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Growth of Industrial Enterprises in LDCS

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**UNIDO'S TECHNOLOGY PROMOTION AND DEVELOPMENT PROGRAMME  
FOR LEAST DEVELOPED COUNTRIES (LDCS)\***

Prepared by  
the UNIDO Secretariat

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## **I BACKGROUND AND OVERVIEW**

### **1. The new environment for industrial and technological development**

The recent changes in the global economy, such as deregulation and privatization, the formation of new trading blocks, the global integration of financial and capital markets, the increasing acceleration in the development and deployment of knowledge reflected in rapid product development/ obsolescence coupled to energy and environmental concerns, and the liberalization of global trade as a result of the Uruguay Round Agreements etc., constitute the framework within which trade, industrialization and dynamic technological change is taking place and where technology-based goods and services account for the fastest growing share. These changes represent enormous challenges to LDCs as it has widened the range of products and industries involving innovative competition as opposed to conventional price competition. Appropriate measures are required to develop the capacity to keep up with a changed dynamics of competitiveness patterns and the new realities of a globalized market.

The traditional distinction between production for internal markets and for exports is also becoming less relevant. With increased trade liberalization and market deregulation, competitiveness extends to both internal and external markets.

On the one hand, globalization of production - including global sourcing - and of research and development (R&D) activities have become an instrument both for cutting costs and capturing markets. On the other hand, developing country enterprises are finding it difficult to compete internationally on the basis of natural resources and cheap labour. Technological change itself has accelerated and become more pervasive, not only affecting virtually all branches of industry, but also changing patterns of demand in international markets.

At the enterprise level, the complex challenge faced entails carrying out multi-organizational innovation processes in alliance with suppliers, clients and even competitors, often in the context of international strategic business alliances (SBAs), in which technological innovations related not only to products, manufacturing process or equipment, but to any activity valued by clients, including those in commercialization and services in general, acquire a critical importance for sustained competitiveness.

In particular, new and rapidly evolving generic technologies, such as biotechnology, new materials and information technologies, present many opportunities and challenges for widespread competitive strategies based on technology. Firstly, entirely new products, services, markets and businesses are being created. Secondly, given their transectoral impact, proper applications of these new technologies can drastically improve the competitiveness of products, processes and services of firms in a large number of traditional industrial sub-sectors. New materials help improve product specifications and lower production costs in engineering and chemical industries. Biotechnologies in chemical, pharmaceutical and food industries are being used for achieving savings in energy and raw materials and for seizing new endogenous sources of biodiversity. The pervasive applications of information technologies are allowing companies to reengineer critical processes and improve overall efficiency and productivity across functional areas, access information key to competitiveness and so on. Technology is, therefore, at the core of competitive strategies of industrial firms.

At the sectoral level, opportunities are sought for joint pre-competitive cooperation technological projects which gather capacities and allow cost-sharing, among other consorting advantages. At national level, industrial chambers and associates are taking the lead in proposing integrated industrial development policies to governments, in which clear directions for stimulating technological innovations are specially highlighted, drawing on fiscal and financial incentives to firms, a framework for technological forecasting, monitoring and benchmarking measures for the creation and development of new technology-based enterprises, support for the institutional strengthening and concerted action in the national innovation system, involving financial agents, R&D institutes, Universities, technology management consulting firms, etc.

## **II. CHALLENGES AND HANDICAPS FACING LDCs INDUSTRIALIZATION**

### **1. The Challenges**

In general, LDCs share typical major constraints for developing their domestic economies and ensuring an adequate standard of living for their populations. Their economic and social development, acutely vulnerable to external shocks and natural disasters, represent a major challenge to themselves as well as to support of the international community. Numerous problems, both internal and external, hinder the industrial development process in LDCs. The process of industrialization in LDCs has often been an enclave type, i.e. large-scale industries were established, often in the public sector, with no clear connexion or general impact on the rest of the economy. Other economic activities remained geared to traditional production of low value-added goods, based on available natural resources, and marketing patterns limited to the domestic market. The size of the manufacturing base in most LDCs is very small, even smaller than in that of developing countries as a group. Food processing, textiles and clothing industries are the predominant sub-sectors of manufacturing in the LDCs. They are primarily final consumer oriented sectors and account for about 70 per cent of MVA. Other sub-sectors of importance in LDCs are chemicals, machinery and equipment, tobacco, wood products and non-ferrous metals. Some other LDCs are still at the stage of import-substitution industrialization and only few of them have successfully graduated to export-led industrialization. The LDCs thus remain heavily dependent on the exports of primary goods which have a very low demand elasticity.

Among the major obstacles to their industrialization are low agricultural and industrial productivity, lack of trained and skilled manpower, underdeveloped local private sector, inadequacy of macroeconomic conditions and mobilization of financial resources, lack of articulation between the industrial sector and the rest of the national economy, limited capacity to design and implement industrial programmes and projects for foreign assistance and foreign investments, and poor physical and institutional infrastructure. Moreover, their past economic policies have tended to generate little or no economic linkages: economic planning was compartmentalized and carried solely on sectoral basis with inadequate reference to the inherent virtues of intersectoral linkages. A major weakness for linkage development and for increased competitiveness in most LDCs is the absence of supporting institutions such as those for: industrial standards, testing, quality assurance, design, training, technology acquisition and dissemination, finance, R&D and extension services.

Most LDCs have yet to recognize the importance of technology in industrial development, and have thus allocated very scant resources for technology development in their national budgets. There is also a tendency to consider technological development as only the importation of equipment. Most LDCs not only have no national technology policy and strategies, but they also lack the capacity to formulate, implement and evaluate them.

Successful industrialization depends increasingly not only on efficient production at today's technology and relative price patterns but also on a capacity to keep up with an often unpredictable pattern of technological change. The success with which countries do this affects importantly the export-oriented industrialization. High rates of technological change permit increase in real wages without adverse implications for profitability and the incentive to invest. Lower rates of technological change often imply that international success can only be achieved by forcing the real wage down. The technological factor therefore plays a crucial role in determining the desirable sustained social development outcome of industrialization.

The policy implications of the above analysis for developing countries in general and for LDCs in particular are the following:

i) To ensure sustained competitiveness in the medium and longer run, SMEs in developing countries should be able to determine their own critical technological needs for competitiveness and profitability and to access, choose and effectively implement the right technological options, including environmental concerns.

ii) The process of building up technological capabilities within the industrial firm should be facilitated by an innovation-enabling environment and the help of innovation system agents, suppliers, clients and interested international partners. Emphasis should be placed on accelerating technology management capabilities as a starting point.

iii) National innovation systems in developing countries should be supported and concerted in ways which will provide manufacturing firms with the integral packages of services required by their technological innovation processes.

iv) Cooperative technological linkages should be sought at cluster, sub-sectoral and international levels.

Consequently, the present pattern of structural adjustment policies require re-examination. The conventional assumption that market forces will ensure that firms seek and find the technologies they need has no sound basis in reality. It is notable that those countries which have been successful in industrial technology, have followed policies of selective state intervention. They have relied strongly on market forces in setting the terms on which competitiveness is to be achieved, but they have at the same time supported actively the accumulation of technological capabilities within firms and the development of the technical and scientific institutions which form the national system of innovation.

