

TECHNOLOGY TRANSFER AND DEVELOPMENT

Problems and programmes

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New Delhi, India

February 1978

Prepared for
The Commonwealth Secretariat
London

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I. PREAMBLE

1.1 To assist the Team of Industrial Specialists, appointed by the Commonwealth Secretary-General, to submit a programme of practical measures of cooperation designed to accelerate the industrialisation of Commonwealth and other developing countries* field investigations concerning the availability, identification, evaluation, selection, utilisation, adaptation and development of technologies were carried out by Pers India Pvt. Limited, New Delhi, India. Apart from an examination of these problems, the work undertaken included the processing of a few specific industrial projects selected from amongst those already identified by countries for implementation.

1.2 Inter alia, the investigations were required to :

- i) demonstrate the problems faced by developing countries in the process of technology acquisition, utilisation and development ;
- ii) identify the inadequacies of existing mechanisms for this purpose ; and
- iii) make recommendations on possible mechanisms of cooperation to overcome such difficulties.

1.3 The problems and difficulties faced by developing countries in the processes of technology acquisition, utilisation and development were investigated through endeavours to initiate the processes of technology identification and selection in respect of a few projects of immediate interest to certain countries. Because of time constraints, the field investigations were carried out in selected Commonwealth countries in Africa and the Caribbean.

* Note by Secretariat: The Team were appointed in late 1976 and completed their assignment in May 1978. Their Final Report has been transmitted to Commonwealth Governments and released for general circulation; it is soon to be considered by a Commonwealth Ministerial Meeting.

1.4 While the results of the investigations in these countries cannot be said with certainty to be fully representative of the problems and difficulties faced by all Commonwealth developing countries, they helped to indicate some of the directions in which future efforts of international cooperation will have to be aimed.

1.5 In respect of those projects selected, hereinafter referred to as the 'Field Projects', the work undertaken related to locating possible sources of the technologies required, and to evaluating the preliminary proposals received and their subsequent processing in the target countries.

1.6 Since, for historical reasons, India has had some years of experience in the processes of technology acquisition, utilisation and development, a study was made of the experiences of that country. Examination was also made, through desk research, of the programmes for disseminating technology information by international agencies, and some of the problems facing the industrially advanced countries as donors of technology to developing countries.

II. OBSERVATIONS

2.1 The following countries were included in the Field Projects :

- A. Africa
Kenya, Nigeria, Sierra Leone, Tanzania,
Zambia.

- B. Caribbean
Barbados, Guyana, Jamaica,
Trinidad & Tobago.

2.2 Nine Field Projects were selected on the basis of information furnished by these countries and that otherwise available to the consultants. In selecting these Field Projects, preference was given to those :

- i) relating to basic needs ;

- ii) utilising indigenous produce ; and

- iii) processing agricultural and other waste materials.

The projects were also selected so as to give a mixture of large/medium and small enterprises. They are detailed in Annex I.

2.3 Enquiries for the technologies needed were sent to 159 firms / organisations in the United Kingdom, United States, Canada, West Germany, Japan, Australia, New Zealand and India. Of these firms/organisations, 37 showed interest in providing the technologies, 8 stated their unwillingness to do so, while 5 were not in a position to do so because of the size of the projects concerned; 16 stated they did not have the required technologies and the balance (93) did not respond. A preliminary evaluation was made from the details furnished, and the firms/organisations screened for further consideration were asked to provide additional information and to indicate the extent to which they would be willing to assist in providing the services relating to effective technology transfer.

2.4 The collected information was reviewed with the country authorities during the field visits. In each case the needs were examined and the appropriateness of the technologies offered evaluated against them. As a result of these investigations, decisions were made to process some cases further. Thereafter, the technology package needed in each case - conditioned by indigenous circumstances - was evolved, and the selected firms/organisations were asked to submit their detailed commercial offers to the respective countries.

2.5 It proved possible to process some of the Field Projects to a stage where the countries were able to locate sources of appropriate technology and initiate steps for further processing. It should thus be possible for these countries to enter into substantive negotiations and to finalise the arrangements for technology acquisition in respect of the projects concerned.

2.6 The experience of the field studies suggests that the basic difficulties relating to technology transfer and development are the same in most developing countries, though the magnitudes and effects vary. In general terms, their difficulties stem from :

- i) inadequate identification of potential industries ;
- ii) lack of related data and information ;
- iii) inadequacy of technological investigation and negotiation expertise and facilities ;
- iv) inadequacy of infrastructural facilities, including those of training and R & D; and
- v) inadequacy of entrepreneurial, managerial, supervisory and operative skills.

A. RECIPIENT COUNTRIES

Industry identification

2.7 Identification of industrial opportunities is the first and most important prerequisite to industrial development. Such a process is not a once for all activity, but has to be continuous, taking into consideration new resource discoveries, changing national needs and priorities, and changing environmental circumstances, etc. While many developing countries have set up industry promotion agencies for tasks which include industry identification, the extent of their work has not been uniform. Though some have been working systematically on the identification of industry potential, others have yet to make a real beginning. This is not for want of proper appreciation of the importance of such activity, but because of a lack of adequate skills and experience backed by appropriate information. There are far too few properly trained professionals available for assignment to this task.

Industry information services

2.8 Countries are aware of the importance of readily available technical, economic, social, administrative and other information relevant to the processes of industrial development. However, little so far has been done to establish proper mechanisms, at the national level, for the continuous collection, collation, analysis, storage and easy dissemination of this information. Unless effective mechanisms are established at national levels to ensure its ready availability, a serious impediment to industrial development will remain. Together with the development of an industry identification capability, this is the most critical area for urgent attention. Once these two areas are developed to effective levels, many of the problems attendant on technology identification, evaluation and selection will be minimised.

Technology source identification

2.9 The most frequently followed practice in the search by developing countries for requisite technologies is for their entrepreneurs, consultants and industry promotion agencies to approach manufacturers of products and/or related equipment. Such sources are, more often than not, the large foreign enterprises whose products are already known in the country or

whose names are familiar through advertisements etc. Following this practice means that a host of other sources are left out of the search. The worst sufferers in this respect are the small-scale industries, since their technologies usually come either from counterpart small enterprises elsewhere or from R & D establishments. Resources available to such organisations for publicising their technologies are minimal, and they therefore remain unnoticed by entrepreneurs elsewhere. This inadequate coverage in the attempt to identify possible alternative sources has frequently resulted in the acceptance of a less than appropriate technology or in a desirable industrial activity not being taken up.

Technology package identification

2.10 There are innumerable examples which show how the processes of effective technology transfer have been seriously hampered because of improper identification of what was needed from the supplier of a given technology and the manner in which the needs were to be fulfilled. There has not always been a clear understanding that effective technology transfer does not imply merely the supply of designs and process documents but a host of other services aimed at achieving a full and effective transplantation; such services include personnel training, the building of proper management and marketing systems and capabilities, alterations to designs and processes to suit local circumstances, etc. Most developing countries are still at a stage where the expertise needed to define correctly the contents of the technology package needed is very inadequate. The development of such expertise is not an easy or short-term task. It will grow largely out of experiences gained through association with such exercises, and till such time as it is built up indigenously, external help will be needed.

Technology evaluation

2.11 The complex nature of technology evaluation is apparent from the variety of factors involved and the need to assign different weights and priorities in each case, according to the obtaining circumstances. This is a highly complex professional task calling for many years of experience. In most cases, such evaluation has been, at best, perfunctory. This has been not only because of a lack of adequate expertise but also because of the continuing - though wholly mistaken - notion that a given technology if

successful in one environment will automatically be appropriate in any other. While authorities in the target countries were reluctant to identify specific instances of the difficulties their industries have been facing because of improper or inadequate evaluation, they drew attention to cases where the operational performance was below expectations in such matters as a continued excessive dependence on imports to sustain production, extended learning periods, inefficient equipment, maintenance, etc. As in the case of technology package identification, expertise in regard to technology evaluation will grow only with experience. Till then, external assistance will have to be sought.

Technology acquisition

2.12 The difficulties faced by developing countries in negotiating the terms for acquiring technologies from selected sources stem mainly from the following factors :

- i) the problem of assigning monetary values to services involved ;
- ii) absence of information about terms negotiated by other developing countries for acquiring similar technologies ;
- iii) external pressures and influences; and
- iv) a psychological handicap caused by the mistaken view that the recipient negotiates from a position of weakness because the benefits accrue only to him.

Resolution of these difficulties is not difficult. Clearer definition of government policies, a better understanding of the benefits (other than direct payments) accruing to technology suppliers, exchange of information and experiences amongst recipient countries, coupled with the engagement of expert services (inducted, if necessary) could help substantially in securing mutually satisfactory terms and conditions.

Technology development

2.13 There is growing realisation in the developing countries that substantial R & D efforts are called for in adapting acquired technologies to local circumstances, as also in developing wholly new technologies for their specific needs. They also recognise the desirability of developing such capabilities and capacities indigenously. While some of these countries have already established some R & D facilities, they are all handicapped in developing adequate capabilities and capacities for want of adequate resources and indigenous skills. Of urgent importance is the need to expand R & D efforts to adapt quickly to local circumstances technologies already acquired, and to help develop the skills for their efficient operation. This is an area in which cooperation with those developing countries which already have the necessary facilities and experience could be most beneficial.

2.14 Another area for early action is to develop new technologies suited to specific needs. These are most urgently needed in the following areas :

- i) processing of agricultural and forestry products ;
- ii) processing of agricultural, forestry and animal waste materials ;
- iii) use of indigenous materials for construction and industrial activities; and
- iv) use of locally available energy sources and equipment.

During the course of field investigations countries drew attention to the following specific areas :

- i) utilisation of the banana stem ;
- ii) utilisation of sisal fibres (other than for rope) ;

- iii) production of sugar from locust beans ;
- iv) production of pulp from agricultural waste materials ;
- v) utilisation of sawdust ; and
- vi) utilisation of laterite clay.

