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REORIENTATION OF INDUSTRIAL STRATEGY IN
DEVELOPING COUNTRIES AND SELECTION AND APPLICATION
OF APPROPRIATE INDUSTRIAL TECHNOLOGY*

prepared by

UNIDO Secretariat

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INTRODUCTION

1. In the aide-mémoire issued in connection with the meeting of the Second Consultative Group on Appropriate Industrial Technology, the objectives of this meeting were defined as being to:

- (i) review basic objectives and aspects of industrial strategies in developing countries and the relationship between reorientation in such strategies and programmes of industrialization with the application and use of appropriate industrial technologies;
- (ii) identify the principal features of selection, adoption and development of more appropriate techniques and processes, with particular reference to industrial sectors where such alternative technologies are most relevant and applicable;
- (iii) discuss the interrelationship and sectoral linkages in the application and use of alternative appropriate technologies in certain sectors;
- (iv) identify and discuss policy criteria and issues which need to be considered by developing countries in the selection and application of more appropriate production processes and techniques; and
- (v) highlight aspects and issues of international co-operation in the application and development of more appropriate industrial technologies in particular sectors.

2. The principal purpose of the Second Consultative Group meeting is to define the basic conceptual and policy framework relating to selection and application of appropriate industrial technology in developing countries. It is expected that the recommendations of this Group would provide a significant input for the deliberations of the International Forum on Appropriate Industrial Technology which is being convened by UNIDO in India in November 1978. The discussions and recommendations in the International Forum are, in turn, likely to provide a major contribution to the UNIDO Conference on Science and Technology (1979) and to the Third General Conference of UNIDO (1980).

3. The agenda for discussion in the Second Consultative Group meeting should broadly relate to the issues and aspects defined in the above-mentioned objectives of the meeting. Consequently, the principal subjects for discussion may be considered under the following agenda items:

- (i) Industrial growth strategy and appropriate technology;
- (ii) Selection and application of appropriate technology in selected sectors;
- (iii) Sectoral linkages and interrelationships;
- (iv) Policy issues in the application of appropriate technology;
- (v) Issues of international technological co-operation.

4. The agenda items mentioned above have been further elaborated in this note in order to highlight the principal aspects and issues that need to be discussed by the Group with a view to arrive at a general consensus. Several papers received in connection with various aspects of technology policy and appropriate industrial technology have been circulated to serve as background documents for the Consultative Group meeting. ^{1/}

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- 1/ 1. Appropriate Technology and the activities to be stimulated by Jan Tinbergen
 2. Dualism, sectoral planning and integration of modern industrial and dispersed traditional sector by J.D. Pene
 3. Appropriate Technology in the context of the redirection of LDC industrial development strategy: concepts and policies by G. Ranis
 4. On the establishment of an Industrial Technology Development Policy by K.H. Yap
 5. Appropriate Industrial Technology: an integrated approach by D.Frost

Other documents received subsequently will be circulated during the meeting.

I. INDUSTRIAL GROWTH STRATEGY AND APPROPRIATE TECHNOLOGY

1. The basic objectives of industrialization in developing countries are to achieve the quantitative production targets in critical growth sectors based on factor endowments of individual countries with a view to meeting socio-economic and developmental needs of the populations. The overall quantitative target has been set by the Lima Declaration and Plan of Action and aims at achieving a 25% share of global industrial production in these countries by the year 2000. The Lima Declaration also defined broad qualitative objectives such as the achievement of greater social justice through more equitable income distribution and optimum development of national and human resources in these countries. Certain employment and social aspects of development were further elaborated in the Tripartite World Conference on Employment, Income Distribution and Social Progress held in Geneva in June 1976.

2. The objectives of industrialization can only be achieved through rapid application of internal and external investible resources, of very significant dimensions and magnitude for industrial programmes and activities. This necessitates optimum generation and mobilization of internal resources, both material and human, in developing countries, together with significant financial and technological resource flows from industrialized nations and easing of the heavy debt burdens which have accumulated in most developing countries. Such resource generation and mobilization has to be dovetailed with a reoriented industrial growth strategy designed to provide adequate income and employment opportunities for as wide a strata of population in these countries as possible. It is increasingly being realized that the 'trickle-down' effect of the existing pattern of industrialization is proving very inadequate to meet the essential needs and aspirations of developing countries, particularly the poorer sections, which represent the great majority. A more comprehensive developmental strategy has to be designed to effectively meet broader socio-economic objectives. These objectives cannot be served by the industrial growth process alone, but industrialization can and must play a critical and pivotal role, as it constitutes the most effective means both of producing a wide variety of goods and services and ensuring employment opportunities, income generation and improvement in conditions of living.

3. There is growing recognition in most developing countries that industrial strategies and programmes, which have largely followed Western models of industrialization, have not fulfilled basic socio-economic objectives and the overall benefits expected from industrialization have not been adequately achieved. Though there has been fairly rapid progress in many production sectors in several developing countries, the overall impact has largely been limited to the creation of enclaves of 'modern' industry, mainly concentrated in metropolitan regions in these countries, with continuing dependence in most cases, on industrial technology, capital goods and technological services from foreign sources. The continued dominance of foreign subsidiaries and affiliates in various sectors of these economies, coupled with the increasing need for direct foreign investment and loans and credits of various forms, has greatly added to debt burdens of these countries, without providing the accelerated take-off in industrial growth to effectively meet their growing indebtedness through effective competition in international markets, except in certain sectors and goods and services. The modern industrial sector constitutes only a small fringe in most developing countries and the benefits in terms of income and employment have been restricted to very small sections.

4. At the same time the economic benefits of industrial progress have not percolated to the poorer sections in these countries, which are mostly resident in the rural areas and which have remained largely unaffected by industrial development concentrated in certain urban areas. Poverty and unemployment have, in fact, become more intensified in the rural areas and in the 'non-modern' urban sector. Income disparities have tended to grow, instead of being reduced as an essential facet of the development process. Above all, certain basic needs of the community remain unfulfilled, creating and accentuating a critical dichotomy in the development process.

5. The broader objectives of industrial progress can perhaps only be achieved through significant reorientation of the industrial growth pattern. Rapid industrial growth is not only fully consistent with such a wider strategy but is, in fact, condicio sine qua non, as accelerated growth rates can only be achieved through greater production of goods and services. What is, however, necessary is that industrial growth strategy must be effectively harmonized with wider socio-economic needs. This may well necessitate considerable reorientation of the future pattern of industrial growth, with

continued emphasis on the growth of basic and critical industrial sectors in each economy on the one hand, and greater stress on more broad-based industrial development, including significant spread of industry to non-metropolitan regions, on the other. This would inevitably involve a degree of restructuring of future industrial growth.

6. The reorientation of industrial growth strategy and the relationship between such reorientation and the application of more appropriate industrial techniques and processes was discussed in the First Consultative Group Meeting of UNIDO in November 1977. It was the view of the Group that such reorientation would necessitate a two-fold approach. On the one hand, the 'modern' industrial sectors in these countries would need to expand rapidly following national policy objectives such as import substitution in certain sectors, development of exports in others, together with optimum utilization of national resources and factor endowments. The 'modern' sector may be conceived in terms of industrial branches as primarily relating to basic industries such as steel, mineral and metallurgical industries, production of fertilizers and chemicals, manufacture of capital goods, development of agro-industries and the like, many of which would require the application of sophisticated capital-intensive techniques employed in large-scale production in these sectors in developed economies. On the other hand, much greater emphasis must also be given to decentralization and dispersal of industries to non-metropolitan regions in developing countries, primarily to provide greater income and employment opportunities to a wider section and to meet basic socio-economic needs to a greater extent. It was stressed by the First Consultative Group that no clear line of demarcation could be drawn between the 'modern' and the 'decentralized' sector and the distinction was primarily for convenience of analysis, particularly in terms of the varying nature of technological requirements that may be applicable in one or other of these broad categories.