## **2. Industrial stages of development in LDCs**

A large number of developing countries started their industrialization process with the processing of available agricultural raw materials, especially food processing using traditional methods, for the domestic market. The structure of land holdings ( e.g. large estates owned by feudal landlords in some countries) at that time did not encourage any processing of agricultural products, since the landlords were happy only to export the raw materials without any processing. However, with the depressing markets for raw materials and the rising unemployment, the governments of some developing countries were forced to resort to a policy of adding value to exports, encouraging agro-processing and import substitution industries for the domestic market.

When the import-substitution industries failed to create enough jobs to absorb the growing unemployed, especially in the rural areas, governments embarked on a policy of encouraging export-oriented industries, trusting in the advantages of cheap labour and availability of natural resources, and using low levels of technology, such as in textiles and garment manufacturing. In order to capitalize on schemes providing liberal access to the European Community and other developed countries' markets, some countries started Export Processing Zone (EPZ) Schemes initially involving assembly of components for exports. But to satisfy the rules of origin, they have had to find ways and means of increasing the local value-added in such types of industries. This policy has been fairly successful in many developing countries in attracting local and foreign investors, through generous fiscal incentives (tax holidays, customs duty rebates and drawbacks on import of raw materials and equipment, etc.), as for example in Mauritius and Tunisia. However, the experience of these countries suggests that unstable industrial development activities, like stock-market investment, first signs of troubled labour relations, exchange rate fluctuations tend to negate the attractive investment package and fly away foreign investors to other countries where better conditions are offered.

Some newly industrialized countries started industrialization in technology undemanding sectors, and then, after accumulating a wider range of capabilities, moved up to more technology advanced sectors characterized by increasing intensity of innovative competition. In other countries, entry into manufacturing trade has been in sectors or subsectors with a low degree of innovative competition, but there has been little subsequent change. Competitiveness has been based on low real wages, which stayed low because there had been little growth of value added per worker. Many countries adopted this pattern after adjusting out of the import-substitution policy. However, in the initial period whilst there is plenty of underemployed labour, technological advance and growth of value added per worker is bound to be slow. As full employment is reached, market forces will cause a shift towards higher value added per worker and so towards technologically more sophisticated exports. This shift depends importantly on accumulation of technological management capabilities within firms and on favourable conditions external to the firm, especially those which produce an efficient national innovative system. The governments of successful NICs played an effective role in creating these conditions showing that a technology policy designed to generate intra-firm learning processes and an appropriate environment for technological change is needed early on in the process of development of manufacturing exports.

Some developing countries have later tried, with varying degrees of success, to encourage the use of higher level technology in the export industrial sector. But this has required large investments in developing technological capability, including physical human

resources development, infrastructure, and information data bases which take time to attain in the short term. In association with the need to attract stable productive foreign investment, this represent the core of the challenge presently faced by LDC's industrialization.

### **3. Implications of Uruguay Round Agreements for LDCs**

The Uruguay Round Agreements, concluded in Marrakesh, Morocco in April 1994, comprise a series of far-reaching decisions on global trade liberalization, which will have a major impact on all trading nations. While the long-term effects of the Uruguay Round can be expected to result in a substantive increase in global trade, the short-term impact is likely to be negative for several developing countries, particularly the LDCs and other countries in Africa. While longer periods have been prescribed for developing countries to fulfill their obligations, and differential thresholds have been provided for certain commitments, particularly for the LDCs, these measures are essentially short-term palliatives that will only mitigate the impact of trade liberalization in the short term, and not lessen its long-term implications.

If developing countries are to take adequate advantage of the positive effects of the Uruguay Round, fundamental changes are necessary in their patterns of trade. These changes entail a major reappraisal and reorientation of industrial strategies, policies and programmes. This task is all the more necessary for African countries, particularly LDCs, where the negative effects are likely to be much more pronounced and the process of adjustment to a liberalized trade regime is far more difficult. The general lowering of tariffs will inevitably reduce the competitive edge of developing countries, since the present gap between the lower tariffs being paid by them under existing preferential agreements and those paid by other countries will be substantially reduced over time, with their existing advantages being greatly eroded.

In general, the successful conclusion of the Uruguay Round has given rise to some optimism since tariff reductions and a set of precise rules and procedures are likely to improve market access, in the long run, for the products of developing countries. However, the extent to which these prospects can be realized depends on the pattern of industrial competitiveness achievement in developing countries in the next few years and on their capacity to overcome non-trade barriers, particularly the ones related to standards and intellectual property rights. At present, as far as African countries and LDCs are concerned, their weak industrial base and their structure of trade indicate that the impact of the Uruguay Round Agreements is likely to be largely negative and mostly related to the agricultural and agro-processing subsector.

In the long run, a more liberalized access to the markets of industrialized countries could have a positive impact on the development of agro-processing in the LDCs, thereby enabling them to increase their volume of processed agricultural export if they can compete effectively and the non-trade barriers mentioned above can be overcome. However, in the short/medium term, world prices for temperate agricultural products are likely to increase mainly due to reduced protection in industrialized countries, while tariff cuts in tropical agricultural products are expected to erode the preferential margins currently enjoyed by many

African countries. High food prices and declining export earnings would consequently worsen the balance of payments of many food-deficit countries.

It must be recognized that the trade liberalization process inherent in the Uruguay Round Agreements is unlikely, by itself, to have a significant impact on industrial growth in present day conditions in Africa and in the LDCs, apart from its negative impact in the short run. The establishment of a sound industrial and technological base has to be viewed as an essential prerequisite to enable developing countries to effectively compete and benefit from trade liberalization in the future. The majority of LDCs have little choice in the short/ medium term but to strengthen their agro-based subsector and move towards increased processing of their raw materials for exports through the improvement of technological capabilities, management and investment.

LDCs should therefore urgently formulate and implement structural macro-economic adjustments and major reorientation of industrial and technological strategies, backed up with effective policy instruments at the macro-economic and sectoral levels in order to cope with this new challenge.

#### **4. Intellectual Property Protection**

The present day world is characterized by technology-led competition, in which intellectual capital and technical knowledge constitute the main assets. Any activity aimed at producing goods or services is in fact based on specific technologies which are not always freely available but subject to exclusive rights. Thus the process of technological innovation and commercialization is all along characterized by the interplay of intellectual property rights. Such rights are involved from the very inventive activity to the stage of commercialization, as well as in any further innovation activities carried out for making improvements in the products/processes and technologies that are marketed.

Acquisition of technology by way of different channels, such as licensing of patents or know-how, engineering designs, joint ventures, turn-key agreements and R&D collaboration agreements, necessarily entails an evaluation of the magnitude of the industrial property assets involved and negotiation and bargaining between the supplier of the technology and the recipient, bearing on the consideration of the proprietary rights.

