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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

**STRATEGIC MANAGEMENT OF THE INDUSTRIAL SECTOR
PREPARATION OF GUIDELINES FOR AN INDUSTRIAL MASTER PLAN
IN THE FEDERAL REPUBLIC OF NIGERIA**

UNIDO PROJECT NO. XA/NIR/90/626

FINAL REPORT

VOLUME ONE

**POLYTECHNA PRAHA
CZECHOSLOVAKIA**

1991

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FINAL REPORT

VOLUME ONE

POLYTECHNA PRAHA

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1991

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INTRODUCTION

This report provides a comprehensive information of the Polytechna team mission to Nigeria (27 May - 14 June 1991) aimed at assisting in the preparation of guidelines for "the Industrial Master Plan" or, in other words, "Strategic management of Industrial Development" for this country.

The report is subdivided into two volumes. Volume One consists of this introduction, three substantive chapters and the terminal section, presenting main findings and recommendations. Volume Two consists of two appendices. The first one provides factual information of the team personnel, its schedule in Nigeria and visited factories and institutions. The second one comprises a full text of the analysis of nine-priority sub-systems in Nigeria's manufacturing prepared by individual experts.

The main body of the Volume One report attempts primarily (I.) to clarify the substance of the concept of Strategic management of industrial development and its Nigerian application, to assess the role of the Polytechna team in Nigeria, to introduce its staff and analyse its work programme. In the second chapter (II.), several main issues concerning the changing position of the entire industry (manufacturing in essence) or related to most sub-systems are discussed briefly. Finally, the last and most extensive chapter (III.) presents abridged analyses of all sub-systems subdivided into four sections each: basic characteristics, identification of major problems and obstacles, strategic directions and suggestions for consideration of Nigerian counterparts.

**I. BASIC CHARACTERISTICS OF THE PROJECT, THE ROLE OF THE
POLYTECHNA TEAM AND ITS PROGRAMME OF WORK IN NIGERIA**

**1. Strategic Management of Industrial Development:
General Principles and Nigerian Application**

As indicated in the project XA/NIR/90/626 "Strategic Management of the Industrial Sector: Preparation of Guidelines for an Industrial Master Plan", the major task of the Polytechna team was to assist its Nigerian counterparts in the preparation of the guidelines for the Industrial Master Plan (IMP) which is also called the "Strategic Management of Industrial Development (SMID)".

The Strategic Management of Industrial Development is a new concept, developed by UNIDO and worked out into operational terms by Nigerian economists (Dr. Uma O. Eleazu and Dr. O. Ojowu). This concept in its present sophisticated form has not yet been applied to industrial development in any other developing country of Africa. 1) Nigeria, seeking new ways and means of industrial strategic management, thus could begin to play the pioneering role in the process of African industrialization. This experiment involves, of course, not only new opportunities but also new risks. It can mean a real break-through in African industrial progress, but it can remain just another attempt without achieving actual results.

1) Some modest attempts have been made, however, in a few African countries, such as Cameroon, Senegal and Congo.

It follows from this special nature of the project that the Polytechna team had to get primarily acquainted with the substance of the SMID approach and to study its main general features as well as Nigerian application. By UNIDO, "SMID is an action-oriented approach to formulate and manage strategies and support programmes to develop a competitive and efficient industrial system" (UNIDO 10/115/PLAN, 22 March 1991, p. 3). As compared with Industrial Master Plans known from the previous experiences of developing countries and characterized largely by the dirigist approach to industrial planning by industry and project within the public sector, SMID represents IMP of special kind. This new type of IMP supports the positive role of market mechanism in the process of economic and industrial development and is based on the two main pillars:

- (i) the strengthening position of the private sector in the economy internally; and
- (ii) the opening up of this economy to the outside world externally.

Irrespective of a number of differences, one can observe that SMID in Nigeria is based on very similar, if not the same, foundation stones and follows also very similar, if not the same, leading strategic line as economic reforms in Central and East Europe, including Czechoslovakia.

In detail, however, some distinct features should be explicitly mentioned.

First, by UNIDO, SMID "focusses on improving the organization and functioning of specific industrial sub-systems (ISS)" "which is the basic unit of organization and development of an industrial system" and "includes the cluster/network of suppliers, manufacturers, distributors, and support services required for efficient production process" (UNIDO 10/115/PLAN, 22 March 1991, p. 3-4). The emphasis on linkages among these actors

is perhaps the most significant characteristic of ISSs as compared to industries or branches.

In Nigeria, nine (9) priority industrial sub-systems, falling under four (4) sub-sectors, have been selected as follows:

<u>Sub-Systems</u>	<u>Sub-Sectors</u>
1. Foundry and forges	1. Engineering and Metallurgy
2. Metal fabrication	
3. Pharmaceutical products	2. Chemicals and Petrochemicals
4. Rubber and Plastic products	
5. Food processing	
6. Leather and leather products	3. Agro-allied
7. Textile and wearing apparel	
8. Cement	
9. Non-Metallic products (mainly bricks, glass, ceramics)	4. Non-metallic mineral

Each of these sub-systems is characterized by different products, markets, resource requirements and organizational forms. These differences are also reflected in uneven growth dynamics and uneven levels of development. Hence, the sub-systems require specific strategies. For all sub-systems and sub-sectors, teams of national experts worked out diagnostic or overview studies respectively. The 9 sub-systems diagnostic studies were made available to the members of Polytechna team a few days before their departure. While it was too late to study them thoroughly, they had at least the opportunity to get acquainted with them prior to their arrival in Lagos.

Second, "the strategies and action programmes to improve the organization and functioning of an industrial sub-system are

formulated by the actors operating in the sub-system" (UNIDO 10/115/PLASN, 22 March 1991, p. 5). This principle can be materialized through the process of consultations among various actors, including the representatives of the private and public sectors. Consultations between these two sectors have, of course, been experienced with varying degrees of success in many developing countries. Beside linkages, these interactions, taking place in the course of consultations, represent, nevertheless, another outstanding characteristic of the IMP in question.

Proper functioning of SMID in practice requires a corresponding institutional framework. In Nigeria, the National Committee on Industrial Development (NCID) was established in the second half of the 1980s with director of the Nigerian Industrial Development Bank, Mr. Rasheed Gbadamosi, as chairman. Correspondingly to the 9 industrial sub-systems, 9 Strategic Consultative Groups (SCGs) were founded. Each SCG nominated its chairperson and rapporteur. In order to be able to fulfil their duties, the SCGs need the regular inflow of information and other technical assistance. This is the main task of the Technical Support Group (TSG). The Federal Ministry of Industries (FMI) decided that its Policy Analysis Department (PAD) located in Ibadan (about 130 km from Lagos) serve as TSG. Finally, there is the Management Support Group (MSG) whose function is to provide documentation, secretarial services, planning and organizational activities. This group, headed by the Chairman and the Secretary of NCID, consists of several professionals, including the Chief Technical Adviser (CTA), Dr. Uma O. Eleazu, and the National Project Co-ordinator (NPC), Dr. O. Ojowu.

The Polytechna team was informed of the institutional structure of SMID in Vienna very briefly. For the sake of its work in Lagos, it was necessary to visit all the abovementioned institutions, get acquainted with their work and meet their representatives in person. This requirement was met (except the representatives of the leather and leather products SCG) thanks

to the organizational effort of MSG (see the schedule in Annex 2.) during the first week of the mission.

Third, as suggested by UNIDO, "the role of the State is to support the actors of the industrial sub-systems in improving their productivity and the organization and functioning of their system "(UNIDO 10, ... p. 6). This principle shifts the emphasis from the priority role played by the public sector to the private sector. The public sector-led industrialization, prevailing in many developing countries in the past, is being transformed in the private sector-led one. The role of the State should presumably be focussed on the creation of a competitive environment and economic policy framework, the combined effect of which would result in increasing efficiency. In UNIDO's view, the State should also be responsible for developing economic and social infrastructures and institutions providing enterprises with resources, and for facilitating the linkages among actors of the sub-system.

While such a change in the economic role of the state appears to correspond to a similar change in some countries of Central and East Europe in broad contours, the Polytechna team found out that its role in the Nigerian economy was despite certain limitations greater. For instance, the State is responsible for the preparation of long-term perspective and short-term rolling plans. Also, the role of the State in the introduction of MID into practical life seems to be essential. The changing position of the State in the economy is certainly one of the issues which deserve attention and should be elaborated in some detail.

(See Chapters II and III of this Report).

2. The Role of the Polytechna Team in Implementing SMID for Nigeria

The ultimate goal of the project XA/NIR/90/626 is "to provide a functioning institutional framework for the strategic management of the industrial sector" (Terms of reference for international sub-contractors, 8 October, 1990). One of the necessary steps to achieve this goal is "to formulate guidelines for an Industrial Master Plan" (same source). In concordance with these objectives, the general task of the Polytechna team was to assist in the preparation of these guidelines.

In more specific terms, the role of the international sub-contractors was to assist the SCGs in the elaboration of scenarios for future development and arising out of that action programmes to deal with the problems and constraints identified for implementation (Terms of Reference). They were particularly requested to deal with selected problems in the four major areas: technology, marketing, strategic directions and action plans.

In this connection, it is necessary to note that the abovementioned Terms of reference assumed that a set of nine sub-systems diagnostic studies would have been completed by the time the international sub-contractors arrived in Nigeria. As noted in Section I.1., the members of the Polytechna team actually received them even a few days before their departure from Prague. After their arrival in Lagos, a revised version of these studies was made available to them during the first introductory meeting with the representatives of NCID (16 May).

According to the Terms of reference and with regard to these circumstances, the Polytechna team concentrated primarily on analysing, evaluating and improving these sub-system studies. It was understood that, in doing so, they would assist the SCGs especially in the preparation of strategic directions which constitute one of the most important components of guidelines. It was also understood that the present report (especially Chapter

III) would be an additional contribution to the formulation of guidelines for Industrial Master Plan. (See "Preliminary briefing", Intermemo to the Polytechna team leader from Chief Technical Adviser, 15 May, 1991).

While this basic orientation of the role of international sub-contractors was in perfect agreement with the valid Terms of reference and perhaps the only possible alternative in that particular situation, a question arises whether their contribution to SMID could not have been maximized, providing that a necessary change in the Terms of reference was made and the time of their mission to Nigeria properly adjusted.

In so far, the process of implementation of the project could conveniently be subdivided into two phases. The most important and most difficult task of Phase one was the preparation of sub-system studies. Phase two was mainly concerned with the elaboration of guidelines. While the activities of international sub-contractors, based on the experience of the Polytechna team in Nigeria, concentrated on Phase two, it could be suggested that their mission should be shifted to Phase one. In other words, international sub-contractors with their experience and knowledge would assist more effectively in working our sub-system studies than in evaluating and improving them. Preliminary formulation of strategic directions constitutes a component part of these studies after all.

In fact, critical remarks related to the role of international sub-contractors in the conduct of sub-system studies sounded during all major meetings of the Polytechna team with its Nigerian partners. This criticism was also explicitly expressed in the Report of the Technical Support Group in the section 'foreign consultants'. The standpoint of the team was that its members (i) would have liked to assist in the preparation rather than in evaluation of these studies, but they had not been invited to do so; (ii) they would nevertheless make efforts to contribute to their improvements and bring some fresh

ideas, particularly in the field of technology, products and technical co-operation in a broad sense.

3. The Polytechna Team and its Programme of Work in Nigeria

The Polytechna team consisted of 10 specialists, including the team leader. The team leader co-ordinated the performance of duties of all members of the team, represented the team on official occasions and in main negotiations, and was also responsible for the preparation of this report. He assisted each member in drafting his contribution and integrated all contributions into one whole (Chapter III). As a development economist, he wrote a chapter on the role of industry in the Nigerian economy and selected issues, pertaining most of nine industrial sub-systems (Chapter II).

The remaining members of the team were sectoral experts - specialists in individual sub-systems. Most of them were essentially technically oriented engineers with practical experiences from various developing countries. Only one of them, however, visited Nigeria prior to this latest assignment. A detailed list of members of the Polytechna team, including names, professions, foreign experience and some other information is presented in Annex 1.

In compliance with the Terms of reference, nine members of the team were briefed at UNIDO Headquarters in Vienna (2-3 May, 1991) about the project, received some relevant reports and studies, and most of them took advantage of medical check-up in the local health centre. The leader of the team was briefed later on (9-10 May, 1991) and received a complete set of the sub-system studies worked out by Nigerian teams in co-operation with local UNIDO experts. These studies were reproduced by Polytechna and distributed to all members of the team. The team left Prague on 24 May, 1991 in the morning and arrived in Lagos the same day in the evening.

In consonance with its role as described in Section 2 of this Chapter, the Polytechna team had to carry out four types of activities while staying in Nigeria. First, its members had to

study the revised version of sub-system studies and assess the progress made in comparison with their original version. Second, they had to be introduced to authors of these studies, including UNIDO consultants, leading members of NCID, SCGs and other related persons to exchange ideas and discuss issues related to their assignment. Third, they had to visit various factories and institutions and meet their representatives to get on-spot-information in order to be in a position to make assessment not only on the basis of reading and discussions, but also on the basis of practical experience in the field. Fourth, they had to draft a preliminary version of their contributions to the report and present their findings at the concluding joint meeting of the leading representatives of NCID, SCGs, PAD and others.

All the activities were covered in the programme of work of the Polytechna team. A detail schedule is presented in Annex 2. This programme may be sub-divided into three phases:

The first one lasted approximately from 25 May to 2 June. It was devoted mainly to study, meetings (NCID, PAD, SCGs), visits and interviews (Central Statistical Office, NIDB, Central Bank of Nigeria, the World Bank Office) and partly also to factory visits. While this phase was inevitable and its content important, it was perhaps too lengthy and could have been organized more efficiently.

The second phase took less than a week from 3 to 8 June. The Polytechna team members, accompanied by UNIDO consultants and SCGs representatives visited a number of factories, organizations and institutions in Lagos as well as in other States of Nigeria. Concurrently, the team leader started writing the introductory parts of the report. The programme of factory visits was very busy, fairly well organized and provided the team members with new practical experiences and plenty of valuable information.

The third phase concentrated mainly on report writing. Each Polytechna specialist was requested to draft his own special

report reflecting his views on the basic characteristics of the respective sub-system, major problems faced and main obstacles encountered, possible solutions and strategic directions by major areas. He was also requested to suggest various recommendations to be considered by SCG as possible inputs in guidelines. This draft special report had to be prepared in two versions: (i) an abridges on to be included in the main body of the Polytechna team report and (ii) a detailed and more extensive one (about 15-20 pages) to be presented as Appendix II. to this report.

II. THE CHANGING POSITION OF INDUSTRY IN THE NIGERIAN ECONOMY: SELECTED ISSUES

1. The Role of the Industry in the Economy:

Growth and Structural Change

In accordance with the most recent statistics available, the level of economic development in Nigeria, expressed in per capita GNP, reached just 290 USD in 1988 (World Development Report 1990, p. 178). About a decade ago, the same indicator was estimated at more than 1,000 USD. The difference between these two reflects not only a negative per capita economic growth in real terms, but also the process of devaluation of Naira and, by the same token, a decline in its exchange rate in relation to USD in the course of the 1980s. One of the main factors responsible for these unfavourable trends is, of course, rightly sought in Nigeria's heavy dependence on oil and its price fluctuations on international markets.

For this very reason, the growth performance in the earlier period was much more favourable. The World Bank estimates that GDP grew by 6,9 per cent annually from 1965 to 1980 and exceeded 10 per cent per annum during the 1970s. Thus, two distinct phases can be distinguished in the growth performances of Nigeria in the last 25 - 30 years. It should be added, however, that some indications of improvement appeared in the last years of "the lost decade" of the 1980s in connection with the introduction of Structural Adjustment Programme (SAP).