7. It is necessary for the Second Consultative Group to consider and highlight the issues and implications of the above dualistic approach, particularly in the context of technological needs and requirements for both the 'modern' and 'dispersed' sectors. The identification of such requirements and an effective programme to fulfil technological needs in both these sectors would constitute an essential aspect of reorientation of industrial and technological strategies in these countries.

8. The 'modern' sector could broadly be characterized in terms of large-scale production, mostly in metropolitan and other urban areas of high industrial concentration, and use of capital-intensive technological processes also utilized in industrialized economies in the respective sectors. As against this, industrial activities in the 'decentralized' or 'dispersed' sector would largely be visualized as manufacture of a wide range of products primarily through small-scale units located in semi-urban or rural areas and using production techniques more directly related to local factor resources and situations.

9. The growth of the 'modern' sector has been fairly significant in several developing countries and has enabled many of these countries to increasingly face international competition in various manufactured products. Apart from large developing countries such as Argentina, Brazil, India and Mexico, which have significant internal markets and can sustain effective demand for a wide variety of industrial products and services, a number of smaller developing countries such as Algeria, Egypt, Hongkong, Iran, Malaysia, Singapore, the Republic of Korea, Venezuela and others are gradually strengthening their competitive capacity and are competing effectively in regional and international markets in various products. The industrial growth pattern of these developing countries has highlighted the need for significant redeployment of industry during the next two decades, as adequate dissemination of technological know-how and expertise extends in respect of various manufacturing branches. In several fields such as wood processing, textiles and garments, footwear manufacture, leather processing, electrical engineering, and consumer products, such as musical instruments, sports gear and the like, developing countries already have considerable competitive advantage over industrialized economies. With greater absorption of technology in other sectors, the fields in which developing-country enterprises would be able to compete effectively in international markets should gradually extend to a wide range of intermediate products and machinery and equipment. It is only, however, with a widely diversified industrial base, particularly in respect of basic industries, that most developing economies can effectively stand the test of international competition over a wide area of manufacture in the 'modern' sector.

10. Industrial growth in the 'dispersed' sectors has tended to be fairly limited in most developing countries. Few countries have embarked on comprehensive programmes of dispersed industrialization and, in most such economies, even the basic infrastructure is lacking. In some countries, extension services and other facilities have been extended for promotion of small-scale industries, but the overall impact of dispersed industrial activity has not been significant.

11. Despite the fact that significant industrial growth has taken place in some sectors in certain developing countries, the process of technological development needs to be greatly intensified, together with reorientation of industrial strategy. The continuing dependence on foreign technology at various stages of development needs to be significantly reduced through the development of adequate technological capability for the effective absorption and adaptation of foreign techniques and processes and for innovative developments in various fields, based on national factor situations and endowments. At the same time, technological service capability, including engineering and design, must also be greatly increased in order that the process of adaptation and innovative development can be adequately accelerated.

12. An essential element of technological development, apart from the growth of domestic capability, is the selection of suitable and appropriate technology in the context of national factor situations in various sectors. Such selection necessitates consideration of various alternatives and the exercise of a degree of selectivity, based on national policies and objectives. This assumes special relevance in the context of selection and utilization of foreign technology. While the acquisition of foreign techniques and processes may be necessary in a number of sectors in developing countries, selectivity may need to be exercised both in the determination of fields in which foreign technology inflow should take place and the nature of technology that should be acquired in various sectors, apart from the terms and conditions of such acquisition.

13. The selection and effective utilization of appropriate foreign technology and development of indigenous technological capability necessitates the adoption of a fairly comprehensive programme for technological development.

The essential ingredients for such a technology plan or programme in each country should comprise:

- (i) the identification of technological needs in terms of processes and services in critical and priority sectors of growth in each country;
- (ii) the establishment of a comprehensive information system which would assist national institutions and enterprises in providing information on alternative techniques and processes;
- (iii) the growth of technological service capability at various levels of development, including capacity for engineering and design;
- (iv) the creation of institutional mechanisms for screening the selection and acquisition of foreign technology considered more suitable or appropriate in a given set of circumstances;
- (v) the development of institutional facilities for monitoring the impact, absorption and innovations in respect of foreign and indigenous technology together with the growth of R+D activities in important industrial sectors;
- (vi) the defining of a suitable policy package for the rapid growth of indigenous technological development

It is perhaps only through an integrated approach covering all these aspects that the development of domestic technological capability on the one hand, and the selection, absorption and adaptation of appropriate foreign techniques on the other, can be effectively achieved. The above prerequisites and criteria for adequate growth of technological capability would be applicable both in respect of the 'modern' sector as well as decentralized or dispersed industry. At the same time, the technological needs of greater industrial dispersal largely through small-scale enterprises may tend to be significantly different and may pose greater problems of choice and suitability.

14. It is necessary, in this context, to briefly consider certain basic issues of industrial strategy which can have a direct bearing on technological development and the use of more appropriate technology. These relate to

- (i) policies in relation to foreign investment, particularly foreign branches and subsidiaries;
- (ii) sectoral priorities; and
- (iii) programmes for rural industrialization.

15. Close linkage continues to exist, principally for historical reasons, between private foreign investment and inflow of foreign technology in developing countries. With foreign branches and subsidiaries occupying a pivotal role in major production sectors, technology inflow has often been contingent on investments. With the activities of foreign subsidiaries being primarily governed by the interest of foreign parent enterprises, usually transnational corporations, the flow of foreign technology and know-how has been limited to the immediate needs of such subsidiaries, with decisions regarding technology being taken by parent enterprises, and often bearing little relation to national technological needs in the host country. Thus, in extractive industries, foreign technology was initially confined to extraction techniques in the fields of oil, mining and exploitation of other natural resources. In the non-durable consumer goods sector, foreign technology was confined largely to the need for controlling internal markets. In sectors such as drugs and pharmaceuticals, technology supply was related to repackaging and formulations, with basic materials and intermediates imported from parent enterprises. In respect of durable consumer goods and most manufactured products, foreign technology inflow was often designed to limit operations to the stages of assembly or semi-assembly. By and large, inflow of foreign techniques in the case of foreign subsidiaries has not only been limited in scope, but has tended to follow the tail-end of technological innovations in parent foreign companies. Research and development activities have also inevitably been conducted in foreign locations and subsidiaries have been wholly dependent on the results of external research.

16. In recent years, the pattern of foreign ownership and control and technology supply to foreign subsidiaries and affiliates is changing significantly. Largely under governmental pressure and with increased regulation of private foreign investment, foreign subsidiaries are developing technological capability to a much greater extent to meet targets of domestic integration, exports and

the like. At the same time, investment and technological decisions of foreign controlled subsidiaries continue to be governed by considerations other than national, or even pertaining to the enterprise in question. Apart from the nature and extent of technology flow in such cases, payments and pricing of foreign processes and services assumes different forms, including significant elements of transfer pricing in various sectors. There is no simplistic solution to dealing with investment-cum-technology packages, and most developing countries must ensure that the package is appropriate to needs of the economy. At the same time, new forms of corporate arrangements are being evolved in several developing countries, with mixed capital ownership between foreign and domestic interests. Such 'joint ventures' necessitate the identification and determination of foreign know-how and technological services to a much greater extent than in the case of foreign subsidiaries.

17. The question of sectoral priorities also assumes considerable significance in technological development and the use of more appropriate technologies. The emphasis on particular sectors may vary significantly in the context of policy objectives such as import substitution in particular fields or a high degree of export-orientation in other branches. In general, however, certain industrial sectors have a high degree of priority in most countries. These include industries based on natural resources, agro-industries, basic industries related to local factor endowments and certain other sectors of common interest to most developing countries. Technological needs have to be identified in relation to such sectoral priorities and selection of appropriate techniques should be directly related to such identified needs.

18. In recent years, increased emphasis is being given in several developing countries to decentralization of industry to semi-urban and underdeveloped regions. This aspect of industrial strategy can have a significant effect on technological needs. With growing stress on dispersal of industries, developing countries will need to place greater emphasis on processes and techniques more closely related to the needs of such a policy. It may well be that less sophisticated production techniques already utilized in developing countries or being used by small-scale units in developed economies may be more appropriate in this context, both from the viewpoint of costs and other economic criteria. The identification of such appropriate processes and techniques would necessitate a systematic search for such technology in specific sectors, and even the development of appropriate processes through research and development efforts.