#### **The TRIPs Agreement of the Uruguay Round for the Protection of Intellectual Property**

The Agreement on Trade Related Aspects of Intellectual Property Rights, including Trade in Counterfeit Goods (TRIPs), forms an integral part of the Final Uruguay Round Agreements. When implemented, the TRIPs Agreement will be one of the most far reaching international instruments ever subscribed on Intellectual Property Rights (IPRs). It covers all types of IPRs, with the sole exception of breeders rights and of utility models (or petty patents). The TRIPs Agreement establishes minimum universal standards on patents,



copyrights, trademarks, industrial designs, geographical indications, integrated circuits and undisclosed information (Know-how). It will supplement with additional obligations the existing Conventions on IPRs. Though freedom shall still remain to legislate on various aspects at the national level, the Agreement shall harmonize to a great extent the substantive and some procedural rules on IPRs.

The TRIPs Agreement also contains detailed provisions on judicial and administrative procedures and other measures related to the enforcement of rights, as well as specific rules to combat counterfeiting in trade of trademarks and pirated works.

The main complaints of developed countries as regards the level of protection available in developing countries which caused the Uruguay Round to focus on such a matter, related mainly to : a) the lack of protection in certain fields, principally pharmaceutical products and the application of new technologies (software, data banks, biotechnology, etc.). These concerns are reflected in the TRIPs Agreement, which stipulates that patents shall be available for any inventions, whether products or processes, in all fields of technology, without discrimination.

As regards biotechnological innovations, the TRIPs Agreement entitle countries to exclude from patentability, plants and animals other than microorganisms, and essentially biological and microbiological processes related thereto. However, countries are required to provide for the protection of plant varieties either by patents or by any other effective system. This new obligation has expanded the scope of intellectual property protection in a field that most developing countries have neglected until now.

The TRIPs Agreement will have a powerful harmonizing effect worldwide in respect to the duration of intellectual property protection in general, and patents in particular for which it establishes 20 years of protection, as a minimum. It also sets forth the right that a patent should confer to its title-holder by referring to two traditional categories of inventions: products and processes. Product patents confer the right to prevent third parties not having the patentee's consent, from making, using, offering or importing for these purposes the product. Such rights widen considerably the scope of patent protection while limiting the possibility for countries to grant compulsory licenses when title-holders do not manufacture or grant a license to authorize the making of their inventions in their territories. Derecognition of the obligation to work patents locally, which follows from the recognition of the exclusive right to import the patented product, may at first glance harm developing countries wishing to promote industrialization in their territories. However the TRIPs Agreement allows developing countries directly to address the primary concern of monopolistic pricing. To this end, the Agreement implicitly allows member States to impose compulsory licenses when, despite negotiation with right holders, the latter have failed to license the patented technology on reasonable commercial terms and conditions. In any event the Agreement limits the scope for lawful compulsory licensing, and it subjects these licenses to equitable compensation and reasonable restrictions on the exportation of the resulting products.

With the adoption of the TRIPs Agreement as part of the Uruguay Round Agreements, the basic feature of the international intellectual property system, which allows each country to frame, within certain limits, the regime of intellectual property protection that it considers best suited to its own level of development, will necessarily give way to a universal set norms

based on the current level of protection granted in the most technologically advanced countries.

It is difficult to predict how and to what extent the adoption of higher standards of international protection of intellectual property may influence the transfer of technology. In countries that have achieved a certain degree of technological and industrial development, intellectual property protection may well be an important tool to promote innovation to the extent that it ensures the exploitation of R&D results by means of exclusive rights. Developed countries which control an overwhelming share of the world's scientific and technological resources, are therefore in a better position to benefit most from the strengthening of the intellectual property protection at an international level.

For the least developing countries, which lack the necessary capabilities and human resources to absorb new technologies and carry out competitive R and D, the reinforcement and expansion of intellectual property protection is not likely to create, by itself, more favourable conditions for technological development. Legal protection of intellectual property constitutes one component of a larger framework conducive to innovation: the general macroeconomic environment, the investment rate, the availability of qualified personnel, the market size, etc. Nevertheless, greater benefits from strong intellectual property protection may be expected as the economy of developing countries grow and their technological infrastructure develops.

#### **5. Selective Government Intervention.**

There is a misconception that the State, in a liberalized economic environment, has no direct role to play in issues relating to technology except in supporting fundamental and basic research at Universities. This indeed is not true. Virtually, all developed countries have well established structures and a variety of mechanisms to encourage the development of indigenous technology; protect it, at least initially, from foreign competition; import and help to assimilate critical technologies; and build enabling and complementary technological structures.

There is therefore no doubt that in developing countries, especially in LDCs, the State has an important role to play in the creation of an enabling environment for technology development and promotion. Development of technological capability is normally a slow and expensive process which requires the interaction of several institutions supported by appropriate policy instruments designed to facilitate the technology development and acquisition process. This is obviously a role for the State, especially in developing countries where the key institutions are managed or receive subsidies from the Government.

There are however other reasons why selective State intervention is called for in national technology-led development efforts. They are summarized as follows:

- The private sector in developing countries, mostly composed by SMEs, does not have the capacity to determine its critical technological needs. Therefore it is reluctant and unable to invest adequate resources in technological innovation activities in support to its sustained competitiveness.

- The imperfect international technology market, lack of technology management capability, infrastructure and high transaction costs tend to frustrate the acquisition of technology.

- The development of human resources, technological infrastructure or technological information is expensive but a prerequisite to national development.

- Macro-economic policies made by governments affect the national climate for the development of technology.

- There is a need for efficient use of national resources in the financial, human and natural resources fields.

An effective route for the State intervention is through fiscal support to industries for acquiring new capital equipment, tax and financial incentives for technological innovation. However, the experience registered in some developing countries suggests that tax incentives for acquiring indigenous technologies have not been fully used by industries nor have they fully utilized all the earmarked funds for joint industry - State collaboration. Another approach that has been suggested would be for the State to offer tax benefits or fiscal incentives in areas where industry sees a direct benefit for itself, such as the training or retraining for its workers, or participating in consortia with other industries in developing technologies or products in which it sees market opportunities.

The Government has therefore an important duty to ensure the free flow of information, to liberalize economic activity in general, to relax foreign exchange controls for the importation of essential raw materials, equipment and spare parts, and to reduce bureaucratic controls on new and existing enterprises thereby releasing the innovative spirit and creative energies of national entrepreneurs.

## **6. Main obstacles for the adequate use of technology in LDCs**

The obstacles hampering the adequate use of technology and technological innovation in the LDCs are numerous and stem from a set of economic, political and structural parameters related to government, research institutes and development agencies functions, as well as from certain culturally adverse habits, including consumption of the local populations.

The lack of an enabling environment constitutes perhaps the most important obstacle. This should ideally comprise: a clear national technology policy and strategies; effective institutional support for industrial standards, for testing, supporting exports, quality assurance, design, training, repair and maintenance services, technology acquisition, dissemination and adaptation and information, and for research and extension services; adequate incentives for the promotion of private sector investments, etc. The absence of some of these critical conditions in many LDCs affects to a great extent the adequate use of technology in these countries.

