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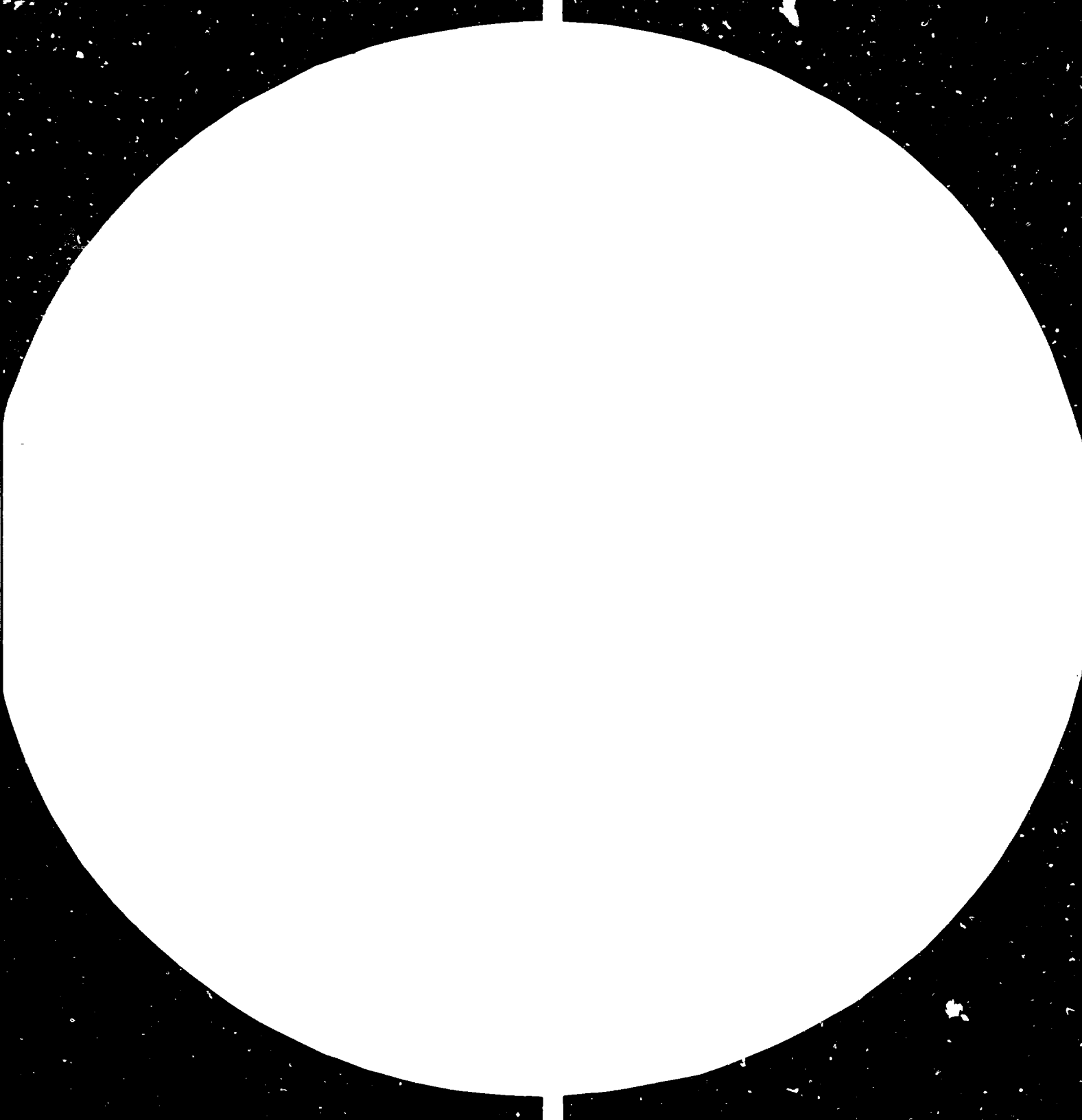
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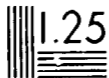
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

**HIGH-LEVEL
EXPERT GROUP MEETINGS
PREPARATORY TO THE
FOURTH
GENERAL CONFERENCE
OF UNIDO**

*Accelerated Development of Human Resources
for Industrial Development
Yaoundé, United Republic of Cameroon,
30 May - 3 June 1983*