19. The basic rationale for industrial dispersal or decentralization stems from the fact that, firstly, a number of goods and services comprising both production inputs for agricultural operations and consumption goods of various categories can be produced in the rural areas and that such production could provide the base for significant rural industrialization. The greater the extent to which such items could be locally produced the greater would be the participation and involvement of the rural community, apart from the increased employment and income opportunities in these areas. Though there is considerable unsatisfied demand for various products and services in rural areas, local production would necessarily have to be closely interrelated to the growth of effective purchasing power in rural communities. Rural industrialization itself could undoubtedly play a critical role in providing such purchasing power through increased employment opportunities.

20. The potential for effective rural industrialization would obviously be different for each country and would inevitably be dependent on several factors including local factor endowments, availability of infrastructure and other facilities, the growth of human skills, the extent of rural purchasing power and the overall industrial policy package which could be implemented. By and large, however, industrial decentralization holds out very significantly possibilities if viewed as an integral and vital element in the industrial growth process.

21. In terms of technology, the needs of rural industrialization would tend to be significantly different from those of the 'modern' sector, primarily because production scales and unit investment outlays would tend to be much smaller. At the same time, a greater degree of labour intensity could be introduced through small-scale production in most branches. It is important to stress, however, that appropriate technology for the 'dispersed' or 'decentralized' sector should not invariably be considered in terms of labour-intensive as against capital-intensive techniques. It may well be that certain techniques which are relatively capital-intensive would be wholly appropriate for small-scale production in the 'dispersed' sector.

22. The choice of appropriate technology both for the 'modern' and for the dispersed sectors therefore raise a number of challenging issues. Firstly, the implications of technological choice, within the framework of a comprehensive policy for technological development and growth of indigenous

technological capability need to be considered. Secondly, the role of governmental and institutional agencies in technology planning needs to be broadly defined in the context of the fact that the application of technology would largely be done through private sector enterprises in most developing countries. Thirdly, the principles governing the choice of appropriate technology in the 'modern' and the dispersed sectors need to be elaborated. Finally, certain criteria need to be defined both for the 'modern' and the 'dispersed' sectors against which the appropriateness of particular production techniques and processes can be assessed.

II. SELECTION AND APPLICATION OF APPROPRIATE TECHNOLOGY
IN SELECTED SECTORS

1. As stressed earlier, there continues to be heavy dependence on foreign technology inflow in most developing countries. While subsidiaries and affiliates of TNCs continue to exercise a dominant role in various sectors, national enterprises including public sector units have also relied almost completely on foreign techniques and processes. The inflow of foreign technology has taken place through various mechanisms including foreign subsidiaries, joint ventures, and licensing arrangements, including varying degrees of control exercised by technology suppliers in management, technical supervision, technological services etc., for different periods of time. While technology is increasingly a marketable commodity and technology transactions are multiplying rapidly, it is imperative that institutions and enterprises in developing countries should ensure that foreign technology which is acquired is suitable and appropriate to local conditions and that such acquisition is consistent with domestic technological development.

2. The last two decades have seen the rapid growth of technology exchange between enterprises in different countries and rapidly-increasing emergence of industrial technology as a marketable commodity. Overall trade in technology rose from around \$ 2,700 million in 1965 to over \$ 11,000 million by 1975, largely in the form of lump sum payments, royalties and fees. Most of such technology trade has taken place between enterprises in developed countries, and technology payments by developing countries, though significantly high in the context of their individual economies, constituted only a small proportion rising to about \$ 1,000 million annually during 1974-76. This figure is likely to increase considerably with increased industrialization and it is estimated that the trade in technology by developing countries, in terms of fees, royalties and other payments for technical know-how and specialized services, would increase to over \$ 6,000 million by 1985, constituting about 15 per cent of the total trade in technology. Both in view of the high cost of foreign technology inflow and its impact on domestic technological development, it is necessary for developing countries to exercise adequate selectivity in order that only technologies which are suitable and appropriate to their factor conditions and circumstances are, in fact, acquired and utilized.

3. The nature of technology acquisition varies considerably in scope and magnitude in the case of technology-acquiring enterprises from developed countries and those from developing economies. In the case of the former, the technology license normally comprises of user rights to a specific production process, usually covered by patents, though often accompanied by specialized knowhow which may be unpatented. Both the licensor and the licensee are functioning in a similar technological environment and are aware of the intricacies of technology transactions. In the case of developing-country enterprises, the situation tends to be different. There is wide divergence in the overall technological background, and significant constraints in the technological services available locally. Consultancy and engineering services are limited, processed raw materials and even relatively simple components more difficult to obtain, and the initial levels of absorptive skills may be lower. There is also greater preference for foreign technological services and material supplies, even when such services and supplies are available within the country.

4. Project implementation in earlier stages of industrial growth in most developing countries often took the form of turnkey arrangements, with a single foreign party being entrusted with full responsibility for implementation. This form is presently utilized to a much lesser extent though it may still be applied in 'tied aid' projects, where project financing is linked to a foreign engineering group entrusted with such responsibility. In the case of such arrangements, recipient enterprises in developing countries need to ensure that (i) plant capacity is related to market potential; (ii) technology is appropriate to domestic factor endowments, including growth potential of skills; (iii) adequate provision is made for training of local personnel to take over plant operations after start-up; and (iv) adequate tests or trial runs are provided as part of the takeover procedure. It is also essential to avoid such a contract becoming unduly expensive. This is usually difficult to evaluate, as the cost tends to be packaged, but as far as possible this should be sought to be disaggregated. In general, turnkey arrangements, although convenient for project implementation, tend to be more expensive than if the various elements were contracted separately. Even more important, however, is the fact that turnkey contracts tend to circumscribe the selection of technology and the use of domestic technological services. The technology package in such cases is invariably more comprehensive and, for this very reason, such an arrangement may not be conducive to domestic technological development.

5. Even when a turnkey arrangement is avoided, the inflow of foreign technology and service may still cover stages of project implementation. From a national viewpoint, it would be desirable that, with progressive industrial development, the size of the imported technology package should be gradually reduced. Domestic enterprises and consultancy agencies must assume an increasingly larger share of responsibility for project planning and implementation. Nevertheless, even in relatively industrialized developing economies, the technology package often continues to comprise a wide variety of technology services, besides process or production knowhow. Disaggregation of the cost of knowhow and of technological services such as plant engineering, etc. is necessary and such services need to be gradually replaced by national enterprises. It may be necessary to evolve a broad policy approach to reduce the size and magnitude of the imported technology package and to ensure that acquisition of foreign technology is largely confined to process or production knowhow and that it is appropriate to local factor circumstances.

6. The nature and size of the technology package and the degree of disaggregation necessary would tend to differ considerably in scope and significance in the 'modern' and in the 'dispersed' sectors. The technology package would tend to be much larger in the case of the former, since sophisticated and relatively 'high' technology would be involved in most cases. In the 'dispersed' sector, on the other hand, the scale and nature of production would, by and large, ensure that the technology utilized would not require an undue degree of unpackaging or disaggregation.

7. The term appropriate technology should be viewed as the most suitable production technique(s) for particular production sectors and projects in a given set of circumstances which would include development goals, resource endowments and conditions of application. Thus, what would be appropriate in one set of circumstances and for fulfillment of certain policy objectives would not necessarily be suitable in another context. The overall requirements of industrial technology in developing countries cover such a vast area of production and manufacturing activities that appropriate technology would necessarily have to cover a very wide range of production processes and techniques extending from sophisticated and capital-intensive technology and knowhow on the one hand to relatively simple adaptations of indigenous processes on the other. While appropriate technology would normally be understood as being more labour-intensive or related to smaller scales of

production, as compared to alternative technologies, these features should not be considered as prerequisites or essential. A capital-intensive process may be quite appropriate in a particular context. Nor should appropriate technology be viewed in terms of techniques used formerly, and since discarded by industrialized nations in favour of more capital-intensive processes. Appropriateness should necessarily be judged only in the context of a particular situation. For example, in sectors and projects which are primarily export oriented, the most appropriate processes could well be highly capital intensive. Again, in several basic industries, capital-intensive technologies and large-scale production would be whole appropriate. At the same time, if an important policy objective is to provide maximum employment opportunities, particularly in non-urban areas and to meet basic socio-economic needs in such areas, the most appropriate techniques could well assume different characteristics for a large number of production sectors and projects.