Although further investigations would undoubtedly add to this list, it could provide an early basis for cooperative endeavours.

Technology utilisation

2.15 The end-result of ineffective utilisation of a technology is the inadequate and uneconomic operation of installed production capacities. The field investigations showed that difficulties in this regard stemmed from one or more of the following :

- i) installed capacity in excess of product demand potentials ;
- ii) inappropriate technological processes ;
- iii) inadequacy of existing infrastructure ;
- iv) inadequacy of developed skills ;
- v) improper or ineffective management, operational and maintenance procedures ;
- vi) imbalance of production facilities; and
- vii) inadequate marketing and servicing arrangements.

While the target countries and enterprises concerned were conscious of deficiencies in plant performance and their possible causes, in most cases no systematic investigations had been made to institute remedial measures.

Substantial external help in the form of expertise is therefore needed to raise plant performance to efficient operational levels.

Technology diffusion

2.16 Technology diffusion within a country (intra-national technology transfer) is a problem which most developing countries face as development proceeds. It has not proved easy to solve, and as a result, it is fairly common to observe repeated inductions of the same or similar technologies from external sources. Difficulties in this regard have arisen due to :

- i) restrictions on intra-national transfer frequently insisted upon in the terms and conditions imposed by donors of technology ;
- ii) aversion by indigenous owners of technology to intra-national transfers on the mistaken notion that they would thus be assisting a potential competitor ;
- iii) aversion by technology recipients to acquiring technologies from indigenous sources, in the belief that their competitive position would be affected by not acquiring technology from a foreign source ;
- iv) inadequate realisation by large-scale manufacturers and users of complex technologies of the benefits of horizontal integration - to themselves and to the process of industrial development of the country ; and
- v) inadequate governmental measures to stimulate intra-national technology transfers.

2.17 The results of such repeated inductions of technology include :

- i) avoidable increases in the foreign exchange burden :

- ii) multiplication of standards inducted, causing difficulties in the formulation and enforcement of national standards ;
- iii) multiplication of the efforts necessary to adapt inducted technologies ;
- iv) avoidable extensions to the period for achieving self-reliance in respect of a given or similar technologies ;
- v) multiplication of the varieties of materials, skills and other inputs necessary for production caused by the differences in the technologies supplied by different sources; and
- vi) multiplication of the problems of maintenance and servicing.

B. DONOR COUNTRIES

2.18 The problems faced by industrially advanced countries in providing support to developing countries in their programmes of industrialisation are many, and those described in the following paragraphs cannot be considered exclusive.

2.19 Proposals which support industrial development in the developing countries frequently raise concern in the business communities of industrially advanced countries. A natural and often voiced fear is that programmes designed to share technology with developing countries will result in the industrially advanced country markets being flooded with cheap manufactures and at the same time will shrink their export potentials. On the other hand, in most cases where technologies have been shared, the suppliers from the industrially advanced countries have found an expansion in their marketing opportunities. Moreover, the growth of new activities in the recipient countries has fostered an expansion in markets for a variety of capital goods, materials and services which the industrially advanced countries can supply.

2.20 There is inadequate information in the industrially advanced countries on the policies and objectives of developing countries, their plans and priorities for industrialisation and the status of the obtaining infrastructure. The result is that even where a particular owner of technology is otherwise willing to transfer it to a developing country, he is just not aware of the opportunities available. Unfortunately, for want of proper resources, the developing countries themselves have been unable adequately to make their potentials known. Other means will therefore have to be found to bridge this information gap.

2.21 There is a fairly large portfolio of technologies available from within the developing countries which are readily adaptable to the needs of other developing countries. However, most of these are possessed by relatively small operators who do not have the necessary resources to advertise their technologies. Even when identified through other mechanisms, such operators will need considerable support and guidance to be able to transfer effectively their technologies to users in other developing countries.

2.22 Research establishments in the industrialised and some developing countries have the necessary capabilities and capacities to undertake development of a variety of technologies appropriate to the needs of developing countries. However, because of the information gap, they are not aware of the specific needs of such developing countries, nor are the latter fully aware of the facilities available; at the same time, because of resource limitations - particularly of a financial nature - the developing countries are unable to undertake such development activities themselves. This is an area offering considerable potential for mutual benefit through international cooperation.

23. Mention has been made earlier of the inadequacy of identification of industry potential in developing countries and of information availability to potential suppliers of technology in the industrially advanced countries. In this connection the Experimental Programme of Industrial Cooperation (EPIC) set up by the Canadian International Development Agency (CIDA) in 1976 is of interest. The objective of the Programme was to identify linkages between the resources and capabilities of Canadian industry and

priority industrial projects in selected developing countries, and to establish mechanisms for effective technology transfer, development of management skills, marketing and entrepreneurship. Teams comprised of Canadian consulting firms with specialised knowledge and experience were sent for extended periods to each country, where they interviewed a variety of government agencies, central and private banking institutions, and private businessmen. The teams were thus able to identify areas of high priority and to draw up lists of potential projects. They then sought out potential partners in Canada for ventures which appeared to have the best possibilities for mutual advantage and which could benefit from a transfer of technology, and financial and marketing experience from Canada. The exercise resulted in the identification of 92 projects, some relating to new ventures and others to expansion or upgrading of existing ones. Nearly 150 Canadian firms showed interest in these projects and work on them is progressing.

2.24 Particularly noteworthy conclusions of the Experimental Programme are :

- i) programmes of industrialisation in developing countries can be materially accelerated if technology supplying countries take the initiative in identifying specific gaps of importance to the recipient country ;
- ii) for such investigations to be really meaningful, they should be undertaken by professionals conversant with a wide spectrum of industry and of development problems ;
- iii) such investigation programmes should include follow-up action at home by the same team, which can identify specific sources of technologies required and thereby bring together technology donors and recipients ;
- iv) industrialised countries should prospect more aggressively for opportunities in the Third World, since developing countries do not

themselves have the resources to go to the industrialised countries, nor at times do they fully recognise the industrial capacity of these countries ;

- v) it is neither automatic nor easy to translate industrialised country technologies into forms that are ideal for developing countries ; and
- vi) development of a cooperative industrial venture in any country is clearly dependent on the economic and absorptive capacity of the country and on the priority which it gives to industrialisation.

C. INTERNATIONAL PROGRAMMES FOR INFORMATION

2.25 Various agencies in the UN system have been seized of the problem of disseminating technology information to developing countries. A brief summary of the resultant programmes is given in Annex II. The programmes themselves are aimed essentially at developing technology information systems at the international and regional levels, and thus to reinforce, but not replace, the national systems.

2.26 On the other hand, the field investigations undertaken helped confirm that, in the ultimate analysis, it is the national system which will be most directly and crucially concerned with serving the detailed information needs of individual entrepreneurs in a country. Also, the mechanisms envisaged at the international and regional levels are intended primarily to be concerned with technologies themselves. But the type of industrial information needed by an entrepreneur or a technology supplier goes far beyond these confines. They need complete and accurate information on local circumstances, infrastructure facilities, unit factor costs, availability of materials and skills, etc. The coverage of information to be sourced by national mechanisms, therefore, is much wider. Not enough has been done so far to build up effective national mechanisms for providing such information in these developing countries. This is an area in which international cooperation can contribute effectively.

III. INDIAN EXPERIENCE

3.1 Since India has had some years of experience in the processes of technology acquisition and adaptation, and also in the development of small-scale industries, its experience was examined as an aid to the work of the Commonwealth Team of Industrial Specialists.

3.2 Investigations were undertaken into the problems encountered in India concerning technology identification, evaluation, acquisition, adaptation and development. Because of the very considerable emphasis placed on the development of small-scale industries in that country, their problems of technology acquisition were investigated separately.

3.3 Government assistance to large/medium industry - referred to in India as 'organised industry' - has been mostly at the policy level. On the other hand, the small-scale sector has in addition been assisted by a variety of institutions set up by the Government. Experience, in general, concerning technology acquisition and development in India are set out in Annex III; those of small-scale industries are elaborated in Annex IV.

3.4 Briefly, the Indian experience points to the following conclusions :

- i) development of institutional capabilities for identifying, cataloguing and disseminating information on industry potentials have substantially assisted in the processes of industrial development ;
- ii) inadequate appreciation of, and attention to technology evaluation, and the formulation of technology packages, in the earlier years, led to undesirable results ;

- iii) growth of indigenous institutional capabilities in technology evaluation and adaptation processes has minimized the problems of subsequent utilisation, and also made for more balanced negotiations for technology acquisition ;
- iv) growth of small-scale industry has been substantially accelerated through the establishment of institutional facilities ;
- v) development of technologies appropriate to small volume production has contributed significantly to the growth of small-scale industries ; and
- vi) difficulties in readily identifying sources of technology have been encountered for want of adequate information.

IV. POSSIBLE APPROACHES

4.1 To set the stage for defining more specifically the possible approaches to international cooperation for industrial development, with particular reference to the development, transfer and utilisation of 'appropriate technology', it would be advantageous to recapitulate the many connected recommendations which have emerged from the work of the various organisations in the UN system, the Commonwealth Secretariat and others. These recommendations, though usually conceptual in nature, provide useful pointers to the approaches for possible programmes of action. The more pertinent of the recommendations are summarized in Annex V.

4.2 Concepts considered useful in evolving specific programmes for international cooperation include the following:

- i) international cooperation could contribute much more if aimed at assisting countries to work for themselves. Emphasis in future international cooperation programmes in the technological field could, therefore, be on training and assistance in establishing required mechanisms/institutions at the national and regional levels;
- ii) developing countries should endeavour to cooperate more amongst themselves to cover the gaps in their technological needs. International programmes could be designed to foster such cooperation;
- iii) it would be desirable to lay greater emphasis in future programmes of international cooperation on the provision of total software services in processing even a small number of industrial schemes up to implementation, rather than spreading the effort and resources in partially covering a wider range; and
- iv) developed country aid programmes and cooperative efforts could more usefully focus to a greater extent on utilising technical resources and R & D facilities to help develop technologies appropriate to the circumstances of developing countries.