The process of growth is always associated with some structural realignment characterized in the developing world mainly by an increasing share of industry in the economy. Since independence, economic progress was accompanied by a transformation of the traditional sectoral structure of GDP, in which agriculture (A) accounted for the largest share, industry (I) the smallest and services (S) intermediary position (A-S-I), to a more advanced structure, with the services sector in the

leading position and agriculture descending the last place (S-I-A). During this process, one or more types of sectoral structure may gradually emerge, depending on variations in internal as well as external conditions. Irrespective of these variations, the structural shift away from agriculture toward industry was the principal long-term trend in most developing countries which entered the industrialization stage.

This drive to industrialization is not a simple and straight-forward process, but a very complicated and sometimes contradictory. In general, Nigeria followed the pattern of structural change as described above in the first phase of its development until the threshold of the 1980s. Yet some structural imbalances could be observed even in that period. They typically grew worse during the 1980s until 1986 when SAP became effective.

The sharp decline in the share of agriculture can hardly be considered a desirable development if it was not accompanied by increased agricultural production in per capita terms. Since total agricultural production grew by 1,7 per cent in the first period (1965-80) and only by 1,0 per cent in the second one (1980-88) ¹⁾, per head agricultural product declined, thus causing a heavy dependence on food imports.

The share of industry increased admirably until the early 1980s, but this industrial expansion (by 13,1 per cent a year) was due mainly to mining, especially oil production and two shocks in international prices of this commodity (1973-74 and 14,6 per cent per annum), but its share in GDP did not reach even the 10 per cent bench-mark which was once considered as one of the most important criteria for the identification of the least

1) World Development Report 1990, p. 180

Table 1:

**Nigeria: Sectoral structure of GDP in current factor cost
(1960/61 - 1989)**

	Agriculture	Industry	(Mining)	(Manufacturing)	Services	Type of Structure
	A	I	(Mi)	(Ma)	S	
1960/ 1961	65,9	10,0	(0,9)	(4,2)	24,2	Traditional: ASI
1970/ 1971	48,8	23,9	(10,2)	(7,2)	27,3	Traditional: ASI
1981	26,9	37,6	(22,0)	(9,2)	35,6	Industrializa- tion structure of special kind: IAS (Mi)
1986	38,6	26,1	(14,0)	(8,7)	35,5	Traditional: ASI
1989	35,3	41,0	(33,2)	(6,1)	23,7	Industrializa- tion structure of special kind: IAS (Mi)

Source: Calculated on the basis of data supplied by the Federal Office of Statistics, Lagos.

Note: Industry (I) covers Mining (Mi), Manufacturing (Ma), Utilities and Construction. Owing to their importance in the economy of Nigeria, only Mining (mainly oil) and Manufacturing are included.

developing countries. The situation became worse in the last decade when industrial and manufacturing growth rates fell to -3,2 and -2,9 per cent respectively as a combined result of the world economic crisis, growing international indebtedness, oil glut, etc.

The expansion of the services sector can be regarded as a progressive trend. Nevertheless, if it is not associated with some progressive shifts within the internal structure of this sector, its growing share in GDP may not necessarily mean a desirable trend. In Nigeria, for instance, the role of most promising groups of services, such as health, education, research and other services appears to be still rather underdeveloped.

The year 1986, when the prices of oil on international markets reached the bottom, was perhaps one of the worst years for the economy of Nigeria since Independence. As mentioned, it was also the year when SAP entered into operation. Despite the fact that the process of adjustment was very painful and brought about new problems and constraints, some improvements in Nigeria's growth performance were registered. Although unsteady and actually very uneven, this renewal of growth dynamics, accompanied by rapid inflation was manifested, inter alia, in peculiar shifts in the sectoral structure of Nigeria's output. Some peculiarities can be observed even in earlier periods.

These can conveniently be analysed in terms of categories of structural development. While most developing countries change in the long-run the sectoral structure of production from the traditional type (A-S-I) via the transitional type (S-A-I) to the advanced structure (S-I-A), such a development pattern in Nigeria did not materialize. Owing to its oil prosperity, this country initiated a powerful industrial growth, but concurrently neglected somehow agricultural development. As a result, its original traditional structure with agriculture as the largest sector (A-S-I) was transformed into a lower type of this structure (A-I-S) and then changed into the so-called

industrialization structures with industry in the leading position (I-A-S and I-S-A). By contrast, the economic set-back in the first half of the 1980s meant simultaneously a step or two backward in structural development: in 1986, the economy returned to the traditional structure (A-S-I) which under the influence of rising oil prices changed in turn again into the industrialization structure (I-A-S) by the end of the last decade (see Table 1).

The occurrence of the industrialization structure is presently nothing unusual in many oil exporting developing countries. It is also known from economic history of some European countries. In the economy of these countries as well as in a few more advanced developing countries (some NICs, e.g. Taiwan), industry became the largest sector not because of mining (oil) but because of their progress in manufacturing. While the share of mining in Nigeria was 33 per cent (oil 32 per cent) of GDP, the share of manufacturing was merely 6% of this aggregate indicator.

Since it is primarily manufacturing and by no means mining, which brings about technological progress and has a big potential to affect through a great many inter-sectoral as well as intra-sectoral linkages the overall process of economic development, its low share in total production of goods and services in Nigeria shows its limited capacity to perform this function properly. The argument that Nigerian manufacturing yet produces about one-fourth or one-fifth of manufacturing value added in developing Africa only demonstrates its underdevelopment in this continent. Manufacturing in Nigeria should therefore expand.

Another structural weakness of Nigeria's manufacturing can be shown on its own industrial structure. Industrialization is associated, inter alia, with a marked shift away from the traditional structure of manufacturing toward a more advanced structure. In Nigeria, nevertheless, the so-called traditional

industries (in a sense that they were established a long time ago), such as food, textile and allied industries, still prevail. It can be expected that modern industries, chemical, metal machinery and allied industries, are likely to grow at more rapid rates as experienced by many advanced developing countries.

It has also been found that manufacturing in this country was characterized by relatively low productivity, high cost of production, heavy dependence on imports of materials and equipment, low value added and geographical allocation in metropolitan areas. Moreover, it is virtually oriented on internal areas. Moreover, it is virtually oriented on internal market and its export effect is practically non-existent.

Irrespective of these weaknesses, manufacturing in Nigeria has already made some progress. Some of its foundations have been built. A new class of indigenous private entrepreneurs was born and increasing number of foreign companies seem to be interested in doing business in this country. The country possess rich material resources and relatively skilled and cheap labour force. It has also the largest single market in Africa. Based on these factors, it can be expected that greater progress could be achieved in the future than in the past providing that a suitable strategic approach to Nigeria's manufacturing will be adopted.

Actually, Nigeria has got a limited choice in selecting the basic strategy orientation of its future development. It cannot rely on its oil wealth as much as in the past because of uncertainties associated with the position of oil on international markets. The development of agriculture, though highly important and virtually indispensable, can hardly be considered as a meaningful development alternative. For one, agriculture and industry must go hand in hand because modern development requires the strengthening of linkages between these two sectors. For another, it is not agriculture, but industry, and manufacturing in particular, which brings about technological

progress and possesses much larger growth potential in the long-run.

In concluding this growth and structural change analysis, three points should be stressed:

First, the high priority consideration attached to further industrialization of Nigeria is correct. The so-called deindustrialization is a false slogan for developing Africa. In Nigeria, favourable conditions for a new drive to industrialize prevail.

Second, industrialization in Nigeria should not be confined just to industrial development. It should be understood as a process of economic growth and structural change, characterized by rapid growth and increased share of industry in total production of goods and services with emphasis on progress in manufacturing and linkages with agriculture and services sector.

Third, the new emphasis on industrialization and its core, manufacturing, in the changing internal as well as international conditions requires new and fresh approaches and strategies.

The strategic management of industrial progress represents a fairly new and hopeful strategic approach to solve the problems of industrial development in Nigeria more efficiently than in the past and deserves full support.

2. Other Issues

A. Self-sufficiency in food and raw materials

The attainment of higher levels of self-sufficiency in the production of food and other raw materials is emphasized as the first key objective in the Federal Republic of Nigeria First National Rolling Plan 1990-92 (p.14). Its attainment will influence, though in varying degrees, actual performance of all industrial sub-systems covered by SMID. Hence, the conceptual clarification on this objective is essential.

It has been rightly explained that this objective should be understood in a relative sense. In other words, it does not imply that absolutely full self-sufficiency should necessarily be achieved. It does imply, however, that the degree to which consumption requirements are met by local supply, should considerably increase.

It should also be added that this issue ought to be interpreted in the context of the leading tendencies of world development. The strengthening of internationalization in the world and the growing interdependence among all countries make actually any efforts at absolute economic self-sufficiency (autarky) misleading. Self-sufficiency in food should mean, e.g., that the country in question will attain a proper balance between its food exports and imports or will export more food than import. The large economic size of Nigeria does not make any difference in this respect. Actually, even the largest economies in the world cannot afford to ignore their increasing dependence on world development. Otherwise, they would be condemned to lag seriously behind the world progress.

B. Import Substitution and Export Orientation

In the past, Nigeria followed essentially the import substitution strategy in its manufacturing development. Most

Nigerian economists are of the view that this strategy resulted in many weaknesses and that it remained in its easy processing stage in a number of cases. The self-sufficiency objective in food and raw materials is likely to orient transition of import substitution toward its more difficult stage, that is, processing local raw materials and supplying intermediary products. On the contrary, Industrial Policy of Nigeria emphasizes "increased export of manufactured goods" on the second place among elements of the major objective of government industrial policy (page 12).

In evaluating the relationship between trade orientation and growth, IMF World Economic Outlook in its October 1990 issue shows that strongly outward oriented countries achieved the best growth results, followed by moderately outward oriented countries. Moderately inward oriented economies attained less satisfactory results and strongly inward oriented ones finished with poorest results (page 90-91). In the attached analysis, Nigeria is mentioned among countries which have recently stimulated export activities and tried to diversify their exports.

In this connection, it is pertinent to note that among the most successful countries included in the first and second categories (fast growers) are primarily Asian newly industrialized countries (ANICs) and some ASEAN countries. Although the export-led and/or export oriented strategies prevailed in their economic policies in the last decade, most of them (except Hong Kong) relied, at least temporarily, on some import substituting protective measures in earlier periods. Moreover, some of them used export promoting and import substituting policies at the same time. In their strategy, however, a realistic exchange rate system, encouraging exports, has always dominated and quantitative controls of imports have been used exceptionally or not at all.

It is true that an efficient combination of both strategies is very difficult to achieve. Some Asian economies, including

some ANICs and ASEAN, have managed to do so. This experience may inspire the government of Nigeria to attempt a similar approach to expanding its exports of manufactures. The argument that the difference in economic size and resource endowments between ANICs or ASEAN and Nigeria is essential and makes it difficult, if not impossible, to draw upon their experience, is not applicable, for instance, to Indonesia. These two countries have got a number of characteristics (large size in terms of area, population and GNP, rich natural resources including oil and vast internal market) in common.

In the light of this analysis, it should be considered whether or to what extent the priority sub-systems should be granted, at least temporarily and on a selective basis, some more advantages promoting exports of their products and imports of some necessary inputs concurrently.

C. A Note on Marketing, Protectionism and Regional Blocks

As already claimed, increased exports of manufactures is one of the priority objectives of industrial policy in Nigeria. In compliance with this objective, most industrial sub-systems, depending, on the one hand, on imports of raw materials, semi products and machinery inputs, desire, on the other hand, to supply not only internal market but also to export their products abroad. Hence, international marketing is undoubtedly one of the issues analysed, though in varying degrees of depth and length, in most sub-system studies. Here, only three points concerning this issue are brought up.

First, most developing countries export their manufactures to the developed market economies of North America, West Europe and Japan. Central and East Europe as well as Australia and New Zealand represent much less important markets. In view of increasing trade imbalances, especially in the last decade, the developed countries started to protect their markets by means of both, tariff and non-tariff measures, such as quotas, the so-

called voluntary export restraints, countervailing duties, and so on. Many developing countries have increasingly protected their markets as well.

In these circumstances, most countries, irrespective of whether developed or developing, felt that the time came to launch a new international initiative attempting to increase trade and investment flows through world-wide economic liberalization. These ensuing international trade liberalization negotiations, known as the "Uruguay round", started in 1986, took four years and were broken down in 1990, without reaching any satisfactory agreement. It would be in interest of most participating countries to renew these negotiations as early as possible. Providing that some satisfactory results are reached, even Nigeria's efforts to expand its exports of manufactures would not encounter so many barriers and would undoubtedly be easier to implement.

Second, beside the threat of growing protectionism, another distinct international trend tended to strengthen a great deal, namely the gradual creation of powerful regional markets. In 1992, a single market will be created in the European Community (EC) and custom union called "European Economic Space" is likely to unify the EC and the Europe Free Trade Association (EFTA) in one integrated whole in the foreseeable future. Moreover, the "North America Free Trade Area", integrating the United States, Canada and Mexico is presently emerging. The third trade regional centre, though not yet institutionalized, may be established in East and South-East Asia, embracing Japan, Asian NICs and ASEAN, possibly also Vietnam and in a way even China.

Japan, thanks to the appreciation of Yen in relation to USD and its growing per capita income, started opening up, albeit rather slowly and gradually, its economy. This led to an unprecedented increase in Japanese imports. This opportunity has recently been taken full advantage of mainly by some developing

Asian countries, but it gives some chance also to other countries, too. However, this growing regionalism in Europe, North America and Asia (i) tends to reduce the access of other countries to these markets and (ii) gives an undeniable advantage of member countries of these groupings (real or potential) to export and import manufactures to integrated markets.

Third, the East-European integration grouping (Council for Mutual Economic Assistance) does not exist any longer and its market is falling apart. Most countries endeavour to become associated members of EC in a short-run and full members of this grouping in a long-run. During this transitory period, however, new opportunities arise for greater economic co-operation between some countries of Central and East Europe, especially Czechoslovakia, Hungary and Poland, and developing countries. In their efforts to decrease their oil dependence on the USSR, they are interested to import oil and gas from developing countries, including Nigeria, and to export manufactures, mainly machinery and equipment, and develop other forms of economic co-operation.

On the basis of this general analysis, the prospects for expanding Nigeria's exports, particularly exports of manufactures, do not seem to be too bright. One strategic option - to concentrate on the strengthening of economic and trade co-operation with other developing countries, particularly in Africa, is self-evident. There may be also a possibility to develop more co-operation with Asia, Japan and Asian NICs in particular. New opportunities are opening in the Central and East Europe. Though some of these countries are interested mainly in Nigeria's oil and gas supply, and in exporting their machinery, technology and equipment, they offer also new forms of economic and industrial co-operation, such as production sharing and various forms of mixed enterprises. A good chance for Nigeria's manufacturing thus appears to meet new partners and find new markets. It is, of course, understood that high quality and competitive prices are the necessary conditions for future co-

operation, based on the principle of mutual advantages and the intention to develop this co-operation in the long-run.

In concluding, the present world economic situation is so complex and so uncertain, that it makes it very difficult, if not impossible, to suggest a proper market orientation for Nigeria's manufacturing exports. Also, the subject is rather wide and diversified. Two kinds of market studies should be undertaken, preferably in co-operation with UNCTAD and UNIDO: The first one, dealing with marketing implications of the changing world economic situation, and the second one, analysing the market prospects and strategies for Nigeria's priority sub-systems.

D. Social Aspects and Employment

All sub-system studies have been designed to provide comprehensive structural characteristics of each priority sub-system. They have been concentrated especially on technology, marketing, strategic directions and policy measures. Most of them analyze, though in varying measure, also some manpower and employment problems. In general, however, employment issues and, more broadly, social aspects of industrial development have been of secondary importance and perhaps somehow under-estimated by the authors of most studies.