Another equally important constraint is the dearth of entrepreneurs and the low level of technical and management skills. Entrepreneurship may be said to encompass two distinct elements: (a) the ability to perceive profitable business opportunities and (b) the capacity to coordinate and control the work which is being done. The lack of these two essential elements amongst entrepreneurs can be a serious handicap for a country's technological progress.

In the LDCs, the majority of SMIEs are traditionally family owned, which in general implies an aversion to risktaking and a necessity for short term profitability, to ensure the financial survival of the family. This is conducive to a lack of long term vision regarding investments in important change processes, and a negative attitude concerning the search for strategic alliances, as they may result in a loss of total control over the company and her policies.

On the other hand, SMIEs do not have strategic capability: sufficient knowledge about the characteristics of the markets in which they operate, including their competitors; about their own critical technological competitive needs (they also lack methodologies and information required), and the capacity to manage change or to innovate. The entrepreneurs are also not interested in enabling their human resources or investing in information and knowledge. They are therefore prisoners of their own mental paradigm - the assumptions, beliefs and implicit and explicit values, and the way they have been managing their operations - which have given positive results in the past but are dysfunctional in the new competitive environment. They have yet to realize that the solutions given to problems in the past are not only no longer valid, but have transformed themselves into the seeds of the firm's current problems.

When they encounter difficulties, they tend to act instinctively and adopt counterproductive measures such as: more control; generalized cost cutting; raw-materials substitution (lower quality); indiscriminate firing of personnel; reduction of production lines and product variety; cancelling new investment, risk-taking and training programmes; centralizing decision-making processes; adoption of autocratic leadership styles as the norm; exclusive focus on existing clients; non-related diversifications (into commerce, agriculture etc.); imitation of successful firms' strategies; lobbying for government's subsidized funds for equipment renewal; and others in line with the short-term vision adopted, including an obsessive concern about the short-term profitability of their modernization process.

All the above leads to typical situations in which there is a high level of insecurity, distrust, loss of valuable resources and quality, beside other barriers to the development of the creativity, knowledge and skill, commitment to objectives and innovation processes required to increase and sustain the company's competitiveness.

Other constraints affecting technology use in LDCs and other developing countries include: the absence of effective science and technology policies; lack of domestic R&D capabilities; wastage of available limited human resources; non-integration of technological considerations in national planning; lack of mechanisms for linking research institutions with industry; lack of an effective technology information system covering sources of raw materials, suppliers of technology and know-how as well as markets; and lack of awareness of the implications of emerging technological changes.

### Typical Technology Management Needs of developing countries' industrial companies

According to the Country Case studies of the World Bank, one of the most important causes of poor technological response by industrial companies in developing countries is their lack of information on their part on a variety of technological tasks which they have to perform in order to become technically efficient and competitive. The main items on which they need information are:

- What technologies are appropriate to survive, grow and (in the longer term) export in the new competitive environment.
- What equipment to buy, how to evaluate its capabilities, where to buy it and what prices to pay.
- Where and how to negotiate the best technology transfer deal.
- How to participate in project engineering, and to persuade foreign technology suppliers to impart elements of process technology to local engineers.
- How to train workers to the necessary skill levels.
- How to establish suitable quality control procedures, standardize products and get them certified, so that they can have market acceptability.
- How to optimize production processes, adapt them to local scales of operation, materials, components, and market conditions, by in-house engineering effort or by getting technical assistance and consultancy.
- How to establish industrial engineering procedures, to schedule production, control inventory, keep track of productivity, set up procurement procedures, and so on.
- How to reduce costs over time and adapt to changing factor conditions, by conducting or contracting research into processes and keeping a watch on international technological developments.
- How to improve products and diversify the product range.
- How to source materials and components locally, by establishing linkages with potential suppliers and subcontractors, and rendering them technical assistance.
- How to establish supply or sales contracts with overseas companies.

Many of these tasks are not performed in a manner that is conducive to competitive growth and diversification, because the enterprises lack the necessary information or ready access to sources of this information. They do not often know what they need, nor how to go about finding out. Even if they could define their technological needs, there are few supporting institutions in the country to which they can turn for effective and economical help.

## **7. Technology development for self-reliance**

Technological self-reliance involves autonomy of decision and the possession of technical knowledge and skills, and the capacity for using them to produce marketable goods and services. It means making conscious strategic technological decision for minimizing the influence of external factors as determinant for socio-economic development. LDCs thus need their own capabilities to manage and produce technology so as to be able to use imported technologies more effectively through proper targeting, selection, negotiation, adaptation and improvement; to upgrade traditional technologies and find new application for generic technologies geared towards its own conditions, in order to derive the expected aggregated return on technological investment.

The levels of development of local capability towards self-reliance in a given technological area usually includes the following steps: (i) Importation of packaged technology; (ii) Importation of unpackaged technology; (iii) Adaptation of imported technology; (iv) Improvement of imported technology; (v) Development of related technology; and (vi) Development of completely new technology. This sequence is by no means fixed by any natural law, and in LDCs the top challenge is how to break this linearity and accelerate technological development.

In order to achieve technological self-reliance, priority should be placed upon the attainment of autonomous decision-making capability in management of technology at all levels, particularly concerning :

- Formulation, adoption and evaluation of technology policies.
- The identification of critical technological needs for sustained competitiveness, implementation and evaluation of technological strategies and progress.
- The search/assessment, selection, negotiation, adaptation, adaptation, absorption and improvement of imported technology.
- Ability to master all phases of the technology component development chain in areas selected for taking advantage of unique national endowments and specialization opportunities.

## **8. Needs of LDCs in technology development and transfer**

With the new emphasis on private sector development and growth, considerable attention will have to be placed upon encouraging the private sector to take the main lead in technological development, in the articulation of policy, and in the adaptation of imported technology to suit local needs. However, to the extent that this emphasis includes a more open and encouraging attitude to direct foreign investment, it may result in a neglect of the needs of SMIs. Certainly large projects are not undesirable, but SMIs have several important characteristics that make them particularly suitable for consideration in the context of LDCs. The advantages of SMIs include employment generation (with low capital investment per job),

import substitution, encouragement of women's entrepreneurship, development of rural areas and arresting rural-urban migration.

Furthermore, recent developments in the international arena, the rapid technological advances and emerging new technologies, the trend towards new modalities of technology transfer, foreign investment and strategic partnerships, the emergence of liberalization regimes and changing approaches to intellectual property, signify a dramatic change in the international technology market. These developments present additional challenges. In particular, developing countries lack awareness of the opportunities and alternatives particularly with respect to accessing new technologies. There is also a want of infrastructure, human resources and information on the availability of technology and skills that facilitate successful technology transfer. There needs to be better coherence between industry and domestic R&D institutions to make better use of domestic capabilities.

The recommendations of African-TIES meetings, ECA Expert Group Meeting on technology transfer, negotiations and acquisition, the Eleventh Conference of African Ministers of Industry, World Bank Country Case Studies and other forums, are all synthesized and grouped below in terms of policy, institutional and entrepreneurial levels.