8. Some of the characteristics which could be applied in the determination of more appropriate technology for the 'dispersed' sector could perhaps be the following:

- (i) The technology would be more labour-intensive rather than capital-intensive;
- (ii) It would generally be geared to small-scale production rather than large-scale manufacturing activities;
- (iii) It would be more intensive in the use of local resources and factor endowments;
- (iv) It would be more responsive to local availability of skills and potential for development of skills;
- (v) It would be more tailored to local requirements and tastes, together with local purchasing power.

9. It would not be practicable to apply the above criteria in full in the selection of appropriate techniques even for the dispersed or decentralized sector. In many cases, even small-scale industry could use fairly capital-intensive technology, such as in the production of precision goods and products. In other cases, production would continue to be dependent on flow

of basic industrial materials from long distances, including imported materials. By and large, however, the characteristics of appropriate technology in the 'dispersed' sector would tend towards the above characteristics though selection and application would have to be related to the particular circumstances of the sector and project concerned.

10. The selection of appropriate technology in the 'modern' sector would similarly need to be related to policy objectives and local factor situations. Apart from these basic factors, however, considerable care would need to be exercised in the selection of appropriate technology in fields involving highly sophisticated techniques for large-scale production. Present-day technological trends are towards greater capital-intensity in most sectors and such techniques may often prove both too costly for developing economies and inconsistent with the objective of providing greater employment opportunities. Together with acquisition of highly capital-intensive technology, which may not be appropriate, there is a danger of continuing dependence for years on the supply of intermediates and components from external sources, often with a significant element of transfer pricing. In most production sectors, considerable technological choice is available and this needs to be effectively exercised. Highly capital-intensive technologies and large-scale production may not necessarily be the most efficient means of production in developing economies because of several constraints such as high initial capital outlay, inadequate availability of skills, problems of continuing imports of intermediates and components, difficulties in maintenance of capital equipment and the like. While the criteria of production efficiency should not be sacrificed, this would still leave considerable scope for appropriate choice between alternative techniques in several sectors.

11. The problem of appropriate technological choice for the 'modern' sector has, in most developing countries, been left to the enterprises concerned, though in an increasing number of countries, regulatory institutions have been and are being set up to screen proposals relating to foreign technology. Such screening is largely confined, however, to the terms and conditions of technology contracts and there is comparatively little effort towards evaluation of alternative techniques in terms of national policy objectives or other criteria. This is partly due to inadequate knowledge regarding alternatives as well as the intricacies of technology selection and a tendency towards acquiring what is considered to be the most modern and sophisticated technology in the sector concerned. The pattern,

however, is changing gradually, with greater knowledge and awareness of enterprises and technology regulation agencies in these countries regarding technological alternatives and implications of technology licensing. Not only are developing-country enterprises able to secure better terms and conditions but they are exercising a greater degree of choice and evaluation between various technological alternatives in the 'modern' industrial sector.

12. The position in respect of appropriate technology for non-urban industrial activities is far less satisfactory. As pointed out earlier, this sector has received little attention in most developing countries. While there is general appreciation regarding the concept of appropriate technology, this has not been translated into concrete aspects of technological choice and application in most countries.

13. It is against the above background that certain sectors have been selected as being of particular significance from the viewpoint of appropriate technology for the 'dispersed' or 'decentralized' sector. The features of technological choice in these sectors, which are listed on Annex I of the Aide Mémoire on the International Forum on Appropriate Industrial Technology, are proposed to be discussed in detail in separate working groups in the Forum in India in November 1978. The list of such sectors is purely illustrative and seeks primarily to highlight the technological alternatives that developing countries may need to consider particularly if greater emphasis is to be given to greater industrial dispersal. Special attention has been focussed on two basic infrastructure sectors, viz. energy for rural areas and rural transportation, and the documentation for the Forum would seek to highlight alternatives that are available and which need to be considered in providing these basic facilities. Apart from infrastructure needs, the list of sectors includes the production of agricultural machinery and inputs, technological alternatives in food storage and processing, production of textiles and other consumer goods, the need for rural workshops and light engineering facilities, production of building materials and other industrial activities which are directly related to rural production and consumption needs.

14. Apart from industrial sectors which are more directly related to industrial dispersal, an important aspect of appropriate technology usage is its application in basic industries, such as steel, metallurgical industries, capital-goods manufacture, fertilizers and chemicals and the like. It is obviously not the intention that the Forum would discuss the various alternative technologies in respect of one or other of these categories. What is intended is to highlight the main principles and criteria which should determine the choice of technology in one or other of these sectors, both in the main production lines and in respect of ancillary and supplementary production operations.

III. Sectoral Linkages and Interrelationships

1. It has been emphasized that no clear line of demarcation can be drawn between the 'modern' sector and the 'dispersed' or 'decentralized' sector in developing economies, and the distinction is primarily for the purpose of analysis of the implications of appropriate technology usage in sophisticated, large-scale industry on the one hand and relatively small-scale industry located in non-urban areas on the other. Depending on conditions and situations in particular countries, these two sectors would invariably merge with one another. In fact, it is essential to stress the very close interrelationship that must be maintained between production and service activities in both these sectors to ensure that very close sectoral linkage is effectively maintained.

2. The concept of industrial dispersal to non-urban areas may be considered under two broad heads. Firstly, industrial production could be decentralized to non-urban areas through small-scale units to concentrate on the production of goods and services which provide basic inputs for agricultural operations and meet essential consumption-goods requirements in these areas. Secondly, production in the 'dispersed' sector should feed the large-scale 'modern' sector and should consequently serve as feeder or ancillary enterprises producing a wide range of intermediates, components, spares, etc. for large-scale industries in these countries. Under both these heads, it is essential that close sectoral linkages and interrelationships are maintained.

3. Subject to the creation of increased purchasing power through greater employment, a large variety of basic goods and commodities can be taken up for manufacture in non-urban areas, such as food products, agricultural items, agro-industries, agricultural implements, pesticides and mixed fertilizers, building materials, pharmaceuticals and a wide range of consumer goods including clothing, shoes, household items and the like, apart from maintenance, repairs, etc. to agricultural and transport items, irrigation equipment and the like. The establishment of production facilities would, however, require a comprehensive package of incentives, which have been outlined in the subsequent chapter. Together with such incentives, a programme for the development of local entrepreneurship would have to be undertaken through upgrading of artisan skills and encouragement of initiative on the part of the rural unemployed. An essential facility, apart from financial and other incentives, would be the provision of regular supplies of scarce industrial materials and common service facilities wherever necessary. It is important that such programmes be carefully assessed in terms of local potential, as mere governmental 'spoon feeding' would not serve the purpose and may even prove counter-productive.

4. A critical aspect of industrial decentralization is to ensure, as far as possible, the efficiency of decentralized production so that the resultant goods and services can be made available at competitive prices. The extent to which such decentralized production would meet the criteria of efficiency would vary depending, inter alia, on the extent to which the demand for any particular commodity is met from large-scale enterprises, the distribution system for products, both of the 'modern' and 'dispersed' sectors, and the extent of difference in product designs and related aspects, as between urban and rural consumption. It would be inappropriate to underestimate the efficiency of the decentralized or dispersed sector as a category. More importantly, a strategy for improvement of production techniques and for increasing the availability of viable alternative technologies for the decentralized sector, coupled with appropriate government policies, has to be initiated leading to the sounder operation of the dispersed sector.