**CRITICAL CAPABILITIES
REQUIRED FOR INDUSTRIAL DEVELOPMENT**

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I. INTRODUCTION

1. In document ID/WG.394/1 it was pointed out that the scope urgency and mechanics for accelerated development of human resources for industrialization would depend considerably on the particular choice of industrialization policy and strategy adopted by developing countries at particular times. An industrialization policy and strategy is effective only if it is fully integrated with other national socio-economic policies, particularly those relating to the transformation of domestic natural resources, trade, education, manpower, etc.. Self-sustaining and self-reliant industrialization, with minimum external factor inputs and reliance on internal demand stimuli, should be the ultimate goal.

2. It was also pointed out that the scope for accelerated development of human resources for industrialization exceeded the scope of manpower for specific industries and industrial enterprises, as conventionally defined. Moreover, the acceleration of the process of industrialization, implies a search for, testing of, and application of accelerators of technical and social processes. To this should be added methods of generation, mobilization, adaptation and optimisation of use of resources of all kinds. It should, in addition, be pointed out that strengths and weaknesses in the development of particular critical capabilities may vary from one country to the other. One of the regrettable aspects of the relative isolation of developing countries until recently is the lack of familiarity with how critical capabilities have been identified, evaluated and developed in other developing countries.

II. POLICY AND DECISION-MAKING AND PLANNING

3. At the early stage of industrial development in which most developing countries find themselves, the most urgent and critical capabilities needed would seem to be the ones directly related to autonomous policy making, planning and implementation. Decision is derived from choices and choices from alternatives. This demands awareness, forecasting and information intelligence which would involve access to information; ability to assess information for relevance and priorities, to arrive at alternatives and to choose. In many developing countries, this competence is yet to be built.

4. In many developing countries, neither political nor civil service senior staff in ministries responsible for industry, natural resources/industrial raw materials, technology or education, labour and manpower planning, are

likely to have had any direct experience of industry. Familiarity at the most will consist of theoretical study of industrial or business economics. In more fortunate circumstances such courses may have included participation of representatives of industry as well as the study of industrial cases. In newly industrializing countries, it is possible that political and civil service heads of ministries of industry have actually been recruited from the industrial sector. But this is unlikely of the bulk of developing countries that are just at the early stages of industrial development.

5. There are two additional factors to be considered. One is the extent to which policy-makers and planners have access to consultants and experts who have broad and direct familiarity with industrial processes, structures and dynamics, but this again may be unusual. The second is the frequency with which, in some countries, policy-makers and planners change their cabinet and civil service locations. For many developing countries, the dire need is for decision-makers to undertake industry familiarization study visits to newly industrializing countries to gain some insights into the kind of preparations required, internal and external problems encountered, etc. for accelerated industrialization. Developing countries have not made good use of ample experiences of Newly Industrializing Countries (N.I.Cs).

6. Further, case studies of the experiences of newly industrializing countries may be incorporated in university and polytechnical courses in economics and management. Developing countries may also obtain from newly industrializing countries, a small team under ECDC arrangements to conduct seminars and workshops for decision makers in several ministries and agencies, representatives of universities and polytechnics, chambers of commerce and other business organizations, heads of public enterprises and counterpart heads of joint enterprises, the press, etc. In general, the local seminar followed by the study visit to industrializing countries is likely to produce the best effects.

A. Planning Capabilities

7. An important category of capabilities for policy and decision-making relates to planning. The somewhat doubtful reliance on macro-economic data and techniques would have to be considerably supplemented by techniques based on e.g. inventories of existing industrial production capacities of

industrial raw materials and other factor inputs; the identification of existing industrial growth nodes; on institutional infrastructures; on the mechanics of planning and realising linkages; measures for monetizing the rural economy; demand studies derived from household budget and expenditure surveys; and so on.

8. Intensive courses on industrial and manpower planning would need to be conducted, making full use of the experiences of newly industrializing countries. For this purpose UNIDO could undertake studies of these experiences, not in theoretical economic terms, but in terms of aspects of the kind just described. These studies could then be distributed to universities and ministries of industry in developing countries with offer to assist in arranging co-operative programmes with other developing countries, especially the N.I.Cs, in the development of planning capabilities. Such a programme could, in effect, constitute a component of UNIDO's regular technical assistance programme in the field of industrial training.

