found real comparative advantage in locating some segment of R, D & E in an LDC are few. The U.S. food-processing industry has done work abroad on such commodities as pineapples and bananas, but little on cocoa beans and other sources of vegetable fats and oils. In the pharmaceutical field, some important research on tropical diseases has been undertaken by the industry in LDCs. Some smaller pharmaceutical firms have begun to see advantages in decentralizing their research activities, with emphasis on engineering and development. Chemical firms, similarly, sometimes undertake local engineering and developmental work to induce demand for their products from other industries. U.S. automotive-vehicle manufacturers are giving throught to establishing regional complexes in Asia and Latin America for specialized manufacture and interchange of parts; these overseas facilities could eventually generate their own R & D systems for vehicle design and manufacturing operations.

FOREIGN INSTITUTIONAL TIES OF U.S. FIRMS

Collaborative or user arrangements by U.S. firms with local technical service or scientific institutions such as testing laboratories, research centers, and universities reflect in part the "systems dependence" and in part the perceived advantages and constraints mentioned earlier. In the food-processing field, the Pineapple Institute (Philippines) and the Central Food Technological Research Institute at Mysore (India) have each played an important role in product design and production systems development. National health services and clinical testing laboratories have had a narrower involvement in product adaptation by U.S. pharmaceutical affiliates. Testing laboratories and national research facilities have also been used to a limited degree for product applications in the chemical field.[18] As more such facilities are created, the opportunities for U.S. firms to establish mutually beneficial ties with them will multiply.

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trial products pass through successive stages during which the exclusive possession of know-how and other forms of industrial proprietary rights of a single firm erode, and production rights and capabilities become generally available on a global basis.

[18]In Mexico, du Pont has undertaken a program that has been described in various places, including "Background Paper No. 22," presented by José Giral B. of the National University in Mexico City to a Study Group of the OECD Development Centre in Paris on "The Choice and Adaptation of Technology in Developing Countries," Nov. 7-9, 1972. The program began in 1964.

> . . . the third stage in the programme is taking place this year [1972]. After a modest success in applying the . . . methodology to three more cases with commercial success (in one of them the technology was used in Mexico and also exported to Colombia, and in a second case the technology is being studied also for Europe)

INCENTIVES TO RESPOND TO LOCAL NEEDS

To date, commercial incentives that would move U.S. firms to address themselves more energetically to LDC needs have been few. Products already being marketed or on the drawing boards include low-cost, highly nutritious foods based on local materials, new drugs and control systems for the eradication of certain endemic diseases, and transport vehicles and farm equipment designed for conditions in LDCs. The panel felt the potential to be considerable but dependent on greater initiative by host countries.

The possibilities of awakening commercial interest could be significantly enhanced if host governments would initiate systematic inventories of their needs and resources. The effort could be on a joint government-industry basis: the cooperation of one or more U.S. firms and affiliates as well as local firms with development-planning authorities and technical research institutions in the LDCs.

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several organisations have become interested in the programme and as a result a working group was formed by the National University, the Chemical Industry Association, the Association of Engineering Firms, and the Institute of Chemical Engineers. Such a group, that incorporates many of the factors essential for this problem, is contributing not only financial resources but, more importantly, expertise on both technological and managerial areas, as well as mechanisms for communication and implementation of results. Interaction with key Government agencies insures advice and support from the public sectors. (p. 1)

See also Jack Baranson. "An Economics Lesson from Developing Countries." *Chemtech.* January 1971. pp. 10-13.

V

Views from Five Industries on their Roles

As already indicated, the views of the five industrial sectors—pharmaceuticals; food-processing; chemicals; electronics and electrical equipment; and automotive, farm, and construction equipment—are far from identical. Because differences also exist within each sector concerning its role in transferring technology and technological capabilities to LDCs, a sector-by-sector summary is also included.

PHARMACEUTICALS

During the past 15 years, the U.S. drug industry has to a large extent "gone global." In the LDCs, commercial activities have followed a sequential pattern of marketing, distribution, and manufacturing, with technical activity confined mainly to quality control and clinical trials.

Performing R, D & E on site in the LDCs ranks low among the priorities of U.S. drug companies. The U.S. companies feel strongly that to be productive, their research efforts should not be scattered over too many R & D facilities. Most companies have small research units in developed countries, principally in Europe; few, if any, have units doing advanced scientific work in LDCs. Research in LDCs may require financial commitments over a longer pre-payoff period than in developed countries. Modern drug research calls for an array of highly integrated and highly sophisticated operations. To produce fruitful results, most drug companies feel it necessary to have a "critical mass" in their research groups. Some firms indicate that at least 200 employees per research unit are required for this critical mass—a total far beyond what production volumes in most LDCs would justify.

Research and development for new therapeutic drugs also call for skills from many disciplines and a great deal of interplay among them, and one of

the industry's strengths has been its ability to use the interdisciplinary team approach. It is difficult to isolate one group or discipline without interfering markedly with effectiveness and efficiency. On the other hand, establishing a research unit embracing the range of disciplines and knowledge to attack even one problem involves a sizable number of people and a substantial investment.

To manufacture a drug in an LDC requires chemical processing, pharmaceutical adaptation, and clinical testing. Because of strict standards in manufacturing and cost control, the critical-mass concept, the relatively small size of markets in LDCs, and their gaps in R & D skills, the adaptation of existing product or process technologies has been kept to a minimum. Some exploratory R & D work is carried out, aimed at finding new markets for drugs in LDCs. But, by and large, the patterns of marketing, distribution, and manufacturing developed for markets in industrialized countries are carried over without change to the LDCs, including the careful selection and training of professional "detail men" to familiarize local physicians with the companies' drug products and their applications.

Local manufacturing, frequently entirely under the direction of nationals of the host country, is common where market size and economic conditions permit. Along with the production plant comes the quality-control laboratory and often the technical service unit, which are granted autonomy from the U.S. operation as soon as possible. Quality controls and technical assistance extend to local suppliers of chemical materials and other intermediary products.

Many firms contribute directly to the development of technical cadres in LDCs through on-the-job training in activities such as the clinical testing of drugs, and indirectly by grants-in-aid to medicine and related fields in LDCs and research grants to government and university laboratories and institutes.

Additional portions of the pharmaceutical industry will find it advantageous to perform some R, D & E work in developing areas. One reason is that public health and control of disease pose special problems in particular countries or groups of countries. A second reason is that in a few of the more advanced LDCs a pool of trained clinicians and other technicians is now capable of high-quality work in certain fields. Third, in many LDCs government restrictions on clinical testing of new drugs are less stringent than in the United States—an advantage that may also carry some risks. Finally, in LDCs that restrict remittances of earnings in a desire to conserve foreign exchange, profits can be plowed back into R & D and the results exported to other corporate entities.

Inadequate patent laws and related regulations dealing with the protection of industrial property constitute a major deterrent to the expansion of pharmaceutical R & D facilities in LDCs. There is also a dearth of general surveys of country medical and health needs as reflected in data on the incidence of particular diseases, human and animal.

FOOD PROCESSING

In food processing, as in most other industries, R, D & E instituted in an LDC must be part of the total enterprise, and must have a result-oriented, profit-motivated objective. The food industry has special justification for carrying out R, D & E in an LDC because food products must conform to local consumption habits and cultural patterns. The taste, form, structure, and texture of a food can best be researched in the country for which it is intended.

The major factor inhibiting a significant R, D & E commitment in the food-processing field has been the lack of commercial incentive (or the small size of market). The need to develop local suppliers of indigenous raw materials—again, on a commercial basis—has also been a brake on the expansion of food manufacturing and related R, D & E facilities.

Associated with an initial manufacturing operation are such relatively unsophisticated functions as process and product control and technical service to the plant. With market growth, particularly in the expanding urban sector, come commercial incentives to broaden the product line and to develop new food forms and flavors from local materials. In its heavy dependence on local R, D & E, food technology differs from almost any other industrial technology in an LDC. Where highly specialized technology is needed, U.S.-based facilities can provide backstop services. Alternatively, foreign affiliates of U.S. firms may turn to local government, universities, or private laboratory facilities or research institutes. Cooperative efforts in the development of high-nutrition foods are not uncommon.

Illustrative of this type of cooperation are the foreign firms that have assisted local affiliates and research groups in the development of high-protein and other special products. A specific example is "Golden Elbow Macaroni," developed in Brazil by General Foods with AID support as a high-protein food product that low-income consumers in LDCs and the United States would find acceptable and suitably priced.

Manufacturing affiliates need to work closely with local suppliers and vendors to assure adoption of the latest processing technology and adherence to quality-control standards at all stages of the operation. Their technical representatives also provide information and technical assistance to local research and educational institutions on such subjects as food sanitation, pasteurization control, and new processing techniques.

R, D & E activities of food manufacturers are not limited to food processing or product development. Several companies have engaged in strong development programs in agriculture, such as seed development and production, pesticide and fertilizer use. Their research staffs work directly with growers to improve operations in primary production and to introduce new crop varieties. These efforts have significantly helped to raise overall standards and efficiency in the agricultural sector and to link it to modern industry. U.S. affiliates

in LDCs are also major participants in the international association concerned with the development of standards for food products (labeling as well as manufacturing).

