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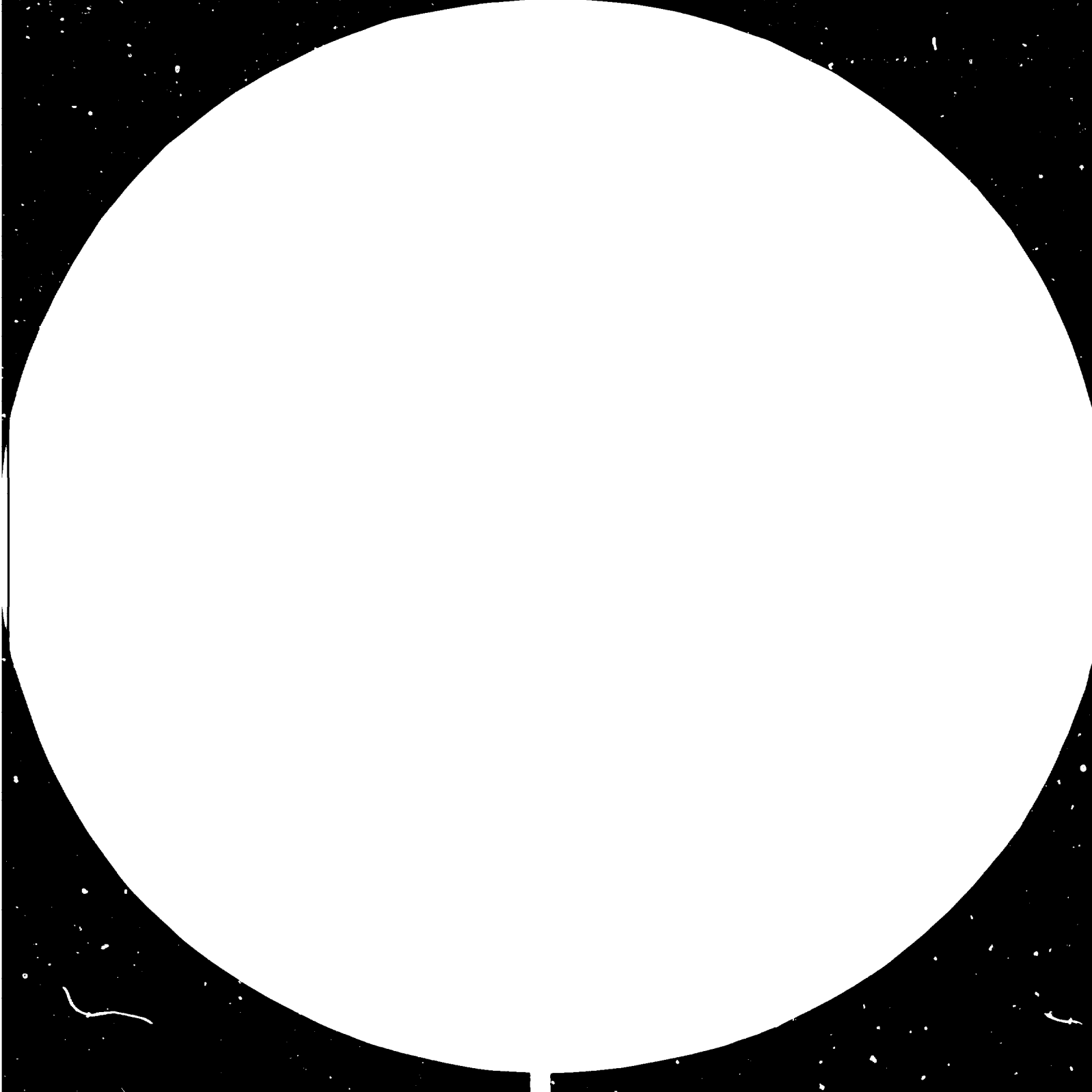
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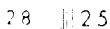
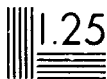
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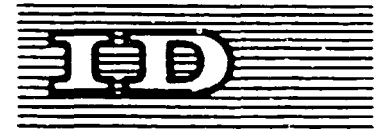




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INDUSTRIAL TECHNOLOGY IN AFRICA:

TOWARDS AN INTEGRATED APPROACH *

prepared by
the secretariat of UNIDO

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INTRODUCTION

Industrial Development in the Context of the Monrovia Declaration

1. The role of industry as a dynamic instrument of socio-economic development has always been prominent in the thinking of African decision-makers. As far back as 1971, the Addis Ababa Declaration on Industrial Development in Africa adopted by the First Conference of African Ministers of Industry expressed its faith in industrialization as a strategic element in the structural transformation of African economies.
2. The guiding principles of the strategy for the African Region in the Third United Nations Development Decade, as enunciated in the Monrovia Declaration (1979) give second priority, after self-sufficiency in food, to "the establishment of a sound industrial base with special emphasis on the development of the requisite national industrial and technological policies, capabilities and institutional infrastructure, as well as intra-African co-operation in order to permit the industrial take-off of Africa".^{1/}
3. The Heads of State and Government of the Organization of African Unity (OAU) committed themselves in the Monrovia Declaration to, inter alia, "the development of indigenous entrepreneurial, technical manpower and technological capacities" to enable the African peoples to assume greater responsibility in achieving rapid industrialization.

UNIDO III and the African Industrial Development Decade

4. In response to the decision of the African Heads of State and Government, the Third General Conference of UNIDO (1980) recommended to the UN General Assembly that the 1980s be declared as the African Industrial Development Decade.^{2/} This would enhance awareness among the African countries of the need to accelerate the industrialization process; mobilise the entire African population to participate fully in the industrialization effort and ensure greater technical and financial support from the international community for industrial development in Africa.