B. Socio-economic and Technical Research and Information Capabilities

9. In view of the need to have accurate information and data to formulate sound policies and to plan and monitor human resources development programmes for industrialization, an important critical capability would seem to be that which is concerned with the socio-economic and technical research basis of national policy-making, planning and programming. This is frequently necessary because of the marked external orientation of earlier development policies and strategies, and the relatively inadequate information and data on the domestic economy: on population growth, age and sex structure and concentrations; on the country's endowments of natural resources/industrial raw materials; on alternative sources of economic supply of raw materials outside the country; on the geographical spread and extent of the use of money; on traditional technologies; on employment and unemployment; on the character and location of poverty; on the nature of local markets; on incentive systems that work and why; on the industrial sector and its links with other sectors; on indigenous entrepreneurship; on transnational corporations; on the services sector; and so on.

10. The research and consultancy role of local institutions concerned with one aspect or another of socio-economic research could beneficially be extended to cover factors which inhibit or facilitate the process of innovation in

respect of particular products or technologies; consequences of acceleration; changes in the status and functions of special groups (women and girls; the aged; drop-outs) and so on. In some developing countries close working relations exist between local institutes of social and economic research or of public administration or university departments conducting research on similar matters. In other countries relations are non-existent and policy-making and planning depend on the small amount of ad hoc research which governments can undertake themselves or that they commission. Where research and consultancy relationships exist and where they can be encouraged, it clearly is to the advantage of governments and international institutions to establish some working links with them, and to supply them with selected documents with a view to strengthening their roles and improving the quality of their contributions to policy-making and planning. Similarly, deficiencies in information and data bases can be given high priority in programmes for local information systems and in training courses for policy-makers and planners.

III. ENTREPRENEURIAL AND MANAGERIAL CAPABILITIES

A. Entrepreneurial Capabilities

11. Entrepreneurship represents the next group of critical capabilities. In document ID/WG.394/1 (Accelerated Development of Human Resources for Industrial Development: Some Issues for Consideration), the subject of the crucial role of indigenous entrepreneurship and entrepreneurial resources has been adequately discussed but some of the main points can be repeated with advantage here. ^{1/} The first point is that no industrial development plan, no process of industrialization, whether accelerated or not, can be implemented or sustained without a very large number of entrepreneurs. The second point is that the process of industrial take-off depends not merely on the establishment of large-scale basic industries (metals, heavy engineering, basic chemicals and petrochemicals, pulp, and so on) under the aegis of public or joint enterprises, but on the readiness of many thousands of entrepreneurs operating medium and small-scale enterprises. The characteristics, strengths and weakness,

^{1/} In this context, an entrepreneur is broadly defined as any person or group of persons or corporate body able to perceive opportunities or challenges to produce a good or a service and who respond by undertaking the organization of factor inputs and their application to such production. Thus all

sectoral and intra-sectoral distribution, susceptibility to particular kinds of incentives, etc., should therefore be the basis for the design of support services and institutions deliberately created to move the entrepreneurs into, and support them in action.

12. Until recently, governments of developing countries had tended to concentrate attention on inducing an inflow of a few hundred (at the most) foreign private entrepreneurs. When the role of indigenous entrepreneurship came to be recognized, attention tended to concentrate on their needs for financial resources (credit) rather than on ways that particular environments helped or hindered the entrepreneurial function. In the same documents referred to above, the role and problems of public enterprise were also considered and suggestions put forward for their improvement. ^{2/}

13. What needs to be firmly stated is that it is entrepreneurs in the private and public sectors (their quantity, orientation, abilities, sectoral distribution, etc.) that determine whether industrialization will at all take place and whether this can be at an accelerated or a slow pace. It is also entrepreneurs that create the demand for industrial manpower and industrial employment and help to develop the technical elements of local culture by undertaking the innovations of social and material inventions. Any effort, therefore, which is devoted to enlarging the supply of entrepreneurs, to improving the quality of their functioning, inducing their transfer from well established or over-crowded areas of production to new ones where their presence and activities are essential for organizing the production of new product lines, etc. must be a prime consideration of policy-makers and planners. Even a cursory look at many developing countries will show a good deal of concentration of local entrepreneurship in trade or agricultural production or, at best, very small-scale industries involving simple technologies, small amounts of capital investment, narrow or even neighbourhood markets, crude or recycled materials, minimum labour employment, and limited management inputs.