5. The question of sectoral linkages assumes even greater significance when small-scale units in the dispersed sector are expected to function as feeder and ancillary plants to large-scale production in the 'modern' sector. This necessarily requires not only closely-knit industrial operations, but also close financial and technological linkages. In some developing countries, a significant beginning has been made in horizontal integration, with the large-scale 'modern' sector principally concentrating on assembly and semi-assembly operations and small-scale units providing a wide range of components, spares and intermediates. Such linkage, however, requires a high degree of planning both at the level of large-scale and small-scale feeder enterprises, together with significant institutional and other support for the effective growth of the latter. Often, however, the trend in developing countries is more towards a greater degree of vertical integration, largely because of inadequate reliance on supplies from a number of small-scale units. This pattern would necessarily need to change significantly if effective interlinkage between the 'modern' and 'dispersed' sectors is to be achieved.

6. The actual potential for rural industrial production would vary from country to country and would be dependent on several factors including the nature of the industrial policy package, local factor endowment, provision of infrastructure and other facilities, the extent of rural purchasing power and the growth of entrepreneurial and human skills in these areas. By and large, however, industrial decentralization could hold out immense and challenging possibilities, provided it is not viewed just as an ancillary pursuit but as an integral and vital element in the industrial growth process. This would, however, necessitate the establishment and maintenance of very close interlinkage between the large-scale 'modern'

ector and industrial production and activities in the 'dispersed' or decentralized sector.

IV. POLICY ISSUES IN THE APPLICATION OF APPROPRIATE TECHNOLOGY

1. An essential aspect of selection and application of appropriate technology in both the 'modern' and 'dispersed' sectors is the formulation of suitable policies and regulations which would achieve the desired objectives. Despite the fact that industrial activities in most developing countries are largely concentrated in the private sector, governmental policies and regulations can have a significant effect on the choice and application of appropriate processes and techniques in different sectors. Such policy measures would obviously require to be oriented to the specific circumstances of each country but, by and large, certain policy norms need to be defined which can be taken into consideration.

2. In the 'modern' sector, it is perhaps necessary, as mentioned earlier, to exercise greater selectivity both in respect of the fields in which foreign technology should be secured and the type of technology which should be acquired. In several developing countries, technology regulation institutions have been set up which are exercising various regulatory functions. Though these institutions have mostly concentrated on improving the terms and conditions under which foreign technology is secured, their functions could be enlarged to provide guidance in the choice of more appropriate techniques. The extent to which large-scale production and highly capital-intensive technology can, for example, be effectively substituted by technologies which are less capital-intensive and relate to small-scale production more directly related to the smaller markets in developing countries, undoubtedly needs to be investigated. Consideration of various criteria to determine the choice among technological alternatives should also be viewed as the responsibility of such regulatory agencies as part of the exercise of greater selectivity in respect of foreign technology. While the choice of technology is the ultimate responsibility of user enterprises, regulatory agencies can and should play a significant role in providing suitable guidance in respect of foreign technology which would not be appropriate or suitable from a national viewpoint. While this may impose a heavy burden on such regulatory agencies, it may be necessary to lay down policy norms and guidelines for the use of more appropriate techniques, particularly for small and medium industries. Regulatory agencies and other national institutions need, in any event, to identify technological needs in various sectors so as to

highlight the areas in respect of which foreign technology may be necessary, as also sectors where such inflow may have an adverse effect on domestic technological development or where adequate technological expertise may be domestically available.

3. It is only through such identification that selectivity can be effectively exercised. The unrestricted flow of foreign technology and knowhow in all sectors may have significant techno-economic impact, not only on recipient enterprises, but also on overall sectoral growth and on domestic technological development. Recipient enterprises in developing countries often tend to remain highly dependent on foreign technology suppliers, particularly where unrestricted technology inflow is permitted and such arrangements are allowed to continue for indefinite periods. This may also serve as a disincentive for other enterprises to use indigenously developed processes and products. Apart from the adverse effect on technological development, competition to import foreign technology and knowhow in the same field or for similar products becomes as much a question of foreign brand names as the use of particular processes or techniques. Nevertheless, it must be emphasized that significant flow of industrial technology in selected growth sectors must take place to developing countries if industrialization in these countries is to be adequately broad-based. In an increasingly complex economic society based on close international inter-dependence, developing countries cannot afford to be isolated from the mainstream of international technological development and the various mechanisms of technological exchange must ensure that adequate and suitable technology flow does, in fact, take place in developing countries in identified and selected sectors of growth.

4. The development of technological infrastructure is also an important policy aspect of technological development. The gaps in such infrastructure need to be defined for each developing country both in respect of information networks and technological service capability. An essential policy requirement is the creation and development of a comprehensive information network, which can ensure a flow of fairly detailed data and material regarding production and technical requirements projected over a period of time and provide, at the same time, alternative sources of technology, both indigenous and external.

5. Inadequate technological service capability constitutes a major constraint in most developing countries. Such services range from macro-level industrial planning to micro-level project identification, feasibility studies, plant specifications, detailed engineering designs, civil constructions and machinery installation, and plant commissioning, start-up and operations. While the extent of the gap varies from country to country, the most significant gap is in respect of detailed engineering and designing and sectoral consultancy services through nationally-owned units. This makes disaggregation of imported technology packages extremely difficult and also creates a critical infrastructure gap, resulting in undue dependence on foreign designs and engineering services, with consequential impact on the pattern of investment for particular projects, the requirements of capital goods and equipment and subsequent plant operations and management. In the lesser developed countries, the gaps in consultancy services are even more marked and extend to almost the entire range of service activities indicated above. The identification of gaps in service capability has to be done both on a country-wide basis and for critical and priority sectors in each economy. Once such gaps are identified, developing countries need to prescribe suitable policy norms and regulations to ensure that domestic service capability is adequately developed and utilized.

6. The growth of national technological service capability can be effectively achieved through detailed scrutiny of foreign technology proposals and relating such scrutiny to the use of domestic service capability to the maximum extent possible. Such capability can only grow through a deliberate policy of utilizing such facilities as are domestically available to the maximum extent.

7. It is also necessary to ensure, through appropriate policies, that a close relationship is developed between institutions dealing with technological investigations and R+D and the requirements of domestic enterprises in both the 'modern' and 'dispersed' sectors. Linkage and communications between such R+D agencies and the production sector in several developing countries have tended, by and large, to be inadequate. Domestic enterprises continue to rely largely on external technological links as these appear easier in practice and timing and are usually more rewarding commercially. The inadequacy of industry-research linkage is particularly pronounced in the 'dispersed'

sector and there has been comparatively little effort either to develop more appropriate techniques for the 'dispersed' sector or to adapt indigenous techniques more effectively to meet needs of small-scale and rural industry.

8. Apart from the above general issues and considerations, it is also necessary to consider certain policy aspects and instruments that can play a significant role in technological choice. Such policy aspects can take various forms and include

- (i) policies defining the role of the private sector and State enterprises together with policies on foreign investment and majority foreign equity holdings in new and existing enterprises;
- (ii) the degree of industrial planning and detailed allocation of resources between various industrial sectors;
- (iii) regulation of production capacities in various sectors through industrial licensing or other regulatory measures, with a view to channelize scarce resources to priority sectors;
- (iv) financial and credit policies, including incentives and concessions for new industrial enterprises in different sectors;
- (v) special incentives for small-scale and rural industries, including provision of infrastructure facilities, credit, supply of scarce materials, preferential purchase by governmental agencies, extension services and common service facilities and the like, together with reservation of certain sectors solely for small-scale production;
- (vi) controls over imports;
- (vii) incentives for exports and for import substitution in particular sectors;
- (viii) control of prices of essential products, basic industrial materials and the like.

9. No uniform set of policies can obviously be suggested to cover all or even most developing countries in view of the wide diversity in resource endowments, levels of development and socio-political circumstances. By and large, however, there is a tendency towards greater regulatory control in respect of industrial activities in most developing economies, even where such activities are almost entirely confined to the private sector. A number

of regulatory instruments are used in varying degrees to suit particular circumstances and situations. It is possible, in such a context, to conceive of an overall policy package, which would follow a reorientation of industrial strategy to bring about more balanced development of the 'modern' and 'dispersed' industrial sectors. Such balanced development may necessitate significant reallocation of resources for the growth of rural-based industries and the use of more appropriate techniques and processes through such units. While existing policies in developing countries give considerable attention to various aspects of investment and technology in the 'modern' sector there has been comparatively little policy attention so far to the needs and potential of small-scale industry in the 'dispersed' non-urban sector.