CHEMICALS

Chemical products typically require fairly sophisticated, capital-intensive processing and manufacturing techniques and a fairly high level of engineering and technical skills; they are also subject to diseconomies of scale (high costs at low production volumes). In LDCs, the usual sequence is marketing and distribution, followed by the establishment of local packaging and manufacturing facilities.

Concurrent with the establishment of the manufacturing process in an LDC is the setting up of quality- and production-control laboratories. These laboratories monitor both manufactured product and incoming raw materials. Technical maintenance services are also provided for the manufacturing facilities to assure production within specifications and minimum down-time of the facilities. "Application laboratories" are normally established to assist in marketing the products. As in most high-technology industries, the chemical companies use technically trained personnel to supply product information to their customers.

Beyond this point, much depends on the nature and magnitude of market growth. Where justified, laboratories are established to adapt processes to local scale requirements and raw material availabilities and to develop or adapt products tailored more closely to local market demands. Such research programs have thus far been minimal. Occasionally, research and development programs are established or supported in local laboratories, usually in the universities. One company noted that it requires about 10 years after establishment before an in-house laboratory can be considered productive and profitable.

Certain trends point to an increase in R, D & E activities in LDCs over the next 10 years. To begin with, a substantial part of planned investments will be outside the United States, and it is expected that in many instances R, D & E activities will follow these investments.

Furthermore, rapid inflation in the cost of doing research in the United States will cause more R & D to be carried out elsewhere.

A second trend is the increasing willingness of companies to license, sell, and trade or buy technology on a worldwide basis. This trend will continue, since individual companies can no longer afford to develop all the technology needed in their operations. A small- or medium-sized U.S. company can afford research only if it can use the results of its efforts on a worldwide basis.

A third significant change of pattern is the willingness of some chemical

companies to consider operating and management contracts with LDCs on a 5–10 year basis. Until recently, most companies were not interested in this mode of operation.

Among the factors impeding the establishment of R & D facilities in LDCs are (1) lack of necessary technological infrastructure, (2) insufficient supplies of technical talents in various disciplines, and (3) lack of long-range planning in technical education to fill R & D needs.

ELECTRONICS AND ELECTRICAL EQUIPMENT

"Electronics and electrical equipment" embraces a wide range of products from transistors and semiconductors to telecommunications and data processing, and on to heavy electrical equipment such as transformers and switch gears. Manufacture of these products, beyond mere assembly of components, requires sophisticated equipment and a high degree of technical knowledge and skill. The wide diversity of products poses acute problems of establishing manufacturing and assembly facilities in markets of limited size.

Two types of overseas activities in LDCs are now established: (1) assembling and partially manufacturing end products for local consumption, and (2) producing both intermediary and certain end products for the world market. In the second category is the now well-known practice of manufacturing electronics components and consumer products in such places as the Republic of China (Taiwan), Hong Kong, and Singapore. Further expansion of overseas manufacture seems likely for items such as cables and miscellaneous hardware.

Most companies design their products for worldwide application and make little effort to adapt individual items to local markets, particularly if the markets are small. When such adaptation is done, it is almost always carried out in the United States. The current trend toward "functional integration" in solid-state electronics reinforces this tendency towards centralized design of products and processes.

One company representative gave the following reasons for his firm's reluctance to undertake, through its affiliates abroad, the kind of research and engineering it does at home: (1) the size of the market is usually too small to support a major R & D effort; (2) in most cases the technology that is best suited to the local market is already available—R & D is not needed; (3) the U.S. market and the markets of highly industrialized countries are the most technologically competitive, thereby providing the necessary impetus for R & D work.[19]

[19] Regional trade among developing countries, particularly when it involves specialized manufacture at international scale, may provide a partial answer to points 1 and 3.

Nevertheless, because of drastic differences in market size, state of development of the country, and needs of the user, the best technology for an LDC market frequently is not the most advanced technology. An awareness exists of the growing demand for products that are more pertinent to the needs and conditions of LDCs. For example, computers designed for LDCs might have systems with simpler programming languages and a much more limited set of options for the attachment of equipment. A need also exists for apparatus designed for simplicity of installation, maintenance, and operation rather than optimum system performance.

Where R, D & E activities beyond the normal quality control and related process engineering (often including assistance to component suppliers) are undertaken in an LDC, they are usually connected with a full-scale manufacturing operation by a company that produces and markets locally a broad range and considerable volume of products. The main R, D & E efforts in such cases are devoted to application and design engineering and to various production-engineering functions. The work of application and design engineering consists primarily of adapting U.S. company technology to products for a local market.

AUTOMOTIVE, FARM, AND CONSTRUCTION EQUIPMENT

Assembly facilities for automotive, farm, and construction equipment are now located in many LDCs. In some, the facility amounts to nothing more than a large garage assembling a few hundred items a year. In countries such as Brazil, Argentina, and India, however, integrated assembly and manufacturing operations produce thousands of items annually with anywhere from 50 to nearly 100 percent of the components manufactured locally.

As in other industries, the need and justification for R, D & E in an LDC depend on the size of its domestic market and its stage of industrial development (particularly of industries supplying materials and parts). Based on these considerations, one company divided its overseas operations into four categories:

1. Large markets such as Germany, the United Kingdom, and Australia. Full-range assembly, parts manufacturing, and associated R, D & E, including product design and, where necessary, adjustments in production techniques to suit the local market needs and supplier conditions. (This category was not within the panel's immediate purview.)

2. Medium-size markets such as South Africa, Brazil, and Argentina. Full range of assembly and local manufacture of components and parts with substantial amounts of engineering, but limited amounts of development, and virtually no research on product design. No radical departures in products or

techniques except for some adjustments to accommodate lower production volumes.

3. Small- to medium-size markets such as Colombia, Iran, and Pakistan. Operations limited to assembly and a small amount of local production of "hang-on" parts, such as tires, batteries, radiators, and exhaust systems. R, D & E limited to quality control and production engineering of locally manufactured parts.

4. Small markets such as Thailand, Morocco, and Ecuador. Only a few hundred items of any one model assembled a year, with little or no local manufacture of parts, and no R, D & E.

This classification illustrates the specific views of one automobile company on the relationship among size of market, scope of manufacture, and extent of related R, D & E activity; it also illustrates more generally the handicaps that small, poor countries face in developing their R, D & E capabilities while they remain insulated from each other by tariff walls and other barriers that make production within their national boundaries uneconomic for much of modern industry.

Firms manufacturing farm, earth-moving, and construction equipment generally adhere to established design standards, regardless of where the product is used or manufactured. Even when local environmental conditions and legal requirements call for certain design changes and substitutions, the necessary work is generally done by the U.S.-based design groups. These equipment manufacturers report that so far no commercial incentive exists to design equipment exclusively for one or more LDC markets. Most products marketed and/or manufactured in LDCs are U.S. prototypes with minor adaptations to LDC conditions made locally.

Where a market develops to sufficient size and commercial attraction, the amount and sophistication of R, D & E undertaken locally will depend, among other things, on the technical capabilities of local nationals and the availability of technical-support facilities (where one company alone cannot justify setting up its own laboratory).

In most cases, U.S. firms and affiliates are prepared to supply technical guidance and training in such areas as quality control, material standards, and process engineering. As a minimum, in connection with manufacturing operations, they supply materials specifications, process standards, and quality-control procedures. Local affiliates are generally required to adhere to global standards, but in some cases affiliates are permitted to modify material outputs standards and specifications so long as they comply with performance and worldwide interchangeability criteria. The flexibility and opportunity to use local ingenuity applies not only to the selection and processing of production materials, but also to machine tools, heat-treating processes, welding, coating, and other steps involved in working base materials into finished

products. Process technology may be extended to local supply manufacturers of such input items as rolled steel, castings, and forgings, as well as components such as electric starting motors, alternators, and turbochargers.

To the panel participants, these activities are part of the learning process that helps lay the foundation for further technological development in manufacturing farm, earth-moving, and construction equipment in LDCs.

In addition, panelists mentioned their ongoing collaboration with local research institutes and universities. A case in point is a farm-tractor manufacturer's continuing program of collaboration with the International Rice Research Institute in the Philippines. Other activities include financial support of engineering students and technicians, engineering studies undertaken on a cooperative basis with local institutions, and donations to institutions of machines and equipment. One company cited as part of its contribution a technical- and agricultural-information journal that is published in eight languages and has a circulation of half a million.

VI

Conclusions and Recommendations

Research, development, and engineering skills are not disembodied competences available for the asking. They reside in men and can be accumulated only slowly. In today's world, they tend to be acquired by a country as a concomitant of its industrial development.

Industrial development for the poor countries of Africa, Asia, and Latin America is possible without the collaboration of U.S. international firms. But with their collaboration (if it is the right kind) industrial development can come sooner and less painfully. The job of the international corporation, however, is only incidentally to promote the industrial development of the countries in which affiliates are located—its real raison d'être is to make a reasonable profit and to stay alive in the face of often severe competition.

Because the potential for conflict between LDC and multinational corporation is so great, a high order of statesmanship—one of the rarest commodities—is required of both sides. Central to this statesmanship are (1) understanding of, and respect for, each other's objectives and constraints; and (2) willingness to eschew short-term advantage and focus on the long-term view.