^{1/} Monrovia Declaration of Commitment of the Heads of State and Government of the Organization of African Unity on Guidelines and Measures for National and Collective Self-reliance in Social and Economic Development for the Establishment of a New International Economic Order (AHG/ST.3(XVI)Rev.1).

^{2/} ID/CONF.4/22, pp. 59-60.

Plans and Programmes for Action:

5. The Council of Ministers of OAU in its Fourteenth Extraordinary Session in Lagos, 21-25 April 1980, formulated a Framework for A Programme of Action for the African Industrial Development Decade (1980-1990).^{3/} The programme of action deals, inter alia, with industrial strategies, policies and plans; industrial and technological manpower; development and transfer of industrial technology and industrial co-operation among African countries.

6. The Plan of Action for the Implementation of the Monrovia Strategy for the Economic Development of Africa adopted by the Heads of State and Government in their Second Extraordinary Session held in Lagos, 28-29 April 1980, calls, amongst many other things, "for the Establishment or Strengthening of national machinery for the establishment of industrial policies and instruments",^{4/} "a consulting engineering and management institution" as well as "a standards and quality control institution".^{5/}

7. The Lagos Plan of Action also contains detailed and in wide-ranging recommendations in the field of technology. What is important now is to operationalize those recommendations, keeping in mind their dynamic interrelation to the productive sectors and using the cause and effect relationship between industry and technology in a manner that will accelerate the growth of both.

8. There is a close interrelationship between industry and technology in general. Perhaps no other single branch of economic activity influences or gets influenced by technology more than industry. Industrial development often paves the way for the initial technological development of the country and thus contributes to the development of skills. Further the application of technology in other sectors often requires the manufacture of products on an industrial scale and may determine the technology to be adopted for such manufacture. Nowhere are the ramifications of technology transfer and development more apparent than in the field of industry.^{6/}

^{3/} Organization of African Unity, ECM/ECO/6 (XIV).

^{4/} ECM/ECO/9(XIV) Rev.1, p.71, "Programme Element 6.2"

^{5/} Ibid., p.72, "Programme Element 6.2(ii)"

^{6/} ECM/ECO.9(XIV) Rev. 1, p. 58, Programme Element 3.

The Joint OAU/UNIDO Symposium on Industrial Technology for Africa

9. It is in this context that UNIDO, in co-operation with the Organization of African Unity (OAU), is organizing the Symposium on Industrial Technology for Africa with the aim of developing operational measures for implementing the decisions, recommendations and action programmes embodied in the Lagos Plan of Action in the field of industrial technology. The Economic Commission for Africa (ECA) and the African Regional Centre for Technology (ARCT) are also collaborating with UNIDO in organizing this Symposium.

10. The three key areas of technological development that have a marked impact on the building of a sound industrial base are:

- (a) Technology policy and planning;
- (b) Technological infrastructure;
- (c) Technological co-operation.

Among them, they cover the critical aspects of the industry technology nexus leading to action across all sectors of priority. They are the major instruments for the development of national technological capabilities. Identifying feasible and effective operational measures in these areas will be a positive contribution towards fulfilling the programmes for African technological development.

11. The Symposium will thus examine and discuss in specific terms a variety of actions and propose those most effective, within the realities and constraints of the African industrial scene, in moving towards the full implementation of the tasks ahead. The Symposium will propose methods for integrating them into individual national technology development policies and plans, thus enabling African countries to identify the most suitable starting points for action and to select the most appropriate actions for attaining their objectives in the context of their own particular situation.

12. In examining ways and means suggested for operationalizing the decisions, recommendations and programmes of action in the field of technology, consideration has to be given to the main elements of a technology development and transfer programme as well as the policy elements that need to be adopted at the national level in order to accelerate the process of endogenous technological development in African countries. Particular emphasis will need to be placed on the overall policy framework, infrastructural arrangements and linkages, and development of manpower capabilities. The documents for the Symposium present some illustrative models or options for action

in respect of each of the other agenda items. It is hoped that other examples and illustrations presented by the participants during the discussions could lead each country, in keeping with its level and path of development, to adopt the approach most suited for effective implementation of action programmes. Measures for promoting collective self-reliance in the field of industrial technology through the strengthening of technological capabilities and ensuring they are utilized to the maximum extent possible in the development effort could then have a more concrete basis. The promotion of further co-operation among the African countries in the field of industrial technology in fulfillment of the recommendations of the Lagos Declaration and Plan of Action will be discussed and appropriate measures identified, including the role of the OAU, UNIDO and external assistance and taking into account the variations of conditions in African countries.

13. It is hoped that on the basis of the material provided, the discussions and recommendations of the Symposium will be oriented towards enabling each African country and the region as a whole to arrive at the broad approach and the substantive content for an action programme most suited to local requirements and the development objectives in view.

THE AFRICAN INDUSTRIAL SCENE

Some basic facts

14. Africa's share in world industrial production now is a mere 0.9 per cent. Its share of the Lima target amounts to only 2 per cent. Although this figure is extremely modest for a region endowed with enormous natural resources and potentially large markets, the value added in the manufacturing sector in the African region would have to grow at the rate of 11.3 per cent per annum in order to meet the Lima target. Yet, during the 20 years between 1955 and 1975, the manufacturing value added in the African region grew only at the average rate of 7.3 per cent per year and the overall average economic growth rate of GDP achieved during the same period was just 4.9 per cent. Thus for each individual country and all African countries collectively the effort required to reach the 11.3 per cent minimum rate of growth is immense. Very few African countries have been able to achieve such a high rate of growth over the past years.