Industry promotion, identification and information

4.3 One of the most important areas where cooperative assistance could make a significant contribution to a developing country's industrialisation programme is in the development of capabilities and capacities for industry identification, industry information and other industry promotional services. This is an area in which some developing countries have already acquired a measure of competence, and the approach here, therefore, may be to harness these resources from amongst the developing countries themselves. However, some countries may not be able to assign the necessary manpower for this purpose, and in these cases, regional or international cooperative effort would have to remain the mainstay.

Technology information sourcing

4.4 The investigations undertaken showed all the countries selected to be handicapped for want of readily available information on sources of technology. Various agencies are already publishing country directories of machinery and equipment. The need has now become apparent for country directories of technology suppliers to be published on similar lines. This is an activity which necessarily will have to be undertaken at country levels. It would therefore be most helpful if countries in a position to supply technologies would recognise the importance, urgency and advantage of compiling and publishing technology source directories.

Technology evaluation, selection and negotiation

4.5 An inadequacy of indigenous expertise, and even of information on suitable sources of expertise, to undertake technology evaluation, selection and negotiation is the main handicap faced by most developing countries. Barring the very small ones, which may not be able to assign the necessary human resources, all the other countries need to build up their own capabilities for this purpose. Experience already gained by some developing countries provides an excellent source for such capability development. The existence of these capabilities, however, needs to be better publicised. In this respect, international assistance aimed at demonstrating the potentials of bilateral cooperation in this field could help. Programmes devised and executed through an international mechanism could bring developing countries closer together while at the same time assist in resolving some of their technology problems.

Appropriate technology development and adaptation

4.6 The need for capabilities and capacities in R & D activities in developing countries is well recognised. There are many such facilities in the industrialised countries and in some of the industrially more advanced developing countries. Cooperative efforts in R & D have not yet got underway to any significant extent; and yet, there is much to be gained through such an approach. International programmes should, therefore, be devised to demonstrate effectively the benefits of cooperative R & D efforts. Such international programmes would have greater validity when the benefits accrue to more than one country.

4.7 Lack of financial resources has been an impediment to accelerating the required R & D activities in the developing countries. Fortunately there are a few countries who are today in a position to provide such financial assistance. International efforts should be directed towards persuading them to participate in cooperative R & D programmes - even when such cooperation is on a strictly commercial basis.

Technology utilisation

4.8 The problem of how to improve the utilisation of investments already made is assuming serious proportions in some developing countries. While some of the causes may be beyond the direct control or influence of plant managements, there are others which, if properly studied, can be rectified. Of immediate assistance to the countries concerned would be programmes designed to investigate cases of inadequate utilisation of installed production capacities and to help in instituting remedial measures. Individual countries could themselves identify plants facing these problems. Thereafter assistance could be provided through devising suitable mechanisms of international cooperation. The experiences of other developing countries in solving such problems could also usefully be employed.

Small-scale industries

4.9 From the evidence forthcoming, it is fairly certain that small-scale industries will play an increasingly important role in the industrialisation programmes of many developing countries. The problems relating to small-scale industry development are, however, substantially different from those concerning large and medium-sized industries. Through recognition of these problems, some developing countries have found it advantageous and, indeed, necessary to:

- i) lay down specific administrative and fiscal policies aimed at encouraging such industries;
- ii) establish special institutions and mechanisms for providing preferential financial assistance;
- iii) establish institutions and mechanisms to provide extension services such as those of industry information, entrepreneurial development, project development, technology development, equipment selection and procurement, personnel training, trouble shooting, marketing, etc; and
- iv) provide a variety of physical facilities such as industrial estates, common facilities, prototype centres etc, which materially assist the development of small-scale enterprises.

Experience has shown that much greater institutionalised assistance is necessary for fostering the growth of small-scale industries.

4.10 Where small-scale industry is expected to play a significant role in industrial development therefore, developing countries should be assisted in examining their needs for such mechanisms and in establishing them. Through suitable bilateral arrangements, they could be helped to get assistance from those developing countries which have already acquired relevant experience and expertise.

4.11 The Commonwealth Secretariat may wish to re-examine its existing mechanisms and arrangements in order to assist the growth of small-scale industries. More specifically, consideration could be given to the institution of special programmes in the following areas:

- i) institution building assistance;
- ii) specific contributions, both physical and financial, to the development of technologies appropriate to the circumstances of small-scale operations; and
- iii) more effective cooperation and sharing of experiences between developing countries in respect of small-scale industries.

Some approaches for donor countries

4.12 A whole variety of aid and assistance programmes have already been instituted by governments and industry of the industrialised countries. This notwithstanding, the present difficulties of developing countries point to the need for:

- i) special agencies, designated (if already existing) or set up in industrialised countries to act as focal points through which the information sought by developing countries and by enterprises in the industrialised countries could be channelled and readily furnished;
- ii) the agencies to be encouraged to enter into bilateral arrangements with their counterparts in developing countries for arranging exchanges of personnel, training and orientation programmes, etc;
- iii) policies and programmes instituted whereby available R & D facilities in the industrialised countries could more readily take up the development of appropriate technologies for developing countries; and
- iv) programmes evolved whereby industry in the industrialised countries could itself take greater initiatives to identify potential sources for technological cooperation for the mutual benefit of themselves and the developing countries.

Commonwealth Secretariat

4.13 The Commonwealth Secretariat has, no doubt, been making contributions in a variety of ways to the socio-economic development programmes of developing countries. The present investigations, however, point to new areas where help from the Commonwealth Secretariat could make significant contributions in the processes of industrial development. In evolving its future programmes, the Commonwealth Secretariat could give consideration to :

- i) fostering greater cooperation among developing countries, and demonstrating the benefits thereof;
- ii) laying greater emphasis on the development of indigenous capabilities and capacities;
- iii) affording priority to programmes leading to the implementation of specific projects, rather than on investigative studies forming only part of preplanning activities;
- iv) evolving special mechanisms to provide technical and financial assistance to the development of small-scale industries; and
- v) packaging of assistance in software services, from inception to production for given industrial projects.

V. SPECIFIC PROGRAMME RECOMMENDATIONS

5.1 Based on the problems and difficulties faced by developing countries and on some possible approaches to their resolution, it was possible to identify some specific programmes and practical measures for implementation. The Team of Industrial Specialists will wish, no doubt, to examine these in keeping with the other issues under consideration and their judgement as to the resources available for implementation and the extent to which the cooperation of countries could be secured. The specific recommendations have been sub-divided into two groups, viz :

- i) programmes for initiation by, and active participation of, the Commonwealth Secretariat ; and
- ii) actions which may be recommended by the Commonwealth Secretariat to governments for their consideration, and in whose implementation the Commonwealth Secretariat may need to assist only marginally.

A. PROGRAMMES BY COMMONWEALTH SECRETARIAT

Industry information services development programme

5.2 The investigations revealed many instances of the handicaps faced by developing countries for want of adequate national mechanisms to disseminate industrial information to entrepreneurs, technology suppliers and others. While present international programmes are aimed chiefly at developing such mechanisms at the international and regional levels, the Commonwealth Secretariat could contribute by assisting developing countries to create and develop such mechanisms at the national level.

5.3 A programme for this purpose could, inter alia, cover the following:

- i) each developing country to be asked to review its present facilities and deficiencies. The aim of the programme would be to develop the basic facilities and required human resources, and not the industry information itself;

- ii) countries, preferably developing countries, known to be in a position to assist develop such services, to be asked to formulate their views on the extent to which they can render such assistance, the manner in which it could be provided, and the contributions they would be willing to make in achieving the objectives; and
- iii) the Commonwealth Secretariat to help country organisations in formulating and implementing assistance programmes on a bilateral basis.

Technology transfer package assistance programme

5.4 Despite lack of time, progress made in respect of some of the Field Projects showed that assistance in the processes of technology identification, evaluation and selection could materially help many developing countries. A Package Assistance Programme could, therefore, be instituted for the following purposes:

- i) to train indigenous professionals in the processes of technology evaluation and selection;
- ii) to demonstrate the advantages of appropriate technology package identification and selection; and
- iii) to demonstrate the benefits of cooperation among developing countries in this area.

5.5 Developing countries would be asked to identify the specific indigenous agency or other institution in which they would like to develop such expertise and also a few industrial projects they would wish to process with a view to early implementation. The Commonwealth Secretariat would then appoint consultants with experience of the problems of evaluating, selecting and acquiring technologies relevant to the environment of the developing country, to carry out the programme with the active participation of the agency nominated by the country. The functions to be performed by the consultants, with the active participation of the agency, would include:

- i) reviewing the techno-economic feasibility and other investigations already carried out;
- ii) developing the technology package needed for each project;
- iii) identifying sources of technology and inviting proposals;
- iv) evaluating alternative technology proposals;
- and
- v) assisting entrepreneurs to negotiate the terms and conditions of technology transfer.

5.6 It would be an important feature of the programme that the consultants should carry out their tasks in the recipient countries and not in their home offices. Through active participation in the programme, the nominated agency should be able to acquire a measure of competence and to shoulder progressively more responsibility for future work.

Roster of technology transfer consultants

5.7 The Technology Transfer Package Assistance Programme would help country professionals to acquire a measure of competence in technology identification, evaluation and selection. However, it would still be necessary for some time to come, particularly for larger and more complex projects, to introduce expertise from outside. The Commonwealth Secretariat could assist in this by:

- i) maintaining a live roster of organisations and individuals who have the requisite knowledge and experience to provide services in the field of technology transfer;
- ii) making available this roster to countries as and when the need arises; and
- iii) assisting the countries negotiate satisfactory terms with the selected organisations or individuals, as and when such services are needed.