Much of the preceding discussion has analyzed objectives and constraints, cataloging obstacles to profitable production in LDCs and indicating sequences through which production moves as it takes root in those areas. In drawing together its conclusions and recommendations, however, the panel concentrated primarily (as its terms of reference intended) on measures for strengthening the industrial R, D & E capabilities of LDCs, rather than the broader problems of producing industrial goods profitably in LDCs. After a few general findings are listed, the conclusions are reported under three headings: (1) actions that can be taken by U.S. international firms, (2) actions that can be taken by host countries, and (3) actions that can be taken by international agencies or agencies of developed countries. These categories are, of course, not mutually exclusive—actions by corporations, for example,

may require reciprocal actions by host governments. Moreover, many of the actions "that can be taken" are in some areas already being taken.

GENERAL FINDINGS

The mutual understanding, stressed throughout this report as a sine qua non for a lasting relationship between international corporations and host countries in the less developed world, calls for agreed-upon mechanisms for negotiating changes in the ground rules. Essentially, such mechanisms should permit joint exploration of emerging problems before the problems have succeeded in arousing strong emotions or have led to precipitate action by one or another of the parties involved.

But two other factors need to be present for a constructive dialogue: Low-income countries must clearly perceive their development goals in relation to industrial R, D & E, and international corporations must begin to look upon their operations from a developmental perspective, attuning their objectives increasingly to those of their host countries.

Another general conclusion is that LDCs should usually approach the R, D & E sequence in reverse, as E, D & R. That is, after the introduction of basically new technology from abroad, the steps in the hierarchy of indigenous technological development first involve the acquisition of engineering capabilities (E), such as the introduction of materials specifications and standards, the management of quality-control systems, and the operation of tool shops. More ambitious work—utilization of new materials, and adaptations of production and processing techniques (D)—can best come next. Only after a firm has the capacity to copy, adapt, and improve existing technology can it safely venture on to the wholly uncharted terrain of creating completely new technology (R).

ACTIONS THAT CAN BE TAKEN BY U.S. INTERNATIONAL FIRMS

1. U.S. firms should re-appraise the qualifications of the management and staff of their own affiliates in LDCs to initiate local R, D & E activity. Existing staff often were selected in a policy framework that did not call for deliberate implantation and upgrading of R, D & E capability in the host country or for professional links with local technological institutions. Several types of activities, which should be strongly supported by the management of the parent company, could remedy this situation:

a. Assigning qualified R, D & E management personnel from the parent

firm to each affiliate or each region in which more local R, D & E activity appears necessary or desirable.

b. Selecting a test group of capable, interested professionals from the firm's management ranks for intensive training in economic and technological development. This is recommended because the harmonization of foreign investors' activities with the development objectives and priorities of host countries will become increasingly urgent.

c. Providing back-up assistance and support from the headquarters of the firm to foreign affiliates in assessing local R, D & E opportunities and in exploring effective linkages with local science and technology structures.

2. U.S. firms have been, and can continue to be, a major source for training technical and managerial personnel from LDCs—in the United States, in host countries, within the firm, and in other institutions. In all but a few cases, however, the extent of such training has been determined by the company's immediate requirements for technical manpower in the host country. It is recommended that U.S. firms explore ways and means of training, at little marginal expense, more personnel than the particular company requires, thereby enlarging the host nation's pool of trained manpower more rapidly than would otherwise be the case.

3. U.S. firms should adopt a policy of deliberately hiring and training qualified graduates from universities in LDCs. Firms should offer these graduates career opportunities matching those offered graduates of U.S. universities: opportunities to advance through the whole of the corporate technical organization, including other foreign affiliates, with the option of eventually being posted to their home countries. Direct involvement of this kind in the industrial world's scientific and technological system is an arrangement available only from multinational firms.

4. Although the product-design function and the production-engineering function in industrially advanced countries are carried out in more or less separate offices, these two sets of design considerations should be combined in LDCs to permit products designed for LDCs to be manufactured in LDCs. Examples are the new vehicles designed for LDCs by Ford and General Motors.

5. U.S. firms should consider carefully the role local R, D & E can play in a joint quest for devising the most appropriate technology—to change product designs and adjust production processes to fit domestic needs. Normally, such consideration should include the following:

a. A search for labor-intensive equipment scaled to the revised product design and to local market volumes;

b. Reduction in the number and variety of product options that are offered;

c. Easing of performance standards in respects that are not critical to safety or quality (as in food), if such easing will permit production at lower cost;

d. Modification of processing techniques to use a wider range of locally available materials;

e. Elimination of expensive packaging materials; and

f. Subcontracting of production to the extent feasible.

6. At one time, the absence of local services competent to undertake challenging R, D & E assignments more or less forced U.S. international firms to rely on U.S. capabilities. By now, however, research institutes, university laboratories, government laboratories, and engineering consulting services have been established in many LDCs. The rationale for total self-reliance of U.S. firms (usually on home-based facilities thousands of miles away) has been undermined, but the pattern persists.

It is recommended that U.S. firms use host-country technical and scientific services to the extent feasible, beginning with assignments appropriate to their present capacities, but gradually increasing the level of sophisticafion required to carry out the assignment. Implicit in this is a long-term relationship between the corporation and the indigenous technical facility.

7. Some affiliates of U.S. firms maintain a diverse range of relationships with universities and technological schools in LDCs. Affiliates should consider extending such relations in specific directions in the R, D & E area. If local laws and regulations permit, affiliates should consider contracts for research projects consonant with the competence of the university laboratories. Similarly, they could arrange to retain members of the science and technology faculty of one or more universities as consultants to the firm. This practice, widespread in the United States, strengthens the links between university and corporate community and brings the reality of the marketplace to academia. Alternatively or additionally, affiliates could make corporate technical personnel available for university teaching and service on research advisory boards.

8. U.S. firms should encourage and facilitate the formation of local professional societies in fields related to R, D & E. They should also arrange for societies in the United States to assist in the formation of local, counterpart professional associations where the need and demand exist. Examples of such societies include the Industrial Research Institute; the American Institute of Chemical Engineers; the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (AIME); the Society of Mining Engineers of AIME; the Institute of Electrical and Electronic Engineers, Inc.; and the Society of Automotive Engineers.

9. Affiliates of U.S. firms can also help R, D & E institutions in host countries by referring to them problems requiring an interdisciplinary team approach for solution. Under this approach, widely used in U.S. research institutions but infrequently in LDCs, the institution's departmental managers, on being presented with a problem for investigation, can select as project leader the person they consider best qualified to tackle it. To provide the various skills and disciplines required, the project leader then selects his team from different departments and leads a coordinated effort.

10. Firms whose affiliates are associated with a local research institute might arrange to grant internships to managerial personnel of the institute to work in the firm's central laboratories. Short-term exchanges of personnel between central laboratories and host-country institutes can improve local capabilities for research management or local competence in specific technical fields. Conversely, multinational firms should, where feasible, arrange to have research-management teams from their central laboratories visit research institutes in LDCs to conduct seminars on research management.

11. Affiliates of U.S. firms, particularly in the electronics and automotive industries, face the problem of developing supplier industries as sources of materials and parts.[20] In an industrially advanced economy the supplier typically has the superior technical capability. In LDCs, on the other hand, the affiliate has access to the extensive R, D & E capabilities of parent firms. Thus, these affiliates are in a position to influence the development of local enterprise through well-designed supplier-development programs.

Such programs could include upgrading and maintaining suppliers' capacities to meet high standards of quality control, improving their ability to comply with more rigorous delivery schedules and more complex design specifications, and increasing their plant capacity and efficiency. Affiliates could also help suppliers to initiate engineering, then development, and finally research capability (the E, D & R rather than R, D & E sequence).

12. Affiliates that have decided to undertake a local R, D & E program should first identify a pilot project that fits corporate and local needs and lends itself to experimentation in techniques of transplanting research and development capabilities. The results of such experimental activity should be relayed to corporate technical headquarters and exchanged with affiliates in

[20]This is true in most LDCs where (1) regulations requiring local content force the rapid expansion of domestic suppliers, many of whom are not technically equipped to meet the managerial specifications of increasingly sophisticated components; (2) restrictive import practices favor local technical infrastructure; and (3) the number of alternative suppliers available for many types of raw materials, machinery, and equipment is limited because, in turn, of the limited markets available.

other LDCs, thus building a body of experience and knowledge on the implantation and cultivation of local technological capability. The emphasis should be on deliberately implanting the capability to build an R & D system, in effect a capability that is self-starting and has a dynamic of its own, rather than one that merely carries out assigned corporate research tasks.

Case histories of experiments carried out in LDCs by U.S. firms and their affiliates should be prepared and assembled on a multicountry basis. Information on failures as well as successes could benefit both host countries and U.S. firms.

13. In addition to developing and utilizing locally available technical resources, affiliates of U.S. firms can and generally should join in various public service activities consistent with the socially responsible behavior now expected of large industrial enterprises.

An affiliate might join with other industrial firms, local or foreign, to establish joint or coordinated efforts related to specific national development objectives of the LDC. Such joint efforts, though difficult to arrange, could bring a broad range of skills and interdisciplinary approaches to situations beyond the reach of a single company. By sharing the costs of, and demands for, resources, such projects could permit the private industrial sector to undertake problem-solving R, D & E that would not otherwise be possible.