In Nigeria, however, social problems are of primary importance. "The population explosion" reaches presently its peak (3,3 per cent a year) and the World Bank predicts that the number of population will have reached approximately 160 million by 2000 and more than 302 million by 2025. It is also envisaged that Nigeria is likely to become not only the most populated African country but also the third most populated country in the world. Its population will supposedly exceed 6 hundred million when it reaches its hypothetical stationary stage (World Development Report 1990, p. 218). Correspondingly, such problems as excessive disparities in income distribution, incidence of absolute poverty

and provision of employment opportunities deserve great attention now and even more so in the future.

The Government of Nigeria is well aware of economic and political implications of this population drive. For instance, the three-year Rolling Plan suggests, perhaps rather belatedly, "laying the foundations for gradually reducing growth rate of the population" among its seven priority programmes (p. 15). But the most pressing problem is undoubtedly the growing unemployment. The most recent official unemployment data (1989): 4,0 per cent overall, 7,5 per cent urban and 3,2 per cent rural unemployment (Central Bank of Nigeria Annual Report and Statement of Accounts 1989, p. 2-3) seem to be rather optimistic and hardly reflect the actual situation. The fact that unemployment problem is much more serious is expressed in Industrial policy of Nigeria. "Providing greater employment opportunities" (p. 12) is emphasized as the top priority element of the principal objective of government industrial policy.

The implementation of the industrial policy employment objective is much more difficult than its formulation for several reasons. The first one is of structural nature. The experience of a majority of developing countries indicates that, while the sectoral structure of GDP changes dramatically in the course of industrialization, no basic change in the structure of employment materializes. The minor changes noted in the economy of Nigeria (see Table 2) took place within the existing traditional structural pattern (A-S-I).

Table 2**Nigeria: Sectoral structure of employment****(1977 - 1990)**

	Agriculture	Industry	(Mining)	(Manufac-	Services	Structural
				turing)		Type
	A	I	(Mi)	(Ma)	S	
1977	62,3	18,2	0,4	16,8	19,5	Traditional: ASI
1990	60,7	12,7	0,5	10,0	26,6	Traditional: ASI

Source: Based on Investors Guide to Nigeria, UNIDO in co-operation with the Federal Republic of Nigeria, (p.5).

In many developing economies, Nigeria being no exception, the production effect of industrialization is much stronger than its employment effect. Under the contemporary conditions of continuous technological progress, driven forward by severe competition on world markets, and only slowly decelerating rapid population growth, it is primarily industry which brings about modernization. This sector alone is unable to generate a similar expansion of employment opportunities. Consequently, new jobs have to be provided also by agriculture and the services sector. Like in other developing countries, particularly in Asia, Nigeria should consider to adopt the all sector approach to solving the problem of employment rather than relying on industrial development alone.

Of all industrial sub-sectors, manufacturing provides the largest share in industrial employment. Also in Nigeria, despite its decline due to the recent crisis, this share attained about 10 per cent of total employment. Hence, its role in implementing the employment objective is not entirely negligible. Manufacturing expansion can contribute to its achievement directly, through its own expansion, and indirectly, through its linkages effect on the remaining sectors.

Its direct effect is, of course, rather weak, owing to a heavy reliance on modern technology which requires quantitatively limited, but skilled manpower rather than numerous and unskilled one. Yet some practical examples in Nigeria show that the employment effect could be to some extent maximized even in modern factories (see Chapter III., Section 3 Pharmaceutical Products). While all major processes which determine the quality of final products are based on modern, usually capital-intensive, technology, all auxiliary processes, such as packaging, internal transport and some other should preferably rely on rather traditional or semi modern labour-intensive technology.

Moreover, the direct effect of manufacturing on employment creation could increase considerably providing that the position of small-scale industries in Nigeria's industry and its role in Nigeria's industrialization will properly strengthen. This issue is rather complicated by its very nature and requires a more detailed elaboration. The following section (II. 2. E) attempts to throw some light on the relationship between the development of small-scale industries, technological progress and some social issues, including employment, education, training, etc. worked out in some detail also in the analysis of nine sub-systems (Chapter III.).

Even on the basic of the preceding analysis, however, two general recommendations should be duly considered: First, social aspects of industrial development should be included in the

Guidelines for the Industrial Master Plan. Second, the employment analysis in most sub-system studies should be strengthened.

E. Small-scale industries and related issues

In the process of industrial development, the scale of production forms a wide spectrum from large through medium to small scale and includes also village and cottage industries. As reflected in most sub-system studies, large-scale enterprises play the major role in Nigeria's manufacturing. Although their position varies from one industry to another, their leading role is undeniable at present and is very likely to remain so in the future. This tendency stems primarily from the relationship between the introduction of modern technology and large-scale production which still persists in many industries. It is also influenced substantially by the large size of the Nigerian economy, its rich resources and big market. Moreover, if the role of modern technology and large-scale production in industrial development of this country does not carry on, the industrial and technological gap between Nigeria and industrialized countries will widen further.

This does not imply, however, that the present position of small-scale and allied industries, which appears to be rather weak, should not be strengthened as well. It is known, for instance, that the scope is growing for the application of highly efficient modern technology in medium and small-scale enterprises in some manufacturing industries (mini steel plants, mini fertiliser plants, mini paper mills). Many industries supplying goods and services to local markets, particularly in the rural areas, provide excellent opportunity for small-scale industries, village industries and cottage industries which may use whatever appropriate technology is available. In some cases, it is a simple, capital-saving and labour-intensive traditional technology or, to be more precise, a modified traditional technology. Small-scale and allied industries based on such appropriate technologies have distinct advantages in the

utilization of local materials and skills, low marketing costs, high market flexibility and, last but not least, strong employment effect. They also contribute to increase incomes in the countryside. These are some of the main reasons why the development of small-scale industries should be supported also in Nigeria where industry is concentrated heavily in Lagos and few big cities.

A more rapid growth of small-scale industries would be facilitated if a more intimate and stable economic and technical collaboration could be established between large-scale and small-scale industrial enterprises. It should be recalled that such different Asian countries as Japan, on the one end of the spectrum, and India , on its other end, have experienced successful industrial development of both large-scale and small-scale enterprises based on their mutual co-operation. For example, Indian "nucleus plants" have demonstrated the central role of large-scale enterprises in providing the stimulus for the establishment of ancillary small-scale enterprises in the rural areas. The Government of India continued its long-term support of small-scale industries for four decades and contributed so to the alleviation of the employment problem in that country. The United Nations Economic and Social Commission for Asia and the Pacific even adopted the strengthening of linkages between large-scale and small-scale industries as one of the most important principles of industrial policies reorientation some time ago.

It should be worthy of considering whether this experience should not inspire the government in co-operation with representatives of the private sector to prepare a programme supporting the development of small-scale industries in Nigeria. In the process of preparation of such programme, a number of economic as well as social issues have to be resolved. For instance, a rigorous appraisal of cost effectiveness of small-scale industry projects is of primary importance since small-scale production units have to be efficient and viable. It should also be taken into account that the implementation of small-scale

industry programmes in the rural areas requires to build up necessary infrastructural facilities which are costly and have a long gestation period.

The development of small-scale industries with emphasis on rural areas has serious implications for the development of human resources. It should be explicitly mentioned that this issue deserves special attention in Nigeria in view of its numerous population, rapid growth and changing age structure. The share of the population in productive age, particularly the young one, tends to increase. Many young people may find jobs in small-scale enterprises, but even the development of small-scale industries based on the use of appropriate technologies involves necessarily some technological improvements. This implies new requirements for workers knowledge, experience and skill. If these requirements are to be met, a heavy burden on educational resources, will certainly grow further.

True, some more advanced small and medium-scale enterprises can themselves organize special education and training courses for their employees or share in their organization. Nevertheless, for a majority of small-scale and allied enterprises, such forms of education and training, excepting perhaps a simple "on the job" training, are largely beyond their possibilities. Hence, the government involvement in this sphere, possibly with external assistance, is needed.

Irrespective of however important this special education and training of personnel for the development of small-scale and allied industries may be, it is just a part of the wider issue, i.e. education and training of skilled manpower for industrial development. In a broad sense, the solution of this issue requires, inter alia, general educational expansion, expansion of technically-specific education, industrial training and skill formation. A number of suggestions to resolve these tasks at various levels are presented in the next chapter (Chapter III.) specified by individual sub-systems. The accomplishment of these

tasks requires a close collaboration between industrial and educational policies and active involvement of both the government and the private sector in integrating industrial and educational development.

F. The Economic Role of the State

As pointed out in the preceding text (Chapter I.), greater reliance on advantages of market mechanism and related shift away from the emphasis on the public sector toward the private sector in industrialization of developing countries, does not necessarily mean that the role of the State in the economy of these countries drastically declines at the same time. True, in the process of privatization, the state gets rid partly of its responsibilities for running public enterprises, but its involvement in economic and social development still remains essential. Moreover, it should be borne in mind that privatization is meaningful if it leads to increasing efficiency of privatized enterprises. And in order to achieve this objective, the proper preparation of the privatization programme by the government is a *condicio sine qua non*. It should also be noted that privatization of large public enterprises in oligopolistic positions is unlikely to bring about higher efficiency if it is not accompanied by creating the competitive environment supported by concurrent liberalization measures. If public enterprises cannot be privatized for whatever reason, attempts should be made to revitalize them as experienced in a number of Asian countries (Industrial Restructuring in Asia and the Pacific, ESCAP Bangkok 1991, p. 111 - 142).

Despite the existing differences in opinions on the appropriate role of the State in the industrialization of developing countries, it is mostly agreed that the State should remain responsible primarily for building up economic and social infrastructures, supplying other important services to the private sector, supporting or, more precisely, regulating its

expansion through various economic policies, including those attracting private foreign capital inflow. It should also fill the gaps left in the economy by market failures. In particular, it should pay growing attention to continuous surveillance of environmental and social problems and adopt effective measures to resolve them. Exceptionally, the State should not hesitate to invest in directly productive activities if such investment is vital for the sake of overall development and the private sector is unable to do so. Finally, initiation of major economic reforms, structural adjustment programmes and, last but not least, indicative planning are also the responsibility of the State in most developing countries.

This selective list of economic and social activities supports the motion that the role of the State in the economy remains essential even if the private sector assumes much greater responsibility for the process of industrialization. Also, it gives the state a good opportunity to concentrate on the remaining duties and improve its performance. These notions as well as the main observations mentioned above are applicable fully to the role of the State in Nigeria when the SMID concept is elaborated and executed.

The State (in co-operation with international institutions involved) should participate very actively in preparing and introducing the SMID approach in practice at all stages of its development. In particular, high level government officials entrusted with due responsibilities and decision making power should be full members of all major bodies of the institutional structure of SMID. Also, the State should contribute to finance SMID operations. Without the active and strong government involvement, the so-called interactive process between the private and public representatives can hardly fulfil expectations.

III. NINE INDUSTRIAL SUB-SYSTEMS: A BRIEF ANALYSIS AND SPECIFIC SUGGESTIONS

1. Foundry and Forges (Jaroslav Benda)

A. Basic Characteristics of the Sub-system

The foundry and forges sub-system constitutes an important part of engineering industries which play a significant role in the achievement of accelerated pace of industrial development. Foundry and forges are core industries producing parts and components for a wide variety of consumer durables, intermediate and capital goods. The uniqueness of founding and forging lies in the fact that in many cases it is the simplest, most economic and frequently the only technically feasible method of obtaining a required solid shape of products. The linkage potentials of the foundry and forges industry are wide and diversified. They range from iron and steel industry, on the one hand, through automotive and engineering industry, to textile industry, on the other hand.

B. Identification of main problems and constraints

The needs for castings and forgings in Nigeria are enormous. The demand is partly covered by imports, partly by domestic production. However, for a number of reasons, the existing capacity utilization is only about 22 per cent.

The whole sub-system is characterized by poor development as a result of a combination of various factors, such as operational constraints, unorganized marketing strategy, poor funding, inadequate infrastructure, etc. Lack of effective backward linkages in metallurgical industry has contributed immensely to this sub-system's high dependence on imported material and machinery inputs. Another shortcoming characterizing the relatively low level of development of this sub-system is that, so far, there is no production of die-forgings.

A detailed list of the main problems and constraints, subdivided into technical, production, marketing, financial and infrastructure ones, is analysed in Volume Two (Appendix II.) of this report.

C.D. Strategic directions and suggestions:

In this section, the international sub-contractor concentrates on several basic strategic directions and specific suggestions in addition to those which have been prepared by the authors of the sub-system diagnostic study.

- (a) Since there is no production of die-forgings in Nigeria and imports of these products would be uneconomical in the long run, it is suggested that this branch of the sub-system should be established and developed in this country. To attain this objective, first a feasibility study should be prepared, preferably in co-operation with UNIDO.
- (b) One of the high priority considerations should be given to rehabilitation programmes in factories that find themselves at a relatively low technical and economic level. These programmes should also contribute to achieve a higher capacity utilization in cast iron and steel foundries.
- (c) The foundries and forges sub-system should further be developed on step-by-step basis in accordance with the growing demand and related changes in its structure. The expansion of other sub-systems will stimulate their production through a combination of forward/backward linkages. It is believed that greater progress in maximizing local content in production cost of many import dependent manufacturing factories/assemblies could be made by the expansion of foundries and forges production.
- (d) In view of unclear prospects of export possibilities of this sub-system, it is suggested to undertake a comprehensive marketing study. This study should comprise, inter alia, the

rules for market research and should result in the proposal for a realistic export strategy of this sub-system.

- (e) In view of the fact that the development of the foundries and forges sub-system is a complex, complicated and difficult task, international assistance should supplement internal efforts. Further co-operation of UNIDO, UNCTAD and, possibly, also UNESCO should be sought, particularly in the field of education and training.
- (f) One of the relatively easy and economical ways to expand this sub-system, particularly in the rural areas, is to support the development of medium and small-scale enterprises. These enterprises may extensively rely on the use of simple appropriate technologies. The expansion of jobbing foundries and jobbing forges, very popular in many developed and also in some developing countries, should also be supported in Nigeria.
- (g) As mentioned above (e), education and training play an important role in upgrading the quality of production and in achieving a higher economic efficiency of the sub-system. It is suggested that various training centres for skilled workers and foremen, high specialized schools for technicians, and university courses for top managers and engineers should be organized. Special attention should be paid to education of teachers at all levels.

2. Metal Fabrication (V. Sitenský)

A. Basic characteristic of the sub-system

The metal fabrication sub-system plays a very important and, in a way, even vital role in the process of development of the manufacturing sector in Nigeria. It is closely linked with the primary, fabrication and capital goods industries. The study, prepared by a team of Nigerian specialists, provides a fairly comprehensive analysis of the current state of the sub-system and its role in the industrial development of the country. It also indicates gaps and weak linkages within the sub-system, formulates main goals and strategies, and suggests a number of development scenarios.

B. Identification of major problems and constraints

The major problems and constraints of the sub-system were identified well by the authors of the study. They emphasized that these problems and constraints are a reflection of the policy failures that historically characterized Nigeria's industrial sector, particularly with respect to manpower development and training, raw materials, planning, external dependence, inefficient infrastructures and weak linkages with other sectors.

In the opinion of the international sub-contractor the ranking of the major problems is as follows:

- (a) Practically, all the raw material inputs for this sub-system have to be imported (flat sheets, alloy steel, aluminium).
- (b) The vast majority of spare parts for the machinery in use in the country must also be imported.
- (c) Low capacity utilization and low local value added.
- (d) About 80 per cent of the production technology in use are obsolete.

- (e) Inadequate and inefficient infrastructure, particularly electricity, water, transportation and communication.
- (f) The shortage of designers and workers at lower skill levels in areas as welding and machinery.

The factors which have hindered the growth of production in the sub-system such as scarcity of raw materials, spare parts and machinery are, of course, important. All of them could be improved, however, through rehabilitation and modernization mainly on the basis of investment in this sub-system. This implies that Nigeria's prospects for growth in the metal fabrication industries heavily depend on thoughtfully selected investment and investment policies.