Appropriate technology development and diffusion programme

5.8 There is widespread acceptance of the importance of developing technologies appropriate to the circumstances of developing countries, particularly in respect of small volume production. With a preponderance of Commonwealth countries in need of such technologies, it would be in the fitness of things if the Commonwealth Secretariat were to establish a programme to assist in the development and diffusion of such technologies. This programme, which could become permanent, would have the following main objectives:

- i) to keep under continuing review the needs of developing countries for the development of new and appropriate technologies, particularly those required for small volume production and the utilisation of regenerative natural resources, waste materials and new energy sources, etc;
- ii) to foster the development of such technologies in suitable R & D institutions, and their exploitation on a cooperative basis between such institutions and recipients;
- iii) to encourage the financial participation of countries in these programmes on a commercial basis;
- iv) to institute such programmes with marginal financial assistance by the Commonwealth Secretariat, if this is found necessary; and
- v) to increase awareness of the availability of technologies which have been developed elsewhere and are available for commercial exploitation in developing countries.

5.9 To implement the programme, the Commonwealth Secretariat should set up a Standing Advisory Committee on Appropriate Technology, comprising senior professionals familiar with the problems and needs of appropriate technology in developing countries, and charged with the following functions:

- i) identify specific programmes for the development of appropriate technologies needed by developing countries from information furnished by these countries and the Committee's own knowledge;
- ii) select R & D institutions where such developments could be undertaken most appropriately, economically and speedily;
- iii) determine the terms and conditions on which such work would be done, and investigate possibilities of funding by donor and recipient countries, and of contributions from the Commonwealth Secretariat itself;
- iv) assist the Commonwealth Secretariat in having the development work done on the basis determined above;
- v) monitor the progress of such work and the subsequent utilisation of technologies developed ;
and
- vi) act as Governing Council for a permanent display of technologies appropriate to the needs of developing countries, as an aid to their effective diffusion.

5.10 For more effective diffusion of technologies appropriate to the needs of developing countries, it is necessary that potential recipients should have a ready means to familiarise themselves with such technologies as have already been developed and those which are at present undergoing development. One effective way to achieve this would be to establish a permanent display of such technologies. London is focal point where many representatives of developing countries go quite frequently, and a permanent display in that city should help these countries become more familiar with available technologies appropriate to their needs. Basic facilities for such a display could be provided by the Commonwealth Secretariat, with the display materials, etc., normally provided by the technology owners at their own cost. The display facilities should be

extended only to those technologies which are judged by the Standing Advisory Committee as being of relevance to the needs of developing countries, and which the technology owners are willing to transfer on suitable terms.

5.11 For some time to come, the scope of the programme proposed above might be limited to those types of technology which are suited to small volume production. Such types should make use of:

- i) agricultural and forestry produce in developing countries;
- ii) agricultural, animal and other waste materials in developing countries; and
- iii) new sources of energy.

Package R & D assistance programme

5.12 The need for R & D into appropriate technologies for specific industrial activities is well recognised. A few of these technologies were identified during the course of the investigations, and with greater time, a more detailed list could be drawn up. However, facilities and resources for such work are very limited in the countries concerned, and international cooperation would be necessary if such work is to have a significant impact. In this, the Commonwealth Secretariat could play an effective role if it instituted a programme aimed at:

- i) demonstrating the potential benefits of cooperative R & D efforts;
- ii) demonstrating the potentials for financial participation in such R & D activities; and
- iii) resolving at least a few urgent problems relating to the development of appropriate technologies.

5.13 As a first step in such a programme, developing countries should be asked to furnish lists of industrial technologies they would wish to have developed. These lists would be analysed by the Standing Advisory Committee referred to in para 5.9 above, which would then select R & D projects to be taken up under the Package Programme. This list would be

sent by the Commonwealth Secretariat to governments of countries where the requisite facilities existed to undertake such work, with an enquiry:

- i) if specific R & D institutions would be willing to take up the identified projects, and their time and cost estimates for doing so;
- ii) if the identified institutions would be willing to associate scientific personnel from target developing countries in their R & D work;
- iii) the contributions the donor country would be willing to make to the projects assigned to its institutions; and
- iv) the terms and conditions on which the institutions would be willing to be partners with the recipient and other countries, in the commercial exploitation of the developed technologies.

5.14 Simultaneously with the above, the Commonwealth Secretariat may approach countries and institutions in a position to provide financial assistance, to enquire about their willingness to fund the identified R & D projects with the object of becoming partners in the commercial exploitation of the technologies developed. Once these initial enquiries and investigations have been made, the Commonwealth Secretariat - through its Standing Committee - would assist the parties enter into firm arrangements for the projects to be taken up. It would be an essential feature of the programme that scientific personnel from recipient countries should be directly associated in the R & D work, and, as far as possible, that field tests should be carried out in the recipient countries.

Small-scale industries' aid programme

5.15 Proper development of small-scale industries calls for substantial institutional and other assistance. There are a large number of Commonwealth developing countries where small-scale industries will play an important role in their development programme. It would, therefore, be appropriate for the Commonwealth Secretariat to devise a suitable programme to help these countries in this sector.

5.16 The assistance programme by the Commonwealth Secretariat would be directed essentially at:

- i) helping developing countries to establish the necessary institutions to aid small-scale enterprises in technology identification, selection and acquisition, in training of personnel at all levels, in the establishment of common facilities, and in trouble-shooting, marketing, financing, etc;
- ii) helping developing countries to establish bilateral arrangements with other countries, on a mutually satisfactory basis;
- iii) arranging the training and orientation of key personnel in other countries;
- iv) assisting in procuring technologies and in arranging joint ventures on satisfactory terms;
- v) promoting the development of technologies appropriate to small-scale operations; and
- vi) providing package services assistance for establishing specific industries in developing countries.

For more effective and concentrated attention, the Commonwealth Secretariat may wish to identify a specific Division for this purpose.

Regional industry advisory committees

5.17 As a result of the various recommendations which the Commonwealth Team of Industrial Specialists may make for practical programmes of international cooperation, the Commonwealth Secretariat could become even more involved with work in the field. Emphasis in the aid and assistance programmes could shift from studies to specific programmes of implementation. This would require that the Commonwealth Secretariat remain in constant and active touch with the field problems as they arise. For this, it might be desirable to set up Standing Industry Advisory Committees in the various regions, in order to fulfil the following functions:

- i) to monitor the progress of specific programmes in which the Commonwealth is interested or is participating;
- ii) to help resolve difficulties in the proper functioning of these programmes;
- iii) to maintain direct and continuing liaison with recipients and donors;
- iv) to examine potentials for new programmes;
- v) to render advice to the Secretariat and to the governments concerned on problems relating to industrialisation in the countries of the region, etc.

The Regional Committees should preferably comprise representatives of the industry promotion and development agencies of countries in the region.

B. RECOMMENDATIONS FOR ACTION BY COUNTRIES

Technology directories

5.18 Many of the present difficulties in locating sources of technologies stem from lack of compiled information in this regard. Country directories of machinery and equipment are already published regularly. Similar directories identifying sources willing to provide technologies would be of immense help. The Commonwealth Secretariat should consider bringing to the notice of those countries in a position to provide technologies, the desirability of publishing such directories. In the case of some developing countries able to supply technologies, marginal assistance by way of expert advice on compiling technology directories, or even some financial assistance, may need to be provided by the Commonwealth Secretariat. This could further assist by ensuring that donor countries distribute the directories to developing countries.

Bilateral technical cooperation arrangements

5.19 Mutual benefits can be derived through bilateral technical cooperation arrangements between counterpart industry promotion agencies, consultancy organisations, R & D institutions, organisations, and similar bodies. Bilateral cooperation in such cases should cover the following:

- i) exchange of information and development of industry information systems;
- ii) personnel training in related fields;
- iii) exchange of personnel;
- iv) orientation-visit programmes to familiarise personnel in one country with developments in others; and
- v) assistance on specific assignments, essentially on a 'twinning-arrangement' basis, etc.

The Commonwealth Secretariat could encourage governments to direct their agencies to enter into such arrangements as early as possible, particularly amongst developing countries themselves.

R & D extension centres

5.20 **Establishment in developing countries of fully-fledged R & D institutions** - involving sizeable financial and human resources - will take time. On the other hand, problems of technology adaptation, improvement of operational technologies, up-grading of technological skills, etc. call for relatively small resources, though benefits can be substantial. In some countries, such work is done by extension centres of field stations set up by the parent R & D institutions concerned, in close proximity to the industry they serve. Such R & D extension centres would be most helpful in developing technologies in the following fields:

- i) leather;
- ii) food processing;
- iii) forest products;
- iv) building materials and techniques;
- v) metallurgical engineering; and
- vi) mechanical engineering.

5.21 Governments of countries having suitable R & D institutions might with advantage be urged to encourage the latter to set up extension centres in those Commonwealth developing countries where the need is

already felt. Such centres should be set up with the direct involvement and cooperation of the recipient countries. In some cases it may be necessary for marginal assistance to be provided by the Commonwealth Secretariat. The centres, when fully operational, would serve the needs of industry with the objective of becoming self-supporting in time. Their specific functions would include:

- i) identification of manufacturing problems of a technological nature;
- ii) resolution of such problems using the facilities of the extension centres, other R & D institutions and industry, to the maximum extent possible. At times, it would be necessary to refer the more complex problems to the parent institutions for resolution or advice;
- iii) identification of new areas for R & D effort. Such activity to be undertaken through direct local contact, either in the extension centres, other indigenous R & D institutions or in the parent institutions, according to needs and capabilities;
- iv) familiarisation of manufacturers and entrepreneurs in the host country with development and improvements in related technologies;
- v) training of local professionals in indigenous institutions and industry in R & D work; and
- vi) providing the nucleus for future expansion into an R & D institution itself and/or assisting in the growth of other institutions.