U.S. firms and their local counterparts might also joint academic institutions and governmental agencies in LDCs in research and study groups established to grapple with urgent socioeconomic problems—unemployment, urban congestion, rural stagnation, environmental pollution, etc. Such activities do not fall within the profit-making mandate of a private company, but they affect national welfare, political stability, and the condition of all private investment in an LDC. (Therefore, they might well be funded in whole or in part by international agencies, national development assistance agencies, or other public entities.)

As noted below, LDC governments will need to consult with local and foreign investor representatives and other potentially interested parties to consider the possibilities for such joint efforts. Such cooperative, problem-solving R, D & E programs require a national policy and an appropriate official institutional framework.

ACTIONS BY HOST COUNTRIES

14. While recognizing the right of host countries to set the rules for foreign investment,[21] the panel also recognized that the manner in which the right is

[21] For a Latin American view, see Appendix C.

exercised will elicit or discourage the maximum contribution a foreign investor can make to the technological development of the host country. Encounters between corporate officials and LDC governments on matters concerning technology tend to be impromptu, partisan, and ill adapted to resolving underlying issues and antagonisms. The panel recommends that such ad hoc encounters be supplemented or, better still, superseded by continuing consultation at a professional level dedicated to discussion and resolution of problems of mutual interest before they become specific, emotion-charged "cases." Governments seriously interested in having foreign firms develop local technical resources and engage in productive R, D & E efforts should join these firms in examining policies and regulations that might interfere with the firms' willingness or ability to proceed along desired paths.[22] To provide foreign firms as much guidance as possible, host countries should attempt to define their development goals in terms that will highlight inherent technological needs.

15. LDC institutions should strengthen their emphasis on applied research and development, often neglected at present in favor of more glamorous, "basic" research. The previous recommendations addressed to international firms on relations with universities and laboratories in LDCs can be acted on only if local laws and regulations permit it. The panel accordingly recommends that LDC governments encourage the contracting of research by industry to university and government laboratories, primarily by eliminating regulations that prevent it. Similarly, they should remove obstacles to exchanges of personnel in which qualified personnel of foreign firms could accept part-time teaching and research functions in local universities and university personnel could take on consulting assignments from industry.

16. LDCs should, where feasible, initiate systematic, comprehensive surveys of their needs and resources on a joint government-university-industry basis. These surveys should include not only mineral resources, building materials, and agricultural commodities, but also information on the state of nutrition, the incidence of particular diseases, and other matters on which industrial know-how might expedite national development and welfare.

[22] A recent study on technical innovation in Canadian industry refers to the hazards of R, D & E commitments:

> There are long-range costs incurred in reducing or disbanding industrial research laboratories. These laboratories represent a long-term investment in human resources. Almost always their total value is greater than the sum of the individual workers, and in real terms there are losses, not gains associated with disbanding a carefully-nutured team of specialists. In short, these decisions are not easily reversible; stop-go R & D is costly, and usually ineffective.

(*Innovation in a Cold Climate: The Dilemma of Canadian Manufacturing.* Report No. 15. Ottawa: Science Council of Canada, October 1971. p. 19.)

17. LDCs should address themselves to the legislative and administrative issues of patent policy and their effects on the willingness of multinational firms to establish overseas manufacturing operations and related research activities. Reconciliation of conflicting views between the profit motives of foreign firms and the economic and technological aspirations of LDCs is imperative—an achievement not likely to be possible outside the international patent system. Foreign firms should particularly reconsider restrictive clauses in the licensing of patents that may inhibit LDC economic growth and development. This applies especially to such restrictions as non-use of licensed patents, excessive fees, and clauses restricting exports.

18. Standards are a vital, seminal component in the technological and industrial development of a nation. Every developing nation should institute a flexibly programmed plan for standardization and for securing compliance with standards. This plan should have the unremitting and active support of all concerned public and private interests. The national system of industrial standards should be compatible with a country's aspirations to enter world markets and to attract foreign corporations to establish industrial facilities—with related R, D & E capabilities—for manufacturing for world markets.

ACTIONS BY INTERNATIONAL AGENCIES AND AGENCIES OF DEVELOPED COUNTRIES

19. Where host governments have established, or are prepared to establish, loan funds that support industrial R, D & E programs, the U.S. Agency for International Development and other external sources of development assistance can play an important ancillary role.[23] In addition to supplementary finance, they can provide technical assistance to train local staff for host-country institutions authorized to make technology loans or grants. Foreign funds can also help to finance the importation of technical equipment, computers, and other hardware needed to develop local laboratories, institutes, and research centers.

External aid agencies can also assist host governments to create institutions capable of relating science and technology to industrialization and national development. Such institutions should stress bringing about effective linkages among government, industry, and the education/research establishments in order to make the national R, D & E effort purposeful and relevant to national goals.

[23]See National Academy of Sciences. *Science and Technology in São Paulo's Development: A Review and Critique of a Proposed Program to Utilize Science and Technology for the Economic Development of the State of São Paulo, Brazil.* Prepared for the USAID Brazil Mission. Washington, D.C., July 1972.

20. Among the specific types of activities that might be assisted by AID, alone or jointly with governments, international agencies, and private foundations, are the following:

a. The establishment, with a local industrial research laboratory working with local industry, of specific, sectoral, experimental work programs such as minerals beneficiation in a mineral-rich LDC.

b. The support, through host governments, of cooperative intra- or interindustry research programs on urgent socioeconomic problems (Recommendation 13) that cannot reasonably be financed by private profit-making enterprises.

21. The regional development banks (Inter-American, African, and Asian in particular) and other regional agencies are playing, and have potentially even more important roles to play, in strengthening the scientific and technological capabilities of their member countries. U.S. international firms should collaborate with them on projects and programs, as should such international business organizations as the International Chamber of Commerce, the Council of the Americas, Consejo Inter-Americano de Comercio Y Producción (CICYP), and the Pacific Basin Economic Council.

The World Bank, the Food and Agriculture Organization (FAO), the U.N. Development Programme (UNDP), bilateral donors, and major foundations have established the Consultative Group for International Agricultural Research. They seek to establish research priorities for agriculture and help solve the problems of financing research efforts to meet agreed-upon priority needs. No analogous arrangement for industrial and technological research exists, but it is possible that with the collaboration of the U.N. Industrial Development Organization (UNIDO) a consultative group could play a useful role in focusing international attention and resources on high-priority needs of the LDCs.

This report by no means exhausts the list of possible recommendations. The panelists hope they have indicated clearly enough the directions in which the parties concerned should move. They reject the idea that "go-it-alone" policies will best serve either the LDCs or the U.S. international firms. They maintain, instead, that cooperation based on understanding of, and respect for, the objectives and constraints under which each side labors will more effectively and more quickly strengthen the industrial R, D & E capabilities of LDCs and serve the interests of the international community.

The panel's work is only a limited and exploratory effort to determine the role of U.S. firms in strengthening R, D & E in developing countries. If the effort succeeds in heightening interest and provokes closer analysis by governments and their agencies, corporations, and universities, it will begin a useful process of cooperation and consultation.

APPENDIX A

Background Reading List

The papers listed below were distributed to panelists with an "information note" briefly describing the viewpoints reflected in the papers and ending as follows:

> In summary, the issues with which the panel is dealing are complex, and these articles can do no more than highlight those which appear to be significant. The current literature deals with many aspects of the problem, but it appears that a comprehensive study of the role of U.S. firms in the technological development of newly industrializing countries has not yet been made.

Comisión del Acuerdo de Cartagena. Decision No. 24, "Common Treatment on Foreign Capital, Trademarks, Patents, Licensing Agreements and Royalties" [Excerpts] Lima, Peru. Dec. 1970. (See Appendix D.)

Michael G. Duerr. *R & D in the Multinational Company.* Conference Board Report No. 8. New York: National Industrial Conference Board, 1970.

Caryl P. Haskins. "Science and Policy for a New Decade." *Foreign Affairs.* Vol. 49, No. 2. Jan. 1971.

Eric Jantsch. " 'The World Corporation': The Total Commitment." *Columbia Journal of World Business.* May-June 1971.

Graham Jones. "Industrialization and Research." Ch. 4 in *The Role of Science and Technology in Developing Countries.* New York: Oxford Univ. Press, 1971.

Y. Nayudamma. "Promoting the Industrial Applications of Research in an Underdeveloped Country." *Minerva.* Spring 1967, Vol. 5, Issue 3.

Organisation for Economic Co-operation and Development. *Science, Growth and Society: A New Perspective.* Paris: OECD, 1971. pp. 52–55, 74–77.

Presidency of the Republic of Brazil. "Scientific and Technological Development." In *Objectives and Bases for Government Action.* Brasilia, 1971.

James Brian Quinn. "Technology Transfer by Multinational Companies." *Harvard Business Review.* Nov.-Dec. 1969. (See Appendix F.)

Jorge A. Sabato. "The Influence of Indigenous Research and Development Efforts on the Industrialization of Developing Countries." In *Industrialization and Development.* H. E. Hoelscher and M. C. Hawk, eds. San Francisco Press, 1969.

United States Council of the International Chamber of Commerce, Commission on International Investments and Economic Development. *Regulation of Foreign Investments in the Andean Group.* Document 111/206. New York. 10 June 1971. (See Appendix E.)