^{2/} Some reference is made to this point in the document on "Measures for more effective international co-operation for Accelerated Development of Human Resources for Industrial Development".

B. Managerial Capabilities

14. Another set of critical capabilities is in the management area - both in the private and the public sector. Execution and expertise, particularly in finance and marketing management, are very crucial in addition to the management of new materials and production processes. As indicated earlier, education of the engineer and administrator should also include development education to make him a practising engineer 'like a practicing doctor'. Here, without in any way understanding the powerful entrepreneurial/managerial role of general management at the top, attention is particularly directed to middle level management, supervisory staff and those providing specialist services at the middle level, e.g. procurement and inventory management, production management and control, including standardization and quality control; R and D (including industrial property), trade marks, etc.; market research and marketing; tool room service; raw materials and product testing; machine assembly and equipment maintenance; staff recruitment (including careers guidance) and development; advertising; project development. The importance of middle level management and specialist services cannot be over-estimated. It is here that the future of the company in terms of performance often rests and where innovations take place. A few illustrations should help. In developing countries the selection, inspection and testing of equipment before final acceptance is a matter of considerable importance, as seen by the fair number of pieces of equipment bought by developing countries on the advice of machine sellers and later found useless or requiring expensive adjustment for the purpose for which it was obtained. A recent report makes the following observations:

"Too often the hospital administration is dependent upon the literature or promotion offered by manufacturers or their agents. Technical guidance almost invariably leads to a more intelligent determination. This function is in fact one of the more important contributions that can be provided by a medical engineering service, whether in-house or external to the institutions. The medical engineer can and should evaluate the design quality of the instrumentation, its mode of operation and performance, and, above all, its probable maintenance demands."^{3/}

^{3/} UNIDO: Draft report of the Ad Hoc Group Meeting on Biomedical Equipment, Vienna, December 1979, document No. UNIDO/IOD.338

16. "The next consideration must be the suitability of equipment for the intended use, for the environment, and for the local situation. Thus equipment which automates many functions that can be done safely and in an acceptable time manually may not be advantageous in an economy where labour is plentiful and inexpensive. Similarly, an instrument designed for laboratory research may not be appropriate for clinical use and equipment designed for a temperate climate may break down when subjected to the high temperature and humidity of tropical regions." 4/

17. "The selection of equipment must be followed up by inspection on arrival. Failure to do so may invalidate any claim against the supplier and will invariably increase the maintenance and repair burden. If this appears to be an unlikely occurrence, consider what happens when equipment is ordered at the time of construction of a new facility. It usually remains in a packing case until the facility is completed. Then it is discovered that the patient applicators are missing, there is no maintenance manual or parts list, rodents appear to have eaten the insulation off wires, and the shipment has been dropped in transit. If the warranty is located it probably will have expired. The work and expense of repair then commences before the equipment ever sees service. It is essential that inspection be linked to selection as the first step in an equipment maintenance repair programme." 5/

18. The central figure in the manufacturing process is the production engineer familiar with manufacturing technology, finance, materials, programming and control, etc. The questions which arise concern the provision of education in universities in developing countries for specialization in the areas described earlier, the extent to which the graduate is provided with industrial experience, the role of centres of excellence in enhancing the experience of nationals after formal education and training in the areas of specialization referred to earlier. These matters should be the subject of periodical surveys by UNIDO and UNESCO in order to persuade governments, institutions of higher education or research, and industrial entrepreneurs and managers to take action for improvements.

IV. ENGINEERING, TECHNOLOGICAL AND SCIENTIFIC CAPABILITIES

19. A very important category of personnel required for industrialization consists of engineers, technologists and scientists. While most developing countries would import, at the initial stages of their industrial development and manufacturing activities, technical know-how from abroad, it is imperative, for self-sustaining and self-reliant industrialization, to develop the wide

4/ Ibid, page 15

5/ Ibid, page 15

range of engineering, technological and scientific competence required in the total spectrum of the industrialization process. With the rapidly changing technological environment and the impact of new technological advances in economic and industrial development, an additional challenge to the developing countries would be to develop the scientific and technological competence to perceive and be innovative in adapting such technological changes to the benefit of each developing country. The development of engineers, technologists and scientists covers a very broad terrain since it encompasses people working in government ministries and institutions, public and private industrial enterprises, educational institutions (especially universities and specialized institutions), R and D, consultancy, standardization and other institutions providing technical and extension services to industry.