Technology diffusion

5.22 Developing countries are already aware of the problems of technology diffusion or intra-national transfer of technology. Their attention might be drawn to the following suggestions as measures based on experiences elsewhere:

- i) suppliers to avoid, as far as possible, placing restrictions on recipients sub-licensing technologies after they themselves have mastered the subject;
- ii) suitable agencies be identified and encouraged to become the mechanism(s) through which available technologies can be transferred within the country;
- iii) governments to consider formulating suitable fiscal and other assistance programmes to encourage intra-national technology transfer, either direct or through agencies referred to in (ii) above; and
- iv) financial institutions to evolve suitable programmes to assist agencies such as those mentioned in (ii) above, including indigenous consultancy organisations, in acquiring technologies with the object of subsequent diffusion.

Information agencies in industrially advanced countries

5.23 Developing countries at times find it difficult to locate readily sources of technology assistance from the industrially advanced countries. This leads to disadvantages to potential suppliers and recipients of technologies. Governments of such countries might be urged to identify specific agencies through which entrepreneurs in developing countries could seek and obtain information on :

- i) technologies available and their sources;
- ii) equipment supply sources;
- iii) agencies/organisations in a position to provide technical services relating to the establishment of industrial projects; and
- iv) R & D establishments in a position to take up programmes.

The same agencies could also be the focal point giving information about developing countries to potential technology suppliers in the industrially advanced countries.

Industry investigations by donor countries

5.24 The EPIC Programme of the Canadian International Development Agency is a good example of how an investigatory initiative by a technology supplying country can lead to an acceleration in the industrial programmes of a developing country. The Commonwealth Secretariat may wish to inform governments of those countries in a position to provide technologies, of the desirability of instituting similar programmes. The attendant benefits would accrue to both recipients and donors.

FIELD PROJECTS SELECTED FOR INVESTIGATIONS

Project	Size	Country / Plant Size				Sierra Leone
		Kenya	Tanzania	Zambia	Nigeria	
1. Sheet glass	L	5,000 t/ annum	-	-	7,000 t/ annum	-
2. Industrial alcohol from molasses	L	7,000 t/ annum	-	-	-	7,000 t/ annum
3. Bakers' yeast	S	1,500 t/ annum	1,000 t/ annum	-	-	1,000 t/ annum
4. Soaps	S	-	5 t/day	10 t/day	-	-
5. Sugar from sugarcane	S	150 - 200 t/day crushing	150-200 t/day crushing	-	-	150-200 t/day crushing
6. Fruit & vegetable processing	S	-	3-5 t/day	3-5 t/day	3-5 t/day	3-5 t/day
7. Peptone and meat extract from slaughterhouse wastes	S	8.5t/annum peptone 1.5t/annum meat extract	8.5t/annum peptone 1.5t/annum meat extract	-	-	-
8. Pulp and paper from agricultural waste materials	S	-	-	20 t/day	-	20 t/day
9. Rubber reclamation	S	1,500 t/ annum	1,500 t/ annum	1,500 t/ annum	-	-

Size: L = Large/Medium
S = Small

FIELD PROJECTS SELECTED FOR INVESTIGATIONS

Project	Size	Country / Plant Size			
		Jamaica	Barbados	Trinidad & Tobago	Guyana
1. Sheet glass	L	-	-	-	-
2. Industrial alcohol from molasses	L	-	-	-	7,000 t/annum
3. Bakers' yeast	S	1,500 t/annum	-	1,000 t/annum	-
4. Soaps	S	-	-	-	--
5. Sugar from sugarcane	S	-	200 t/day (St. Vincent)	-	-
6. Fruit & vegetable processing	S	-	1-2 t/day (St. Kitts)	-	-
7. Peptone and meat extract from slaughterhouse wastes	S	-	-	-	8.5t/annum peptone 1.5t/annum meat extract
8. Pulp and paper from agricultural waste materials	S	20 t/day	-	20 t/day	20 t/day
9. Rubber reclamation	S	1,500 t/annum	-	1,500 t/annum	1,500 t/annum
Size:	L	=	Large/Medium		
	S	=	Small		

INTERNATIONAL PROGRAMMES FOR INDUSTRIAL
AND TECHNOLOGICAL INFORMATION SYSTEMS

INTRODUCTION

1. In December 1975, the United Nations General Assembly adopted Resolution 3507 XXX on institutional arrangements in the field of technology transfer. The Resolution reaffirmed the importance of wider dissemination of scientific and technical information and stressed the need for developing countries to have access to information on advanced and other technologies needed by them as well as on the new uses of existing technologies, new developments and the possibilities of adapting them to local requirements, and the need to enable developing countries to select technologies appropriate to their requirements and circumstances.

The Resolution further called for the establishment by UNIDO, in consultation with the appropriate organisations of the UN system, of an Industrial and Technological Informational Bank; it called upon other UN organisations, including the Regional Commissions, to undertake feasibility studies on the establishment of regional and sectoral information banks; and requested the organisations to build up appropriate linkages among these banks.

2. The Lima Declaration and Plan of Action on Industrial Development and Cooperation gave particular attention to the importance of industrial and technological information. In paragraph 61 (k) of Section B III, 'Cooperation between developing and developed countries', it made the following recommendation :

' Appropriate measures, including consideration of the establishment of an industrial and technological information bank, should be taken to make available a greater flow to the developing countries of information permitting the proper relation of advanced technologies'.

3. At the fourth session of UNCTAD held at Nairobi, the Conference adopted Resolution 87 (IV) which recommended, inter alia, that in order to

supplement national efforts, action should be taken at the sub-regional, regional, and inter-regional levels for the establishment of centres for the development and transfer of technology.

4. Arising out of these Resolutions, the following actions have already been taken :

- i) setting up of an Industrial and Technological Information Bank by UNIDO in Vienna ;
- ii) setting up of a Regional Technology Transfer Centre by ESCAP in Bangalore, India; and
- iii) setting up of an Information Referral System by UNDP in New York.

The planned activities for these are briefly described in the following section.

INDUSTRIAL & TECHNOLOGICAL INFORMATION BANK (UNIDO) Vienna

5. The results of surveys carried out by UNIDO in the developing countries reflect the diverse levels of their industrialisation and hence, of their requirements in this field. In the case of the African countries, the proposed Bank would, in addition to collecting and storing information, be expected to assist its clientele in analysing their information needs in order to respond adequately to their specific requirements and development objectives. In the case of the Asian countries, the requirements for technological information relate to the processes of industrial planning, technology selection and transfer, and industrial operations. In the Latin American countries, the need is for techno-economic information to enhance the bargaining position of recipient countries. The survey stressed the need for an integrated system which, on the one hand, would develop and reinforce the national capabilities and infrastructure and, on the other, would provide a meaningful and effective set of services consisting of access to a wider range of information sources, the unpackaging and assessment of information, and its analysis for specific needs. Emphasis is to be given to building up and maintaining adequate links between the Bank and the relevant institutions in the developing countries.

6. The Bank, envisaged as an apex of the existing national systems to facilitate institutional cooperation and to foster intensive cooperation amongst developing countries, is thus expected to accelerate the transfer of technology. Users of its services are expected to be governments, R & D organisations, technology transfer centres, financial institutions, manufacturers, potential entrepreneurs, chambers of commerce and industry, technical institutions, etc. At the government level, the Bank will provide industrial and technological information designed to assist in the policy and decision making processes. At the institutional level, information will be oriented to enhancing capabilities. At the enterprise level, it will be provided to enable entrepreneurs to take investment decisions and to establish and operate manufacturing units.

7. Activities initiated by the Bank will include the preparation of document lists, technological profiles, guides to information sources, and special documentation on relevant areas such as choice of equipment, licenses and patents, and on specific industrial sectors or products.

8. It was decided by the Industrial Development Board at its Eleventh session held in Vienna in May-June 1977 that a pilot operation of the Bank would be undertaken for eighteen months from July 1977. The sectors selected for the pilot operation include iron and steel, fertilisers, agro-industries and agricultural machinery. In this first phase, the Bank would not be in a position to serve individuals or specific firms, and would confine itself to selected institutions in developing countries. The pilot activities would include :

- i) mobilising and organising in-house information in the sectors chosen ;
- ii) collecting selected information from external sources ;
- iii) creating an information network for the identification and selection of technologies through joint action with United Nations agencies and other international or national institutions ;

- iv) establishing links between the Bank and developing country users, including a continuing appraisal of their information requirements ;
- v) preparing technology profiles in the sectors chosen ;
- vi) building up a stock of technology information in the chosen sectors and processing it for selection purposes; and
- vii) identifying and utilising technology sources and capabilities available in developing countries.

REGIONAL TECHNOLOGY TRANSFER CENTRE (ESCAP), Bangalore

9. The Regional Centre for Technology Transfer was established at Bangalore, India, by ESCAP with the object of establishing an institution to disseminate information on technology transfer among developing countries in the region and to facilitate improved cooperation for enhancing technological and industrial capabilities.

10. The functions of the Regional Centre for Technology Transfer include :

- i) promoting the establishment of appropriate institutional machinery, including assistance in designing effective national institutions for the development and transfer of technology and in forging links between these and other relevant institutions ;
- ii) helping to strengthen existing national institutions for technology transfer ;
- iii) assisting countries personnel in the various aspects of technology transfer activities ;

- iv) intensifying the search for suitable technologies by investigating their characteristics, costs and conditions, and finding alternative sources where necessary ;
- v) promoting the exchange of information and experience on technologies and their transfer among the countries of the region through regular meetings of national centres and of government officials and other decision-makers, including those in commercial enterprises ;
- vi) assisting, where possible, in the harmonisation of national legislation, regulations, and guidelines relating to the import of technology, foreign investment, etc. ;
- vii) arranging, on request, for expert advice on the evaluation and selection of technologies, on implementing a code of conduct on the transfer of technology, and on preparing model contracts for licence agreements ;
- viii) promoting and organising regional cooperation in R & D of technologies appropriate to several countries of the region, including networks in specific critical sectors ;
- ix) acting as a focal point for the conduct of detailed studies on technology aspects of interest to the region or to several countries, including comparative studies of technology costs ;
- x) acting as a medium for inter-regional cooperation in technology adaptation, development and transfer, and supplementing the efforts of national centres; and

- xi) functioning as a 'think-tank' for the region in technology development and transfer, with a view to initiating innovative projects and helping members collaborate in negotiations for technology transfer; sponsoring of research into basic technologies required by the region; and negotiation of standard licence fees, if called upon to do so.