Economic rehabilitation and growth depends not only on internal efforts, but also to an increasing extent on external forces. In this regard, the role of private direct foreign investment can hardly be overestimated. In the view of international sub-contractor direct private foreign investment, bringing about new technologies, new management, progress in organization and provide a new employment opportunities. In this connection it is encouraging that a system of incentives to attract the inflow of foreign capital has been issued recently. (Investor's Guide to Nigeria by UNIDO and Federal Republic of Nigeria).

C. Strategic Directions

(a) Steel Production Plants

The metal fabrication industry basically transforms steel into various products for both household and industrial uses. Almost all raw materials are imported, some of them, especially angles, channels, joists, bars and rods from carbon steel are locally available. Other steel types, like the cold rolled sheets and alloying steel, are still being imported. For further development, it is necessary to build-up the second phase at

Ajaokuta, to produce sheets and strips (spiral welded pipes), including deep-drawing steel by continuous casting of slabs technology HDR (Hot direct rolling) on CSP (compact strip process). The following firms: Danielli (Italy), Vost Alpine (Austria), Demag (FRG) can supply the needed technology and equipment.

In respect of alloying steel, its production in the arc furnace requires imported ferro-alloys. The world prices from May 1991 are as follows:

FeCr	-	1,1	-	1,67	USD/kg
FeMn	-	0,69	-	1,2	USD/kg
FeMo	-	6,95	-	7,3	USD/kg
FeW	-	6,4	-	6,5	USD/kg
FeV	-	14,0	-	14,2	USD/kg

It is necessary to make a choice between imports of alloying steel, on the one hand, and its local production, dependent, of course, on imported ferro-alloys. Such a choice has to be made on the basis of a detailed cost-benefit analysis.

(b) Aluminium Industry

The Nigerian aluminium industry comprises about the post-smelting enterprises engaged essentially in transforming imported ingots into finished products.

The anticipated growth in demand foreseen for aluminium can be solved by aluminium smelting plant at Ikot-Abasi with annual capacity 180,000 tons. About four tons of bauxite (Bayer process) are needed which, in turn, yield one tone of aluminium. The production of aluminium from alumina is highly energy (15-16 MWh/t Al only electrolysis) and capital intensive. Another possibility is to import alumina and to build-up rectifiers, anodes plant and electrolysis cells. This possibility should be taken into consideration particularly in view of environmental damage caused by red mud.

The world market of aluminium is dominated by big companies (Alcoa, Alcan, Pechiney) and the updating price of aluminium is 1,320 - 1,340 USD per ton (purity 99.7%). There is a surplus of aluminium on international market at present. The local production of aluminium gives a possibility to increase production of products such as varnished foils for food industry and AlSi foundry alloys for precision casting with grain refinement and modification using Al-Ti-B and Al-Sr alloys. (Kawecki-Billiton, the Netherlands).

(c) Spare Parts

One of the major problems, accompanying also other sub-systems, is lack of spare parts. More than 75% of the metal ones are imported. Spare parts represent a strategic commodity with linkage on foundries and forges. It is therefore advisable to join forces and create conditions for production of big series of spare parts without necessarily constructing new plants and/or halls.

The following types of castings can be made:

- industrial and agricultural spares;
- manhole covers;
- railway spares (brake blocks);
- non-ferrous bearings, bushes.

The different components that can be forged are as follows:

Machine Tools:

- bolts and nuts;
- main spindles;
- gear blanks;
- hydraulic cylinder blocks;
- levers, shafts, cams.

Parts for tractor and transport vehicle:

- leaf springs, coil springs;

- overhaul of engine;
- railway spares;
- connecting rods;
- crankshaft;
- hubs, levers, valves, axles.

There is a chance to consider the building-up of a forge shop with annual capacity of about 2,000 tons of forging components at Oshogbo, Nigeria Machine Tools Limited.

In order to modernize effectively the spare parts and allied industries, powder metallurgy technology should be introduced. This technology enables to reach high efficiency and utilization of metals (up to 98%) with relatively low production costs. In the first stage, the iron powder could be imported with expansion programme to produce 10,000 - 20,000 tons per year of details such as gears, pinions, bushes, sliding bearings, etc.). Available facilities required presses with feeders, sintering furnaces and calibration presses (e.g. Mannesmann, FRG).

(d) Scrap Collection

The sub-system suffers from lack of raw materials. By contrast, there is not any systematic collection and separation of ferrous and non-ferrous scrap for recycling. Two types of scrap can be identified:

- primary scrap which originates in manufacturing processes;
- secondary scrap, based on used or obsolete products.

If the scrap exists in a metallic form, like steel, aluminium, copper and lead, the scrap metal material (aluminium cans, vehicles, household appliances, leadacid batteries) can serve rightaway as a feedstock for a significant secondary refining industry.

Recycling of secondary scrap should be encouraged. The costs of collection and separation could be covered by establishing a buy-and-sell network which could be very easily self-financed.

(e) Technological Development

As a supplement to major directions in technological development suggested in the sub-system study, the following technologies are proposed:

- plasma jet (torch) cutting of stainless steels;
- plasma coating, that is, wear-resistance and anti-corrosion surface layers;
- laser beam treatment (hardening);
- CNC centres with many operations and shapes of product;
- rigid lathes and cutters using tools from sintered carbides, synthetic diamonds and cubic boron nitride tips or ceramic inserts;
- the introduction of new advanced materials - composites and engineering ceramics in gradual stages.

(f) Appropriate Technology

The metal fabrication industry produces an extensive range of various products. While some of them have to be produced in modern capital intensive and large-scale production units, other can be produced in medium and small-scale enterprises. These can operate particularly a number of downstream industries and maintenance/service facilities. Such enterprises can use appropriate devices and labour intensive technologies.

D. Suggestions

In this section three additional propositions are suggested for inclusion in strategic guidelines of this sub-system:

(a) Research and Development

In order to accelerate scientific and technological progress in Nigeria, an attempt could be made to introduce medium-term or long-term planning or programming of scientific and technological development.

On the basis of an in-depth-analysis the most appropriate lines of scientific and technological development should be chosen jointly by the representatives of the Government and the private sector, Universities and the research institutes. The Government budget could finance about a half of total expenditure while the other half should come from private sources and from foreign assistance.

(b) Manpower Training

In order to improve technological skills and capabilities in the metal fabrication sub-system, it is advisable to promote various on-the-job and off-the-job training courses. It is also advisable to make use of services of expatriates with extensive foreign experiences in metal fabrication as teachers and instructors in technical courses.

(c) African Co-operation

In the long-term development, the possibility of co-operation among African developing countries should not be lost of sight. In particular, metal fabrication projects, exceeding the limits given by national frontiers, should be prepared jointly, on regional or sub-regional basis. Such a co-operation has undeniable economic advantages. However, it also encounters a number of various obstacles. For this reason, the possibilities to achieve this objective should first be examined in the framework of ECOWAS.

3. Pharmaceutical Products (J. Křepolka)

A. Basis characteristics of the sub-system

The Nigeria's objective for its pharmaceutical industry is to make available at all times and in all parts of this country comparable conditions for its health care system by supplying safe, effective and good quality drugs. The health care system is now dependent on imported drugs. The share of imports in consumption of drugs is about 70 per cent. Paradoxically enough, local manufacturing drug capacity is utilized at less than 30 - 35 per cent due mainly to shortages of raw materials. Pharmaceutical companies possess the industrial and technical potential to manufacture most of the drugs covered by the National Essential Drugs List. The development of the pharmaceutical sub-system is influenced adversely by the following factors: capacity underutilization, shortage of raw materials, small capacity in injectables and ophthalmologics, inadequate economic policy (tariffs, duties, taxes), insufficient incentives for private investors to support extensive and intensive investments, and weak linkages of various industrial sub-systems with pharmaceutical industry and agriculture. Also, underdeveloped infrastructure, concentration of pharmaceutical companies in the urban areas, poor storage facilities and problems affiliated with the distribution of drugs are further characteristic factors limiting its development. Moreover, the pharmaceutical market is penetrated by faked and adulterated drugs from unregistered suppliers.

B. Identification of major problems and constraints

The total market of drugs in 1990, estimated at about 1.69 billion Naira, was covered only by 30 per cent of local production. Many pharmaceutical companies utilize less than 30 - 35 per cent of their installed capacities. Among the factors mainly responsible for these shortcomings absence of integrated industrial policy covering the present as well as future needs of

this sub-system, unsatisfactory distribution network of drugs and weak infrastructural facilities should especially be mentioned. Nigeria with its huge economy and largest single market in the developing Africa has favourable conditions for building up the pharmaceutical sub-system and future exports of drugs. This goal is, at least for the time being, too far away and the development strategy should be planned stepwise on the basis of a detailed analysis of the following problems:

- (a) Technology: There is no pharmaceutical fine chemical industry on stream and the first multi-purpose plant for manufacturing of paracetamol and ampicilline is under construction. The level of processing technology and its capacity in ophthalmologics, vaccines and small-volume parenterals is unable to meet the increasing demand.
- (b) Quality of Processing Machines: The technological level of processing machines is appropriate to local conditions and is conveniently combined with labour intensive technology. Some other serious problems are connected with the shortage of spare parts.
- (c) Product Quality: The system of the GMP is implemented in all visited and contacted companies, including in-process quality control. The highest quality has been achieved in multi-national companies and several large-scale indigenous ones. In most smaller companies, the conditions for the GMP rules will have to be improved stepwise, strictly meeting the guidelines issued by PMGMAN in 1991. (Pharmaceutical Manufacturer's Group of Manufacturer Association of Nigeria).
- (d) Availability of Raw Materials: 90 per cent of raw materials are still imported. Locally obtainable materials don't meet the reliability and pharmaceutical grade quality requirements.

- (e) Industrial Linkages: Linkages of pharmaceutical industry with the key sectors (petrochemical, engineering and agrc-allied industries, infrastructure) are weak and unreliable.
- (f) Marketing: There is probably no official body making periodic analyses of the evolution of drug consumption in the most important therapeutical classes, including forecasts of future needs. Private pharmaceutical companies are planning the establishment of a pharmaceutical Market Audit Group for monitoring sales and marketing research of drugs.
- (g) Manpower and Personnel: The present quality of manpower corresponds to the present level of technology. For more modern technologies, training programmes should be prepared in advance.
- (h) Research and Development: The R and D activities, lagging behind the needs, exist in both public and private enterprises, concentrating on practical improvements in commonly used products and processing technologies. The R and D programmes suffer from lack of funds and seems to be scattered on too many problems.
- (i) Bureaucracy: The real position of pharmaceutical sub-system in the National Drug Policy is not clearly specified. The PMGMAN and the NIPMA (Nigerian Indigenous Pharmaceutical Manufacturers Association) make efforts to facilitate many cumbersome interrelationship and procedures among local drug regulatory bodies.

C. Strategic directions

- (a) Higher utilization of installed capacities: The present installed capacities of pharmaceutical companies are sufficient in tablets, liquids and powder dosage forms. Their higher exploitation needs urgently a reliable supply of raw materials in pharmaceutical grade quality. Under the present

conditions, this objective can be achieved mainly through imports because the local production is not yet prepared to meet high quality requirements. The self-sufficiency goal cannot be achieved without establishing the necessary industrial linkages in a short time. The gradual substitution of imported raw materials for locally produced ones (starch, sugar, alcohol, inorganic salts, talc, glass, plastics, cellophane) could be attained in the course of 2 - 3 years at best.

- (b) Step-by-step expansion of small processing capacities: The critical shortage of manufacturing capacities of small-volume parenterals and ophthalmologics can be solved only on the basis of building up new facilities or operating units meeting the strict requirements of the GMP. Similarly, it is possible to increase the capacities for hard and soft gelatin capsules and topical drugs (ointments, creams). The strategies could probably reduce the dependence of the local drug market on imported drugs to about a half of the present needs by increasing the utilization of installed capacities to 60 - 70 per cent within 2 - 3 years.
- (c) Growth of local production of raw materials: Local production of auxiliary materials and active substances has to be analyzed from the point of view of necessary investments and possible economic effects. Prior to a final decision, a thorough marketing research should be made not only to determine the needs of pharmaceutical companies, but also to estimate future export possibilities. In the case of bulk production of active substances, the progress can be planned only in relation to the future production of petrochemicals and chemicals. The construction of the multi-purpose plant for paracetamol and ampicilline production (TOKI DABUR, IKEJA) is paradoxically based on imports of nearly all necessary chemicals and intermediates. Convenient technologies for bulk production of raw materials would have

to be purchased abroad because indigeneous R and D is not able to ensure local supply of these technologies.

- (d) Utilization of local raw materials: The future development of pharmaceutical sub-system needs its own production of new drugs on the basis of antibiotics and vitamins. Nigeria has favourable conditions for fermentation processes from local sources (sugar, starch, corn-steep, proteins from food industry). The high-productive technologies are available in both the developed and developing countries (Brasilia, India).
- (e) Formulation of industrial policy in the pharmaceutical sub-system: Heavy dependence on imported inputs, low level of inter- and intrasectoral linkages, lack of engineering and basic chemical industries could be improved if SMID (Strategic Management of Industrial Development) becomes operational. An action plan should be prepared, including financial costs, distribution of responsibilities, organizational and institutional measures, to achieve consolidation and transformation of the pharmaceutical sub-system.

D. Suggestions

- (a) To formulate the pharmaceutical industry development strategy, including the strengthening of sectoral linkages.
- (b) To work out a more detailed plan of action, estimate financial costs (local and foreign) in order to execute the consolidation and transformation of pharmaceutical industry.
- (c) To develop the pharmaceutical industry on step-by-step basis and in connection with intended and realized projects in the other sub-systems:

- (i) increasing utilization of installed capacities in processing final dosage forms by improving conditions for more advantageous imports of raw materials;
- (ii) expansion of capacities in small-volume parenterals, ophthalmologics, hard and soft gelatin capsules and topical forms;
- (iii) expansion of the local production of basic raw materials:
 - for processing of final dosage forms,
 - for bulk production of active pharmakons,
 - for exports.
- (d) To develop local production of the spare parts and multi-purpose devices usable in various industries (food processing, chemicals, pharmaceuticals), e.g. sterilizers, mixing vessels, driers, extractors and accessories.
- (e) To appraise the possibility of construction of the fermentation plant for manufacturing basic antibiotics and vitamins, relying on local sources of inputs (sugar, starch, corn-steep, proteins).
- (f) To prepare a feasibility study on using traditional plant medicines in modern forms for treatment of various diseases, on the basis of domestic herbs as a supplement of chemically produced drugs.
- (g) To define the rules for market research and to adopt the aggressive strategy for exports of raw materials, active pharmakons and final dosage forms primarily to the ECOWAS countries.
- (h) To formulate research projects aimed at collecting data on raw material prospects for local development. The National Institute for Research and Development in Abuja could be

considered as a coordinator and auditor of these research projects.

- (i) To expand labour-intensive technologies in combination with modern high-productive ones in such phases of manufacturing processes in which subjective factors of manpower (unskilled and semi-skilled) cannot influence adversely the quality of products, capacity utilization and economy production.
- (j) To prepare a system of training, especially for personnel of indigenous private companies where the rules of the GMP have not yet been implemented to sufficient extent.

4. Rubber and Plastics (A.Tauchmann, Z. Laita)

A. Basic characteristics of the sub-system

The documents analysing the Rubber and Plastics sub-system characterize the role of this sub-system in the economy of Nigeria, its evolution, present problems and constraints. They suggest how to improve the present situation of the sub-system and lay out recommendations. The sub-system contributes 1 per cent to the GDP. This is about 12 per cent of the manufacturing sector's contribution to GDP.