15. Sixty to 90 per cent of the labour force and around half of the national output in Africa is in agriculture; yet Africa's self-sufficiency ratio in food production and local processing and preservation of agricultural produce declined from 98 per cent in 1962-1964 to 30 per cent between 1972-1974. Moreover the average annual rate of food production per capita which had been approximately stable, fell by 1.4 per cent a year between 1970-1977. This draws attention to the complementarity between industrialization and the development of agriculture in Africa, which has to be borne in mind in planning industrial development.

16. Africa's share in world output in the leading sectors of metal and engineering products remained unchanged at 0.2 per cent between 1955-1970. The share of metals and engineering products in total industrial production seems to have declined. Africa has the lowest ratio of engineering production to engineering imports of all developing regions. Yet the growth rate of heavy industry has risen by 9.3 per cent yearly while that of light industries has increased by a mere 4.1 per cent yearly.

17. Employment in manufacturing has also grown more slowly than manufacturing value added because of the manufacturing industry becoming more capital intensive. Africa's trade in manufactures continues to be characterized by a large and increasing imbalance of imports over exports.

18. If these trends continue, per capita GDP in Africa will be considerably below that of South and East Asia while the region's per capita manufacturing output will be less than one half that of other regions.

19. There are considerable differences in the state of industrialization in Africa. Table 1 gives some industrialization indicators for individual African countries. Twenty-two, out of a world total of about 30, are classified as non-industrialized countries in which manufacturing is concentrated in a handful of factories producing mainly construction materials, textiles, footwear and processed food. Another 19 fall in the middle bracket of industrializing countries. They also show marked differences in the level of industrial activity.

20. The value added in manufacturing (MVA) varies from more than three billion dollars to a few millions, even though some figures include the elements of the extractive and service sectors for a number of countries. Only in six countries does contribution of MVA to GNP exceed 20 per cent.

In seven others, the contribution of MVA is less than 8 per cent of GNP. During the period 1970-1976, MVA grew at widely varying rates from country to country. In Africa, negative rates of MVA growth co-exist in some countries together with rather high positive rates in others.

21. These wide differences can be related to historical antecedents and time horizons in overall development, and in industrial development in particular. Yet, they also reflect the considerable variations in endowments of material and manpower resources. Populations vary from just over half a million in one country to close to eight million in another. Coupled with this, discrepancies in natural resources account for the variation in per capita GNP, from around US\$2,500 to as little as US\$100.

22. The sectoral composition of African industry is reflected in table 2, which lists the major industrial sectors in 22 African countries, as well as their share in total MVA. Food, beverages and textiles predominate.^{1/} The low contribution of the industrializing industries is particularly striking and significant in the context of self-reliance in industrial technology.

23. Until quite recently, the involvement of Africa in industrial development has been marginal. It was left mainly to foreign capital and to expatriates to staff industrial enterprises. It was based on importation of plant, equipment and even skilled manpower. It catered mainly for urban populations and seldom for the rural and less affluent sectors of society. African governments had little control on the flow of capital or equipment or the choice of product.

Constraints and problems

24. While it may be claimed that this unsatisfactory level of industrial development is largely due to inappropriate actions in the past based on certain conceptions and approaches that have now come to be recognized as inadequate, other constraints too have played a role in limiting the nature and magnitude of industrial development in Africa. Those imposed by the existing international economic order as well as geopolitical and global problems are being addressed by the Heads of State and Government and do not fall immediately within the scope of the deliberations of the Symposium, even though they will always influence them, particularly in connexion with the flow of external assistance. But, constraints within the national and regional frameworks must be taken into consideration.

^{1/} It is worth noting here that some of the products in these industries, for example soft drinks with brand names, do not seem to reflect a high priority need in African development today.

Table 1: Industrialisation Indicators for Individual African Countries, by Stage of Industrialization, 1976

Country or area	Population (millions)	GNP			Value added in manufacturing			Manufacturing exports as percentage of total exports (%)		
		Per capita (dollars)	Average annual growth rate, 1960-1975 (%)	Total (millions of dollars)	Per capita (dollars)	Average annual growth rate (constant prices), 1960-1976 (%)	As percentage of value added in commodity production		Percentage of GDP	
									1960	1976

A. Industrialized countries and areas

Developed

None in Africa

Transitional

Africa (south of Sahara)

Zimbabwe	6.53	550	2.4	851 ^{a/}	135 ^{a/}	-	44.2 ^{a/}	16.7	24.8 ^{a/}	-
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B. Semi-industrialized countries

None in Africa

Table 1 (contd.)