10. It is consequently necessary to consider the nature and implications of a policy package to ensure the balanced growth of both the 'modern' and 'dispersed' sectors in developing countries. Such policy package could cover the various policy and regulatory mechanisms mentioned above. These could assume the following broad pattern in so far as the 'dispersed' sector is concerned:

- (i) The role of the 'dispersed' sector could be specifically defined in that certain products could be reserved for production in the small-scale sector and at locations away from areas of heavy industrial concentration.
- (ii) Such reservation should not only be prospective but may have to be applied to existing large-scale units in the concerned sectors, which could be redeployed for other production functions to the extent possible.
- (iii) A comprehensive package of financial incentives should be prescribed for small-scale industry covering various aspects referred to in para 8(iv) above.
- (iv) The technological needs of various sectors which lend themselves to dispersal should be specifically assessed and appropriate technologies identified, evaluated and disseminated to such enterprises.
- (v) Programmes of adaptation and R+D in respect of such techniques should be undertaken in R+D institutions and suitable incentives provided at plant level for adaptation and innovation.

- (vi) Adequate extension services should be provided for the growth of small-scale units in the 'dispersed' sector, together with common machine and service facilities.
- (vii) Adequate training programmes should be undertaken for upgrading of artisan skills and development of industrial skills in non-urban areas.

11. In so far as the 'modern' sector is concerned, an increasingly well-defined pattern is emerging in most developing countries in respect of issues such as foreign investment, majority foreign holdings, regulation of technology, levels of protection, domestic integration and the like.

12. The policy issues and implications of a reoriented industrial strategy with greater stress on industrial dispersal and appropriate technology usage, need to be viewed in fairly comprehensive terms, as these would undoubtedly be critical to the fulfilment of the objectives of such a strategy.

V. Issues of International Technological Co-operation

1. The selection and application of more appropriate technology in developing countries necessitates a significant degree of international co-operation, both among developing countries and between institutions and enterprises in industrialized and developing economies. The existing pattern of external technology inflow will need to be suitably modified and adjusted to meet the technological needs of developing countries more effectively, both in the 'modern' industrial sector and in the 'dispersed' sector, where alternative techniques have to be identified, evaluated and applied in particular fields of manufacture.

2. The process of technological exchange can be greatly accelerated if a comprehensive programme for international co-operation can be conceived and implemented. Such a programme could be designed to (i) facilitate technology flow to developing country enterprises on suitable terms and conditions in sectors where foreign technology is considered necessary by the developing country; (ii) facilitate the flow of information regarding technological alternatives, particularly those relating to smaller-scale production and having less capital intensity; (iii) assist in evaluation of alternative techniques through exchange of information and experience regarding the use of such alternatives; (iv) initiate an extensive programme of research and development, including adaptation of existing processes and techniques, in respect of more appropriate industrial technologies, particularly those relating to smaller-scale production and having a greater rural bias. Such a programme could be undertaken through an international agency such as UNIDO. It would, however, require considerable financial support, particularly in respect of research and development programmes and activities. It would also necessitate greater awareness and appreciation of various issues and aspects of such co-operation, both between developing countries and between developing and industrialized economies.

3. Increased co-operation among developing countries is necessary because of the considerable similarity in the problems and issues of technological development facing these countries. Closer direct relationships between enterprises in developing countries would also be advantageous, not only because commercial acquisition of technology from enterprises in developed countries often poses various constraints and limitations, but because technological needs and experience in developing countries bear close affinity and follow a similar pattern. Technological development and capability in several developing countries has also achieved a level, both in terms of indigenous processes and techniques and absorption and adaptation of foreign technology, where it can be effectively transferred to enterprises in other developing countries. Such technology and

knowhow extends over the production of a wide range of consumer durables, intermediate products and light and medium engineering goods and equipment in which enterprises from developing countries are achieving increasing technological competence. Technological service capability has also grown considerably in many of these countries, including consultancy and engineering services which can be suitably extended to other developing economies. The arrangements for commercial transfer of technology between enterprises in developing countries should, however, ensure that technology supply is made in a manner and on terms and conditions which are suitable and appropriate for recipient countries.

4. The need for greater industrial and technological co-operation between developing countries was stressed in the Round Table Ministerial Meeting held in New Delhi, India in January 1977. In this meeting, specific areas of co-operation were identified which included, inter alia, co-operation in respect of industrial technology so as to improve the use of techniques already available; co-operation in respect of contract and agreements already concluded to provide guidance to others; promotion and collective action for negotiating and bargaining for more equitable economic relationships and acquisition of technology; development of concrete programmes for using engineering and consultancy capabilities available in developing countries; and co-operation in the establishment of national regional technology institutions and for research and development in specific sectors.

5. The necessity for greater co-operation in technology was also emphasized in two meetings of senior representatives of national offices of technology regulation from several developing countries, held in Vienna in March and May 1978. The specific objectives of such co-operation were identified as being:

- (i) enhancement and development of national capabilities in the identification evaluation and selection of foreign technology;
- (ii) rationalization of inflow of foreign technology, emphasizing both the regulatory and promotional functions necessary in this regard;
- (iii) strengthening the bargaining position of governmental institutions and industrial enterprises in developing countries in negotiations on foreign technology;
- (iv) mutual assistance in the formulation of policies and programmes for technology application and development;
- (v) monitoring and review of the impact of foreign technology on national economies; and
- (vi) promotion and development of indigenous technological capability, including appropriate indigenous processes and techniques, technological service capability, and the development of technology institutions engaged in research and development activities.

A number of measures were also agreed to in respect of exchange of information and experience between the various national regulatory agencies on terms and conditions and experience of technology contracts. Information and experience of technology contracts would be exchanged through:

- (i) a periodical review by each participating country on trends and features of foreign technology inflow;
- (ii) general information on certain selected appropriate sectors in the participating countries; and
- (iii) specific information on individual contracts.

6. It was also considered necessary to exchange information among developing countries in respect of legislative or administrative measures introduced in each country, guidelines for evaluation being compiled in each country and information on indigenous technologies and services which could be utilized by other participating countries. The programme for exchange of information between developing countries would greatly strengthen their information base and bargaining power because of the greater knowledge and information at their disposal, apart from extending the area of technological choice.

Information on alternatives

7. There is, in general, inadequate knowledge and awareness regarding the availability of appropriate technology and knowhow in other developing countries. The fact that such knowhow could be transferred to other licensees in other developing economies, who would be operating in a similar technological environment, and that the knowhow may consequently be more attuned to local constraints and difficulties, is also not adequately appreciated. Most prospective developing country licensees continue to seek knowhow from transnational corporations in developed economies even in respect of relatively unsophisticated production processes, in which a fairly wide range of technological choice is available in other developing countries. The problem is partly of lack of knowledge regarding such alternatives and partly a continuing preference for more sophisticated production techniques used in highly industrialized countries. Both these aspects need to be overcome through closer contacts and greater sharing of knowledge and experience between developing countries.

8. Apart from dissemination of information regarding availability of technology and knowhow in certain sectors of developing country enterprises, specific programmes need to be undertaken for transfer of technology and knowhow in such sectors of other developing countries. In view of the historical preference for acquisition of technology from enterprises in developing countries, particularly transnational corporations, it may be necessary for national institutions in developing countries to specifically encourage enterprises in their respective countries to consider the availability of technology and knowhow from other developing countries where this may be available. This would be particularly relevant in the middle- and small-scale sectors where conditions in respect of

raw materials, local skills, plant size, etc. are similar. Unless positive measures are taken to encourage the flow of technology and knowhow between developing countries, developing country enterprises are likely to continue to seek technology from industrialized economies even in sectors where adapted technology from other developing countries may be more suitable and appropriate.