11. The functions of this Regional Centre, which has yet to become fully operational, are thus directed primarily at assisting governments and national institutions.

INFORMATION REFERRAL SYSTEM (UNDP) New York

12. The purpose of this system is to prepare, publish and distribute directories of bibliographies of technologies, equipment and consulting engineering services, R & D services, and training facilities available in various developing countries. The primary purpose of these directories is to make known to the developing countries such capabilities as are available in other developing countries so that an increasing use could be made of each other's capacities and capabilities.

TECHNOLOGY EVALUATION, SELECTION
AND DEVELOPMENT COMPETENCE IN INDIA

I. Industrial growth

1.1 Although the engineering industry in India is over 100 years old, it was only after Independence in 1947 that significant developments took place. Such developments, in both the public and private sectors, have been guided and directed by the Industrial Policy Resolutions of the Government and by the successive Five-Year National Plans.

1.2 The primary objectives of industrial development in India have included:

- i) increasing the potential for productive development;
- ii) exploiting the natural resource endowments;
- iii) accelerating the growth of the agricultural sector;
- iv) removing the regional economic imbalances;
- v) maximising self-reliance in the provision of manufactured goods; and
- vi) increasing the contribution by manufactures in the exports of the country.

1.3 Much of the effort since Independence has been directed at laying the foundations for the self-reliant and self-generating growth of industry. There has, therefore, been great emphasis on basic industries such as steel, aluminium, machine-tools, machine building, castings, forgings, basic and intermediate chemicals and dyes, drugs, etc. Between 1950 and 1976 industrial production rose from Rs. 808 million to Rs. 91,850 million, industrial employment from 170,000 to 6.8 million, and exports from negligible values to Rs. 5,500 million; between 1950 and 1975 productive capital rose from Rs. 724 million to Rs. 37,410 million.

1.4 Impressive in itself, the foregoing does not account for the growth of the infrastructure related to industrial development. It was recognised from the start that self-reliant industrial growth would not be possible without the necessary institutional and technical supporting

infrastructure. As such, equal, if not greater, emphasis has been laid on these developments.

II. Industry identification

2.1 As an aid to the processes involved in planning for industrial development, the National Council of Applied Economic Research was set up to undertake, amongst others, investigations into the natural resources of the country and their potential for exploitation. These investigations were followed by detailed techno-economic surveys to establish, at macro-level, the possibilities and potentials for specific industries.

2.2 Similarly, the National Industrial Development Corporation (NIDC) was set up in 1954 to identify gaps in the industrial spectrum and to study the methods and schemes for filling them. Since then, the work of industry identification has also been undertaken by the NIDC and other institutions in the States, by industrial financing institutions and by consultancy organisations.

2.3 These endeavours, supplemented by individual investigations by prospective entrepreneurs, have meant there is continuously available a substantial catalogue of potential industrial projects in the country.

III. Technology source identification

3.1 In earlier years there were few occasions when deliberate attempts were made to locate and evaluate alternative sources of technology before a choice was made. Where large investments were involved, the choice was predetermined by the sources of foreign funding. In the case of smaller projects - essentially those in the private sector - the choice was generally made by an ex-importer or agent who had graduated to industrial entrepreneurship. It was natural, therefore, for him to seek assistance from the foreign principals with whom he had been dealing and whose product already had a market in the country. Examples of these products include tractors, bicycles, paints, airconditioning and refrigeration equipment, machine-tools, and process instrumentation. This does not mean that specific searches for sources of technology were never made in the early years; teams were frequently sent to the industrially advanced countries to endeavour to locate such sources.

3.2 With time, more information was collected by the various organs of Government, Industry Promotion Agencies and consultancy organisations, the search for sources of technology became more extensive. Today attempts are invariably made to locate alternative sources, both from within the country and from abroad.

3.3 The position, however, remains far from satisfactory. While a substantial amount of information has been collected, it is far from comprehensive; moreover, the information is fragmented and dispersed in a bewilderingly large number of organisations and institutions. An entrepreneur or his consultant has, therefore, to expend a significant amount of time and money in the search. For want of both, the search is rarely sufficiently exhaustive and, at times, schemes tend to suffer because of this.

3.4 Despite the large variety of technologies now available in India, either through indigenous R & D efforts or through adaptation of imported technologies, no systematic attempt has yet been made to compile information on them except for the limited work done by the National Research and Development Corporation (NRDC) to compile information on indigenously developed technologies which are offered through it for commercial exploitation.

3.5 It would not only assist Indian industrial development efforts, but would be of help to other developing countries, if steps were taken to compile and publish a directory of technologies available in India. This would be particularly useful to other developing countries in respect of technologies evolved for small-scale operations and of those acquired and adapted to local circumstances.

IV. Technology package identification

4.1 During the first decade after Independence, identification of the required technology package was left largely to the selected technology supplier. This was predicated not merely by the lack of adequate indigenous competence to undertake such work, but also under the mistaken notion that the foreign technology supplier knew best. The importance of complete familiarity with the operational circumstances obtaining in the country - an area of considerable darkness to the foreign technology supplier - was not fully appreciated.

4.2 The result was that quite frequently the technology package did not provide adequately for the problems encountered in the course of technology transference. Some of the difficulties which began to manifest themselves fairly early included:

- i) provision of excessive plant and machinery caused by inadequate understanding of local productivity capabilities;
- ii) substantial extensions in gestation periods, for want of adequate provision for training at all levels;
- iii) excessive and extended dependence on external sources for materials and components for want of adequate familiarity with indigenous programmes and capabilities;
- iv) unnecessary provisioning of large numbers of expatriate personnel, caused by inadequate information on indigenous capabilities in related fields;
- v) provision of plant facilities and utilities not in keeping with obtaining climatic conditions, availability of materials etc; and
- vi) extended delays in adapting product/process designs to conform to user needs and available production inputs, caused by lack of familiarity with indigenous circumstances and inadequate provisioning for required R & D effort.

4.3 Fortunately, the causes and effects of such problems were recognised fairly early. In the second decade after Independence, therefore, greater insistence was placed on a direct association of Indian technical agencies/organisations familiar with the circumstances obtaining in the country and with the processes of technology package identification. Such association - generally by the appointed Indian consultancy organisations -

not only brought a substantial measure of realism to the formulation of the technology package contents but also provided an opportunity for the local organisations to acquire expertise in developing the package.

4.4 It is relevant in this connection to cite an instance which illustrates not only the above point but also how the need for external assistance reduces with the growth of indigenous capabilities. When Government established Hindustan Machine Tools Limited in 1953, it entered into a technical collaboration agreement with Oerlikon Machine Tools Co. of Switzerland. Pursuant to the provisions of the technology package to be supplied under that agreement, Oerlikon provided a considerable amount of technical assistance, even though production concerned simple centre lathes. In 1976, the same company took up the manufacture of 'special purpose transfer line automatic machine tools' with technical collaboration from Cross Company of USA. Because of the build-up of indigenous capabilities in the intervening period, and the allowance made for this in the technology package, the assistance needed was substantially reduced. This is evident from the following tabulation:

<u>Item</u>	<u>Oerlikon Collaboration</u>	<u>Cross Collaboration</u>
i. Product design	F.C.	F.C.
ii. Adaptations to product designs	F.C.	F.C./HMT
iii. Manufacturing operation sheets and data	F.C.	F.C./HMT
iv. Jigs, fixtures, and tooling designs	F.C.	F.C./HMT
v. Production facilities identification and layouts	F.C.	F.C.HMT
vi. Production planning procedures, etc.	F.C.	HMT
vii. Personnel training abroad	Substantial	Negligible
viii. Induction of expatriate specialists	Substantial	Negligible

(Note: F.C. - Foreign Collaborator
HMT - Hindustan Machine Tools Ltd.)

4.5 With the growth of competence in Indian technical organisations, it is now normal practice for the required technology package to be developed by these Agencies. It is only in the case of highly complex and sophisticated technologies that it is found necessary to associate the selected technology supplier in this activity. This is a field of activity in which the expertise acquired by Indian consultancy organisations can be of significant benefit to other developing countries.

V. Technology evaluation

5.1 Most entrepreneurs, both in the public and private sectors, have become alive to the importance of evaluating alternative technologies before making a choice. New entrepreneurs depend on consultancy organisations to help in this regard. Existing enterprises introducing new programmes generally depend on their own technical resources, though occasionally they do seek the help of consultants. Assistance in this regard is provided to small enterprises and entrepreneurs through various technical assistance programmes.

5.2 A few recent examples of detailed evaluation prior to selection and negotiations for acquisition may be cited here:

- i) manufacture of heavy duty process pumps and compressors;
- ii) manufacture of high pressure gas cylinders;
- iii) manufacture of fibre glass;
- iv) manufacture of 500MW power generation equipment;
- v) manufacture of process valves;
- vi) manufacture of GLS lamp manufacturing equipment; and
- vii) manufacture of high horse-power diesel engines.