Victor L. Urquidi. "Technology, Planning and Latin American Development." *International Development Review.* Washington, Jan. 1971.

APPENDIX B

Final Resolution of UNCTAD III:

Transfer of Technology [Excerpts]

39 (III). Transfer of Technology

The United Nations Conference on Trade and Development,

Convinced that scientific and technical co-operation constitutes one of the main factors of economic and social development and contributes to the strengthening of peace and security of all nations;

Bearing in mind the importance of the transfer of adequate technology to all countries, and in particular to the developing countries;

Considering the recognition given in the International Development Strategy for the Second United Nations Development Decade, in particular in paragraph 64, to the promotion of the transfer of technology to developing countries; . . .

IMPROVING THE ACCESS TO TECHNOLOGY

3. *Invites* the developing countries to establish institutions, if they do not have them, for the specific purpose of dealing with the whole range of complex questions connected with the transfer of technology from developed to developing countries, and takes note of the wishes of the developing countries, that these institutions should *inter alia*:

(*a*) Be responsible for the registration, deposit, review and approval of agreements involving transfer of technology in the public and private sectors;

(*b*) Undertake or assist in the evaluation, negotiation or renegotiation of contracts involving the transfer of technology;

From United Nations Conference on Trade and Development, Third Session. Santiago, Chile, May 16, 1972. *Transfer of Technology*. Final Resolution of UNCTAD III. Agenda Item 19. TD/III/RES/39. pp. 8-15.

The Conference adopted this resolution without objection.

(*c*) Assist domestic enterprises in finding alternative potential suppliers of technology in accordance with the priorities of national development planning;

(*d*) Make arrangements for the training of personnel to man institutions concerned with the transfer of technology;

4. *Invites* the developing countries to take the specific measures they deem necessary to promote an accelerated transfer of adequate technology to them under fair and reasonable terms and conditions.

5. *Recommends* that developed market-economy countries facilitate an accelerated transfer of technology on favourable terms to developing countries, *inter alia*, by:

(*a*) Providing capital and technical assistance and developing scientific and technological co-operation;

(*b*) Endeavouring to provide possible incentives to their enterprises to facilitate an accelerated transfer of their patented and non-patented technology to developing countries on fair and reasonable terms and conditions and by assisting these countries in using effectively imported techniques and equipment;

(*c*) Assisting developing countries to absorb and disseminate imported technologies through the provision of necessary information and technical assistance, such as training in planning and management of enterprises and in marketing, as well as other forms of scientific and technological co-operation;

(*d*) Endeavouring to provide their enterprises and their subsidiaries located in developing countries with possible incentives to employ wherever possible local labour, experts and technicians as well as to utilize local raw materials, to transfer specifications and technological processes used in production to local enterprises or competent organizations, and also to contribute to the development of know-how and expertise by training staff in the developing countries;

(*e*) Designating institutions able to provide information to developing countries concerning the range of technologies available;

(*f*) Assisting through their over-all co-operation programmes in the application of technology and in its adaptation to the production structures and economic and social requirements of developing countries at their request;

(*g*) Taking steps to encourage and promote the transfer of the results of the work of research institutes and universities in the developed countries to corresponding institutions in developing countries;

(*h*) Participating actively in the identification of restrictive business practices affecting the transfer of technology to developing countries with a view to alleviating and, where possible, eliminating these practices in accordance with paragraph 37 of the International Development Strategy for the Second United Nations Development Decade;

6. *Recommends* that the socialist countries of Eastern Europe, in accordance with their economic and social systems, undertake to facilitate the accelerated transfer of technology on favourable terms to developing countries *inter alia* through agreements on trade, economic and scientific and technical co-operation;

7. *Requests* that the Secretary-General of UNCTAD:

(*a*) Implement the programme of work for UNCTAD in the field of transfer of technology approved by the Intergovernmental Group on Transfer of Technology, and undertake the studies necessary for the formulation of

concrete policies to be applied at the national, regional and international levels;

(*b*) Provide advice through UNCTAD's own services to be financed through the United Nations Development Programme within the framework of specific projects and/or by any voluntary contributions, in co-operation, as appropriate, with other bodies, with a view to making available at the request of the developing countries, especially the least developed among them, experienced personnel to assist, within UNCTAD's competence, in the transfer of technology to developing countries;

(*c*) Initiate, and participate in, through the United Nations Development Programme, and in accordance with its procedures, and in co-operation with other competent bodies within the United Nations system and the World Intellectual Property Organization, training programmes concerning transfer of technology for personnel from developing countries, especially from the least developed among them;

(*d*) Assist the Board in reviewing and implementing within UNCTAD's field of competence, the provisions in paragraphs 37 and 64 of the International Development Strategy for the Second United Nations Development Decade;

8. *Decides* that UNCTAD should co-operate with other bodies in the United Nations system, and with other competent international organizations, including the World Intellectual Property Organization, so as, in conformity with Part II of the Programme of Work, to supplement their activities in order to:

(*a*) Assist developing countries in the application and adaptation of technology to their production structures and economic and social requirements;

(*b*) Explore the possibility of setting up multilateral institutions such as technology transfer centres, patent banks and technological information centres;

(*c*) Explore proposals for bilateral and multilateral arrangements to facilitate the transfer of technology on reasonable terms and conditions without causing strain to the balance-of-payments of developing countries;

(*d*) Study possible international mechanisms for the promotion of the transfer of technology to developing countries and particularly take the necessary steps for co-ordinating action with the World Intellectual Property Organization on studies to be carried out in this field.

9. *Resolves* to request the Secretary-General of UNCTAD and the Director-General of the World Intellectual Property Organization, in co-operation with other competent bodies of the United Nations system, to carry out jointly a study of possible bases for new international legislation regulating the transfer from developed to developing countries of patented and non-patented technology, including related commercial and legal aspects of such transfer, for submission to the Economic and Social Council and the Trade and Development Board;

10. *Invites* the Secretary-General of the United Nations, in co-operation with the Secretary-General of UNCTAD and the Director-General of the World Intellectual Property Organization, to carry out a study with a view to bringing up to date the report prepared by the Secretary-General of the United Nations on the *Role of patents in the transfer of technology to the developing countries* and to devote special consideration in this study to the role of

the international patent system in such transfer, with a view to providing a better understanding of this role in the context of a future revision of the system;

11. *Recommends* that the international community, in recognition of the special position of the least developed among the developing countries, should:

(*a*) Assist such countries, for instance by the establishment and/or consolidation of information centres and applied technology institutes;

(*b*) Furnish on easier terms the specialized institutions of such countries with the results of research relevant to their economic development;

(*c*) Give special consideration to the terms, conditions and costs of transfer of technology to such countries;

12. *Urges* that international organizations and financing programmes, in particular the International Bank for Reconstruction and Development and the United Nations Development Programme, should give high priority to providing technical and/or financial assistance to meet the needs as defined by developing countries in the field of transfer of technology, particularly for the purpose defined in paragraphs 3, 7 and 8 above.

IMPROVING THE SCIENTIFIC AND TECHNOLOGICAL INFRASTRUCTURE

13. *Recommends* that urgent measures be taken by the developed countries, as well as by competent international organizations at the national, regional and international levels, to improve the scientific and technological infrastructure of the developing countries;

14. *Invites* the developing countries at the national level:

(*a*) To apply the provisions of paragraph 61 of the International Development Strategy for the Second United Nations Development Decade;

(*b*) To develop an efficient infrastructure geared to the specific socio-economic needs of each country as a solid basis for the adoption and/or adaptation of imported technology, the creation of national technology and the application thereof, and strengthening the domestic, scientific and technological capabilities;

(*c*) To readapt their education and training systems to the needs and demands of a technologically progressive developing economy [and] society;

15. *Further invites* the developing countries at the regional and inter-regional level to consider action:

(*a*) To assist the transfer of technology to themselves by exchanging information concerning their experiences in acquiring, adapting, developing and applying imported technology, and in this regard, to set up regional or sub-regional information centres;

(*b*) To make appropriate institutional arrangements for the training and exchange of technical personnel;

(*c*) To establish joint technological research centres for projects of regional interest and for exchanging between developing countries, within the region or between different regions, adapted or recently developed imported technology;

(*d*) To promote the study of scientific and technological projects between developing countries with common technological requirements arising from similarities in their sectoral structure of production;

(*e*) To set up machinery to facilitate the dissemination and exchange of technologies originating in the developing countries, so that the comparative advantages and specialization offered by each sector of activity may be fully utilized;

(*f*) To endeavour to co-ordinate their policies with regard to imported technology, including its adaptation to domestic conditions;

16. *Recommends* that the developed countries:

(*a*) Give urgent consideration to the possibility of taking prompt measures to move toward fuller implementation of the provisions of paragraph 63 of the International Development Strategy for the Second United Nations Development Decade;

(*b*) Endeavour to provide possible incentives to encourage their national enterprises to transfer to their associated enterprises in developing countries a substantial and increasing volume their research activities;

17. *Takes note* of the wishes of the developing countries that the developed countries should:

(*a*) Devote 0.05 per cent per annum of their gross national product to the technological problems of developing countries;

(*b*) Allocate at least 10 per cent of their research and development expenditure to programmes designed to solve problems of specific interest to developing countries generally, and as far as possible devote that expenditure to projects in developing countries;

18. *Calls on* the socialist countries of Eastern Europe to increase further, in accordance with their social and economic systems, their assistance to the developing countries, taking account of their own possibilities and to continue transferring adequate technology to the developing countries on favourable terms;

19. *Recommends* that bodies in the United Nations system, including UNCTAD, within its field of competence as defined in part II of the programme of work which provides that it will supplement the activities of the bodies competent in this matter, and of the World Intellectual Property Organization, should:

(*a*) Bring to an acceptable conclusion the United Nations World Plan of Action for the Application of Science and Technology to Development;

(*b*) Assist the developing countries to create the necessary infrastructure, as regards both institutions and personnel, for the development and transfer of technology;

(*c*) Co-ordinate their efforts and programmes for the support of science and technology at the regional and international level in order to facilitate the transfer of technology to developing countries;

(*d*) Should support the regional economic commissions and the United Nations Economic and Social Office in Beirut in order to enable them to carry out fully their role in the application of science and technology to development within their respective regions.