Industrialization Indicators 1976 (continued)

Country or area	Population (millions)	GNP			Value added in manufacturing				Manu- facturing exports as percentage of total exports (%)		
		Per capita (dollars)	Average annual growth rate, 1960-1975 (%)	Total (millions of dollars)	Per capita (dollars)	Average annual growth rate (constant prices), 1960-1976 (%)	As percentage of value added in commodity production			Percentage of GDP	
							1960	1976		1960	1976
C. Industrializing countries											
Northern Africa											
Algeria	16.23	990	1.8	2 027	125	9.1	20.4	10.4	13.0	-	
Egypt	38.07	280	1.5	3 329	87	5.1	40.9	20.1	23.9	24.5	
Morocco	17.20	540	1.9	1 021	59	4.8	23.7	12.1	12.4	12.5	
Tunisia	5.73	840	4.1	431	75	9.8	21.5	-	10.8	25.6 ^{d/}	
Africa (south of Sahara)											
Central African Empire	1.83	230	0.4	89	49	5.8	31.1	5.7	22.9	23.7 ^{a/g/}	
Congo	1.36	520	2.9	93	68	8.7	46.3	8.2	13.0	8.0 ^{e/}	
Ghana	10.14	580	-0.2	1 973	195	3.0	33.5	9.8	24.8	1.4 ^{e/}	
Ivory Coast	7.03	610	3.5	551	78	9.9	26.3	7.1	11.8	7.0 ^{e/}	
Kenya	13.80	240	3.2	362	26	9.7	22.1	9.4	12.1	12.8 ^{e/}	
Madagascar	9.11	200	0.1	341	37	3.0	37.5	4.1	18.5	9.2 ^{e/}	
Malawi	5.17	140	4.1	105	20	12.4	23.0	5.8	13.5	3.9 ^{e/}	
Mali	5.84	100	0.9	66	11	6.4	19.9	4.7	10.9	11.1 ^{e/}	
Mauritius	0.89	680	0.8	99	111	2.8	33.2	13.1	19.1	11.0 ^{a/}	
Nigeria	77.05	380	3.4	2 395	31	10.4	11.0	4.8	7.9	0.2 ^{a/}	
Senegal	5.13	390	-0.7	491	96	5.1	46.3	12.4	23.8	21.5 ^{a/}	
Swaziland	0.51	470	6.8	52	103	15.0	36.4	5.3	24.1	- ^{h/}	
United Rep. of Cameroon	7.07	290	3.0	324	46	8.0	25.9	-	13.5	10.5 ^{a/}	
Upper Volta	6.17	110	0.7	82	13	5.6	27.1	7.9	13.8	6.0 ^{a/}	
Zambia	5.06	440	2.0	413	82	8.0	32.8	4.0	17.8	0.4 ^{a/}	

Table 1 (contd.)

Industrialization indicators 1976 (continued)

Country or area	GNP			Value added in manufacturing					Manu- facturing exports as percentage of total exports (%)		
	Population (millions)	Per capita (dollars)	Average annual growth rate, 1960-1975 (%)	Total (millions of dollars)	Per capita (dollars)	Average annual growth rate (constant prices), 1960-1976 (%)	As percentage of value added in commodity production			Percentage of GDP	
							1960	1976		1960	1976
D. Non-industrialized countries											
Africa											
(south of Sahara)											
Angola	5.47	330	3.6	168 ^{a/}	31 ^{a/}	7.6 ^{c/}	9.4 ^{a/}	4.3	5.3 ^{a/}	9.4 ^{d/}	
Benin	3.20	130	-0.3	51	16	6.0 ^{c/}	19.1	-	10.1	17.9 ^{d/}	
Botswana	0.68	410	6.0	16	23	5.5	13.6	8.1	5.4	-	
Burundi	3.81	120	2.7	26	7	12.7	13.1	-	10.1	1.2 ^{d/}	
Chad	4.12	120	-1.1	45	11	2.3	14.6	4.5	9.6	3.2 ^{d/}	
Ethiopia	28.68	100	2.0	275	10	7.6	15.8	6.1	10.3	1.3 ^{a/}	
Equat. Guinea	0.32	330	-0.9	-	-	8.5	-	-	-	-	
Gabon	0.54	2 590	5.0	105	194	-	14.9	6.1	7.4	4.8 ^{f/}	
Guinea	5.69	150	0.2	-	-	17.8	-	-	-	- ^{h/}	
Lesotho	1.24	170	4.6	2	2	17.8	5.4	-	2.4	- ^{h/}	
Liberia	1.60	450	1.8	36	22	12.2	7.6	-	5.3	1.0 ^{d/}	
Mozambique	9.46	170	2.0	314 ^{a/}	34 ^{a/}	8.5 ^{c/}	20.1 ^{a/}	7.7	12.0 ^{a/}	3.3 ^{d/}	
Niger	4.73	160	-1.3	99 ^{a/}	23 ^{a/}	12.5 ^{c/}	25.8 ^{a/}	4.4	16.4 ^{a/}	8.4 ^{a/}	
Reunion	0.50	1 920	3.9	-	-	-	-	-	-	14.6	
Rwanda	4.21	110	0.5	29 ^{d/}	7 ^{d/}	7.0	13.5 ^{d/}	0.7	10.0 ^{d/}	-	
Sierra Leone	3.05	200	1.5	30	10	2.3	13.8	-	-	62.8 ^{g/}	
Somalia	3.25	110	-0.3	25 ^{a/}	8 ^{a/}	16.8 ^{c/}	20.9 ^{a/}	2.4	8.3 ^{a/}	0.6 ^{d/}	
Sudan	15.88	290	0.1	397 ^{a/}	26 ^{a/}	1.9 ^{c/}	17.0 ^{a/}	4.7	9.7 ^{a/}	0.1 ^{a/}	
Togo	2.28	260	4.4	63	28	6.7	30.0	7.7	10.6	3.2 ^{d/}	
Uganda	11.94	240	1.0	176	15	1.9	10.7	8.8	6.1	3.6 ^{a/}	
United Rep. of Tanzania	15.13	180	3.0	244 ^{a/}	16 ^{a/}	8.5 ^{c/}	17.0 ^{a/}	5.1	10.3 ^{a/}	11.9 ^{a/}	
Zaire	25.39	140	1.6	210 ^{a/}	9 ^{a/}	8.0 ^{c/}	21.5 ^{a/}	13.2	10.0 ^{a/}	2.0 ^{a/}	

a/ 1975; b/ including Botswana, Lesotho, Swaziland and Namibia; c/ 1960-1975; d/ 1974; e/ including mining, electricity and construction; f/ 1973; g/ mostly diamonds; h/ included in South Africa

Source: Helen Hughes, "Industrialization and development: a stock-taking, *Industry and Development*, No. 2, 1976.