#### Policy level

- There is need to organize a national dialogue involving economic agents and social organizations in order to create social awareness of the necessity for technology policies.

- Developing countries are urged to design, elaborate and implement technology policies in order to maximize, rationalize and facilitate the transfer and acquisition of appropriate technology.

- A national technology policy should urgently promote the development and application of domestic technical research capabilities for meeting basic needs; the development of technical training at all levels of education systems to respond to the needs of technological development based on local demand; the selective development and production of the industrial equipment and of machine and tools which foster the generation and diffusion of technologies within various priority sectors; and the building-up of the national capacity to effectively handle the technology transfer process in so far as it concerns the selection, evaluation, adaptation and negotiation of imported technologies.

- There is need to review the economic policies of member states in order to make them compatible with the imperatives of technology policy, particularly as regards budget and fiscal policy, monetary and exchange policies and foreign trade and investment policies.

- To enhance sound technology transfer, Governments are urged to provide appropriate incentives in the form of exemption from double taxation through agreements between countries, setting up of capital venture funds, streamlining up of entry facilities for consultants and facilitating the accelerated transfer of funds for payments of royalties, patents, commission etc.

- There is need to have a clear technology transfer and development policy that will facilitate the access to and mastery of technologies; create an enabling environment conducive to technology absorption and innovation; and promote a more efficient process of selecting, acquiring, negotiating and assimilating transferred technologies. Such a policy should be integrated with investment policies taking into account the changes brought about by the globalization of the world economy.

#### Institutional level

- Institutional responses continue to be required such as in the form of capacity-building or advisory assistance in contract negotiation and implementation as well as in access to information. Special attention should also be given to the needs of SMIs in developing countries in the area of technology choice, selection, evaluation and negotiation in view of their structural weaknesses and resource constraints.

- There is the need for institutions in developing countries to continue the exchange of information not only at both the regional and national levels. For this purpose, the importance of networking at the national level was underscored as an avenue for building awareness on the information available as well as the sources of information existing within a given country.

- Governments are urged to set up a Technology Transfer Centre with adequate funds and human resources, institutionalize policy measures to ensure that the programmes and activities of local R&D are derived from and contribute to the industrialization strategy, and exempt from local customs duties and subject to accelerated fiscal depreciation machineries and equipment required for R & D.

#### Entrepreneurial level

- Since the private sector is called to play a major role in technology transfer, Governments should stimulate private initiatives through regular concertation with stakeholders so as to get them involved in and committed to decision-making and implementation process.

- Systematic links should be established between the private or entrepreneurial sector, as the ultimate users of technologies.



### **III. FOCUS OF UNIDO'S TECHNOLOGY PROGRAMMES FOR LDCs**

#### **1. Overcoming the obstacles: UNIDO's approach for sustained competitiveness**

Following the experience of the newly industrialized countries of Asia and Latin America, many LDCs have come to realize that private sector development is the key to successful industrialization and overall economic growth. They are therefore taking appropriate measures to reorient and adjust their industrial policies and strategies to take account of this new imperative. Ideally, the articulation of private sector development policies in the field of industry will have three main components: (a) selective state intervention; (b) a supporting environment; and (c) a system of industrial services.

A supportive environment means more than a desirable stability in macroeconomic variables, such as "incentive" interest rates (both for savers and investors), low inflation rate, a realistic and stable exchange rate etc. A number of other elements will also be required for industry to grow, such as access to technological and market information, news about potential new products and sources of raw materials (Technology Sourcing).

UNIDO's technology programmes for developing countries follow an integration of Industrial Development Policy and Technology Policy, and focus on capacity building at national, institutional, sub-sectoral and enterprise levels, seizing on the Organization's accumulated experience.

At the **national level**, assistance is provided: to governments in the formulation, implementation and evaluation of S & T policies and strategies; in training of officials, entrepreneurs, practitioners and training of trainers in technology transfer issues through workshops and seminars on technology acquisition and negotiation, on the basis of the UNIDO Manual on Technology Transfer Negotiations; in organizing training programmes for officials of national institutions in investment promotion (including attachment to UNIDO's Investment Promotion Services around the world), and in the preparation of industrial feasibility studies on the basis of the UNIDO Manual and the COMFAR software; in the establishment/ strengthening of technology information systems; etc.

At the **institutional level**, UNIDO provides assistance in the assessment, strengthening and creation of Innovation System Agents (R&D centres, Standardization, Quality Control and Metrology centres, engineering design and management consulting services, Genetic Engineering and Biotechnology centres, Technology management centres, Financial agents, Industrial Chambers/ Associations in Technology Innovation Policies etc.). Apart from providing technical advice on specific areas such as Monitors on generic technologies, INTIB etc., UNIDO has assisted in the creation of International Centres such as the International Centre for Genetic Engineering and Biotechnology (ICGEB) and the International Centre for Science and High Technology (ICS). Promotional work is ongoing for the establishment of an Arab Centre for multidisciplinary materials research, an International Centre for Materials Evaluation Technology (ICMET) in the Republic of Korea, an International Centre for Hydrogen Energy Technology in Turkey, and an International Centre for the Advancement of Manufacturing Technology in India. Networks have also been established by UNIDO on bio-safety (BINAS), lactic acid and food fermentation technology (LABNET) and bio-

conversion and mushroom technology (MUSHNET). LDCs may benefit from the above institutions through expert advice, training and information exchange.

At the **sub-sectoral level**, UNIDO provides industrial consortia for developing or acquiring pre-competitive technologies for satisfying common needs among competing enterprises. In view of free trade agreements and the globalization process, those consortia tend to be of an international nature.

At the **enterprise and plant level**, UNIDO's assistance includes the development of technology management capability, including Total Quality Management (TQM) and ISO 9000, Reengineering of critical processes, the creation of new technology-based enterprises (incubators), facilitating strategic business alliances between LDC firms and those in developed and newly industrial countries; rehabilitating industrial enterprises, especially prior to their privatization; study of market prospects; conducting feasibility studies for new industrial projects; short-term advisory services in the acquisition of specific foreign technology, technology auditing and diagnosis of a company's technological-competitive position; the design, implementation and assessment of technological strategies and portfolio of technological innovation projects, and other technological functions, such as technology monitoring and forecasting, R&D management, technology transfer and others.

## **2. Programmes at regional and sub-regional levels**

### **2.1. Collaboration with regional technology institutions (ARCT, APCTT, ARSO, ARCEDEM, OAPI, ANSTI, ANB etc.).**

UNIDO is collaborating with regional technology institutions in developing countries (such as the African Regional Centre for Technology (ARCT), the Asia and Pacific Centre for Technology Transfer (APCTT), the African Regional Standards Organization (ARSO), the African Regional Centre for Engineering Design and Manufacturing (ARCEDEM), Organisation Africaine pour la Propriété Industrielle (OAPI), African Network of Science and Technological Institutions (ANSTI), African Network of Biosciences (ANB) etc.) in the design and implementation of subregional programmes for technological capacity building in developing countries. In some cases, UNIDO has strengthened the capacity of some of these institutions (e.g. ARCT and ARCEDEM) in areas where they are weak, and has been using their experts as consultants.