Manufacturing of rubber goods and parts is characterized by a highly diversified internal structure. It consists of 24 groups which contain 250 sub-groups and these represent about 1000 kinds of rubber goods and parts. Most of them have their own special chemical formulas, technologies and machineries. According to the latest information, there are only 44 formal and informal firms manufacturing rubber goods and parts in Nigeria. Many rubber products are still imported. Nigeria is only at the beginning of manufacturing rubber goods and parts made from its own sources of raw materials at a large scale. In this industrial sub-system, there is a possibility for Nigeria to increase industrial production, reduce imports and increase exports, especially of goods used in the health sector and industry, including automobile spare parts, mainly tyres.

Enterprises in the plastics and foam sub-group - plastic products manufactures, foam products manufactures and chemical raw materials suppliers - differ in their size from small ones (less than 60 employees) to large ones (up to 2000 employees). According to recent estimates, there are over 1000 firms in both the formal and informal sectors active in this sub-group. There are also big differences in terms of technology and equipment. Usually, most large-scale enterprises can afford to modernize their machinery and introduce new technologies while a majority of small-scale enterprises have not enough finance to replace

their obsolete equipment. The sub-group is almost entirely dependent (97 per cent) on imported raw materials. This is one of the main reasons for a low degree of its capacity utilization. Large crude oil and natural gas reserves can, however, source upstream activities (polymer production) and improve the trade balance of this sub-group.

The main goal of this sub-system is to increase its export ability. This can be done mainly by increasing the natural rubber production, by improving downstream manufacturing and by minimizing its import dependence.

B. Identification of major problems and constraints

The following main problems are identified in the rubber and plastics sub-system:

- (a) Insufficient quality control of raw rubber, raw materials and rubber products, and inability of the Standards Organization of Nigeria to enforce quality standards.
- (b) Absence of the indigenous applied research and development of rubber and plastics technology.
- (b) Shortage of experienced mechanical engineers - designers and shortage of production facilities and materials to produce machinery and spare parts.
- (d) There is no market research for rubber and plastics.
- (e) Underutilization of plastics processing and foam manufacturing capacities and high costs of imported raw materials, additives, machinery and spare parts.
- (f) High additional production costs owing to the necessity to build up their own infrastructural and social service facilities by most enterprises themselves.

Experiences gained by the international sub-contractors during their field trips are essentially in compliance with the statements in the Report prepared by Nigerian experts and intended for submission to the Federal Government of Nigeria. However, attention paid in the Report to marketing activities does not seem to correspond to planned increase in production of natural rubber, rubber products, polymers and plastics and foam products to be produced in Nigeria at the end of this decade. This is understandable in view of the fact that the time for the preparation of this Report was rather short. About a year or so would be needed to work out a comprehensive study. However, in the present circumstances, characterized by a low raw-material supply, manufacturers are able to sell easily their whole production and pay only limited attention to new potential markets.

C. Strategic directions

In addition to strategic directions recommended in the Report, the following suggestions should be considered by the Rubber and Plastics SCG in the stage of preparation of the guidelines for the Industrial Master Plan.

- (a) The most efficient way how to accelerate technical development that was widely applied e.g. in Japan is to buy modern technologies (licences and know-how) and to develop them further by well educated and highly qualified indigenous scientists and engineers with international experiences. If this process is understood under the term "reverse engineering process" used in the Report, it should be supported and applied.
- (b) To reach a higher efficiency and international competitiveness, indigenous Nigerian applied research and development capacities for rubber and plastics manufacturing technologies should be created. In view of great diversity in

rubber and plastics manufacturing technologies this suggestion is imperative.

- (c) In order to resolve the shortage of spare parts for manufacturing machinery used in the sub-system, it is recommendable to build up an indigenous center for production of spare parts. Simultaneously, it is needed to educate and train experienced mechanical engineers - designers to be able to work out technical documentation, and skilled toolmen to produce the necessary spare parts in acceptable quality. The experience of international sub-contractors based on factory visits in Nigeria shows that all manufacturers concerned support fully this suggestion.
- (d) On the basis of consultations with interviewed top managers of all factories visited in Nigeria, it is suggested that the development of proper infrastructural facilities should receive a top priority consideration by the government. Without adequate infrastructure, the manufacturing industry and its market cannot function properly, efficiently and competitively.
- (e) In view of the fact that imports of rubber and plastic goods to Nigeria and West Africa tend to increase rapidly, it is suggested to undertake a marketing study based on a solid market research for rubber and plastics. It is essential to note that this study can be undertaken only by an internationally experienced market specialist and that its preparation requires about a year. One of the best specialists in international marketing is Mr. Ahonen from Finland who worked out such a study for a West African country under the auspices of UNIDO.
- (f) Account should be taken of the fact that the government does not possess unlimited financial resources and that excessive money spending may accelerate inflation. It is therefore not recommendable to ask the government for further lowering

rates of taxation. Priorities should be given to finance infrastructural development and to reduce import duties on basic raw materials.

- (g) To reach a higher economic efficiency and competitiveness in rubber and plastics manufacturing, it is suggested to upgrade the quality of management at all levels, to stimulate motivation of all workers, to strengthen their working discipline including the technological discipline.
- (h) In connection with foreign trade experiences in the field of rubber and plastics, it is pertinent to mention that the image of Nigeria abroad has somehow deteriorated. In order to renew this image, it can be recommended that all exporters should pay increased attention to greater reliability, seriousness and continuity of trade relations with abroad.

D. Suggestions

- (a) A new capacity for manufacturing tyres should be built on the basis of Nigerian sources of rubber. Thus, greater portion of Nigeria's market could be supplied by local production and in the future even exports to some African countries (Ghana) could be attempted.
- (b) Also, new capacities should be built for manufacturing rubber chirurgical gloves, examination gloves, condoms and children soothers, based on Nigerian sources of natural rubber - latex. Manufacturing of these items in West Africa is a fairly new phenomenon. One of the advantages of the first-comer in this industry is a good chance to export to a number of West African Countries. For details, see Appendix II.
- (c) In view of the emphasis on the so-called Nigerianization policy, it could be considered that top managers, engineers and technicians should be preferably Nigerians. This intention could be materialized on the basis of co-operation

with UNIDO which organizes advanced courses and trainings for rubber plastics specialists.

(d) Due attention should be paid to the development of small-scale enterprises also in the rubber and plastics sub-system. Such enterprises, using a simple technology and providing more labour opportunities, can operate already in an early stage of rubber processing, e.g. in centrifuging natural rubber latex. They can also operate in later stages, producing rubber goods and parts made from this centrifugal latex. Simple dipping units powered by hydraulic systems and vulcanizing ovens represent the major technical equipment. Other operations, including inspection and packing, can be done manually. Capital investment in such enterprises are much lower (about 20 per cent) than comparable investment needed in larger and technologically more advanced enterprises. The necessary training for workers employed in small-scale enterprises is simpler and less costly, too. However, a more advanced training of specialized rubber technologists and operators can better be organized in some countries of Europe and South-east Asia.

(e) In concluding the development of rubber industry in Nigeria, the following scenario is suggested:

(i) To work out a comprehensive marketing study including market research for Nigeria and West Africa for all rubber products.

(ii) To select the optimum development programme on this basis.

(iii) To prepare feasibility studies covered by this programme. To implement selected projects, preferably in co-operation with foreign assistance.

(f) Considering the domestic raw material resources and the absence of the upstream industries (e.g. nitric acid

production, phosgene production, etc.), it is suggested that Nigeria specialize in polyolefin, PVC and polyester production. The polyolefin production, based on rich raw material resources, can be intensified and a large portion of the production exported. Export earnings should be used to finance imports of other polymers. As soon as the necessary chemical plants are on stream, production of other polymers can take off. To keep the technologies for polypropylene and polyethylene production up-to-date, and to ensure their further development, it is suggested to start immediately research in polyolefin synthesis. The existing fundamental and applied research centres engaged in polymer science are interested in acrylics, blending and polymer modifications, but not in polyolefin synthesis. Research in polyolefin synthesis ought to be strongly supported even if it requires costly equipment.

- (g) Plastics processors and foam manufactures should try to keep their obsolete machinery and technology on go before higher capacity utilization and higher profits enable them to invest. It is not advisable to ask for loans if low capacity utilization and high raw material costs are responsible for low profits.
- (h) Composites of polyolefins with inorganic fillers are able to replace more expensive engineering plastics in some applications. As engineering plastics (ABS, polyamides, polycarbonates) will not be produced in Nigeria in the near future, it is suggested to appraise the possibilities of using local calcium carbonate, mica and talc deposits for composite production. Some research institutes in Czechoslovakia are experienced in composites production and processing and could help develop these technologies in Nigeria.

5. Food Processing (P. Brokeš)

A. Basic characteristics of the food processing sub-system

The Nigerian Food Processing Sub-system study, prepared by national specialists, characterizes in some detail the present state of the Nigerian food processing sub-system, provides the general overview of economic and policy environment in which the sub-system operates, analyses the structure of its markets, compares the structure of demand and supply in both domestic and foreign markets, describes the level of technologies used, identifies the problems faced and obstacles encountered, indicates the gaps that can be filled. Four groups of food products have been selected for a detailed analysis: grain and milling products, vegetable and fruit products, vegetable oils and fats, beverages.

The sub-system is presently characterized by uncompetitive production, large imports, and negligible exports. The main goal of the sub-system is to attain food self-sufficiency and initiate export of some food products. Strategies to achieve this goal, suggested in the study, include almost all possibilities of upgrading the current traditional raw material base, technologies and products of the sub-system. However, according to the comparison of the projected supply and demand for selected food products, given in the study, the goal of food self-sufficiency for Nigeria does not appear to be realistic, at least in the course of the 1990s.

B. Identification of major problems and constraints

In the opinion of international sub-contractors, influenced to some extent by discussions with his counterparts and contact persons on his field trips in Nigeria, the main problem of the food processing sub-system is a rapid introduction of some restrictive measures (bans) in the food processing industries. The bans on some basic raw materials imports increased their

prices, contributed to the creation of black market and smuggling. It made the food production very uncompetitive. The results are discouraging: market distortions, underutilization of capacities, growing unemployment, lack of capital in food production, decreasing interest of foreigners to invest in Nigerian food processing sub-system. The bans should be introduced gradually on the basis of consultations with the producers. The food producers should react on these inevitable economic policy changes more flexibly by introducing modifications in production programmes. These programmes should seek new ways and means how to increase utilization of domestic raw materials and promote the domestic raw materials production.

Serious consideration should be given to the overall organization of the food processing sub-system. One of the greatest problems is viewed in uncertainties in the availability of raw materials and food products at given prices. Oversized plants suffering, moreover, from high import dependency, e.g. Nigerian flour mills, are extremely underutilized. At least in some of them, new production programmes should be introduced. The medium and small-scale plants seem to have adjusted more flexibly to the changing economic climate. Small and medium-scale entrepreneurs should be encouraged in their production efforts in order to achieve a more dynamic and competitive environment. For example, small and medium-scale mills could be built up in the countryside in order to minimize high transport costs.

Another problem of the food processing sub-system is seen in the shortage of well-trained and highly qualified manpower. Specialized personnel should be trained in various food technologies, machinery maintenance, quality, hygiene control, marketing and management methods. The training should involve short-term courses, with emphasis on practical orientation. While management appears to be technically qualified, a lack of real managerial skill is deeply felt. Management training should be organized for managers at higher levels with accent on financial management.

C. Strategic directions

The Nigerian food processing sub-system study, prepared by national specialists, suggests as the strategic direction to achieve the food self-sufficiency in Nigeria. This strategic direction has been rightly chosen and should be accomplished as soon as possible. The technical progress in agriculture, improvement in postharvester storage, modernization of food processing equipment, technologies and packaging lines, training of manpower, solution of energy, water supply and transport problems are imperative. However, the rapid population growth, limited sources of local raw materials and lack of capital question the validity of the assumption that traditional strategic directions are good enough to achieve the food self-sufficiency goal. For this reason, the international sub-contractor recommends to complement the proposed strategic directions by some non-traditional approaches to resolving the food processing problems. These non-traditional approaches comprise, inter alia, : utilization of non-traditional sources of raw materials for food processing, application of non-traditional food processing technologies and the development of non-traditional food products.

(a) Utilization of non traditional sources of raw materials for food processing.

(i) Application of biotechnologies Biotechnologies enable by activity of selected microorganisms to convert the non traditional sources into valuable raw materials for food processing. Such non-traditional sources include wood waste hydrolysates, solid and liquid wastes and also crude oil and its derivates. However, the most common raw material for biotechnology is molasses.

The products of biotechnologies are proteins, aminoacids, organic acids, fats, enzymes, flavors, thickeners. Most of these valuable food processing raw materials are at present imported at high prices.

Again, at least some of these technologies should be introduced into food processing industry in Nigeria. One of the advantages of this proposal is that the sources available in Nigeria, such as crude oil and its derivatives or various wastes, will be utilized for production of some abovementioned food processing raw material.

(ii) Isolation of valuable nutrients from by-products and wastes. Some by-products and wastes of food processing contain valuable nutrients which are not yet fully utilized. For instance: whey, animal blood or waste water from starch industry contain proteins. Orange, apple peels and pomace contain peel oils, flavonoids and pectine. These valuable substances can be isolated by means of modern separation methods (for example ultrafiltration) and used for fortification of food products.

(iii) Promotion of soybean cultivation and its modern complex processing. Soybean received a great commercial attention during the last 20 years for its good nutritional value and relatively high yields. Oils, protein concentrates, protein isolates and texturated proteins produced from soybeans by modern complex technologies are important sources of raw materials, especially for fortified and fabricated food products as well as for soybean beverages. In the opinion of international sub-contractor, the soybean cultivation and its modern complex processing should be substantially promoted and widened in Nigeria for this reason.

(b) Application of non traditional food processing technologies. With the advance in science and technics, many modern technologies have occurred also in food industry. Application of these modern technologies enable to develop new top

quality products, save energy and utilize by-products and waste.

(i) Application of membrane processes.

The separation of fluid mixtures by membrane processes has many merits. There are no temperature or phase changes involved, and so, the valuable vital and nutrient substances, such as vitamins or flavors, are not damaged during the separation process. The energy consumption in membrane processes is extremely low. The energy consumption for separation of volume unit by ultrafiltration is about 100 times lower than by evaporation. Also the capital costs are relatively low. Microfiltration is used for cold sterilization of water and fluid food. Ultrafiltration is used for concentration and purification of proteins from milk, white eggs, soybean and alpha-alpha extracts, water and waste water treatment. Reverse osmosis and electrodialysis are used for demineralization of water and juice concentration.

(ii) Application of new drying methods.

Spray drying of milk, yeasts, protein concentrates or fruit juices as well as fluid bed drying of vegetable and a combination of membrane processes with spray or fluid bed drying are the finest dehydration methods.

(iii) Application of extrusion methods.

Extrusion technologies are used for mixing, dispersion, gelatination, plastification and texturization. They enable to produce new types of fortified food products with the possibility of modifying their composition and structure.

(c) Development of non-traditional food products.

(i) Fortified food products.

The food products can be fortified to improve their nutritional and organoleptic properties. They are fortified by limiting essential aminoacids (lysine, methionine, threonine), by proteins (yeasts, soya protein, milk protein), by flavors (protein hydrolysate, yeast autolysate, sodium glutamate, 5-ribonucleotides, organic acids) or by vitamins (A,B,C,F).

(ii) Fabricated food products.

Interest in fabricated foods has been heightened by the threat of critical food shortages in the foreseeable future and the need to alleviate these shortages by advanced engineering and technological techniques. Production of meat, poultry, and sea food substitutes is already a big business and will probably get bigger. Soybean is the principal raw material for the vast majority of meat substitutes.

(iii) Top quality concentrates.

The products of fluid foods concentration by membrane processes or powdered foods produced by fluid bed or spray drying are characterized by the high content of vitamins and excellent organoleptic properties, for example, tomato concentrates produced by reverse osmosis.