20. *Requests* UNCTAD, within its field of competence, as defined in Part II of the Programme of Work which provides that it will supplement the activities of the competent bodies in this matter, to contribute to the studies being carried out on the outflow of trained personnel from developing countries which constitutes a reverse transfer of technology.

21. *Recalls* that as recognized in the preamble to Trade and Development Board resolution 74 (X), none of the existing United Nations bodies deals

exclusively with the specific question of the transfer of operative technology to developing countries and that, therefore, as decided in paragraph 2 of the same resolution, UNCTAD would perform its functions in this field in co-operation and co-ordination with other bodies in the United Nations system and other international organizations with the aim of avoiding any overlapping and unnecessary duplication of activities in this field, in conformity with the responsibilities of the Economic and Social Council, particularly those of co-ordination, and with the agreements governing the relationship between the United Nations and the agencies concerned.

APPENDIX C

CACTAL:

Consensus of Brazilia on the Application of Science and Technology to Latin American Development [Exerpt]

PREAMBLE

The Specialized Conference on the Application of Science and Technology to Latin American Development (CACTAL) finds its inspiration in the Declaration of the Presidents of America, who, at the meeting held in Punta del Este from April 12 through 14, 1967, recognized the decisive importance of science and technology to the development of Latin America.

The Presidents of the American Republics affirmed on that occasion that "Latin America will share in the benefits of current scientific and technological progress so as to reduce the widening gap between it and the highly industrialized nations in the areas of production techniques and of living conitions." They further agreed that "national scientific and technological programs will be developed and strengthened and a regional program will be started; multinational institutes for advanced training and research will be established; existing institutes of this kind in Latin America will at the same time be strengthened and contributions will be made to the exchange and advancement of technological knowledge."

Likewise, they stated that "science and technology offer infinite possibilities for providing the people with the well-being that they seek. But in

From *Specialized Conference on the Application of Science and Technology to Latin American Development.* May 12-19, 1972. Brazilia, Brazil. *Final Report.* Part III, "Decisions." OEA/Ser.C/VI.22.1. Washington, D.C.: General Secretariat Organization of American States, 1972. pp. 10-13.

Latin American countries the potentialities that this wealth of the modern world offers have by no means been realized to the degree and extent necessary." They also affirmed that "science and technology offer genuine instruments for Latin American progress and must be given an unprecedented impetus at this time. This effort calls for inter-American cooperation, in view of the magnitude of the investments required and the level attained in such knowledge. In the same way, their organization and implementation in each country cannot be effected without a properly planned scientific and technological policy within the general framework of development."

In the spirit and letter of the Declaration of the Presidents of America, the Latin American countries expressed in the Consensus of Viña del Mar (May 1969), their willingness to convene an inter-American meeting on the application of science and technology to Latin American development. Determined to put this aspiration into effect, the Eighth Special Meeting of the Inter-American Economic and Social Council (CIES), held in Caracas in February 1970, the First Special Meeting of the Inter-American Council for Education, Science, and Culture (CIECC), held in Washington in April 1970, and the Second Regular Meeting of CIECC, held in Lima in February 1971, recommended that a specialized conference be held; and the General Assembly of the Organization of American States, at its first regular session (San José, April 1971), endorsing to that recommendation, convoked the Specialized Conference on the Application of Science and Technology to Latin American Development (CACTAL), to be held in Brasilia in May 1972.

CACTAL is therefore a response to the political decision to give impetus to an eminently dynamic process intended to mobilize Latin America for the systematic application of science and technology to accelerate the region's development.

DECLARATION OF PRINCIPLES

1. The member states of the Organization of American States represented at CACTAL hereby reaffirm, as guiding principles for the work of the Conference and for the specific action arising therefrom, the economic and social standards as well as the standards on education, science, and culture contained in the Charter of the Organization.

2. The member states, inspired by the principles of inter-American solidarity and cooperation, and bearing in mind in particular Articles 29 to 50 of the Charter, reaffirm their determination to join efforts at ensuring social justice in the hemisphere and overall, dynamic, and balanced development for their peoples. They likewise ratify their pledge to mobilize their own national human and material resources as a fundamental condition for their economic and social progress.

3. The member states reaffirm, as an essential condition for the full exercise of national sovereignty, without impairment to regional cooperation, the need to strengthen their capacity to make their own decisions regarding creation and adoption of the science and technology required for the development of their peoples.

4. The member states, in conformity with the provisions of Article 40 of the Charter, recognize that integration of the Latin American countries is one of the objectives of the inter-American system and, consequently, reaffirm

that they will orient their efforts and adopt the necessary measures in the field of science and technology, in such a way as to contribute to the attainment of that objective in the shortest possible time.

5. The member states, with the aim of ensuring the well-being of their peoples, and pursuant to Article 36 of the Charter, agree to adopt concrete measures to extend among themselves the benefits of science and technology by encouraging the exchange and utilization of scientific and technical knowledge.

6. The member states recognize that in Latin America the primary function of science and technology is to contribute to overall development and improve the quality of human life.

BASES FOR A SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT STRATEGY IN LATIN AMERICA

1. The systematic and continuous application of science and technology to the overall development of Latin America, at the national and multinational levels, demands that each country shall first of all define its overall development strategy. This definition shall take into account the fact that scientific and technological policies must be geared to the permanent objectives of that strategy concerning economic growth, social justice, and the enhancement of culture.

2. Concern over the attainment of social justice should be translated into adoption of the suitable development policy instruments in each country that will ensure that its technical and scientific component will contribute effectively toward attainment of the goals of full employment and full utilization of human resources.

3. It is the sovereign right and the duty of the states to define the major objectives of their overall development. The formulation of comprehensive national policies and plans constitutes the frame of reference of the scientific and technological effort that the accelerated progress of the peoples of Latin America demands. Consequently, it is urgent to design, determine, and apply national policies on science and technology that are closely coordinated with economic and social development policies. The agencies responsible for policies on science and technology should be located at a high level in the political and administrative structure of the respective states so that they may truly participate in the decisions that directly or indirectly, affect those policies.

4. Overall strategy for scientific and technological development should seek the continuous interrelation and coordination of the pertinent activities of the governmental sector, the productive sector, the financial sector, and the scientific and technological system.

5. The objectives of an overall, integrated strategy should include narrowing the technological gap, eliminating technological dependence on the developed countries, and advancing toward the creation of indigenous technologies.

6. The Latin American countries need to strengthen and reorient their domestic scientific and technological systems with a view to absorbing, adapting, and generating technologies. This requires increasing applied and experimental research and conducting properly oriented basic research that will serve those systems as an input.

7. To achieve the goal of technological modernization, the Latin American nations should orient their respective national development policies toward the best possible utilization of economies of scale and toward strengthening national production systems through improvement in the technological and managerial capacity of enterprises.

8. Domestic resources should, in general, be the main source of financing for national efforts aimed at development of the scientific and technological systems of the Latin American countries. The policies for execution—fiscal, monetary, trade, etc.—of the development strategy should include, among their major objectives, the capacity to allocate sufficient resources so as to increase those devoted to scientific and technological activities, ensuring stability, continuity and efficiency in their implementation.

9. External aid should supplement domestic efforts, should be oriented by the country receiving it on the basis of integrated programs as regards scientific and technological planning, and should be geared to priority needs.

APPENDIX D

Treaty of Cartagena [Andean Group]:

Common Treatment on Foreign Capital, Trademarks, Patents, Licensing Agreements, and Royalties [Excerpts]

Article 18. Any contract regarding importation of technology or regarding use of patents and trademarks shall be reviewed and submitted to the approval of the pertinent agency of the respective Member Country, which shall evaluate the effective contribution of the imported technology by means of an appraisal of its possible profit generation, the price of the goods embodying technology or other specific means of measuring the effect of the imported technology.

Article 19. Contracts for importing technology shall at least contain some clauses regarding the following:

a) Identification of the manner in which the technology to be imported shall be transferred;

b) Contractual value for each of the elements involved in the transfer of technology expressed in a similar way as that used in the registration of foreign direct investment; and

c) Determination of the time period during which the contract shall be in force.