**2.2.** Through the IDDA Programme, UNIDO is following a regional or sub-regional approach to the provision of its industrial advisory services in project monitoring and coordination, in the African TIES Programme, in the Leather and Leather Products Development Programme etc.

**2.3.** Other developing countries in Africa and Latin America have shown an increasing interest the experience/development model of the newly industrialized countries of the Asia. In addition to the technology information exchange already taking place, through

INTIB and TIES, UNIDO is developing programmes for sharing that experience with developing countries in other regions through the ECDC/TCDC framework.

### **3. Programmes at national level**

#### **3.1. Assessment of Country Needs and Technological Innovation Policy**

UNIDO provides assistance to LDCs and other developing countries in the design and formulation of comprehensive S&T policies. However, the basic step before designing a S&T policy is the collection and analysis of data and information on the present economic and technological conditions in the country to determine needs and areas of technology relevance to the national socio-economic plans. This exercise, constituting the preparatory phase, usually includes an inventory of available capabilities and locally-developed technologies in the country in order to identify needs and also avoid duplication in the provision of support services. Next comes the formulation phase, which involves the nationally-led process of identification and prioritization of areas for policy intervention, the S&T programmes and the design of appropriate policy instruments. During the implementation phase, policies are implemented, monitored and appropriately modified as needed. It is particularly important to involve all stakeholders in these phases. Industrial Associations and Chambers are increasingly playing the leading role in sensitizing governments for the need of defining those policies.

As indicated earlier, the creation of favourable environment is crucial for the growth and development of the private sector in all developing countries. The main element of an enabling environment consists essentially of the institutional, legal, financial and fiscal framework established for the development and application of technology to the solution of socio-economic problems, together with the policies and measures for policy implementation. The ideal framework consists of:

- a) The establishment and/or strengthening of promotion agents for efficient planning, coordination, management and promotion of R&D and S&T activities.
- b) The establishment and/or strengthening of policy instruments and measures for each of the components of technology:
  - Allocation of material and financial resources to promote S&T activities.
  - Guidelines for technology acquisition, negotiation and choice of foreign technology, products and services.
  - Human resource development, upgrading and utilisation of indigenous skills and matching supply to demand.
  - Development of S&T infrastructure and support services, including engineering design and consultancy services, total quality management, S&T information system, popularization of S&T, etc.

- Linkages between S&T development institutions and various sectors of the economy, including commercialization and diffusion of indigenous technologies.
- International cooperation, including efficient sourcing of foreign technology and effective use of foreign aid and technical assistance.

### **3.2. Technology transfer programmes**

For most developing countries, industry is upgraded technologically largely by acquisition and transfer of imported technology, and this is especially true in the LDCs. Identification of needs, search, assessment, selection, negotiation, extensive knowledge and application of skills during the negotiation process are therefore vital if such acquisitions are to be achieved on equitable terms.

UNIDO provides a package of interrelated programmes, activities and tools aimed at:

- assisting developing countries in gaining access to technology and promoting technology transactions, e.g. through techMarts;
- assisting in building capacities (at the institutional, the enterprise and the human resource development levels) conducive to increased and more effective technology flows; and
- supporting technology transfer operations (and investment operations) through advisory services, training programmes, technical documentation, guidelines and other specialized tools such as Experts Systems.

Among the above-mentioned programmes, activities and tools, reference can be made to the following:

#### **(i) TechMart:**

A business forum where SMIs can find, offer, negotiate and eventually acquire and sell the type of technology which is suitable for their industrial operations. TechMart provides project promoters and entrepreneurs with a unique setting for the conclusion of technology and joint venture agreements.

#### **(ii) Capacity Building and Training on Technology Transfer Operations:**

A programme which creates and strengthens the capacity and competence at the institutional, the enterprise and the professional levels to deal more effectively with technology transfer operations. It involves systematic training to create awareness of acquisition issues including recent developments affecting access to technologies by developing countries, and to enhance negotiation skills on the basis of the UNIDO Manual on Technology Transfer Negotiation. The programme also covers the training of trainers so

as to create sustainable indigenous capacity to conduct national training programmes on technology acquisition and negotiation on a self-sufficient basis.

**(iii) Expert System on Contract Drafting and Negotiation:**

UNIDO is now developing the Expert System, which will come as a package of the knowledge system, a software, advisory and training service, and will have a data bank of clauses and contractual structures relating to different types of agreements and different sectors, as well as information on the legal requirements of specific countries. It is intended to facilitate negotiations, reduce the time and cost of contract drafting and improve the quality of contracts for developing country recipients.

**(iv) Build-Operate-Transfer (BOT) Programme:**

The BOT scheme provides an alternative means for developing countries to have access to private sector finance, technology and know-how for building public infrastructure. It is also a mechanism to strengthen their capacities in such areas as engineering, consultancy, equipment manufacturing, management. The UNIDO programme includes awareness building and capacity building as well as technical assistance and advisory services for the implementation of BOT projects. The BOT concept has enormous potential application in LDCs. Nevertheless, all the required conditions ( e.g legal framework, supporting institutions etc.) have yet to be developed.

**(v) Technology and Investment Enhancement Strategy (TIES):**

A programme which promotes cooperation, dialogue and policy discussions at regional and international levels among technology and investment institutions as well as user groups of developing countries on issues pertaining to and influencing technology and investment flows. While providing a forum for countries to exchange and share information on technology and investment-related trends and developments, TIES serves as an avenue for mutual learning as it draws upon the diversity of experiences, perspectives, visions and needs perceptions of the various participants in the network; and a platform for deliberating on the implications and deriving appropriate strategies in response to the constantly changing international technology and investment scenario. The African-TIES network, which has now 15 national focal points, is very active and it meets regularly every two years, under the aegis of UNIDO and ARCT, to exchange information and experience on technology transfer issues.

**(vi) Technology Monitoring**

UNIDO keeps several advanced technologies under review but directs special attention to five generic technologies which are having an increasing impact on the nature of industrialization and the competitive situation of developing countries. These are genetic engineering and biotechnology; microelectronics, informatics and telecommunications; new materials; new energy technologies; and marine industrial technologies. UNIDO monitors and evaluates trends and advances in the above fields in relation to the needs and opportunities of developing countries. UNIDO has been providing assistance in the establishment of

national and regional capabilities for the monitoring and evaluation of new technologies and for promoting cooperation among developing countries and preparing policy recommendations.

#### **(vii) Technology Management**

UNIDO's approach has been to integrate technology management issues in its awareness building and technical advisory service activities. The training component on the other hand draws on the experience with other UNIDO training programmes in technology transfer, acquisition and negotiation, financing, technical information, R&D management, investment planning and sectoral industrial development.

### **3.3. Development of an effective Technology Information System**

The provision of adequate industrial information constitutes an essential support function for the development of competitive capability in SMEs in all developing countries. UNIDO is undertaking a major programme for development of national information systems and information centres in developing countries.