D. Suggestions

In addition to the recommendations made by Nigerian food specialists the international sub-contractor suggests the following propositions:

(a) Introduction of biotechnologies into Nigerian food processing industries:

- (i) - citric acid production on starch, capacity 5.00 t/year;

- (ii) - lysine production on Nigerian raw materials, capacity 5.000 t/year;
- (iii)- yeasts production on n-alkanes, capacity 15.000 t/year;
- (iv) - enzymes production and possibilities of their application, feasibility study;
- (v) - production of protein hydrolysates and yeast autolysates;

(b) Utilization of by-products:

- (i) - ultrafiltration and spray drying of whey and animal blood;
- (ii) - spray drying of brewery yeasts;
- (iii)- solvent extraction of oil from press cake in oilseed processing;
- (iv) - pectine production from orange peels.

(c) Promotion of soybean cultivation and its modern comple processing.

(d) Development and introduction or new food products:

- (i) - development, production and advertisment of fortified and fabricated food products;
- (ii)- introduction of tomato concentrates produced by reverse osmosis;
- (iii)- production of powered soft drinks.

(e) Increase in capacity utilization:

Possible modifications in the production programme of large-scale flour mills which are presently underutilized. Partial utilization of already existing buildings and equipment (for example, complex corn processing: production of starch,

modified starch, citric acid, corn oil, gluten, etc.; complex soybean processing: production of oils, lecithine, proteins concentrates, isolates, texturated protein or soybean beverages.); feasibility study.

(f) Education and research:

(i) Organization of intensive short-term courses for specialized personnel in various food technologies, machinery maintenance and quality control.

(ii) Organization of management postgraduate courses.

(iii) Organization of postgraduate courses, and research in the biotechnology, waste treatment and membrane processes.

(g) Technical cooperation:

International technical cooperation in the field of biotechnology, waste treatment and membrane processes. The international sub-contractor is prepared to take active part in it.

6. Leather and Leather Products (K. Kubec)

A. Basic characteristics of the sub-system

The sub-system "Leather and Leather Products" is characterized by the highest labour intensity in manufacturing. The expansion of this sub-system would contribute considerably to the achievement of the employment objective in Nigeria. The majority of visited managers of leather and leather goods factories expressed their interests in practical recommendations suggested by the international sub-contractor, particularly in the field of new technological know-how and low pollution technology for leather production.

B. Identification of main problems and constraints

This assessment is based on international sub-contractor's experience, gained during his visits of tanneries in Kano and Lagos. Also, the sub-system study "Leather and Leather products" has given him some information and analytical material that facilitated his evaluation and formulation of main recommendations. The contemporary situation in this industry requires immediate practical actions, first of all in leather production technology, necessary to improve the quality of intermediary and final products and, consequently, the economic position of the whole sub-system.

(a) The numbers of livestock in Nigeria are relatively high

cattle	20 - 30	mil. pieces
sheep	12 - 14	mil. pieces
goat	16 - 29	mil. pieces

It should be noted that data concerning absolute numbers of livestock differ in various information sources.

(b) The demand for skins, and hides and leather exceeds considerably the supply. The main causes are as follows:

- (i) exports of skins and hides;
 - (ii) lots of hides and skins are damaged or completely destroyed, owing to the method of slaughtering, handling and transporting to tanneries;
 - (iii) in Nigeria, hides and skins are traditionally used as a foodstuff by many inhabitants of the country;
 - (iv) leather, processed in old traditional tanneries, mostly does not reach acceptable quality;
 - (v) the existing method of processing, stocking, and transporting pickled skins and hides cannot eliminate the danger of damage caused by hydrolysis.
- (c) Nigeria is the country with comparatively low labour cost. This fact can play an important role in the process of transition of raw material and pickled skins toward wet blue, crust and finished leather exports. In the future, Nigeria could receive much greater export earnings for crust and finished leather exports than it does for raw and pickled skins exports.
- (d) Goat and sheet skins from Nigeria represent with respect to their actual quality grain very perspective intermediary products for export.
- (e) The method of slaughtering and preserving skins and hides in Nigeria is rather underdeveloped. Very often this is not only due to the shortage of good slaughtering tools but also due to the lack of skilled workers.
- (f) The technological treatment of skins in the beamhouse is on low level in some tanneries and in combination with imperfect degreasing it leads to the creation of "spew" on final leathers.

- (g) The applied technology does not make it possible to achieve the maximum yield of the leather.
- (h) The quantity of sulphide used for unhairing is much higher (in most cases) than the technological process really requires. Consequently, it causes unnecessary environmental damage.
- (i) In some cases, utilization of chrome salts in the process of chrome tanning is not sufficient. This can cause not only financial losses, but has also a negative influence on the environment.
- (j) Activities of the National Research Institute for Chemicals are not directly related to practical activities in tanneries.
- (k) Shoe-making and leather goods factories need very urgently supplies of leather of higher quality. The quality of shoes and other leather products in Nigeria depends first of all on the low quality of leather.
- (l) The production capacity of the leather industry in Nigeria exceeds the current raw material supply.
- (m) For Nigerian leather products, there appears to be a potential market in Europe and USA. In order to increase exports of Nigeria's leather products, the quality of leather must be improved.

C. Strategic directions and suggestions for the improvement of the Nigerian leather industry

- (a) It is absolutely necessary to close down (to put a ban on) exports of all skins and raw hides from Nigeria.
- (b) It is necessary to improve the quality of raw hides and skins (including better care of the livestock). The treatment of

raw hides and the improvement of their quality requires the assistance from the Federal Ministry of Agriculture, specialists from leather factories and from NARICT. Even purchase of better slaughtering knives can influence remarkably the quality of skins and raw hides.

- (c) Weak linkages between grazing animals, abattoirs, tanneries and production of leather goods and footwear should be strengthened. This basic recommendation was also written in report "Leather and Leather Products" (page 100).
- (d) The economic position of the leather sub-system in Nigeria can be improved through exports of intermediary products like wet blue and crust. Higher prices can be achieved only if improvements in the quality of products are achieved.
- (e) To achieve the higher yield and better quality of wet blue and crust, it is necessary to change the tanning technology. The process should proceed in two stages. After careful pretanning, with use of small quantity of Chromitan B or basified aluminium salts, shaving and retanning with chrome salts should follow. In this way, at least 4 per cent yield increase can be achieved along with much smoother grain.
- (f) To improve the ecological situation of tanneries and also the quality of goat leather produced, it is recommended to apply the enzymatic unharing technology. This technology ensures conservation of hair that can be sold to other industries. In addition, there are no problems with water treatment, because the hairs, which represents highly organized and valuable protein (keratin), is not dissolved in tanner effluents).
- (g) Careful weighting of the raw material and shaved leather is recommended. On the basis of this simple measure, it is possible to reduce the consumption of chemicals, especially toxic sulphide, by 30 - 40 per cent.

- (h) The Machinery and equipment of Nigerian tanneries is characterized by the average technical level. With respect to the contemporary economic position of the Nigerian leather sub-system, it is not recommended to replace the "in-run" tanning drums by more sophisticated mixers. Besides, their high price, highly qualified personnel is required and higher maintenance quality for their functioning is needed.
- (i) For current production of finished leather in Nigeria, it is advisable to use staking machine Mollisa with Lycra conveyer instead of actually used rubber ones (higher yield, softer leather).
- (j) For the introduction of a simple low pollution technology and improvement in quality of the leather, it is recommended to seek services of an experienced UNIDO expert (leather technologist).
- (k) The shoe and leather goods making factories in Nigeria need urgently supplies of good quality leather. In this respect, the introduction of the simple system of measurement of the relative elongation under wet conditions can be recommended (hygienic leather properties improvement).
- (l) The private sector in Nigerian leather industry is able to operate well, but it needs higher quality of raw material and implementation of the above-mentioned steps, especially technological know-how.
- (m) Until now, Germany, Spain, Italy and Czechoslovakia imported wet blue from Ethiopia, Afghanistan and Iraq. The declining exports from these countries could be well replaced by Nigeria. However, implementation of all above mentioned measures and improvement in the quality of the Nigerian leather are necessary preconditions to develop trade co-operation between these countries and Nigeria.

- (n) Most of the existing Nigerian small-scale leather factories have good hand fleshing system, but in most cases, they use improper vegetable tanning materials of the domestic origin. To improve the situation, it is advisable to apply new methods of tanning technology in selected tanneries.
- (o) In view of the international sub-contractor, Nigeria should ask for technological assistance (know-how, low-cost and low-pollution technologies) from UNIDO. This activity should be implemented through a "leather industry cell", created and situated in Kano, which represents the real leather center.
- (p) For organization of training courses and for research and development of leather technologies, a small pilot plant would be sufficient, equipped with 3 drums and a simple finishing department including spraying box.

Personnel recommended:

- 1 worker for the beamhouse
1 worker for the finishing dept.
1 worker auxiliary labourer
1 highly qualified UNIDO expert with rich practical experience.

7. Textile and Wearing Apparel (J. Eder)

A. Basic characteristics of the sub-system

The Nigerian textile industry is the largest in West Africa in terms of production capacity and employment. It is a leading manufacturing sub-system of Nigeria accounting for about 14 per cent of MVA in 1985. The contribution of the sub-system to the total manufacturing employment was about 19 per cent, representing about 80,000 employees. In 1989, the sub-system included 178 registered companies. More than 50 are large- and medium-scale textile enterprises. Most of the textile industry is controlled by the private sector, largely as joint ventures of foreign and Nigerian investors (Hong Kong, India, United Kingdom, United States of America, Japan, Holland). The major product is African prints, accounting for 35 to 40 per cent of cotton fabrics production, followed by shirting, drills, polyester/cotton fabrics, brocades, fancy weave, bed sheets, wax-type fabrics and others.

About twenty enterprises or groups of associated companies are fully or partially integrated, comprising spinning, weaving and finishing facilities. Only five plants cannot fully supply the needs of their down stream weaving units and only three mills sell yarn outside their group. Nigeria produces only a fraction of the fibre and virtually none of the dyestuffs and chemicals required by its textile industries, except for some starch made from cassava. Various textile companies have gone into seed-cotton production in order to increase their low material resource base. The bulk of synthetic fibres are imported except of polyester fibre produced in several chemical plants in the country on the basis of imported granulates.

B. Identification of major problems

Low productivity level, product quality and competitiveness limit seriously export possibilities of the textile sub-system in Nigeria. Labour productivity in spinning and weaving operations is not sensibly higher than in other African countries and lags behind productivity levels in Asian developing countries such as Hong Kong, Korea, Thailand and others.

The following major problems were identified in the textile sub-system:

(a) Increase in technical level of equipment:

Technology in use in Nigeria originated from England (about 40 per cent), Belgium (20 per cent), Italy, Germany and Switzerland. This technology is similar to technology used overseas. Some equipment and machinery are obsolete and have to be replaced.

All visited mills have their expansion programmes in which acquisition of the computerized technology is often included. The textile industry seems to be changing from a labour-intensive to a capital-intensive industry.

(b) Mastery of technology and management skills:

The management styles and technical skills vary from plant to plant. The style is mostly determined by foreign partners (Chinese, Indians). However, there are some factories characterized by unsatisfactorily qualified technical and managerial personnel.

Among the visited mills, the high standard of management appears to be in Nichemtex, President Industries Limited and United Textile Mills Limited. It seems that some mismanagement was in the past years in Nigerian Textile Mills Limited and Kaduna Textile Limited. It is proposed that both plants request for UNIDO Technical assistance.

Afprint and Gaskiya Textiles Limited suffer also from some deficiencies. One of the most important principles of factory management is to maintain cleanliness and order in factory halls of all spinning mills. However, this requirement is not frequently fully respected, with adverse consequences on productivity and quality of products. Unfortunately, Afprint is poor in housekeeping with cones lying on the floor and lint cotton flying in all directions. The mill has all prerequisites for better running. Gaskiya Textiles has the best equipped weaving mill with sophisticated Sulzer looms in Nigeria and the latest Platt machinery in spinning. Despite all this modern equipment, African prints produced by the plant in Kano are considered to be of inferior quality.

There is permanent need to train workers and technical staff to acquire the skills necessary to operate new technology. One of the latest examples in Nigeria is the relatively low level of utilization of 70 Autocoro rotor spinners equipped with Piecer carrier. It seems that only Nichemtex use this sophisticated equipment at 95 to 97 per cent of efficiency having one specially trained technician. In other mills the efficiency seems to be lower.

(c) Scarcity of foreign exchange:

The limited availability of foreign exchange resulting in the consequent shortage of imported inputs (raw materials, dyestuffs, chemicals and spare parts) is one of the main causes of the low capacity utilization in the textile sub-system.

The most serious is the shortage of spare parts. In some textile mills, the incidence of the so-called "cannibalism" is a current practice. Some machines, still able to operate are used as the only source of different spare parts of the last resort instead. In this difficult situation, some foreign exchange should be released to cover the necessary imports of these parts.

(d) Inputs of raw materials - cotton and man-made fibres:

The cotton supply covers only 45 per cent of the spinning mills consumption. The short staple Nigerian cotton is good for the production of African prints. It will take a long time to increase considerably the consumption on the basis of local cotton. There is a lack of permanent cotton markets and adequate facilities for the storage of cotton. Most of man-made fibres and chemical inputs required in the textile industry still have to be imported due to the non-completion of the Nigerian petrochemical complex.

(e) Improving textile mills quality control system:

Some mills have to complete the equipment of their laboratories and to improve the quality control system. Afrprint has to complete some necessary equipment in its fibre laboratory for testing the cotton properties.

(f) Inadequate electricity and water supply:

Many plants in Nigeria cannot rely on public power supply and water supply. Every textile mill has his own diesel generating set fully covering its electricity consumption. Some plants have their own source of water supply.

(g) Accelerated development of the small-scale textile enterprises and cottage industry:

The traditional methods of fabric production were introduced in various parts of Nigeria in the 15th century by the different ethnic groups. Nowadays, the traditional Nigerian textile industry includes three main sections:

- production of handspun cotton yarns;
- weaving on the horizontal narrow band and vertical broad looms;
- dyeing and finishing of locally woven and imported fabrics, using locally sourced dyestuffs.

Small-scale enterprises represent a vast majority (about two-thirds) of 180 registered companies in the textile sub-

system, including an unknown number of artisanal or family type of production units. More than 700 small-scale knitting plants are estimated to work in Nigeria. The small-scale and traditional industry in the textile sub-system plays, therefore, an important role. The development of small-scale and traditional textile enterprises as a generator of employment should be encouraged by various support programmes including upgrading traditional technology, improving product quality, marketing services, manpower training (even for workers at a low level of technology), and special training programmes for the managers.

Unfortunately, out of 26 Universities and 27 Polytechnics in Nigeria only two Universities offer programmes in textile technology. The Federal Institute of Industrial Research is also involved in upgrading traditional textile technology.

The establishment of some Development and Training Units in the main areas of textile industry is essential for solving the day to day technical problems of small-scale and traditional textile enterprises. The main task is to suggest appropriate technologies and machineries corresponding the country's level of economic development. Setting up of Design Centres should also be considered.

C. Strategic directions

(a) Technology:

Over 60 per cent of the textile sub-system in Nigeria uses conventional technology. The textile industry is estimated to operate some 617,000 spindles including 4,588 open-end rotor spinners and the above mentioned 70 Autocoro rotor spinners. There are 17,770 looms including about 2,500 shuttle-less looms and 1,300 Sulzer looms with micro-computer control system. The growing competition among textile mills leads to gradual modernization of the textile sub-system.

In the field of choice of technology, the selected equipment should be appropriate not only to the market requirements, but also to the levels of technical and managerial capabilities and the quality of labour force available in the country.

In spinning mills, the introduction of open-end spinning rotors should be encouraged. This technology is suitable for English count 20's - 30's cotton yarn used for African prints. The use of ring frame should continue for processing long and medium staple fibres in the production of man-made fibres and finer cotton yarns.