20. The availability of trained engineers, scientists, designers, high-level technicians and persons with specialized skills is an important infrastructural base for the adaptation and absorption of technology. Designing of industrial products, tools, fixtures and production aids, pre-planning, methods engineering, production technology, quality control, materials management and value engineering, are some of the essential facets of industrial engineering needed in any manufacturing industry. In the engineering and heavy machinery manufacturing industry, the technical competence needed is of a particularly high level and of diverse types. Systems analysis, operations research, design and development/socio-economic cost benefit analysis, prerequisite of feasibility studies, project reports, etc. are other areas for competence building. It takes a long time and considerable resources to develop these cadres for industry and business. Hence, careful and advanced planning is called for.

A. Civil Engineering Capabilities

21. In connexion with engineering capabilities, an area which is often overlooked by developing countries, often with disastrous consequences, relates to the role of civil engineering in accelerated industrialization. The importance of civil engineering arises partly from the fact that most developing countries have only greenfield sites for substantial industrial projects and the burden of designing and constructing power plants and power supply systems, transport networks, water supply inflow and storage,

effluents, staff housing and in some cases whole townships, falls upon the civil engineer. In effect, therefore, acceleration of the pace of industrialization can reasonably be expected to increase considerable pressures on national civil engineering capabilities.

22. But the role of civil engineering goes beyond the above. It includes site planning and development, design and construction of factory, office and other buildings such as storage facilities and recreation centres, construction and assembly of plants, and so on. Although these fall somewhat between the manufacturing of plants and equipment, on the one hand, and the manufacturing operations of industrial installations on the other, they indubitably constitute a critical and substantial part of the process of accelerated industrial development and any neglect of manpower and corporate instruments to undertake such construction will seriously affect the process.

23. It is obvious that civil engineering expertise of this order is not easily gained in the university, whose main contributions will have been in the thoroughness and imagination with which knowledge of design, structures and materials had been taught to students. It is important here to recognize that these three subjects are profoundly affected by the local physical and social environment in which civil engineers have to work and that the reference to thoroughness includes relevance to this environment. Thus, questions arise as to what formal arrangements exist for civil engineering students, whether undergraduate or postgraduate, to work on major national or multinational civil engineering projects with experts from (usually transnational) foreign corporations to whom contracts for such projects are usually awarded.

B. Raw Materials Development Capabilities

24. Another area of critical capabilities just outside, but fundamental to accelerated industrialization, is that concerned with the exploration, evaluation, transportation and trade in industrial raw materials. On many occasions extensive discussions and resolutions are made regarding industrialization with little regard for the following considerations:

- that the range of industrial production depends, in the first place, on the variety of local industrial raw materials, and the degree of complementarity among them, available for conversion into industrial products;

- that the economies of developing countries have depended for many decades on the production of only one or two dominant primary products/industrial raw materials;
- that, consequently, many developing countries have done little to build up capabilities - at national or multi-national levels - for the exploration, evaluation, extraction, transportation and marketing/procurement of industrial raw materials;
- that no process of accelerated industrialization can take place in developing countries, as a whole, which is not backed, firstly, by the expansion of their intra-trade in industrial raw materials which, secondly, depends on the rapid development of national and multi-national capabilities for exploration, evaluation and extraction of these industrial raw materials and on the development of the physical and institutional infrastructures to facilitate such trade.

25. Resource generation and mobilization are the first steps for their effective utilization. Resources are both natural and human resources. No systematic resource surveys have been made in developing countries, thus making the planning exercises more questionable and more a reflection of aspirations and ambitions, than plans that could be implemented.

26. Human resources survey should include traditional skills and natural genius. Modern tools like Remote-sensing could be used for survey of natural resources above and below ground followed by inch to inch field surveys. In such an exercise, the students and teachers of Zoology, Botany, Geology, could be profitably involved. Another important area is ocean resources survey.