Table 2: Major industrial sectors in 22 African countries
1970, with shares in total manufacturing
value added (percentages)^{a/}

Country	Major sectors (with shares in MVA) ^{b/}
Burundi ^{c/}	Beverages (46), clothing (16), metal products except machinery (15), food (14)
United Rep. of Cameroon ^{c/}	Food (30), non-ferrous basic metals (17), beverages (12)
Congo	Beverages and tobacco (20), petroleum refining and products (18), food (16)
Egypt	Textiles (32), food (10)
Ethiopia	Textiles (28), food (27), beverages (16)
Ghana	Petroleum refining (15), textiles (11), food (11), non-ferrous basic metals (11), beverages (10)
Kenya	Food (19), transport equipment (11)
Libya	Tobacco products (44), food (14), other chemical products (11)
Madagascar	Food (29), textiles (20)
Malawi	Food (22), beverages (17), tobacco products (12), textiles (11)
Mauritius	Food (61)
Mozambique	Food (36), textiles (11)
Nigeria	Textiles (24), beverages (15), food (12)
Rwanda	Food and beverages (89)
Somalia	Food (89)
Zimbabwe	Food (12)
Sudan	Textiles and clothing (27), food (21), beverages (14)
Swaziland	Wood, wood products and furniture (57), food and beverages (37)
United Rep. of Tanzania	Textiles (22), food (21)
Togo	Textiles (37), beverages (33), food (20)
Tunisia	Food (19), industrial and other chemical products (13)
Zambia	Beverages and tobacco products (41), food (14)

a/ Major sectors defined as accounting for at least 10 per cent of total MVA (1970).

b/ Precise sector definitions are based on the ISIC classification.

c/ Refers to shares of output.

Source: UNIDO, Recent Industrial Development in Africa, (UNIDO/ICIS.117), 6 August 1979.

25. In general, like all developing countries the major problems of African countries mainly relate to:

- (a) Lack of a well-developed industrial environment. In most African countries, industrial technology is still part of an imported culture. Industrial development is generally at an embryonic stage. It lacks sufficient basic facilities such as fiscal and tax incentives on the one hand, and the energy and infrastructural services to encourage investment by entrepreneurs on the other. No substantial sector of the community has a vested interest in industry. The establishment of industries has largely been in the hands of foreign elements using their technologies and personnel.
- (b) Inadequate industrial planning, programming and evaluation. In most African countries, local technological institutions, where they exist, are generally not called upon, nor do they succeed in seeking to play a significant role in development. There is, nowadays, an increasing movement in Africa towards establishing national technological institutions and developing various indigenous technological expertise for initiating industrial projects and programmes. Yet, there is nevertheless a lack of evaluation systems for assessing on-going production, market and technological trends; identifying changes arising from revised national and sectoral plans; and providing technical information and data required for assessing short- and long-range industrial and economic trends of the country and the changing needs of industry. There is little systematic effort to analyse past successes and failures in depth and to learn from them.
- (c) Lack of well-defined national technology policies and plans. Only very little attention has so far been given to preparing technology plans and programmes as well as determining the technological manpower required to implement the industrial and economic plans at the overall, sectoral, and even sub-sectoral levels. This is directly related to the fundamental issue of development strategy of the country and its efforts to seek new development alternatives.^{8/}

^{8/} See document Action in the Field of Technology Policy and Planning in Africa (ID/WG.332/2) prepared for the Symposium.

- (d) Underdeveloped national machineries and institutions for industrial and technological research and development. Also related to this problem is the lack of a national system in most African countries capable of the economic exploitation of industrial and technological research and development results. According to "Science and Technology in African Development", there are 355 industrial research institutions in Africa. While in some countries, some of these institutions fulfil important functions, in most countries where they exist, their role is still limited, excluding especially such areas as technological planning and forecasting, project identification and evaluation and project and engineering design, and implementation. It is in these stages that the basic decisions concerning design, development or selection of appropriate technologies are made.
- (e) Underdeveloped national machineries and institutions for the selection, evaluation, acquisition and transfer of industrial technology. In their efforts to industrialize, African countries have been relying heavily on imports of technology, almost wholly, from developed countries. In spite of this dependence, African countries, on the whole, lack the machinery and institutions for the selection, evaluation, acquisition and transfer of industrial technology. They are therefore in a weak negotiating position due mainly to their lack of sufficient and precise information on various aspects of technology transfer. Africa still lacks machinery for developing capacities and capabilities for absorbing and upgrading technology. It consequently has to resort to massive imports of equipment connected to large turnkey projects which essentially involve the purchase of the products of off-the-shelf technology and know-how with little or no involvement of national elements and no acquisition of technological know-how or accumulation of experience.

9/ UNESCO document SC/CASTAFRICA/3, para 62.