5.3 When permission is sought for technology acquisition from abroad, the results of such evaluations have to be furnished in detail to the Director General of Technical Development. Because of the pressure from Government to employ technologies more appropriate to the obtaining circumstances and to ensure optimum utilisation of indigenous materials, equipment and skills, consultants engaged in such evaluation exercises have acquired expertise in determining the relevance of a particular technology. This is an area of technical activity in which Indian consultancy organisations can provide assistance to entrepreneurs in other developing countries.

VI. Technology acquisition

6.1 There have been many instances where, with hindsight, one can say that the terms and conditions on which technologies were acquired from abroad were unduly weighted in favour of the technology suppliers. Examples of such terms and conditions included:

- i) payments unconnected with results achieved from effective technology transfer;
- ii) undue restraints on adapting product/process designs to suit local circumstances (e.g. standards, materials, skills etc.);
- iii) inadequate provisions for development of indigenous R & D capabilities, resulting in avoidable extensions to external technical dependence;
- iv) severe constraints on use of patents;
- v) unnecessarily long periods of collaboration;
- vi) restrictions on export;
- vii) restrictions on diffusion of acquired technology.

6.2 In time, not only was experience gained from the difficulties encountered, but it became more obvious and better understood that technical collaboration allowed technology donors to derive benefits in addition to the direct payments received. These benefits included:

- i) improvements in product/process designs to make them more appropriate to developing country circumstances, at little or no R & D cost to the donors;
- ii) improvements in marketing potential in other developing countries, arising out of (i) above;
- iii) better appreciation of the problems attendant on technology transfer - an asset for future business;
- iv) experience gained by technology donor personnel of working in an alien environment; and
- v) increase in sales - largely through supplies of components, with minimal competition.

6.3 Arising from these benefits the Government formulated a set of guidelines for the induction of technologies from foreign sources. Recognising that there cannot be a standard set of terms and conditions to cover all cases, the guidelines are largely indicative of the approaches to be adopted for technology acquisition from abroad. Apart from indicating the Government's own views on what would be considered as satisfactory, the guidelines have assisted the recipients in their negotiations. At the same time, they have provided a better appreciation by the technology supplier of the Government's views.

VII. Technology development

7.1 Amongst the first steps taken by the Government after Independence was to set up a chain of national research laboratories. Today, there are 43 such laboratories; in addition, there are a number of research institutions sustained by industry itself, while some of the larger manufacturing

establishments, particularly in the public sector, have their own R & D facilities.

7.2 A preponderance of the work done by R & D establishments has hitherto been directed at import substitution, i.e. on developing technologies indigenously even though they were already available elsewhere. Apart from the benefits of self-reliance, these technologies had the additional advantage of being based on indigenous materials, machinery and skills, developed in conformity with the obtaining environment. In other words, they were instances of the development of 'Appropriate Technology.'

7.3 The NRDC, established in 1953, is charged with:

- i) commercial exploitation of technologies developed by indigenous R & D institutions;
- ii) promotion in collaboration with industry, of R & D programmes in fields of national importance;
- iii) promotion of technology diffusion within the country;
- iv) promotion of technology transfer to other countries; and
- v) encouragement of the inventive talent in the country.

The number of technologies developed in India and offered through the NRDC for commercial exploitation has reached 1605, of which 834 have been granted licenses.

7.4 A substantial amount of R & D effort has been expended by manufacturers in adapting acquired technologies. This adaptation has been influenced by the volumes of production required, the need to conform to national standards, and directives from Government to increase the indigenous content of technologies.

7.5 In so far as small-scale industries are concerned, dependence on foreign technologies has been negligible and nearly all requirements have been satisfied indigenously. In this case, though, the contribution of the

national and other research establishments has been marginal; much of the effort has come from equipment manufacturers, but entrepreneurs and their technical personnel have played an equally significant role. In recent years, Government influence has also brought action by the large industrial establishments in providing technologies to their ancillary suppliers - mostly in the small-scale sector.

VIII. Technology diffusion

8.1 Considerable success therefore has been achieved in the diffusion of technology among small-scale industries. Unfortunately the same cannot be said for large and medium scale industries.

8.2 This situation has largely been caused by:

- i) constraints in the terms and conditions of technology acquisition imposed by foreign suppliers;
- ii) reluctance of Indian owners to transfer technologies, in the belief that the entry of a competitor would be adverse to their interests;
- iii) fears by technology recipients that they would acquire something less than the best, or that their costs would increase while operating in the same market; and
- iv) lack of adequate effort by consultancy organisations to acquire technologies for subsequent diffusion, mostly due to inadequate financial resources.

8.3 Of late, there has been greater awareness of this problem. Encouragement is, therefore, being given to consultancy organisations to acquire and diffuse technology within the country, while the NRDC is also now taking a more active interest in this aspect. However, there is as yet no clear overall plan of action for the effective diffusion of technology.

IX. Consultancy organisations

9.1 It was recognised fairly early that self-reliance in industrial development necessitated the development of capabilities in consultancy and engineering services. This development received substantial support from Government, which directed that the prime consultant in any project must now be an Indian organisation, except in very special circumstances.

9.2 At present there are over 200 consultancy organisations ranging in size from less than 10 persons to over 1,000. Not all these organisations are in the private sector; some have been set up by Government in specialised fields, such as petroleum and petrochemicals, fertilizers and heavy chemicals, metallurgy, engineering, etc.

9.3 For a variety of historical reasons, such organisations have been independent of manufacturers or contractors. Whilst good from a professional standpoint, this position has led to these organisations having inadequate funds either to finance new developments or to acquire technologies for subsequent exploitation. They do not receive any preferential treatment for this purpose by way of assistance from financial institutions.

9.4 In the last decade, a few of these consultancy organisations have found recognition abroad. They have rendered services relating not only to the planning of industry or the engineering of specific projects, but also to augmenting and developing the indigenous technological capabilities of some developing countries.

9.5 The role of these consultancy organisations in the various activities leading to technology acquisition has been mentioned earlier. Their capabilities are of particular relevance to the need for rendering such services in developing countries.

DEVELOPMENT OF SMALL SCALE
INDUSTRIES IN INDIA

1. Through the Industrial Policy Resolution of 1956, the Government of India clarified its approach to the development of small-scale industries as a vehicle for creating more employment opportunities and for removing regional, social and economic disparities. Such industries offered considerable potential for mobilizing the traditional skills and resources of the country. Encouragement to their development was also envisaged as a means of creating new growth centres in rural and semi-urban localities and of avoiding the excessive concentration of industry in urban centres.

2. With a view to evolving a well planned and coordinated policy for the development of small-scale industries, the Government invited a Team from the Ford Foundation of USA to carry out investigations in 1953 and 1956, and as a result a number of significant steps were taken during 1956-61. Such steps included the establishment of:

- i) the National Small Industries Corporation Ltd., for the supply of machinery, raw materials and facilities for the marketing of end-products;
- ii) Small Industries Service Institutes and their extension centres for providing necessary technical guidance and training;
- iii) prototype centres for the adaptation and development of product designs and technologies, and for training of personnel;
- iv) State Finance Corporations for providing financial assistance to small industries;
- v) industrial estates at suitable locations; and

- vi) common facilities' centres to provide such services as those of tool rooms, machinery maintenance, foundries, etc.

3. From modest beginnings, small-scale industries recorded phenomenal growth during the last two decades; the extent of this growth can be seen from the following table:-

	1960	1975
No of units registered	361,000	500,000
Persons employed	1.3 million	5.5 million
Fixed capital investment (Rupees million)	1,700	15,000
Gross output (Rupees million)	8,000	110,000

4. Of significance is the diversity of technologies which have been developed during this period. Whereas in the early 1950's production was mainly of products involving relatively simple technologies, such as those for manufacturing handtools, hosiery, sports goods, stationery articles, builders' hardware, agricultural implements etc., small-scale manufacturing now encompasses sophisticated technologies for manufacturing such products as electronic components, cables, transformers, clocks, scientific instruments, domestic electrical appliances etc. What is more, many of them - including soaps, footwear, machine tools, automobile ancillaries, radios and electronic products - are now competing with similar products made in the large-scale sector.

5. The general quality of products produced in the small scale sector is such that many of the enterprises are now consistently exporting. Their achievements in this regard are illustrated by the following figures for 1975:

	Value (Rupees million)	% of production	% of total industrial exports
Small-scale industry sector	6,375	6%	32%
Large-scale industry (organised) sector	13,590	6%	68%

6. These achievements reflected the success of small-scale industries in adapting and developing technologies suited to their needs, and dependence on imported technologies has been minimal. Whereas in the large-scale sector nearly 35% of the operating units have had to secure technologies from abroad (some having more than one collaboration), the corresponding figure in the small-scale sector is less than 1%. The main causes of this reliance on indigenous technologies include:

- i) the enterprise displayed by emergent small-scale entrepreneurs, particularly engineers (who are given considerable encouragement for this purpose);
- ii) the force of circumstances, particularly the lack of financial resources and the inability of small entrepreneurs to go through the many hurdles in acquiring foreign collaborators or purchasing costly and sophisticated machinery from abroad;
- iii) the cooperation of indigenous equipment manufacturers develop equipment and technologies suited to small-scale production; and
- iv) the aids and assistance provided by Government.

7. A further factor which is now contributing to the extensive use of indigenous technology in the small-scale sector is the Government's policy to encourage the growth of ancillary production units. In this policy, an enterprise with an investment of up to Rs. 1.0 million in plant and machinery

is defined as a small-scale unit. However, if it is engaged in the manufacture of parts, components, sub-assemblies, tooling or intermediates, and if such production is not less than 50% of its total annual production, then the investment ceiling for the definition of small-scale industry is raised to Rs. 1.5 million. Greater emphasis is now being placed on horizontal rather than vertical integration of production in large enterprises. Significant success in this regard has been achieved by a number of public and private sector enterprises in the large-scale sector, including Hindustan Machine Tools Ltd., Bharat Heavy Electricals Ltd., Scooters India Ltd., and Enfield Ltd. These enterprises have not only allocated sections of their production to small-scale units, but have provided the necessary technological support, training and guidance. Some of them have even established industrial estates with attendant facilities for this purpose. This development, though relatively recent, demonstrates the substantial benefits to be derived through the diffusion of technology, and the role which large scale industry can play in this process.