The UNIDO Programme consists of the following activities:

(i) Developing and enhancing computer computer-linked INTIB regional networks as well as a number of subregional, national and sectoral networks, so as to ensure developing countries the widest possible access to industrial information.

(ii) Expanding the International Referral Information System on sources of technology and investment information to provide an efficient decentralized advisory and inquiry service to SMEs.

(iii) Providing advice and assistance to developing countries in formulating policies, programmes and projects related to industrial information, including training in and upgrading of information handling and resource management capabilities for information services.

(iv) Issuing and disseminating Technology Monitors on technological advances as well as INTIB data-base products and publications in printed and/or electronic form; and

(v) Upgrading the skills of INTIB network members in applying modern information technology and providing services to SMEs.

UNIDO has thus assisted the governments of 27 developing countries, including 8 LDCs (Burkina Faso, Botswana, Burundi, Mali, Sudan, Sierra Leone, Tanzania and Zambia) and their agencies not only to obtain information of crucial relevance in the construction of a domestic technological information infrastructure but equally important, in the design of domestic diffusion systems so as to ensure that relevant information is obtained by decision-

makers in firms, service institutions and enterprises that comprise the industrial production system. 170 specialized world-wide information organizations have agreed to provide technology and investment information in response to enquiries from developing countries.

At present, INTIB's national focal points exist in 80 countries, including in 11 LDCs and UNIDO is encouraging their establishment in other LDCs.

### **3.4. Investment Promotion Programmes**

The UNIDO investment promotion programmes in LDCs comprise of the following activities:

(i) Assistance in the formulation of national industrial investment policies and programmes, the identification of investment opportunities and the preparation of pre-investment and feasibility studies.

(ii) Assistance in the identification of domestic (private or institutional) sponsors and potential (domestic and foreign) partners providing finance, technology and management for investment projects, and to strengthen local investment project development and promotion facilities and capabilities.

(iii) Assistance in increasing the flow of resources to productive investment projects by identifying, appraising, promoting and supporting industrial investment and rehabilitation opportunities, and by promoting enterprise-to-enterprise cooperation involving direct foreign investment and technical cooperation agreements.

(iv) Organizing promotional events, such as investment forums and INVESMARTS, to allow local sponsors to discuss individual investment opportunities with overseas investors.

(v) Analyzing a country's investment climate (including its Investment Code) to determine its attractiveness for national and foreign investors.

(vi) Establishing contacts between national investment promotion agencies in LDCs and the various UNIDO Investment Promotion Services (IPS) for the promotion of specific projects, for arranging country presentation tours (e.g. to launch an Export Processing Zone Scheme or a new Investment Incentive Scheme) and for the attachment of national investment promotion officers on training at IPS offices.

### **3.5. Policy linkages: The Investment and Technology Partnership Initiative.**

UNIDO has responded to market liberalization and privatization by bringing closer those activities which are directly related both to industrial investment and to technology transfer and promotion. Furthermore, it has launched the Investment and Technology Partnership Initiative to assist developing countries in their efforts to secure and widen investment and technology inflows. These inflows are reckoned not only in terms of

individual contracts between two business firms, one domestic and the other foreign. A secure return for all the partners involved can be assured only if a national capability to access such inflows and to utilize them effectively has been created. An integral part of such a capability is the establishment of a conducive investment climate, the generation of matching national investments and the creation of an adequate infrastructure for the utilization of technology in industry. Thus, through its Partnership Initiative, UNIDO can be instrumental in linking investment promotion with technology upgrading and the enhancement of domestic technological capabilities, through promoting integrated investment and technology policies.

#### **4. Programmes at enterprise, cluster and plant levels**

##### **4.1. Development of technology management capability in existing firms**

###### **4.1.1. Elements of the programme of direct assistance to SME clusters.**

The programme of assistance comprise an awareness material package of tools and methods for immediate application of sound technology management in enterprises, the strengthening of small and medium Consulting and Engineering firms and the creation of Technology Management Centres. The set of tools is designed to improve the business of the enterprise in terms of sustainable competitiveness.

###### **4.1.2. Problem of creating a new mentality amongst entrepreneurs.**

UNIDO is trying to bring a change in the attitude of small and medium entrepreneurs in developing countries through awareness and sensitization seminars and training workshops in technology management. UNIDO is also developing a methodology for self-diagnosis of critical technological needs for enhancing competitiveness in SMIEs.

###### **4.1.3. The linkage between technological innovations and turnaround techniques, including Total Quality Management (TQM) and Reengineering.**

It is important to highlight that the introduction of technological innovation, including technology transfer, R&D, and blends of both, to the firm and cluster of firms within a production and commercialization chain can be greatly facilitated by making an explicit linkage between fashionable restructuring and turnaround techniques such as TQM and reengineering and technological innovation processes. This may be achieved by underlining R&D and technology transfer processes as sources of knowledge for continuous improvement projects (in the case of TQM) and for the redesign of critical organizational processes, including the introduction of information technologies. By the same token, as both techniques require an overall appraisal of the firms' mission, vision for future development and strategies, these processes represent an ideal opportunity for bringing in the interplay between technological strategies and the general competitive strategy of the firm, emphasizing the role of technology in shaping and achieving the firms' overall objectives for profitability, growth and competitiveness.

###### **4.1.4. The establishment of technological innovation strategies and project portfolio.**



The UNIDO programme for the establishment of technological innovation strategies within SMIEs in developing countries is based on the results of, and lessons learned from, the UNIDO/UNDP successful Technology Management Programme in Central America, which was completed in 1993.

The UNIDO approach consists of the following:

1) Carrying-out an awareness and sensitization seminar of a half-day with prospective SME's directors and senior personnel, in which basic technology concepts are discussed and technology's role in solving existing barriers for the achievement of current objectives and goals, in benefiting the firm's position with respect to critical competitive factors and in other aspects of organizational life are made explicit.

2) Carrying-out a national survey to identify prospective participants, in key subsectors of the economy, and to select the SMEs which will participate in the programme, based on the following criteria:

- Existence of (or concern about) a competitive strategy.
- Technological changes planned (product, services, process, equipment, distribution and commercialization, etc.).
- Inventory of inventions and innovations carried-out.
- Engagement in quality control systems, total quality management, supplier development programmes, reengineering and management techniques for modernization.
- Existence of strategic planning activities or technology planning activities.
- Organizational structure, systems and climate conducive to change and flexibility.
- Professional capacity of employees.
- Profile of top management.
- Commitment to change existing programmes.
- Readiness to establish a full time technology management nuclei (TMN).

3) Cooperation agreements signed, for a period of one year, between each participating SME and the project management (usually a counterpart institution such as Association of Manufacturers, Federation of Employers, Chamber of Commerce and Industry). The cooperation agreement would provide, inter alia, for the setting up of a nucleus (TMN) to effectively introduce technology management concepts and methodologies within the company; identify the critical technological needs for the company's sustained competitiveness and profitability; generate a corresponding portfolio of technology innovation projects; help

find outside financing and effectively implement and manage the projects; and to open the way to strategic alliances with other organizations and enterprises and to provide the missing linkage between the enterprise and research institutions in the country.