From Comisión del Acuerdo de Cartagena, Third Special Meetings, Lima, Peru, December 14-31, 1970. *Common Treatment on Foreign Capital, Trademarks, Patents, Licensing Agreements, and Royalties.* Decision No. 24. (Unofficial translation.)

Article 20. The Member Countries shall not authorize contracts for the transfer of foreign technology or use of patents containing:

a) Clauses stipulating that the provision of technology carries with it an obligation on the part of the receiving country or enterprise to purchase capital goods, intermediate products, raw materials or other technologies from some given source or to make permanent use of staff appointed by the firm supplying the technology. In exceptional cases, the receiving country may accept clauses of this nature for the purchase of capital goods, intermediate products or raw materials provided that their price falls within the levels prevailing in the international market;

b) Clauses stipulating that the technology-supplying firm reserves the right of establishing the sale or resale prices of the products manufactured on the basis of the respective technology;

c) Clauses stipulating restrictions as to the volume and structure of production;

d) Clauses prohibiting the use of competitive technologies;

e) Clauses stipulating a total or partial purchase option in favor of the supplier of technology;

f) Clauses committing the buyer of technology to transfer to the supplier those inventions or improvements obtained through the use of said technology;

g) Clauses stipulating payment of royalties for unused patents to the holders of said patents; and

h) Other clauses having equivalent effects.

With the exception of special cases, duly verified by the pertinent agency of the receiving country, clauses prohibiting or in any way limiting the export of the products manufactured on the basis of the respective technology will not be accepted.

In no case will clauses of this type be accepted with regard to subregional trade or for the export of similar products to third countries.

Article 21. Intangible technological contributions will have a right to payment of royalties, with the prior authorization of the pertinent national agency; but may not be registered as capital contributions.

When these contributions are made to a foreign enterprise by its parent company or some other affiliate of the same enterprise, payment of royalties shall not be authorized nor will any deduction be accepted for this reason for tax purposes.

Article 22. National authorities shall undertake a continuous and systematic identification of the technologies available in the world market for the different industrial fields, for purposes of having at their disposal the most favorable and convenient alternative solutions for the economic conditions of the subregion and shall submit the result of their task to the Junta. This action shall be implemented in coordination with those adopted in Chapter V of this treatment with respect to the production of national or subregional technology.

Article 23. Upon proposal by the Junta, and before November 30, 1972, the Commission shall approve a program directed to promoting and protecting the production of subregional technology as well as the adaptation and implementation of existing technologies.

Among other elements, this program shall contain:

a) Special benefits, tax or otherwise, to encourage the production of technology and specially those related to the intensive use of subregional inputs or which are designed to make an efficient use of subregional productive factors.

b) Encouragement of exports of products manufactured on the basis of subregional technology to third countries; and

c) Channeling of domestic savings to the establishment of subregional or national research and development centers.

Article 24. The Governments of the Member Countries in their purchases shall give preference to products incorporating subregional technologies in the way which the Comisión deems it convenient. The Comisión, upon proposal by the Junta may propose to the Member Countries to levy taxes on those products using foreign trademarks which involve payment of royalties when easily available or known technology is used in their manufacture.

Article 25. Licensing agreements for the exploitation of foreign trademarks in the area of the Member Countries may not contain restrictive clauses such as:

a) Prohibition or limitations to export or sell products manufactured under the respective trademarks or similar products in some given countries;

b) Obligation to use raw materials, intermediate goods or equipment supplied by the trademark holder or its affiliates. In exceptional cases, the receiving countries may accept clauses of this type provided their price is within the levels currently prevailing in the international market;

c) Establishment of sale or resale prices of the products manufactured under the trademark;

d) Obligation to pay the trademark holder royalties for unused trademarks;

e) Obligation to provide permanent employment to personnel provided or appointed by the trademark holder; and

f) Other clauses having equivalent effect.

APPENDIX E

International Chamber of Commerce:

Regulation of Foreign Investments in the Andean Group [Excerpts]

The International Chamber of Commerce has carefully examined Decision 24 of the Commission of the Cartagena Agreement (the Andean Group); this Decision, which proposes a common treatment for foreign capital, trademarks, patents, licensing agreements and royalties, was adopted by the Commission in December 1970 and should, in accordance with the Cartagena Agreement, enter into force in the five member countries on 1 July 1971. It is hoped that the considered views of the ICC, which represent the reactions of businessmen with wide experience in direct investment in Latin America as well as other areas, might be helpful to the governments concerned and to the Commission. . . .

Reciprocity and absence of discrimination between nationals of different countries are principal features of international industrial property law. These principles, together with equitable contracts, have proved to be important means for facilitating the transfer of technology. The successful transfer of technology, however, involves not only the acquisition of legal rights. Technical information, experience, skills and know-how are also involved and are often of greater significance than the specific legal rights concerned. These can be communicated only in an atmosphere of mutual trust and confidence.

From International Chamber of Commerce. Commission on International Investments and Economic Development. *Regulation of Foreign Investments in the Andean Group.* Statement adopted by the Standing Group of the Commission 2 April 1971 and confirmed by the Executive Committee of the ICC 18 April 1971. Document 111/206. Paris: ICC, 1971.

Provisions which distort the relationship between the parties in such a transfer inevitably disturb this confidence and will ultimately have the effect of restricting the flow of technology, however great may seem the benefit to be gained in the short term.

Many of the procedures foreshadowed in Articles 18–26 are patterned on procedures followed elsewhere but the requirements are very detailed and specific and not always appropriate. Their rigid observance will inevitably interfere with the negotiation of equitable arrangements acceptable to all parties, and will interfere with the transfer of technology to affiliates, the importation of technology in the form of patent rights and the incentive to develop markets in the area.

It is recognised that countries must always have regard to the value of the technology for which they are paying and to their fiscal position, but rigid rules, laying down the form and size of payments, the terms and other provisions of agreements and the circumstances in which industrial property rights and technology are to be transferred and used, only frustrate the free flow of technology and eventually produce the opposite result to that which they are intended to achieve. . . .

The ultimate objectives of Decision 24—a more rapid pace of economic and social development, greater participation by national enterprise in the process and benefits of industrial growth and a closer integration of the regional market—are fully supported. So, too, is the recognition by the Andean Group of the necessary contribution of foreign investment and technology to the achievement of these objectives. The ICC fears, however, that the overall effect of Decision 24 will be: to deter rather than to attract the inflow of foreign resources; to lead to the slowing down, if not interruption, of the transfer of technology; to adversely affect the balance of payments; and to result in a wasteful utilisation of local capital resources. The ICC further fears that Decision 24, instead of contributing towards the attainment of its stated objectives, will impede rather than promote progress towards development, national participation and regional integration.

APPENDIX F

A Model for Introducing Technology into Developing Countries [Excerpts]

G. W. Allen and L. A. Howard

ABSTRACT: A practical method for the introduction of new technologies by private enterprise into developing countries is shown, using IBM experience. The method starts with marketing and user education. Further technology transfer to citizens, commerce and industry takes place through manufacturing operations set up with the assistance of a parent company. The transfer grows to higher levels of technology as personnel technical competence and supplier support grows. Extensive training of users, employees, suppliers and subcontractors is conducted to assure balanced growth. A multiplier effect is seen through associated several layers of education, commerce and industry.

IBM has developed its business throughout the world by providing the tools and methods by which government, commerce, business and education can solve problems more efficiently. Primarily, the customer is interested in the application and use of our data processing equipment, not just the hardware. This requires that the local IBM marketing and service forces and the customer's employees receive extensive training in the technology involved in the use of the equipment. This training continues at all levels: the IBM Branch Office, at laboratories and plants, at the customer's office and at IBM Education Centers (one is located in Cuernavaca, Mexico, for example). Obviously, this is the major part of the transfer and diffusion of our kind of technology.

We have located most of our manufacturing plants in the major market areas of the world. There are some rather obvious reasons for doing so, such

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as the ability to respond more quickly to customer desires and the reduction of inventory, transportation and duty costs. The market needs plus recognition of economic, geographic and political realities have resulted in also placing manufacturing plants in some of the less-industrialized countries such as India and some years ago, in Argentina and Brazil. These manufacturing facilities also contribute to the transfer and diffusion of technology at another level by the training of our manufacturing employees and the utilization of local suppliers and sub-contractors. . . .

When IBM has started manufacturing operations in developing countries, we have built toward the higher technologies by establishing a sound base for innovation and the diffusion of what might be called the rather ordinary technologies. For instance, despite the public glamour of building monolithic semiconductors, it doesn't make much economic sense in our business to spend millions of dollars to produce the semiconductors locally and then have to continue importing such relatively unsophisticated but necessary items as the power switches, circuit breakers and indicator lamps, which tell the operator whether or not the computer is working. In addition, the establishment and improvement of industrial manufacturing capabilities in the developing country for such items have a very great potential for other related markets.

We start with the premise that all of the technology to produce computers already exists in the parent company. Our theme here is to apply, develop further and to diffuse that technology in a country where it does not now exist.

In the IBM experience, we can initiate a manufacturing operation with the assumptions that many important conditions have been met and that certain capabilities already exist. First, we have a parent company which is capable of and predisposed to support the initial investment costs of starting up a manufacturing business in that country. This parent company or its older subsidiaries also have a pool of existing marketing, technical, administrative and management people to draw on for start-up activities.