In weaving mills, the equipment is more modern than in spinning (including air-jet, water-jet and rapier looms). The weaving plants continue gradually with the installation of modern Sulzer looms equipped with microcomputers. This trend of introducing high technology in weaving should be supported mainly because it contributes to the strengthening of the competitiveness of textiles in foreign markets.

However, the medium level technology is more appropriate for the country for the following reasons:

- it provides more employment opportunities,
- it is easy to maintain,
- some spare parts could be found locally.

As an example of suitable technology for Nigeria, the rotor spinning machine BD200 produced in Czechoslovakia characterized by high efficiency and reliability could be considered. This machine is less costly than highly sophisticated Autocoro rotor spinner and more labour-intensive. Similarly, the use of automatic shuttle looms, indispensable for the production of African prints, should continue. Special attention should be paid to upgrading traditional textile technology.

(b) Marketing:

(i) Local market

Nigeria has some undeniable advantages over other developing countries:

- the enormous size of growing internal market and considerable scope for expansion of textile production supported by import restrictions of fabrics;
- the privilege to export textiles to a number of European Countries not limited by any quotas.

Under normal conditions, every Nigerian needs about 10 metres of cloth a year. It is assumed that about 20 per cent of Nigerian market is now being supplied through importation and smuggling. The Nigerian textile market for the years to come is expected to grow. Although one may suggest alternative and more accurate methods of projections, the prospects suggested in the Strategic Consultative Group's study are, by and large, acceptable.

Table 3.

Market demand/supply balance of fabrics in Nigeria in the period 1991 - 2000
(in million of metres)

	1991	1992	1993	1994	1995	2000
Local demand	1,000	1,020	1,040	1,060	1,080	1,190
Supply by Nigerian						
Industry	400	416	433	450	468	571
Import/Smuggle	200	204	208	212	216	238
Supply Gap	400	400	399	398	396	381

The difference between the local demand, local supply and smuggling causes the supply gap which could be easily overcome by increasing local production.

(ii) Export potential:

Recent economic policy measures, promoting exports coupled with actual devaluation of Naira, have created a favourable climate for exporting textiles, particularly to ECOWAS countries. While the domestic market is to remain a major customer, the Nigerian textile and garment sector can strengthen its position on foreign markets. The present orientation towards low-priced basic textile goods should be substituted gradually for higher value added goods characterized also by a wider product range. At the same time, their relatively passive marketing attitude will have to be replaced by a more active involvement in foreign markets. It will be necessary to study the potential for exports, especially to developing countries, Western Europe and the United States.

Some Hong Kong entrepreneurs have established export-oriented textile mills in Nigeria with a view to escaping the strict quota imposed by the Multi-Fibre Agreement on their country. They are interested in supplementing their country's quotas with quota-free exports from Nigeria.

USA, Italy, Switzerland, Korea and Taiwan import grey cloths or grey yarn from Nigeria. African prints are exported to some ECOWAS neighbouring countries. In August 1990, the textile industrialists have signed agreement with the USA on the basis of which 48 million of metres of various textile items can be exported from Nigeria (such as duck fabrics, special weave fabrics, cotton sheeting, cotton point cloth, cotton popelin and cotton twil).

It is necessary to mention that in some other countries new possibilities for Nigerian export exist: United Kingdom and Belgium (grey cloth and yarn), Germany (fabrics for ladies dresses and man clothing) and some other countries.

Unfortunately, these opportunities can hardly be exploited because of expensive imports of raw materials and other inputs, and insufficient quality of textiles produced in some cases on obsolete equipment. The medium-term objective in the textile sub-system should therefore be to ensure that an increasing number of firms become more effective and internationally competitive.

D. Suggestions:

- (a) To reconsider the possibility of government intervention in the seed-cotton production for ensuring the following operations:
- seed improvement, multiplication and distribution,
 - decontamination of seeds,
 - check the grading of inputs (seed-cotton) and outputs (lint cotton) in the ginneries.
- (b) The priority consideration placed on the textile sub-system requires a considerable increase in foreign exchange allocation to this industry.
- (c) To achieve the objective of mastering modern technology, the training centres in textile mills are recommended to focus primarily on on-the-job skill training. As one of the most efficient forms of training a practical training on machinery is suggested. Special attention should be paid to the training of technicians in some plants. Some of them suffer from insufficient technical competence. UNIDO Technical Assistance should be requested for assistance in this field.

(d) In the framework of UNIDO project "Rehabilitation of the textile and leather industries in Nigeria" (envisaged to be executed in the periods from July 1991 to July 1992), covering the entire range of:

- technical, managerial and technology issues at the plant level in 4 to 6 selected companies;
- financial, commercial and structural issues at the sub-sector, sector and macro-economic level; it is proposed to include Nigerian Textile Mills Limited and Kaduna Textile Limited among selected textile companies.

(e) To inform all textile companies in Nigeria of Technical Assistance granted by UNIDO (Textile Unit), Vienna in the following spheres:

(i) Assistance in Establishing a Weaving Productivity System based on introduction of a computerized production/productivity control unit (hardware and software) in selected mills, which is used:

- to pinpoint the real reasons for low performance of the plant;
- to decide necessary corrective measures.

(ii) Assistance in Establishing a Micro-computer weaving quality and productivity monitoring system including:

- product quality monitoring section (all data come directly from the company's Grey Cloth Inspection sheets);
- productivity monitoring system (data are usually taken directly from loom cards at the end of each shift).

(iii) Assistance in improving management of selected textile mills.

(f) To ask UNIDO for technical assistance in the preparation of the pre-investment study for the marketing and construction of large-scale wearing apparel factory equipped with modern technology.

(g) Measures in the field of small-scale and cottage industry in the textile sub-system:

(i) To prepare a restructuring programme for small-scale enterprises to achieve a higher degree of their product specialization and increasing efficiency on the basis of new investment.

(ii) To introduce special incentives for small-scale enterprises such as tax-free investment allowances, accelerated depreciation rates, exemptions from profit tax, custom-free imports of equipment and raw material inputs.

(iii) To consider the establishment of the "Development and Training Units of the Small-scale and Traditional Textile Industry".

(iv) To organize co-operative groups of weavers to enable them to purchase yarn at lower prices.

8. Cement (Evžen Kratochvíl)

A. Basic characteristics of the sub-system

Cement occupies certainly the most important position of all Nigerian home produced building materials. For this very reason, a separate sub-system was created for it in the Industrial Master Plan project, irrespective of the fact that the cement production has many common features with other non-metallic industries. The cement industry, being one of the heavy and investment intensive industries, is nearly fully self-sufficient in local raw materials as non-metallic industries mostly are. It is typically organized in large-scale plants because of technological and economic reasons. Like other non-metallic industries, the cement production also requires application of highly energy intensive firing process which is indispensable for completing the decarbonization of the meal and running the complicated solid-state reaction during the clinkering process.

In Nigeria, actually 8 large-scale cement factories are working, owned by 7 production companies. The basic raw materials (limestone, marl, shale and clay) are indigenous. However, some cement factories are still importing gypsum which has to be added to the milling of fired cement clinker as hardening regulator, usually in an amount, not overstepping 4 per cent.

In the Nigerian cement industry, three different production technologies are used. The older plants are mostly based on the wet production process, characterized by an extremely high energy consumption, but relatively low dust escape, saving environment. The newer factories employ the dry process which is more energy saving. However, some plants, after reconstruction from the originally installed wet process technology, are actually utilizing the semi-wet process. The choice of technology for the cement production has to respect the strict requirements on high and constant quality of the final product according to the valid quality standards. This implies the application of reliable

automatic control systems in all parts of the technological process.

As a source of heating energy various types of fuels are used in different plants: pulverized coal, heavy and light fuel oil. For the future, the possibility of using gas is also considered by some companies if this fuel type is economically advantageous.

For the purpose of the Industrial Master Plan project, a team of Nigerian specialists prepared a fairly comprehensive study on the cement sub-system. This comprises main characteristics of the sub-system with statistic and analytical data and final conclusions and recommendations. While no serious objections can be raised against these conclusions and recommendations, and most of them should be supported, only a few additional suggestions are proposed by the author of this report for consideration of the SCG.

B. Identification of major problems and constraints

- (a) The total installed production capacity of the Nigerian cement industry exceeds slightly 5 million metric tons P/A, but its utilization in the 1990 reached only 3,05 million tons, what means about 61 per cent. Two of the cement producing companies are operating with satisfactory capacity utilization (the Ashaka plant even over 100 per cent) and two plants reach about 50 per cent. The remaining three factories show really very poor performance, utilizing their installed production capacities at rate fluctuating from 11,5 to 24 per cent. Since a lack of spare parts is shown to be the main reason for the low capacity utilization, a top priority should be given to the establishment of specialized spare parts manufacturing plant. Such step, as suggested in the sub-system study, could help increase considerably capacity utilization of the Nigerian cement industry, meet the market demand and reduce the imports of cement.

Though, some special spare parts have always to be imported, some spare parts, e.g. steel balls for mills, can easily be produced in Nigeria, as soon as the large-scale steel industry is running. Also, building up Nigerian own production of refractory materials, as suggested by the international sub-contractor for the non-metallic sub-system, could partly eliminate the dependence of the cement sub-system on imports of refractories.

- (b) The introduction of other hydraulic compounds (as blast - furnace slag) and their mixing with the clinker is sometimes used in countries with well developed ferrous metallurgy industries to increase cement production while saving energy costs. However, the application of this type of cement production to Nigeria seems to be improbable at present, because the country does not dispose with appropriate blast-furnance slags.
- (c) During the last decade, the demand for cement on the Nigerian market, oscilating from 6,6 to 7,7 million tons P/A, has never been fully satisfied by both home production and imports. In the last 5 years, due to reduced imports, supply gap increased to 2,5 - 3,7 million tons P/A. This created a special market situation, when prices of cement, influenced by distributors and sub-distributors, rose by 488 per cent from 1985 to 1989.

However, the demand prognosis for the period 1990 - 2000, indicated on the page 34 of the sub-system study, does not seem to be correct. Simple multiplication of real national cement supply 1990 (4,08 million tons) by average annual growth rate of gross domestic product (supposedly 11,7 per cent between 1986 - 1990) to estimate the demand for cement in the 1990s seems to lead to wrong conclusions. For instance, based on 1990 real demand (7,7 millicn tons) the projected demand estimates in the first half of the 1990s lag seriously behind while in the second half of the decade these

estimates appear to be excessively high. Moreover, it is not clear, why the rate of GDP growth 11,7 per cent was taken as the most important dynamic parameter for the calculation of the demand for cement in the 1990s. It is known that average rate of growth in the second half of 1980s was well below 5 per cent (1987 - 4,1; 1988 - 4,0; 1989 - 5,2; 1990 - 5,2 per cent).

The demand projection should be revised prior to planning new investments and reconstructions in the cement industry. The future production capacity extension should therefore be based on a detailed analysis of the market demand and should take also full account of the specific infrastructural conditions of the country.

- (d) Although finding-places of gypsum are known in Nigeria, some cement plants still import this material. In order to change this situation and prevent unnecessary losses of foreign exchange, it is indispensable to verify the reserves and quality of gypsum and, if the answer is positive, it is imperative to start mining activities without any delay. On this basis, the objective of self-sufficiency in gypsum could promptly be achieved.
- (e) Another problem consists in the lack of skilled technical staff employed in the cement industry. Similarly as in the non-metallic sub-system, the solution should be sought in establishing a specialized chair of silicate chemistry and technology at one of the Nigerian chemical-technological universities, and another specialized chair of silicate engineering at one of the technical universities. This would help provide the cement industry with adequately prepared technical personnel. It is assumed, that both these university chairs would educate engineers for the cement as well as for the non-metallic sub-system.

C. Strategic directions and suggestions

- (a) To establish a specialized mechanical engineering plant for production of spare parts needed in the cement industry. Thus, to increase gradually the independence of the cement sub-system on imports of spare parts and promote higher capacity utilization.
- (b) To verify the reserves and quality of the gypsum in Nigerian finding-places and, if found satisfactory, to start industrial mining (including eventual processing) of this mineral and reach full import substitution.
- (c) In respect of education and training the same recommendation as for the non-metallic sub-system is suggested here. This recommendation reads as follows:
"To establish at one of the Nigerian chemical - technological universities a specialized chair of silicate chemistry and technology and at one of the technical universities a chair of silicate engineering, which would educate skilled Nigerian technical staff for the non-metallic and cement industries.

9. Non-Metallic Products (Evžen Krameš)

A. Characteristics of the sub-system

Non-Metallic industries are generally understood as industries exploiting silicate raw materials and producing mainly bricks, ceramics and glass, which are important building materials. All of them have two common characteristics:

The first one is the common base of silicate raw materials. These exist usually in sufficient quantities and more or less satisfactory qualities practically all over the world. Rich reserves of these materials in Nigeria make it possible that non-metallic industries are independent on imports. Only relatively small volume of very special raw materials have to be imported (e.g. fritts and colours for tile glazes). However, the brick industry is fully selfsufficient in raw materials.

The second common characteristic of the non-metallic industries is the necessity to use energy intensive high temperature technological firing or melting processes, which are indispensable for reaching the required technical properties of final products. In the glass production the high temperature enables the perfect homogeneity of the glass melt, which is the basic condition for shaping glass products. In the production of bricks and ceramics complicated chemical solid-state reactions, occuring during the high temperature firing process, give rise to new compounds and crystal phases, which determine the physical and technical properties of the products.

For the purpose of the Industrial Master Plan project a team of Nigerian specialists prepared a fairly extensive and comprehensive study on the non-metallic sub-system. This study comprises main characteristics of the three sub-systems' branches (glass, bricks and ceramics) with statistic and analytical data and final conclusions and recommendations.

While no serious objections can be raised against these conclusions and recommendations and most of them should be supported, some additional suggestions are proposed by the author of this report for consideration of the SCG.

B. Identification of major problems and constraints

(a) As a base for further development of non-metallic industries and especially for the ceramic industry, better knowledge of the indigenous raw materials should be achieved. There are references and evidence of finding-places of many important non-metallic minerals and raw materials, but only few of them have been adequately geologically investigated and even less so mined and utilized. High priority consideration should be given to the geological survey activities as a necessary condition for investment decision making in the sphere of raw material refining, purification and factories for consequent processing of final products.

In this way, the production of high duty refractory materials (on the base of sillimanite and kyanite) or of graphite crucibles for foundries of non-ferrous metals could be introduced. This could certainly contribute to the achievement of the self-sufficiency goal in this branch and would also reduce the Nigerian import requirements.

(b) The promotion of the refractory industries development should be considered as the basic step for reaching self-sufficiency of many important industrial branches, including the non-metallic sub-system itself. The Nigerian government should concentrate earnest attention on the development of this industry.

(c) Another serious problem is lack of skilled technical staff employed in non-metallic industries. This shortage is likely to be increasing due to the gradual introduction of advanced technologies. The solution of this problem should be

sought in establishing a specialized chair of silicate chemistry and technology at one of the chemical-technological universities in the country and another specialized chair of silicate engineering at one of the technical universities. This would help to provide the industries concerned with adequately prepared technical personnel. It is assumed, that both these university chairs would educate engineers for the non-metallic as well as for the cement sub-system.

- (d) In housing construction in Nigeria, the concrete blocks are usually preferred to bricks, because of their larger size, which enables the construction process to move on more rapidly. Larger sizes of the produced bricks could probably promote the popularity of using bricks for building construction, because they would save consumption of mortar and speed up the brick laying.
- (e) Some plants of the brick industry feel a serious shortage of specialized mining machinery of their own. Hiring bulldozers and other mining and transport equipment is not very economical and, moreover, can cause temporary lack of raw materials and consequent brakes of production with considerable losses.
- (f) The production process in some brick factories is not technologically well balanced. As a result, some bottlenecks arise in one phase or another and low capacity utilization appears. If kiln is underutilized, the fuel economy deteriorates and exerts negative impact on production costs.
- (g) In the brick production for housing construction relatively favourable possibilities could be found for the development of small and medium-scale undertakings. Local raw materials of satisfactory quality are abundant. More over, the relatively simple production technology can create new employment opportunities for both skilled and unskilled workers.