Technological services

9. It may also be necessary to consider measures to promote greater utilization of technological services, including consultancy engineering facilities available in other developing countries. In a number of such countries, considerable development of consultancy and engineering service capability has taken place. Since such growth has taken place in the context of local requirements and skill endowments, these may prove more adaptable and suitable to conditions in other developing countries. This would be particularly so in several sectors such as light consumer goods and intermediates, certain categories of capital goods and equipment and a wide range of small-scale industries, apart from fairly sophisticated engineering and other facilities in sectors such as petrochemicals, electronics and the like. While there has been some exchange of technological services between developing countries, only a beginning has been made so far and there is considerable potential for greater exchange of service capability among these countries. Part of the problem again is in respect of lack of detailed information regarding such capability and the preference given to service agencies from industrialized countries.

New norms of conduct

10. In this regard, a vital consideration could well be the formulation of a new set of norms to promote technological co-operation and transfer of technology and knowhow between enterprises in developing countries. While commercial transfer of technology and knowhow and of technological services can and should take place to a greater extent between developing countries, it would perhaps be appropriate that new norms of conduct should be considered. The determination of a new set of guidelines and norms in respect of such arrangements between enterprises in developing countries would greatly facilitate such technology flow. Licensor enterprises from developing countries should not adopt the same role as was often assumed in the past by technology licensors from developed countries. On all critical negotiable issues such as extent of foreign holding, duration of agreement, technology remuneration, technical service support and other contractual conditions, new standards and principles should be set and agreed upon, based on a maximum degree of co-operative partnership. A model set of guidelines should be prepared, which should be considered and adopted by governments in developing countries, who should ensure the application of such guidelines by licensor-licensee enterprises from their respective countries. With the greater degree of regulatory control exercised

by governmental agencies in most developing countries over the production sector, it should be feasible and practicable that such guidelines and principles, as are agreed upon, can be effectively applied in technology and investment-cum-technology transactions between developing country enterprises.

11. While the adoption of new norms of conduct in respect of technology supply arrangements would ensure greater uniformity in contractual arrangements, developing countries need to ensure that technology suppliers, particularly transnational corporations, do not create a competitive situation between two or more developing countries in respect of specific projects and technology supply arrangements. This is especially relevant in different regions in respect of projects of fairly large magnitude. It would be desirable that a system of information and consultation should be developed among the developing countries concerned to ensure that no undue advantage is taken on this account.

Collective bargaining

12. A significant field of technological co-operation among developing countries could be the joint acquisition of technology and knowhow for use in more than one developing country through a process of collective bargaining. Though seemingly difficult, the joint acquisition of technology and knowhow for use in more than one project can hold out considerable possibility in the future. There is considerable commonality in industrial programming in countries in comparable stages of development and projects in the same field may be undertaken in more than one developing country at around the same time. Such projects can range from large-scale industries such as steel, petroleum, fertilizers and chemicals, machine building and the like to medium- and small-size plants for textiles, sugar, cement and agro-industries, besides covering a wide range of intermediates and consumer products. In a number of these cases, the acquisition of foreign knowhow on a collective basis for more than one project can be considered. This would enable more detailed evaluation and consideration of technological alternatives and would reduce technology costs, apart from securing better contractual terms. Such an approach towards collective bargaining would have particular significance in countries geographically contiguous to one another, as in the case of the Andean group or regional country groups in Asia and Africa. It would also, however, have relevance for countries in a similar stage of industrial growth. Significant collective action has not so far been initiated in acquisition of technology, primarily because this issue has been viewed in national terms and left to the initiative of individual enterprises. With growing realization of the interrelationships in technological growth, a joint or collective approach in technology acquisition has dynamic possibilities for developing countries in the future.

13. The institutional arrangements for joint acquisition of technology also need to be considered. These can either take the form of joint negotiations by a group of developing countries for identified sectors in which the country groups are interested or the establishment of an international mechanism through which technology can be acquired and transferred to projects in more than one developing country. The former approach necessitates close collaboration and co-ordination between developing country groups and the identification of common technological needs in specific industrial sectors, after which a joint body can be constituted for evaluating, negotiating and acquiring selected technology in the identified fields. The second alternative requires the creation of an appropriate international mechanism through which such joint technology transactions can be channelized.

Joint consultancy services

14. An important area of co-operation could be the development of consultancy and engineering services, particularly for the 'dispersed' sector. With the need for development of technological service capability, most developing countries need to set up certain domestic facilities in this regard. This could undoubtedly be a very fruitful area of co-operation among developing countries, both in the setting up of such facilities where they do not exist and in the development of such facilities on the basis of a joint programme or exchange of information or knowledge. Hitherto, linkage in these fields have been established primarily at enterprise level between developing country licensees and foreign parent organizations and technology licensors from industrialized nations. The potential for greater co-operation among developing countries is particularly marked in respect of consultancy services and detailed engineering facilities for the 'dispersed' sector and for medium- and small-scale industries, and there is considerable scope for setting up joint consultancy and engineering services, either on a regional basis or between developing country groups at similar stages of industrial growth.

15. Greater co-operation should also be developed in respect of joint training programmes. To some extent, training facilities for personnel from developing countries are being provided in one or other developing country at present. This has, however, been a very limited programme in as much as such training is normally linked with the overall technology supply arrangements entered into with licensors and suppliers from industrialized economies. It would be desirable to define certain appropriate sectors where programmes of training could be jointly undertaken in enterprises in one or other developing country, irrespective of the source of investment and technology.

Joint research and development programmes

16. Co-operation in research and development among developing countries is extremely necessary and has great potential, particularly in the application and adoption of more appropriate technology. A number of institutions engaged in various types of research and development, including multi-disciplinary research, have been set up in several developing countries. There appears to be a pressing need and considerable possibility of greater co-operation in joint research and development activities between such institutions. Experience of industrial research and development in the several institutions set up in developing countries has, at best, been fairly mixed, and this further highlights the need for sharing of experience and the implementation of joint research activities. The sectors which lend themselves to greater dispersal to non-urban areas should be areas of special attention and concentration on the part of research and development institutions in developing countries, together with infrastructure such as rural energy and transportation. It is essential, however, that research and development programmes are directly related to the needs of the production sector.

17. It will thus be seen that technological co-operation between developing countries can and needs to be extended over a fairly wide area. The role of national institutional agencies in developing countries could be very crucial in formulating and developing such programmes of co-operation or co-ordinating such programmes with other concerned institutions in each country. In certain areas of co-operation, it may even be necessary for developing countries to arrive at inter-governmental agreements which would specify the nature and extent of mutual assistance and co-operation and, within the framework of which bilateral or multilateral arrangements could be worked out. In this respect, international agencies, such as UNIDO, could play a significant role.

Regional technological co-operation

18. An important aspect of technological co-operation also relates to regional programmes in this field. In this regard, UNIDO has established active links with the regional economic commissions and, in particular, with the newly established ESCAP Regional Centre for Technology Transfer, as well as the African Regional Centre for Technology Adaptation and Development. UNIDO also promoted a joint ESCAP Workshop for representatives of National Focal Points for the ESCAP Regional Centre in Bangalore, India from 18 to 25 April 1978. Thirteen countries of the region were represented at this meeting and drew up a programme of work for the promotion of co-operation among the countries of the region to strengthen their national technological and development capacities.

19. In order to implement the work programme of the Regional Centre for Technology Transfer (RCTT), UNIDO would provide assistance in organizing workshops, on a national as well as regional level, on development plans and policies, improving the working position for technology in selected sectors, as well as providing assistance in the negotiation of contracts. It is also proposed to develop RCTT as a sub-regional focal point as well as a means of contact with the relevant national agencies on information regarding technological alternatives to facilitate technology selection. It is expected that regional centres for transfer of technology such as the RCTT would actively promote technological co-operation at the regional level for the benefit of the developing countries in the region.