27. It would therefore appear that the first steps in the industrialization process should include regional surveys of existing facilities for education and training in the industrial raw materials field followed by regional or sub-regional consultations on programmes for developing such facilities. Once again, links with the business sector - whether public or private - and its contributions to the development of education and training facilities should be well examined.

28. Governments of developing countries sometimes tend to believe that a majority share in foreign companies (e.g. the mining and petroleum industries) provides them with effective instruments of national policy for exploration, evaluation and exploitation of national industrial raw materials. Frequently this ownership is exercised through a state holding company. It is not unfair to say that such arrangements are mere extensions of the Treasury and the Ministry of Finance. The development of the industrial raw materials sector calls not only for considerable expansion and

improvement of government departments responsible for them but also for national corporate instruments to implement its policy and strategy.

29. UNIDO, in concert with other appropriate agencies, could assist the developing countries in this crucial field. Such assistance could include the preparation of case studies on government ministries and departments responsible for industrial raw materials with emphasis on their organization, staffing and functions. Similar studies - which would, in addition, cover entrepreneurial and managerial authority - should be conducted on well-established and widely-recognized public enterprises in the raw materials field in developing countries, particularly in the Newly Industrializing Countries.^{7/} UNIDO could also assist in negotiating, where requested, technical assistance from these public enterprises for governments or similar enterprises in other developing countries.

C. Consultancy Capabilities

30. The next group of critical capabilities consists of individuals or groups providing consultancy services. Indigenous business consultancy groups, Development Banks and Small Industry Service Institutes, can play a very important role in guiding the development and expansion of middle and small-scale enterprises which can rarely afford not only the size but the foreign exchange content of fees of foreign consultancy groups. In any case, so rapidly does the demand for such services grow that foreign consultancy services, even if available at reasonable prices, simply could not cope with demand. Where industrialization policy gives weight to subcontracting (by public utilities and public enterprises in the first place) as a means of organizing broad forward surges the importance of local support services, including consultancy services, is clear.

31. In the initial stages, these groups tend to be technically imbalanced in composition, reflecting the pattern of specialization. For example, emphasis in earlier times was on civil engineering, mechanical engineering,

^{7/} See for example, the list set out in Turner, Bradford, Franko. McMullen and Woolcook: Living with the Newly Industrializing Countries, Royal Institute of International Affairs, Chatham House, London, 1980, page 9. See also chapter VIII of UNCTAD: Energy Supplies for Developing Countries: issues in transfer and development of technology; document TD/B/C.6?31 of 17 October, 1978.

but not manufacturing technologies, industrial management, R and D, etc. This imbalance can be to some extent corrected if governments deliberately spell out policies and measures for attracting back nationals with broader skill ranges who have settled abroad. Among measures for the fairly rapid building up of industrial consultancy services, governments could deliberately encourage some of their nationals with qualifications and experience in manufacturing, production engineering, accountancy, procurement, market research and marketing, design development, preparation of bankable projects, pilot-plants, to form local consultancy groups. They can initially be associated with foreign consultancy groups in governments or public enterprise contracts. The importance of the development of indigenous consultancy services is two-fold. First, it can make immeasurable contributions to the process of accelerated industrialization, and second, it can slow down the rate of foreign exchange loss in the external services account.

D. Research and Development Capabilities

32. The last set of critical capabilities dealt with in this paper comprises those related to industrial research and development. There are at least four main challenges in the field of industrial R and D. The first is the adaptation and improvement of technologies acquired from developed, and in due course, from other developing countries, and also eventual transfer of technology from laboratory to the industry. This adaptation may take the form of the application of a given technology to materials or processes for which it was not originally intended. The second challenge, only recently taking shape (particularly in tropical agriculture and traditional medicine) is the emerging claim of traditional technology to recognition and development. How to upgrade traditional tools and technologies and how to weave in modern methods into traditional tapestry is the real challenge. The third challenge is the emergence of new technologies (e.g. ocean engineering, outer space, climatology and desertification, micro-electronics and biotechnology) and finally, the task of devising optimum mixes of the three classes of technology to fit particular contexts and times. It is suggested that in so far as mechanical technology is concerned, the basic areas of specialization for industrial research include the science and technology of materials; engineering design, new or improved power sources and systems, and tribology (the science and technology of lubrication), etc.