4) The organization of a training workshop of three days, for the professional staff of the TMN and production managers of the participating enterprises, in modern technology management techniques and instruments with a view to enhancing competitiveness in both domestic and international markets.

5) Provision of specialized short-term advisory services for the introduction of technology management practices at plant level to needy enterprises.

6) Organization of a follow-up seminar of 3 days, after one year, to review and assess the results of the technology innovation projects achieved by the participating enterprises, and propose additional recommendations.

7) A prize (award certificate and a trophy) is awarded jointly by UNIDO and the counterpart institution to the most innovative enterprise, at the end of the follow-up seminar, and publicity is given to that enterprise in the national media as well as in UNIDO Newsletter.

#### **4.2. The creation of new enterprises: Technology-based industrial incubators.**

Technology-based enterprises can play a strategic role in the modernization of a country and the generation of wealth and jobs. These enterprises normally have a strong impact on industry through forward and backward linkages. In the process of creating this type of enterprise, the availability of a special innovation environment has proven to be essential in order to speed the start-up phase, to direct technological knowledge towards market demand and characteristics and to introduce technology management practices. This special environment is called an incubator for technology-based enterprises.

Incubators are a means by which an innovation-oriented environment and a shared infrastructure offer the basic conditions for the development of new enterprises. Common services are normally available for the creation and start-up of enterprises, such as workshops and research laboratory facilities, administrative and secretarial support, maintenance, marketing, quality control, training and legal assistance.

#### **4.3. Strategic Business Alliances (SBAs) as an alternative to direct foreign investment.**

It is sometimes considered that the concept of strategic business alliances may not be applicable to lesser developed countries. However, to properly seize the opportunity of globalization and minimize risks, foreign investors normally prefer to commence potential investment activities in a given country through commercial associations with local companies. The results of those business alliances will determine the scope and depth of the cooperation, which can gradually be enlarged, over time, to subcontract manufacturing activities, transfer of technologies, cross-commercialize product lines, carry out joint product

innovation etc., thus gradually involving significant foreign investment. The upgrading of the "quality" of local partners in developing countries for achieving stable alliances, should therefore be a major concern for both developing countries interested in promoting foreign investment, and to developed countries interested in fostering sustainable trade beyond shortsighted short-term interests.

Business alliances of all kinds are, therefore, possible in some LDCs under the following arrangements:

In the initial stage, a developing country firm imports a certain product from a manufacturer in a developed country. After a few years, when the exporter is satisfied with the seriousness of the importer, they may both agree on the terms and conditions for local assembly of the product. The foreign firm usually provides the necessary components and the training of the local workers.

When that stage of collaboration has proved of mutual benefits to the two parties, they may then agree for the local fabrication of the product under joint-venture or partnership. The foreign firm will then provide the necessary equipment, the technicians to instal it and to train local operators, as well as the training of the factory managers either locally or in its own factory.

Strategic business alliances on the above lines, together with the upgrading of the capabilities of the developing country's partners in technology management, appear to be a good alternative to direct foreign investment, especially in LDCs where the investment climate is not very attractive. UNIDC can promote SBAs as a mechanism for technology transfer first by facilitating contacts between entrepreneurs in the LDCs and those in developed and other developing countries. Then through information, capacity-building training programmes and technical assistance, to upgrade the "quality" of local partners so that they become "good" partners, the SBAs become stabilized and the LDCs can derive much benefit from them.

#### IV. CONCLUSIONS

Sustainable industrial development is unlikely to take place without technology, and developing countries, especially LDCs, are increasingly becoming conscious that technology is a critical asset for production, competitiveness and long-term growth. The linkage between technology policy and industrial policy, as well as the attitude of firms and governments towards innovation, technology transfer and diffusion are determinant factors for successful technological development. The achievement of successful industrialization over a long period of time calls for an ability to adapt to constant change. Furthermore, the LDCs which by definition have limited industrial or technological competence, have to pay due regard to technological trends and developments. Domestic technologies, rooted in traditional customs, skills and materials, can often be beneficially upgraded by what modern technology techniques have to offer.

In the context of the global and increasingly interdependent economy, the competitiveness and comparative advantage of a developing country depends very much on its technological capability. The identification of critical technological needs, questions of

access to technology, technology selection, evaluation, negotiation, as well as the whole range of problems associated with the technology transfer cycle are of major importance. The effectiveness by which technology could fulfill its role as a determining element in a country's industrialization is however influenced by a variety of factors: among these are the capacity of recipients to receive, utilize, absorb and adapt imported technologies; the behaviour of technology suppliers and their capacity and willingness to impart technology efficiently; the supporting technological infrastructure including the availability of skilled manpower and local consultants; and above all the policy environment as dictated by the government.

Most developing countries have now liberal regimes for investment and technology transfer, which are seen as a key to industrialization and to their integration in the international economy. It has become clear that liberalization is a necessary but not sufficient condition for industrial growth. Investment and technology flows from outside a country have to be matched by domestic investments and the strengthening of technological capabilities. Hence, the local investment and technological potential have to be mobilized on a complementary basis. In addition, we must distinguish between the factors affecting the competitiveness of a country and those of an enterprise. In both cases, the need for an enabling environment for the flow of technology and investment is obvious. However, this would require not only liberal policies and speedy administrative procedures but also the building up of the technological production infrastructure.

Technology is a crucial determinant of industrial enterprises' creation, growth, competitiveness, profitability and attractiveness for investment and partnership. However, technology is a very dynamic variable, constantly changing through the incorporation of new knowledge and skills, and not a static package that will solve problems forever. It is therefore important for governments of LDCs to create the necessary enabling environment for the sustained growth of private small and medium industrial enterprises, to be prepared to reorient technology policies and strategies in the light of changes in the global environment, including trends and opportunities in new emerging technologies. On the other hand, small and medium entrepreneurs in the LDCs should adopt technology management practices to enhance their competitiveness and forge business alliances with other firms in developed and newly industrialized countries in the traditional sub-sectors as well as in new emerging technologies.

Modern technology presents enormous challenges. One of the main challenges is how to spread technology's benefits to the people of developing countries. The developing nations of the world enjoy few of modern technology's benefits, but the people of these countries want the goods and services that technology has made available to industrialized countries. The transfer of technological knowledge from developed to developing nations is therefore one of today's greatest challenge.

UNIDO cannot do much, through its technical assistance programmes to LDCs, to enable them to create the necessary technological capacity to face all the problems associated with technology development. It is up to themselves to take all actions necessary for attaining that objective. UNIDO can only show them how other (small) developing countries which have no or limited natural resources, like Singapore and Mauritius, and which could have become potential LDCs, have succeeded in their industrialization process.

**Footnote:** The analysis in this paper refers extensively to developing countries and African countries throughout. This is normal because out of the 160 developing countries in the world, 48 are LDCs out of which 32 are in Africa. The findings in, and prescriptions for, Africa elaborated in this paper are therefore applicable to a great extent to the LDCs in general.

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