- (f) Inadequate allocation of funds. While African countries have invested significant funds, both from local and external sources, in establishing industries, an almost insignificant amount has been allocated for developing the necessary technological capacities, manpower and institutions to ensure not only a smooth operation of these industries but also their integration in economic development. The importance of long-term investment required for acquiring the software of technological activities and institutions has not been recognised by decision-makers in most African countries. Funding has been mainly allocated for hardware and materials.
- (g) Shortage of technological manpower. The shortage of skilled technological manpower has placed serious constraints on development. There is a general lack of correlation between skill requirements and the training provided. The present educational system does not permit an appropriate development for technologists. Universities need to take practical measures to diversify their course options so as to reflect the actual needs of the economy. Many African countries do not have adequate training facilities to train technicians. This has resulted in shortages of, for instance, fitters, machinists, welders, electricians, carpenters and pattern-makers, required especially for industrial production, quality control and for the installation, smooth operation and maintenance of industrial machinery and equipment. The limited number of technological personnel, especially high-level personnel, continues to migrate internally to the commercial and business communities or, worse still, to other countries, particularly industrialized ones where better conditions exist. In terms of the number of scientists, engineers and technicians, a majority of African countries possess only about a half to one third of the corresponding numbers (per size of population) in Asia and only one thirtieth of those in Europe. Further, only a few African countries have so far achieved the target laid down for the Second United Nations Development Decade in the World Plan of Action (200 research workers per 1 million inhabitants by 1980).^{10/}

^{10/} See tables in document on Industrial Technology Manpower in Africa prepared for this Symposium.

(h) Lack of suitable industrial and technological information systems.

In most African countries, there is a general lack of industrial and technological information, data and statistics, without which planning and forecasting the development of relevant sectoral and national targets is impossible. To a great extent the weakness in most African countries in the area of technology policy formulation, planning, programming and institutional development is a reflection of the weakness of the industrial and technological information structure and expertise. The problem is particularly acute with regard to knowledge and information on alternative sources of technology and the existence of alternative technologies in various fields. At the national level, there is little information on the existing technological capability of the country, in terms of both manpower and institutions. At the subregional and regional levels there is a lack of information channels for the dissemination of the achievements in various technological activities; although there have been some attempts to communicate with similar regional institutions at the sectoral level.

The need for co-ordinated and effective external assistance

26. Although the external assistance for Africa in technological development falls far short of her needs and what is her due, it is even doubtful whether whatever assistance that has been accepted has been given to the right project or has produced optimal results. More often than not, the assistance has been proposed by the donor, rather than given in response to a well-defined need by the recipient. The institutions administering aid do not always succeed in making the best use out of it. A well-defined national policy for development would contribute greatly to improving the benefits from external aid and would, in all probability, generate more assistance. While the disadvantages and inequities of foreign technology (and capital) transactions have now come to be analysed and generally appreciated, little systematic attention has been paid in Africa, or indeed elsewhere, to optimizing the benefits of external assistance and minimizing whatever adverse effects it may have. Generally speaking, Africa needs a clear strategy in accepting and administering external aid. Since this will probably continue to play a prominent role in development and in industrial technology in particular, the subject is dealt with in a separate document.^{11/}

^{11/} See the document on External Assistance prepared for this Symposium.

GENERAL CONSIDERATIONS

27. The application of science and technology for development is a means to an end, the end being the development goals of each country.^{12/} To achieve these goals the pattern of industrial development, as outlined above, would need to combine a rapidly growing modern industrial sector, side by side with a sound and efficient decentralized industrial sector. Concomitantly, the pattern of industrial technologies to be applied should combine the access to, and the application of, modern and large-scale technologies, with the use (after upgrading, if need be) of technologies more suited to the requirements of the decentralized industrial sector. Only such a reoriented pattern of application of science and technology can enable accelerated industrial growth of a nature consistent with over-all development goals and the achievement of the Lima target.

28. Thus the vital need for integrating science and technology in economic and social development through linkages with development goals is, in a sense, more important and fundamental than the mere consideration of mechanisms to be employed to promote transfer of technology and technological development. A key element in the process of integrating industrial technology with industrial development is the stimulation of interest and the sensitization of all partners and decision-makers in the process of industrial development. It is largely through such integration, both conceptually and in practical terms, that the application of industrial technology can make the most effective contribution to industrial and economic development.

29. It is largely within the framework of such basic considerations that science and technology can be applied realistically and effectively. To promote such application of technology, three major elements have been identified for the purpose of national and international action. First, the linkage of technology to industrial development, and through industrial development to overall development goals, will be successful only in the context of the formulation of relevant policy measures by the national governments; technology policy and planning therefore become important elements. Second, the development of technological capabilities in each country is a prerequisite for the selection, acquisition, adaptation, absorption or development of industrial technology. This involves, among other things, access to relevant information, the building up of technological

^{12/} See the document Action in the Field of Technology Policy and Planning in Africa (ID/WG.332/2) prepared for the Symposium.

institutions and the training of industrial and technological power.

Another element is the appropriate choice of technology, since inappropriate choice will not only be expensive but will also distort the pattern of development.

30. In fact, it is in the area of policy and planning, manpower and institutions for industrial technology that the core of the discussions of the symposium lies. Each of these key areas is dealt with in separate documents.

31. With the wealth of conceptual studies of the problems in hand and with a target clearly defined by the Monrovia and Lagos Declarations, what is needed now is action. The discussion will no doubt help to identify possible alternatives for feasible and meaningful actions that could be started now, within a well-defined framework of what should follow. Many promising initiatives have failed in the past because interest has waned too quickly and the quest for quick results has overshadowed the imperatives of long-term action based on a solid foundation. There is an obvious need for planned and integrated action within the limits of the availability of resources, the time span envisaged and the degree of political support.