Second, and fundamental, is the assumption that IBM has already established in that country a marketing and service organization which has developed a sound market for the product line; developed national employees toward the general business management levels; and has developed good relations in the business community, the financial community and with the government. . . .

It is important in the initial plans to establish a balanced and manageable growth rate of the new operations: balanced between the growth of market in size and complexity on the one hand and the manufacturing capability, including local suppliers, on the other hand. This growth rate should be planned in advance so that there is opportunity for career advancement and development of the people at all levels in the operation, especially in the local management.

With this planned growth in mind we would initially choose a rather narrow range of products and these would be selected for the best fit to the local marketing program requirements. We would also try to start with some capability to export these products to neighboring countries.

In Figure F-1, this growth plan is portrayed as a cube expanding with time and personnel technical development. As the people grow, they become involved in higher levels of technology and increase the local "value added" in the products.

The next major step is to make a thorough analysis of the products selected, detailing the parts, processes, materials, skills, and tools that will be required in production. This analysis must be matched against a thorough survey of the capabilities of suppliers and vendors in the host country, and where practical

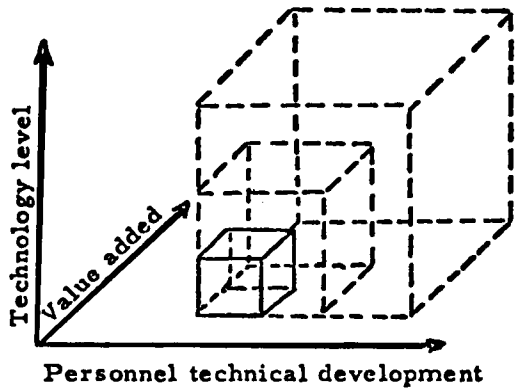

Figure F-1. Interdependence of value added and technology

in neighboring countries. Following this analysis, we set initial targets for the Purchasing Department to find material and parts suppliers for some substantial percentage of the local value added to the product. We would definitely not "try to do everything ourselves in our own plant." Where local capabilities exist, we prefer to use them and build on them rather than duplicate them. This approach gives us the ability to concentrate our resources on improvements in parts, processes and products as quickly as possible.

An important part of the supplier survey is to separate those things which are immediately available from those which can in a short time be developed or improved to meet technical standards, from those items which will require long range development or, in some cases, may continually have to be imported. There will, for example, always be certain items for which the capital investment and production costs required to establish multiple sources cannot be justified. Obviously, each of the manufacturing locations aspires to capture some such item for itself and to become essentially the single IBM world-wide source for that product or part. In recent years, our Argentine plant has developed to the point where it is a major world source for the punched card sorting machines in our line of card handling equipment.

During the earliest phases of production, we have occasionally used the approach of importing complete sets of parts with assembly instructions. This provides initial assembly and test work, management development, value added, product line familiarization and local output in the few months period before the support services such as production control, purchasing and tool engineering can become fully operable.

Following the product analysis mentioned above, we immediately start an import substitution program. This is aimed at using local raw materials in our own plant, and toward the extensive use of locally available finished products and subcontracted assembly and process work. This program, however, remains tied to economic reality because we measure its effectiveness against the item cost at the original source. This measurement requires that the new source be reasonably competitive with the previous foreign source or with our in-plant cost.

We have during this phase of activity extensively used what we call "vendor seminars" to build up our local purchasing base. At these seminars, we invite a broad range of suppliers to our plant for one or two day sessions with various members of the plant management team. The vendors are able to see, inspect and discuss with us a list of parts, materials or processes (painting, plating, heat treating) that we wish to buy. At the same time, we take several hours to acquaint the vendors with our standards and specifications for materials, tolerances, workmanship and quality. We give them full information, not only on the technical aspects of what we expect to buy, but the business and financial practices in use by our purchasing people.

During these seminars, it often happens that a potential vendor would like very much to bid on an item, but he lacks the ability to acquire a certain kind of material or a certain tool, or certain component parts of the assembly. Our purchasing and manufacturing engineering people make every effort to assist him by consignment of parts or materials for his use, loans of our tools for his use, and help in finding local or foreign sources for items that he might not have available. We have often helped a supplier get started by providing progress payments on major jobs, or by placing a large enough order so that he can use that order as a foundation to buy a new machine tool which will generally upgrade his entire operation. . . .

An important aspect in building the supplier's capability is that of training his people in new skills. We have done this in several ways. Commonly, when the operation has been performed in the local IBM plant and we wish to subcontract it, we bring into our plant the supplier's people for on-the-job training and we send skilled IBM people (not just "teachers") to train the supplier's people on his premises. We have also brought in foreign cadres to train the supplier's people. A recent example occurred in Europe when we established a major subcontract operation with a supplier in Portugal to do work which had previously been done in one of our German plants. Despite the fact that the skilled operators in Germany and the learning operators in Portugal could not speak each other's language, we were able to transfer the work successfully by putting the people side-by-side in Germany and in Portugal to teach the supplier's people by direct "hands-on" kind of training.

The IBM buyer must call upon a broad range of skills in other departments of the plant and from other plants for supplier assistance and training. He regularly uses the services of quality engineers at the vendor's location to assure that specifications and standards are fully understood and that they can be met in order to reduce the embarrassment and expense of rejections. Manufacturing methods engineers and tool engineers are made available to assist the vendor in solving process and tool utilization problems. This kind of assistance often includes the development of a complete process or assembly method for the vendor based on his equipment and capabilities. Production control and scheduling people assist in fitting the supplier's work schedules to the plant schedule.

A very important item in this theme of transferring and diffusing technological skills is not often considered as being part of the technological process, and that is the ability to develop accurate cost estimates, accounting records, costs and prices for one's product. It is obviously in our best long-range interest that our suppliers are financially stable and competitive, as well as technically competent. When a supplier has become involved in a new field of technical activity on our behalf, we also try to insure that he understands how to identify,

control and manage his costs related to that new activity and continue it successfully.

During the period of building up the plant activity, it is important for the local IBM company management to take an active interest in the technical and vocational schools and apprentice training programs in the area, in addition to the university programs. We have frequently made contributions of equipment for testing and training purposes to such schools. Obviously, the intent is to hire people having the required skills and knowledge but that can, over the long run, be most successful if we try to synchronize our technical requirements with the school plans. We encourage our engineers and professionals to participate in community education programs and to be guest teachers when the opportunity presents itself. Some countries such as Spain and Singapore give strong government support to vocational apprentice programs. Even though we have no manufacturing operations in these countries, we do have purchasing activities there and try whenever possible to add our support to these schools. In Singapore, where the school partially supports itself by small subcontracts, we have purchased from them or have encouraged our other suppliers to do so.

At the university level, our management tries to maintain a continuing technical exchange with the professors and university administration in order to enhance our recruiting efforts. We encourage our employees to continue their education through voluntary education programs sponsored within the company and in conjunction with nearby universities through tuition refund programs for advanced professional training.

Another example of university support is the practice of our Bombay, India plant to subcontract laboratory, chemical and metalurgical analyses to local technical universities. . . .

This training goes on in two ways. In the early stages of the plant activity or during the introduction of a new product, we may bring in a foreign expert from another IBM company, not necessarily the U.S.A., for a short-term assignment to accomplish specific tasks and to train local employees in his particular field or product. As the plant grows and people begin to develop, we also send these people to the U.S., or to Europe, or to Canada for extended training and working assignments. The U.S. Department of Commerce suggests strongly that the benefits of such training are broader than the "selfish" interests of the company providing it. . . .

This kind of international reputation and outlook benefits the plant manager in his training of the other people in the plant, and it gives him a broader outlook in his dealings with the local business community. It provides him with the management and technical knowledge to recognize and to utilize opportunities for increased local value added and export potential, whether in his plant or among his suppliers. From his international business contacts, he is able to anticipate new needs and opportunities for technological growth which through advance preparation can be applied in his country. . . .

As illustrated in Fig. 1, when the local plant grows in capability, it broadens its base of supplier support and, therefore, local value added in the products. It becomes able to get into more technologically sophisticated products and activities. In Bombay, India, our plant has progressed from rather simple reconditioning and repair-kind of activities into major assembly programs for the local market and a significant new machine building program with exports to other Asian countries. They have for some time assembled the Model 1401

computer and have filed application with the government to produce and assemble the System/360 computer series.

During the past five years, the IBM plants in Buenos Aires and Campinas have found and developed about two hundred new suppliers in Argentina and about one hundred in Brazil. Of these more than one hundred and fifty have become involved in completely new products or processes, or have made significant improvements in their capabilities. Some examples are:

- fractional-horsepower electric motors for electric typewriters
- electrical wire and cables
- high-precision machining and assembly
- precision metal castings and plastic moldings
- precision tools, fixtures, molds, etc.
- close-tolerance heat treating and plating.

IBM provided extensive manufacturing engineering, quality assurance, standards, product engineering, and cost accounting support to these vendors to help them develop these new and improved capabilities. The vendors who now have these new skills and capabilities should be able to improve the quality of their sales to other companies and to promote similar improvements among their own subcontractors and suppliers.

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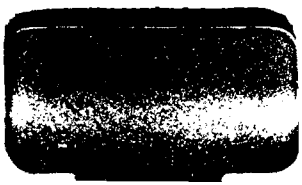

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