8. Significant contributions to the up-grading of operational technologies have been achieved by the extension centres set up by some of the national research laboratories. In the last 20 years, these laboratories have set up over 45 extension centres/field stations located near to the industries they serve. The specific function of these R & D extension centres is to bring the knowledge and facilities of the laboratories to the operational enterprises. The centres are staffed by experienced scientists from the parent institution. These scientists, being in direct and daily communication with enterprises in the area, are familiar with the problems of industry, help to solve technical problems and to upgrade the operational technologies. Where the facilities of the centres are not adequate to solve the problems encountered, these problems are transferred to the parent institutions.

9. In large measure, the choice of technology has been predicated by the equipment available to an entrepreneur and by his personal experience. Contributions to technology evaluation and selection are made by the Small Industries Service Institutes and their extension facilities, but they are only marginal. One of the handicaps faced by small-scale entrepreneurs is a lack of ready information on sources of technology. Discussions with a

number of such entrepreneurs, and with agencies concerned with providing them with technological assistance, point to the benefits that could be derived if, at least, an Indian Directory of Technologies were made available. Similarly, there is no established mechanism whereby the entrepreneur can obtain at nominal cost a proper evaluation of alternative technologies before making a final choice. Consultants offering services in this field are generally too expensive for the limited resources of such entrepreneurs. With small-scale industries moving towards the higher and more sophisticated technologies, the need for proper evaluation of alternative technologies has become more critical.

10. It was recognized fairly early that for such industries to develop, the entrepreneur needed a variety of aids to overcome difficulties in mustering adequate financial resources and technical management skills. The success of small-scale industries has been due substantially to the various assistance programmes of Government which has established a large number of mechanisms for this purpose. Some of these are summarized at the end of this annex.

11. An important contributor not only to the growth of small-scale industries, but also to their dispersal and the creation of new growth centres has been the setting up of industrial estates. By the end of 1976, over 470 such estates had been established, over 200 of which are in rural and semi-urban areas. The majority of these 470 estates have been highly successful, providing accommodation for over 14,000 units, of which 12,000 are already operational. A comparatively recent development has been the setting up of functional industrial estates, established primarily to locate similar and/or related technologies at one place. This is particularly advantageous for the more sophisticated technologies, which require capital-and skill-intensive common facilities, particularly those of tool-making, quality control and testing.

12. Following requests by Governments, Indian Survey Teams have been sent to 39 developing countries, while experts in various fields relating to small-scale industries have been sent to over 40 such countries. Besides visits by foreign officials to study the growth of small-scale industries in

India , a large number of foreign personnel have received, and are receiving, training in India in these fields. The most recent example of bilateral co-operation to assist in the development of small-scale industries in another developing country is the agreement between India and Tanzania. A Team of Experts from India made an in-depth study of the potential for small-scale industries in Tanzania, with particular emphasis on those areas where technical assistance could be provided. As a result, 64 small-scale industry units were identified. There followed an Agreement between the two Governments under which the National Small Industries Corporation Ltd. of India was assigned overall responsibility for collecting and providing the required technology packages for setting up these units in Tanzania. The Industrial Development Bank of India agreed to provide the necessary financial assistance for related supplies. Tanzanian personnel are receiving training in India to man these units.

13. The experience of India in developing small-scale industries, though not totally or directly applicable to other environments, does point to the potential of this form of organization in furthering a country's economic development. Particularly noteworthy in this regard is the success achieved by the Indian small-scale industries in scaling-down production volumes by adjustments in technology. This led to economic production at small volumes with the attendant social benefits of higher employment generation per unit of capital invested, reduced regional economic imbalances and the establishment of new growth centres.

14. For India also, there is much to be learnt from past experience. Difficulties are still faced by entrepreneurs in locating sources of technology and properly evaluating them. Another problem arises from the multitude of organizations concerned with this activity in India, an aspect which makes it difficult for foreign entrepreneurs to make speedy contact with the appropriate agency when seeking information. It would be helpful therefore if a single Nodal Agency could be nominated (or, if necessary, created) and given responsibility for disseminating information on Indian small-scale industries, particularly the availability of technologies, names of agencies competent to undertake work and provide services relating to the establishment of such enterprises, sources of R & D, training facilities, arrangements for financial assistance, etc.

SOME ORGANIZATIONAL AIDS TO GROWTH
OF SMALL-SCALE INDUSTRIES

Organization	Level	Functions/Aid Programmes
1. Development Commissioner, Small-scale Industries, Ministry of Industry, Government of India	Central	As the organ of the Central Government to formulate policies and programmes for the growth of small-scale industries, to coordinate and direct programmes and to provide advisory services to various institutions.
2. Directors of Industries, State Governments	State	As organs of State Governments to carry out above functions and supply industrial inputs such as land, raw materials, etc.
3. National Small Industries Corporation Ltd.	Central	To assist small enterprises to manufacture and supply goods for the use of Government, supply machinery and equipment on hire purchase, undertake marketing of specific products, distribution of scarce raw materials, running of prototype-cum-training centres and provision of technological inputs.
4. Small Industry Extension Training Institute	Central	Training of Government and managerial personnel, research programmes for development of small industries, consultancy services, modernization studies, etc.

Organization	Level	Functions/Aid Programmes
5. Small Industry Services Institutes	Central	Operating in the Status and through their extension centres, they provide technical services including technical know-how, problem-oriented consultancy, designs and drawings, workshops and laboratory services, operator training.
6. State Finance Corporations	State	To grant term finance and equity capital to small and medium industries.

SUMMARY OF SOME RECOMMENDATIONS
BY INTERNATIONAL AGENCIES ON
QUESTIONS OF TECHNOLOGY
TRANSFER

- i) A world industrial programme cannot be built in a vacuum. It must start from national programmes, for which countries must strengthen their institutional capacities for planning, control and decision-making, and develop their information system.
- ii) The free-play of the market mechanism is not sufficient to reconcile the various interests existing in the world to produce an international industrial structure acceptable to all concerned.
- iii) Adequate mechanisms should be created to organize, in a progressive manner, interdependence and complementarity among the various partners. Industrial cooperation must embody not only the complementarity of the means for industrialization, but also of the results.
- iv) Decisions to transfer industries or establish new ones cannot be made on the basis of identical criteria applicable to all situations.
- v) Economic progress in the industrially advanced countries is very much related to that of the developing countries. Consultations between the two groups and amongst the developing countries themselves is, therefore, of very great importance.
- vi) Industrialization cannot be looked at in isolation. The contribution of other sectors is clearly crucial to any increase in manufacturing production. Thus, there must be complementary expansion in the primary sector, such as agriculture, forestry and mining, and in the tertiary sector such as power, communications, transport and distribution.
- vii) The developing countries have widely varying capabilities to absorb and sustain industrialization. There is, therefore, need in both multilateral and bilateral arrangements for industrial cooperation to be structured to meet these diverse requirements.

- viii) Programmes of selective import substitution on a national or regional basis and of regional cooperation to exploit natural resources are necessary to provide the major thrust for future industrialization of developing countries.
- ix) Arrangements for widening market access to the developing countries must be complemented by systematic programmes and measures for the location in these countries of certain industries or parts of industries in which they have or can develop a clear comparative advantage. This necessitates carefully devised government policies, including appropriate adjustment measures, to encourage resources in those industries which are less competitive internationally, or which, for environmental reasons, are considered no longer suitable for countries, to move into more viable activities.
- x) It is necessary that the transfer of technology to developing countries is undertaken in a manner consistent with their stages of development and internal requirements and in conformity with their strategies for future growth and development.
- xi) There is need for a Code of Conduct in the Transfer of Technology, evolved within a framework which is basically acceptable to all parties.
- xii) For **many** industrial opportunities, technologies are available from sources other than the transnational enterprises. Most developing countries lack adequate knowledge of appropriate technologies, but they can acquire much of this through adopting methods already used by countries with production and market conditions similar to theirs.
- xiii) While establishment of data banks may be valuable, it is necessary to introduce new arrangements nationally to enable developing countries to have ready access to information. Industrially advanced countries should support early implementation of schemes to improve the information systems available to the developing countries, including the establishment of data banks on technology and technical investigations.

- xiv) Inadequate research has been applied to developing new uses for the products of developing countries. Universities, private foundations and research institutions in industrially advanced countries can make an important contribution to solutions in this area. These institutions should be mobilized for this purpose.
- xv) There is an urgent need to establish management training facilities and arrange for exchanges of management personnel between industrially advanced and developing countries, and among developing countries themselves.
- xvi) Developing countries must develop their own capabilities through effective institutional mechanisms, including the establishment of training and research centres for the adaptation, development and diffusion of appropriate technology.
- xvii) Industrially advanced countries should review their patent laws.
- xviii) Industrially advanced countries should assist, through their universities and other research institutions, the search for methods to use materials in the developing countries which are now wasted.
- xix) High priority should be given in aid programmes to the early establishment of training and research centres aimed at the indigenous development, adaptation and diffusion of technology.
- xx) Industrially advanced countries should establish mechanisms for stimulating the interest and involvement of their industries in the industrial development of developing countries.
- xxi) Industrially advanced country governments can make a significant contribution to the flow of crucial industrial information to developing countries. Such technical knowledge which is in the public domain and of considerable benefit to industrialists in developing countries includes bibliographical material on industrial processes, ownership of patents, structure and location of existing firms in different product lines, trade and market data etc.
- xxii) Where the market itself does not produce proposals for industrial ventures at an acceptable rate, governments of developing countries should create industrial promotion centres charged with such responsibilities.