32. Furthermore action must not be spread too thinly across the board. There is no choice but to be selective and to set priorities; what those priorities are will be the choice of each country. This is the most crucial part of the exercise and it merits the maximum possible attention and careful consideration.

33. Finally, it is important to make a distinction between science and technology. Science is the "know-why" and technology is the "know-how". Over the last few centuries industrialized countries have achieved a very close and fruitful link between the two. This is not yet the case in Africa. In fact, the establishment of this effective twinning will be one of the hallmarks of development.

34. The working documents of the symposium present each of the topics to be considered; but they offer no ready-made solutions. They simply describe the problem in what is hopefully a meaningful way, relevant to action. They indicate points for discussion and outline some options. The wealth of experience of the participants will clarify what each of them entails, its prerequisites, and its chances of success or failure in Africa today. Other options for action will no doubt also be proposed

and reviewed. It is felt that this will help each African state to decide, in the light of the discussion and its specific conditions on the course of action to take at the national, subregional, regional and international levels in achieving the aims of developing industrial technology. The African and international agencies will, by the same token, be better placed to structure and implement actions in support of African national and regional programmes in developing industrial technology capabilities in the continent.

AN APPROACH TO ACTION-ORIENTED PROGRAMMES

35. The wide-ranging actions recognized by African governments to be necessary in the field of technology call for a systematic approach which should correspond as closely as possible to the specific African conditions and the priorities arising therefrom. The major elements of such an approach could be identified through a broad exercise in matching the demand for industrial technology in Africa with the available supply, in order to locate those key areas of action which will have a maximum impact.

36. The demand for industrial technology and technological products is ultimately decided by the development goals of the country. Technology policy is a derivative of the industrial development strategy, which itself has to be derived from the overall development goals of the country.^{13/}

37. The priorities of industrial development in Africa have been identified and approved in Monrovia and Lagos. In almost every one of the sectors identified,^{14/} the range of technological options, in

^{13/} A/CONF.31/BP/UNIDO

^{14/} viz. Food and agricultural industries, building materials and construction industries, engineering industries, metal industry, chemical industry, forest-based industries, energy industries.

products or technologies is remarkably wide in Africa today. Not many African countries are historically committed to particular technologies. This is an advantage as well as a potential point of vulnerability.

38. It is necessary for the African governments to take note of the technological options available in the priority sectors. Some illustrations are provided here in this regard. In the food industry sector, a number of options are available in the areas of preservation, processing and packaging including several technologies available in the African region itself in the form of traditional methods which could be upgraded and provide more viable alternatives in terms of local consumer preferences than those imported from abroad incorporating different life-styles. In the agro-industries sector, wide choices are possible in the field of agricultural implements and machinery and in the processing of agricultural products as well as of livestock and fisheries. In the case of pesticides, while formulation of technical ingredients could be undertaken, the feasibility of using local materials, such as pyrethrum, could be explored simultaneously. In regard to fertilizers, while the manufacture of synthetic fertilizers would call for large-scale plants and correspondingly large-scale markets, the manufacture of fertilizer mixtures could be undertaken locally and the use of natural fertilizers, such as biomass, could be increased. While a number of traditional technologies in the field of agro-industries could be improved, export-oriented technologies may have to be adopted for the processing of export crops, such as cocoa and palm. In regard to engineering industries, the areas of concern in the beginning are more likely to be maintenance, repair, metalworking and manufacture of tools, implements and spare parts. Here again, there is ample scope for technological choices and these have to be exercised in such a manner that the engineering industries provide the skills necessary for technological development and also enable the gradual disaggregation of technology or equipment packages. In the field of small-scale industries, the size of the markets for certain products in several African countries is such that small-scale units will be the only viable option and the question of choosing between large and small-scale industry units may not arise. Such "non-competing" groups of small-scale industries can be identified and promoted. In the field of energy, in view of the distances and terrain

to be covered and the limited demand for electrical energy in the initial years of development, mini hydro generating units may present a viable alternative and sometimes the only method of providing electrical energy in certain areas.

39. While the demand for technology is identified for each of the priority sectors within the development strategy of the country and the product mix derived from the desired life-style and consumption pattern, investigation on the supply would need to cover the country's stock of institutions, manpower, information, experience, know-how and infra-structural facilities that together form the capacity of the country to select products, technology and equipment wisely, to control effectively their inflow and to stimulate the widest possible utilization of endogenous creativity and traditional technology. The above is essentially a transdisciplinary task which calls for an integrated systems approach involving all institutions and individuals taking part in implementation. Isolated, unco-ordinated action, as well as action without at least a framework of basic guidelines, if not a plan, would not lead to the desired goals. It is realized that the pattern of joint multidisciplinary action is without strong historical roots in developing countries. It will call for patient determination and mutual understanding and respect on the part of all involved.

40. With this approach in mind, the documents presented for discussion of each item of the agenda have attempted a rough diagnosis of the common features of the African industrial technology scene, looked into past experience and present problems and sketched some models and options for action in enhancing indigenous capabilities in industrial technology, both in the long- and short term perspectives. The main ideas for immediate action which emerge are briefly summarized here.

41. In the field of industrial technology policy and planning it is realized that it may not be possible to embark immediately on the drafting and implementation of comprehensive technology plans. Yet, every country should have a basic "tool box" of policy guidelines and ongoing programmes in industrial technology matters.

42. By way of immediate tasks, the initial step in technology planning cannot avoid being one of collecting and bringing together an aggregate of relevant programmes in specific sectors. In regard to technology policy the first priority would be to integrate such a policy with the basic development strategy and the monitoring of action at the national level in close association with development policy-making.