Co-operation between industrialized and developing countries

20. While there is great need and potential for technological collaboration among developing countries, it must be emphasized that such co-operation must increasingly be extended at the international level. For quite some time to come, enterprises and institutions in industrialized nations will continue to be major sources of industrial technology. In recent years, there has been increased recognition in highly industrialized economies of the necessity of more rapid technological growth in developing countries as a prerequisite for global restructuring of industry. This needs to be translated in terms of a more sympathetic appreciation of the genuine problems and difficulties in developing countries and concrete action programmes by enterprises and governments in developed nations to achieve more effective technological co-operation.

Terms and conditions

21. Except for the centrally-planned economies, ownership and knowledge relating to industrial technology in developed countries largely rests with individual enterprises and groups, and technology flow takes place through various mechanisms, ranging from supply of capital goods and licensing arrangements to joint ventures and foreign affiliates with varying degrees of foreign ownership. In almost all cases, technology transfer takes place through contractual arrangements between enterprises in these countries and those in developing countries. It would be increasingly difficult in the present context, when elaborate screening procedures are operative in several developing countries and likely to be set up in others, to expect that highly restrictive and unreasonable provisions would continue to be part and parcel of technology contracts. It would be desirable, nevertheless, for representative bodies of technology suppliers and licensors in industrialized economies to prescribe and adopt such guidelines in technology supply and contracting as are consistent with the requirements of developing countries.

It is only then that the difficulties faced at present by developing countries would be more effectively resolved and a more appropriate climate created for investment-cum-technological collaboration at enterprise level.

Extending technological choice

22. There is also need for greater flow of technology from a larger number of enterprises in developed countries, particularly from medium- and small-scale units. Hitherto, investment-cum-technological collaboration with developing country enterprises has largely been concentrated in the hands of relatively few transnational companies having close trade or industrial links with one or other developing country. Technological knowledge and capability in various sectors is, however, available with a much larger number of enterprises in industrialized countries, particularly medium-sized manufacturing units, and the field of technological choice would be considerably widened if such enterprises were also brought within the ambit of technological collaboration with developing country enterprises.

Policy and institutional measures

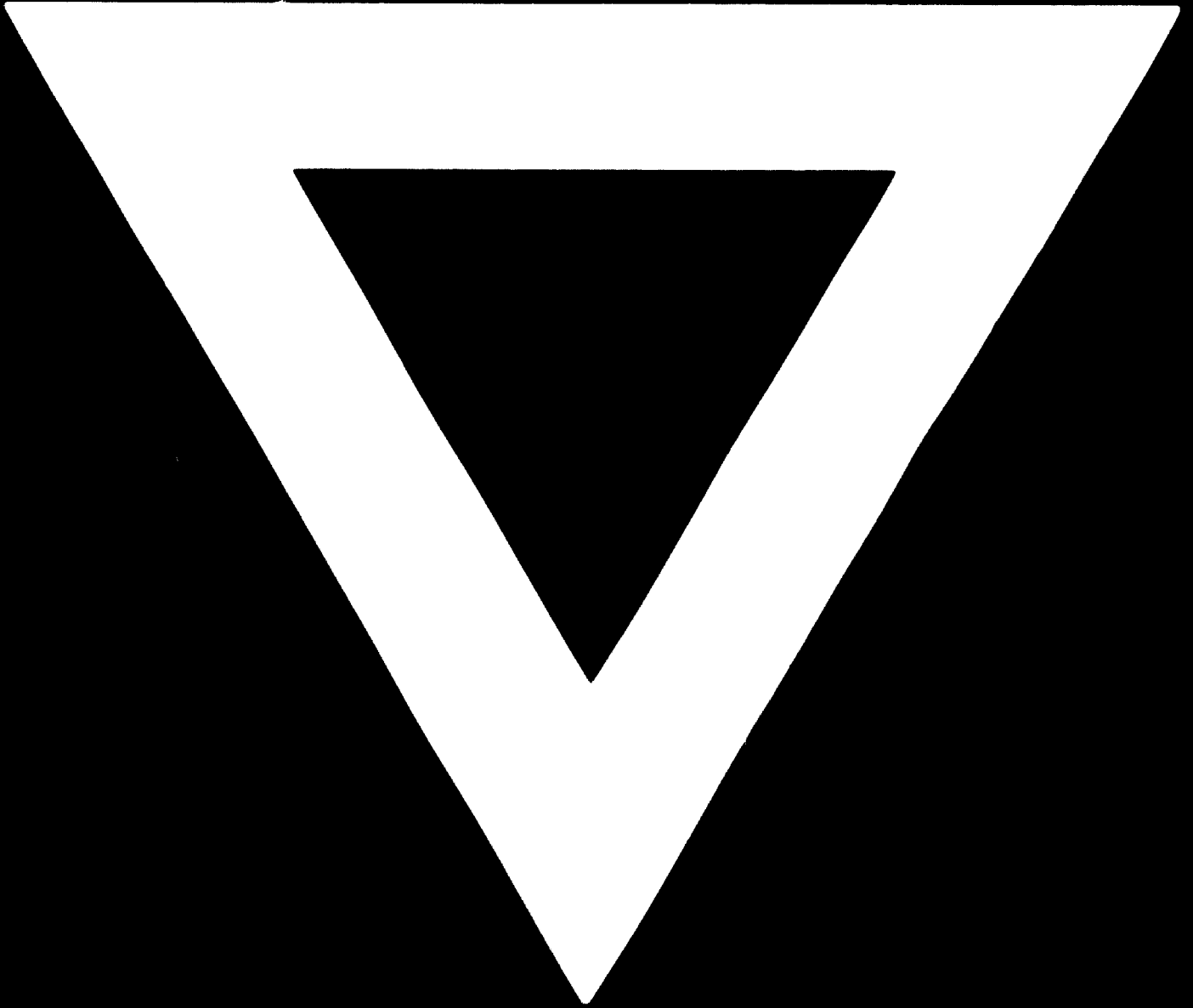
23. It is also necessary to consider the need for industrialized economies to take certain positive policy and institutional measures in the interest of greater technological collaboration with developing countries. Firstly, an appropriate agency could be set up, either at international level or by individual developed economies, to ensure that technology-supplying enterprises from these countries comply with guidelines for technical collaboration or investment-cum-technological collaboration with developing country enterprises. Secondly, greater incentives could be provided for flow of technology to developing countries. These could take the form of tax relief or subsidies in respect of incomes accruing from supply of technology or technical services to these countries. Thirdly, greater technological co-operation could be ensured through governmental and semi-governmental institutions dealing directly or indirectly with research and development in various production branches with corresponding institutions and enterprises in developing countries, particularly in the development of more appropriate processes and techniques. Further, it is necessary that developed countries should participate financially in providing a greater flow of suitable and appropriate technology to developing countries. Even if a small percentage of the income generated from external technology supply could be set apart by these countries for financially assisting the flow of industrial technology to developing countries, a significant beginning could be made in generating adequate resources to ensure a substantial increase in the supply of technology and expertise to these countries. Such resources could be channelized through an international mechanism which would represent a practical and tangible expression of greater international technological co-operation.

Overall dimensions of international co-operation

24. While a number of specific policy and institutional measures for international technological co-operation have been identified, the overall scope and dimension of such co-operation must necessarily be examined in terms of rapid growth of technological capability in developing countries. This would necessitate major new initiatives and additional programmes of co-operation, particularly between industrialized and developing economies, to significantly raise the level of domestic technological capability of developing economies through (i) establishment of multi-disciplinary technology institutions in developing countries which could significantly adapt and innovate new technologies; (ii) development of technological capacity in new sectors of critical importance to developing countries, such as non-traditional sources of energy, etc.; (iii) development of design and engineering capabilities in critical and priority production sectors, such as steel, metallurgical industries, fertilizers and chemicals, agro-industries, capital goods manufacture and the like; (iv) growth of innovative capability for small-scale production and development of appropriate processes and techniques in various sectors; and the like. Such a programme of international technological co-operation, which comprehensively covers aspects of technological development and domestic technical capability in developing countries, would necessitate the transfer of significant additional resources from industrialized to developing economies and require a basic re-orientation in the structure of bilateral and multilateral financial transfers between such countries.



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