33. The natural question which arises from the above relates to the role these subject areas play in education and training in manufacturing technology in developing countries. Closely associated with specialized knowledge which is very often gained or enriched as a result of involvement in actual factory production is the extent to which the entrepreneurs in a public or private (indigenous or foreign) enterprise can and will provide funds and facilities for substantial industrial research and development, since the bulk of technological improvements are designed to solve their operational problems. The medium and small-scale industrial entrepreneur in general wants to deal only with well-established materials and processes not subject to experimental vagaries. The foreign private entrepreneur (often a subsidiary or affiliate of a transnational corporation) depends on centralized R and D policies and facilities of the parent foreign company, especially where the local production effort represents only a link or two in a vertically integrated chain, so that production follows pre-determined materials, formulae and tolerance specifications and routinized procedures.

34. In practice, therefore, R and D becomes a ward of public enterprise. Regrettably, however, public enterprise in many developing countries is as much committed to receiving technology in the same manner as the small-scale indigenous entrepreneur. Where governments have established industrial R and D institutions, there may exist no genuine working links between them and public enterprises or other government agencies. The preceding picture is of course, not true of all developing countries, and study visits to, and exchange of experts and experiences of more successful developing countries would prove fruitful. Such programmes and the expected changes in attitudes and evaluations of policy-makers and planners are likely to be far more effective in attracting highly qualified nationals settled abroad than some other popularly conceived incentives.

V. TECHNICIANS AND SKILLED LABOUR

35. Since the bulk of industrial operations, especially at the plant level, is carried out by technicians, vocational and trade-specific skilled personnel, this category of personnel also needs to be accorded priority in national manpower development programmes. In some countries it has been estimated that for every engineer/technologist/scientist there should be at least five technicians/skilled workers. If one takes the service sector into consideration,

the need for technicians becomes critically fundamental in industrial development. It should also be noted that technicians are required not only in industrial operations but also in various institutions.

36. In so far as workshop operatives are concerned, it is known that virtual illiterates can be taken into training operations - designed on a modular basis - to acquire operating skills within a very short time. Modular systems depend on the presence and activity of specialists in job breakdowns and analysis so that the first question would be about facilities and plans for selection and training of nationals in this area of specialization. The preparation of modules and training instructors in their use is a matter of importance when account is taken of the very large numbers of nationals living in rural areas with no primary school education, and who may need training in industrial manipulative skills. This means that plans for local training in such skills ought to be integrated with vocation-oriented literacy campaigns. This combined operation could be carried out by young men and women engaged in the performance of their national service. On the job training in several industrial projects must become an integral part of the project formulation.

37. Indeed, some evaluation studies ought to be made of how national services could be organized so as to serve as vehicles for carrying wave after wave of new and improved techniques, tools, implements and instruments into the rural areas. This could involve, say, three months to four months of intensive technical training at selected training schools on techniques related to the natural resource/industrial raw materials-base of the communities to which they are to be assigned, carrying with them sets of appropriate tools, implements and equipment. Their operations could be supported by mobile demonstration units and appropriately re-designed video-cassette systems. The objective would be to organize a revolution in the use of new tools, implements, etc., in rural areas where, at present, simple carpenters' tools are often rare. Such a revolution would be difficult without facilities within the country, or groups of co-operating countries, to produce large numbers of selected tools, implements, etc....

VI. CONCLUSION

38. Consideration has been given in this paper to the critical capabilities required for accelerated industrial development. In the actions to be taken by the developing countries on this matter, attention also has to be given to their types and numbers. The estimation of the types of industrial manpower depends upon a clear understanding of the industrialization process which, in general, involves the exploration, extraction, processing and utilization of industrial raw materials and the acquisition or development of the various factor inputs, such as technology, for this process. The type and number of human resources would depend upon the manpower profile required for each operation of the industrialization process. In general, the critical capabilities required cover such areas as socio-economic and technical research and information; policy and decision making and planning; industrial entrepreneurship and management, including supervision by technical and non-technical personnel; engineering, technology and science; technical, vocational and skilled labour.