In addition an assessment of both the existing technological policies and the ostensibly non-technical or implicit policies, such as the relevant fiscal, monetary, trade and industrial policies should be made in order to see how far they are consistent with the objective of technological development and the overall development objectives. The field of technology imports may require special watch in regard to both technologies and equipment in order to see that such imports contribute to the growth of production and the fulfilment of development objectives. Since, as of now, most industrialization programmes in Africa are based on import of technology or equipment, the need for monitoring this activity cannot be overemphasized. At the same time formulation or review of policies for promoting endogenous technological development and the use of endogenous technological services should be initiated. Several African countries still have a fairly wide margin of choice in their strategy for industrial and technological development and this choice should be exercised effectively to avoid the pitfalls that other developing countries have faced in the past.

43. A good deal of the national and regional information resources for industrial technology are as yet unidentified, their stores and data bases need to be upgraded, access to them made easier and their linkages strengthened. The nucleus of an industrial technology information system, no matter how small or unsophisticated, is needed in every country to cater for the very specific needs of technological development. It has to be manned by professionally-qualified information officers with an enterprising approach in contacting end users and encouraging them, by successful performance, to seek information and to use it in decision-making. Some effort towards building a technological intelligence capability in the country is also needed. Both long and short-term action are required including a clear definition of needs, strong and effective relations with

users of information and developing a capacity for handling and processing technological information. The immediate demands for information in the fields of industrial and technological development are such that the first priority has to go to mission-oriented information tasks to help policy-makers, enterprises and research institutions particularly in the field of selection of technology, which provides the starting point for industrial development actions. This would necessitate, inter alia, close links with UNIDO's Industrial and Technological Information Bank (INTIB) through the provision by each African government of a national counterpart to liaise with INTIB and identify immediate and practical needs of each country in this field.

44. Industrial technology manpower is in particularly short supply in Africa. Education and training are ultimately the basic solution to this problem. However, a certain flexibility in the approach of existing educational and training institutions coupled with adoption of unconventional and innovative methods of training in particular, could provide a measure of the quality and quantity of skills needed in this field. Both long and short-term actions are needed. Particular attention has to be paid to a number of skills and capabilities required for the selection, acquisition, adaptation and development of technology. Specific short-term training courses using the existing institutions to the maximum extent possible may be required. Considerable use will have to be made of the instrument of co-operation among developing countries so that they complement each other in providing training and education facilities. Multidisciplinarity dictates that much stronger links have to be established between the various educational, training and production elements both within the government and the business community. This is best done around specific tasks in the upgrading and reorientation of existing manpower as multidisciplinary teams in group training courses.

45. Several African countries have some technological institutions which vary in their functions and effectiveness and suffer from many handicaps. Although new institutions for industrial technology will no doubt be needed, appreciable progress could be achieved by enhancing the capabilities of existing institutions and relating them organically to the execution of the

industrial technology functions in the country. Better linkages between the institutions in different disciplines, the identification or establishment of 'centres of excellence' could go a long way in satisfying the most urgent needs in national industrial technology development.

46. A balanced approach to institution building would call for an approach which looks at the functions or services which the institutions represent rather than at the institutions themselves. In this way, it is possible to see to what extent the technological functions and services required have an institutional basis in the country and what the gaps, definitions and redundancies are. A check-list for this purpose is suggested. ^{15/} The institutions themselves should be designed and linked to operate as a technological system with corresponding links to the productive sector. A multidisciplinary approach may have to be adopted increasingly with reference to specific major R and D goals around which mission-oriented R and D projects should be built. The institutional requirements in the field of technology acquisition would require further examination. All this calls for a new approach to the overall question of institution building for industrial and technological development. There is plenty of scope for regional action and co-operation among developing countries in this regard.

47. It is obvious that in all these areas intra-African co-operation is imperative for achieving rapid progress on the national and continental levels. Rather than dwell on the mechanisms for further co-operation, per se, which have already been identified and are fairly well known today, it would be more beneficial to dwell upon the areas of such co-operation and the desirable modes in each aspect of the major elements of strategy considered above. A more systematic approach to co-operation and collective self-reliance is suggested in the document on this subject.

48. External assistance in industrial technology will continue to be of considerable value to the majority of African countries for some time to come. It is doubtful whether the maximum possible use has been made so far of such assistance or that new sources have been tapped to the

^{15/} See document, Industrial Technology Institutions, Table 2, prepared for this Symposium.

maximum of their potential. There is as yet no clear strategy for integrating external assistance with national effort. The main outlines of such a strategy would indicate the prime importance of defining national needs and particularly their order of priority: being well-informed on the capabilities and interests of the donor; skilful and careful negotiation of the external assistance programme; making a proper assessment of the cost to the recipient and careful monitoring and implementation of the programmes. A document on this subject highlights the above considerations.

49. Finally, UNIDO's present and forthcoming activities in the field of industrial technology, as approved by its governing bodies, as well as their historical antecedents have been outlined in a document. Its services in this field, interrelated with the other aspects as well as the overall strategy of industrialization would continue to be available to support national and regional efforts in building African industrial technological self-reliance.

50. The deliberations of the Symposium, it is hoped, would enable: -

- (a) each African country to decide to adopt at least a minimum programme in the field of industrial technological development and formulate the contents of such a programme (for which important elements and illustrative models are before the Symposium); and
- (b) the African countries individually and collectively, to monitor the action taken in the implementation of the Lagos Plan of Action and other relevant inter-governmental decisions in this field;

The UNIDO secretariat would continue to provide assistance, as required, in both these respects.