- (h) In the glass industry, attention should be primarily concentrated on upgrading the drawing technology (drawn sheet glass for building purposes) which suffers from considerable temporary production losses at present. The intention to introduce extremely complicated technologies (as for instance the production of float glass) would be premature.

Owing to the investment intensity of the sheet glass production, there is only a limited room for small and medium-scale undertakings.

- (i) Efficient industrial production of high quality building ceramics (walltiles, floortiles and sanitary ware) also requires considerable capital investment. Therefore only theoretical chance exists for the development of small and medium-scale enterprises in this branch. However, in well designed factories (without excessive automation) new employment opportunities may be found for both skilled and unskilled manpower.

C. Strategic directions and suggestions

- (a) To concentrate due attention on undertaking and evaluating geological survey of important non-metallic minerals and raw materials as a necessary condition for investment decision making in the sphere of raw material refining and purification and factories for consequent processing of final products.
- (b) To work out a feasibility study with the objective to build up a factory of refractory products, based on the evidence of existence of Nigerian refractory raw materials. Nigerian dependence on imports of refractories would be thus reduced.
- (c) To establish at one of the Nigerian chemical-technological universities a specialized chair of silicate chemistry and technology and at one of the technical universities a chair

of silicate engineering, which would educate Nigerian skilled technical staff for the non-metallic and cement industries.

MAIN FINDINGS AND RECOMMENDATIONS

In accordance with the ultimate goal of the project, i.e., "to provide a functioning institutional framework for the strategic management of the industrial sector in Nigeria" and its objective in the present phase, i.e., "to formulate guidelines for an Industrial Master Plan", the main task of the Polytechna team was to assist in the preparation of these guidelines.

In the process of implementation of the present phase, the preparation, evaluation and revision of the nine priority industrial sub-system studies played the central part. According to the Terms of reference, these studies should have been completed by the time the Polytechna team arrived in Lagos and its first task was to analyse, evaluate and supplement them by new ideas and suggestions. In doing so, the Polytechna team assisted the Strategic Consultative Groups in the preparation of strategic directions which constitute one of the most important components of the abovementioned guidelines. Moreover, this Report represents an additional contribution to the formulation of guidelines.

All major findings and conclusions, included in this Report, were presented in oral statements made by the leader and all members of the Polytechna team on the occasion of the concluding meeting of NCID secretariat with top representatives of SCGs. This meeting was convened on Thursday 13 June 1991 at NIDB in Lagos. The statements were appreciated and received with applause. Some members answered questions raised by the other participants during the meeting and/or after the meeting was adjourned. A copy of the preliminary version of the draft Report was handed over to the NCID chairman and CTA.

Although the task of the Polytechna team, judging by this outcome, was fulfilled successfully, the Nigerian counterparts regretted that international sub-contractors had not arrived earlier to take part in working out rather than in evaluating and

revising sub-system studies. Such critical remarks, concerning the role of the Polytechna team in the conduct of sub-system studies sounded repeatedly at all official meetings during the first week of the mission. UNIDO may wish to take this criticism into account while planning a similar mission in the future.

In the course of their assignment to Nigeria, international sub-contractors carried out four types of activities. They analysed sub-system and sub-sectoral studies, were introduced to and consulted with their authors and other Nigerian representatives involved, visited a number of factories and institutions, and prepared their contributions to this Report, including suggestions to be considered by SCGs and NCID for inclusion in guidelines for the Nigerian IMP. It should be mentioned that most members of the Polytechna team used their factory visits not only to obtain the necessary information and practical experience, but also to grant consultancy and advisory services. Some of them have been requested by managers and/or owners of visited firms to make suggestions and recommendations for further development of these enterprises, particularly in the field of technological innovations, new processes and products. In several cases they suggested and demonstrated simple technological changes with immediate favourable effect on the quality and economy of production.

The first introductory phase was undoubtedly too lengthy and could have been organized more efficiently. By contrast, the programme of factory and institution visits was fairly well organized, but needed more time. The report drafting and completing was hectic, needed also more time and suffered from lack of secretarial support. Moreover, most international sub-contractors were not invited to participate in the hurriedly convened SCG meetings which were supposed to formulate their strategies and present them in the concluding meeting.

In order to achieve a high professional efficiency in the conduct of such a mission, effective cooperation between

international sub-contractors and national counterparts is imperative. This is particularly necessary in Lagos, where especially transport, communication and secretarial work shortcomings generate problems difficult to resolve and obstacles hard to overcome. The Polytechna team desires to express its deep gratitude for great efforts made by the NICD chairman, his staff, CTA and UNIDO consultants to create favourable conditions and friendly atmosphere for its work. On the contrary, it should be added that more assistance was expected from the UNDP office in Lagos.

However, even if the most favourable environment were created for its work, the task of the Polytechna team in Nigeria as formulated in the Terms of reference was so huge that it required much more time than just three weeks available. In this connection, UNIDO may wish to consider this experience in preparations for similar projects in its work programme. Moreover, UNIDO may wish to consider a possibility of recruiting some members of the Polytechna team for a follow up of the completed assignment providing that the Nigerian counterparts find this suggestion useful.

So far as substance of the matter is concerned, the following observations and recommendations can conveniently be subdivided into two groups: (1) The First one comprises some major issues related to industry as a whole or to most of the priority sub-systems (2). The second one includes selected suggestions pertinent to each single sub-system.

1. Major Issues

A. The changing position of industry in the economy

As a result of the preceding economic growth and structural change analysis it is stressed:

First, the high priority consideration attached to further industrialization of Nigeria is correct. The so-called deindustrialization is a false slogan for developing Africa. In Nigeria, favourable conditions for a new drive to industrialize prevail.

Second, industrialization in Nigeria should not be confined just to industrial development. It should be understood as a process of economic growth and structural change, characterized by rapid growth and increased share of industry in total production of goods and services with emphasis on progress in manufacturing and linkages with agriculture and the services sector, including economic and social infrastructure.

Third, the new emphasis on industrialization and its core, manufacturing, in the changing internal as well as international conditions requires new and fresh approaches and strategies.

Fourth, the strategic management of industrial progress represents a fairly new and hopeful strategic approach to solve the problems of industrial development in Nigeria more efficiently than in the past and deserves full support.

B. The strategic management of industrial progress in Nigeria

Nigeria, seeking new ways and means of industrial strategic management in the changing internal as well as international environment could play the pioneering role in the process of Africa's industrialization. This objective is both ambitious and difficult, but very important. It involves both risks and opportunities. On the one hand, there is no or little experience with such an industrial management experiment. This experiment is likely to be accompanied by differences in opinion and possible errors. On the other hand, the core of the institutional structure, both inter-sub-system and intra-sub-system consultations provide forum for interactions between the representatives of the private sector and the public sector. This

gives the private sector an excellent opportunity to influence meaningfully the economic policy of the government.

C. External factors

(a) The attainment of higher levels of self-sufficiency in the production of food and other raw materials is presently emphasized as the first key objective in Nigeria. Its attainment will influence, though in varying degrees, actual performance of all industrial sub-systems covered by SMID. It has been explained that this objective should be understood in a relative sense. It should also be added that this issue ought to be interpreted in the context of the leading tendencies of world development. The strengthening of internationalization in the world and the growing interdependence among all countries make actually any efforts at absolute economic self-sufficiency (autarky) misleading. Self-sufficiency in food should mean, e.g., that the country in question will attain a proper balance between its food exports and imports or will export more food than import. The large economic size of Nigeria does not make any difference in this respect. Actually, even the largest economies in the world cannot afford to ignore their increasing dependence on world development. Otherwise, they would be condemned to lag seriously behind the world progress.

(b) In the light of import substitution and export orientation strategy discussions, it should be duly considered whether or to what extent the priority sub-systems should be granted, at least temporarily and on a selective basis, some additional advantages stimulating exports of their products and facilitating imports of some necessary inputs concurrently. This issue is of vital importance because the introduction of such policy measures may partly interfere with the creation of competitive environment which was one of the most significant policy intentions of SAP. The present world

economic situation is so complex and so uncertain, that it makes it very difficult, if not impossible, to suggest a proper market orientation for Nigeria's manufacturing exports. Also the subject is rather wide and diversified. Two kinds of market studies should be undertaken, preferably in co-operation with UNCTAD and UNIDO: The first one, dealing with marketing implications of changing world economic situation, and the second one, analysing the market prospects and strategies for Nigeria's priority sub-systems.

D. Social aspects and employment

All sub-system studies provide comprehensive structural characteristics of each priority sub-system. They concentrate especially on technology, marketing, strategic directions and policy measures. Most of them analyze, though in varying measure, also some manpower and employment problems. In general, however, employment issues and, more broadly, social aspects of industrial development appear to be of the secondary importance and perhaps somehow under-estimated by the authors of most studies. It is therefore suggested that social aspects of industrial development should be included in the Guidelines for the Industrial Master Plan and the employment analysis in most sub-system studies should be strengthened.

E. Small-scale industries and related issues

Although the position of small-scale, village and cottage enterprises in Nigeria's manufacturing is still rather weak, they could play much more important role in the process of industrialization of this country in the near future. They may rely on various appropriate technologies, have distinct advantages in the utilization of local materials and skills, in low production costs, high market flexibility and have strong employment effect. They also contribute to increase incomes, particularly in the rural areas. It is therefore suggested that

the Government should consider the strengthening of linkages between large-scale and small-scale industries and prepare a programme, supporting the development of small-scale and allied enterprises as some Asian countries did some time ago. One of the most important directions of government support of these enterprises can be seen in the sphere of education and training. A number of specific suggestions are submitted for consideration by sub-system and presented in some detail in Chapter III.

F. The economic role of the state

The role of the State in the economy remains essential even if the private sector assumes much greater responsibility for the process of industrialization. It gives the state a good opportunity to concentrate on other functions and improve its overall performance. This notion is also applicable to the role of the State in Nigeria at the time when the SMID concept is elaborated and executed. The State should participate very actively in preparing and introducing the SMID approach in practice at all stages of its development. In particular, high level government officials entrusted with wide responsibilities and significant decision making power should be full members of all major bodies of the institutional structure of SMID. Also, the State should contribute to finance SMID operations. Without the active and strong government involvement, the so-called interactive process between the private and public representatives can hardly fulfil expectations.

2. Selected Suggestions by Sub-system

A. Foundry and forges

Since there is no production of die-forgings in Nigeria and imports of these products would be uneconomical, the international sub-contractor proposes that this branch of the foundry and forges sub-system should be built up in this country.

To achieve this objective, it is first necessary to work out a feasibility study, preferably in cooperation with UNIDO.

B. Metal fabrication

One of the major problems faced by most sub-systems is lack of spare parts. In order to modernize effectively the production of spare parts and allied industries, powder metallurgy technology is suggested for serious consideration.

Another major problem is shortage of raw materials. However, there is no systematic collection and separation of ferrous and non-ferrous scrap for recycling in Nigeria. It is suggested that this collection and separation of ferrous and non-ferrous scrap, organized on self-financed basis, should be encouraged.

C. Pharmaceutical products

The development of the pharmaceutical sub-system requires the introduction of new drugs on the basis of antibiotics and vitamins. Nigeria possess some favourable conditions for fermentation processes based on local sources of raw materials (sugar, starch, corn-steek, proteins from food industry). High productive technologies are readily available in the developed as well as some developing countries (Brazilia, India).

D. Rubber and plastics

A new capacity for manufacturing tyres should be built on the basis of Nigerian sources of rubber. Thus, greater portion of the local market could be supplied by domestic production and even exports could be considered to some African countries in the future. Also, new capacities should be built for manufacturing rubber chirurgical and examination gloves, condoms and children soothers based on Nigerian sources of natural rubber - latex.

Considering the domestic raw material resources and the absence of upstream industries, it is proposed that Nigeria specialize on polyolefin, PVC and polyester production. The polyolefin production based on rich raw material resources could be intensified and a large portion of the production exported.

E. Food processing

The assumption that traditional strategic directions are good enough to achieve the self-sufficiency objective should be questioned. It is recommended to supplement the proposed strategic directions by some modern approaches to resolving the food processing problems. These non-traditional approaches comprise, inter alia, the utilization of non-traditional sources of raw materials for food processing, introduction of new technologies and development of non-traditional food products. All the three non-traditional approaches are elaborated in detail in Chapter III.5. International technical cooperation in the field of biotechnology, waste treatment and membrane processes is suggested, with active participation of international sub-contractor.

F. Leather and leather products

It is necessary to put an effective ban on exports of all skins and hides from Nigeria. The international economic position of the leather sub-system can be improved by exports of intermediary products such as wet blue and crust. To achieve higher prices, improvements in the quality, based on changes in the tanning technology, are needed. The enzymatic unhairing technology is recommended to meet economic as well as ecological objectives. For the sake of current production of finished leather, it is advisable to use staking machine Mollisa with Lycra conveyer. For introducing a simple low pollution technology and improvement in the quality of leather and leather products,

it is recommended to request for the services of an experienced UNIDO leather technologist.

G. Textile and wearing apparel

The medium level technology is more appropriate for the textile sub-system for a number of reasons. However, modern technology in weaving mills should be supported mainly because it contributes to the strengthening of competitiveness of textiles on foreign markets.

The supply gap on internal textile market can be easily filled up by increasing local production. There are possibilities to expand exports to West Europe, America and also to some developing countries. In order to increase local supply of raw materials Government intervention in the seed-cotton production is supported. UNIDO technical assistance is recommended in order to master new technologies and accelerate technological progress.

H. Cement and non-metallic products

To concentrate on undertaking and evaluating geological survey of important non-metallic minerals and raw materials. To verify the reserves and quality of gypsum with a view to reach effective import substitution in this regard. To prepare a feasibility study with the objective to build up a factory of refractory products based on local raw materials.

For both sub-systems, it is recommended to establish a specialized chair of silicate chemistry and technology and a chair of silicate engineering at Nigerian universities which would educate skilled technical staff for non-metallic and cement industries.

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

STRATEGIC MANAGEMENT OF THE INDUSTRIAL SECTOR
PREPARATION OF GUIDELINES FOR AN INDUSTRIAL MASTER PLAN
IN THE FEDERAL REPUBLIC OF NIGERIA

UNIDO PROJECT NO. XA/NIR/90/626

FINAL REPORT

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POLYTECHNA PRAHA
CZECHOSLOVAKIA

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VOLUME TWO

POLYTECHNA PRAHA

ALOIS HOLUB, Leader of the Team

**JAROSLAV BENDA
PETER BROKEŠ
JIŘÍ EDER
EVŽEN KRAMEŠ
JIŘÍ KŘEPELKA
KAREL KUBEC
ZDENĚK LAITA
VLADIMÍR SITENSKÝ
ADOLF TAUCEMAN**

1991

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APPENDIX I.

ANNEX 1

LIST OF MEMBERS OF UNIDO-POLYTECHNA TEAM

Sub-system	Name	Profession	Long-term foreign experience
1. Foundry & Forges	J. Benda UNIDO expert	Metallurgical Engineer	United Nations; Asia and Africa;
2. Metal Fabrication	V. Sitensky Deputy Head of the Department (Ministry of Industry)	Metallurgical Engineer	
3. Pharmaceutical Products	J. Krepelka (Ph.D) Director of the Research Institute	Chemical Technology Engineer	Asia;
4. Rubber & Plastic Products	A. Tauchman Head of the Research Dept. L. Laita (Ph.D) Head of the Research Project	Mechanical Engineer Chemical Technology Engineer	Africa
5. Food Processing	P. Brokes (Ph.D) Head of the Research Project	Food Technology Engineer	Latin America
6. Leather and Leather Products	K. Kubec (Ph.D) Director of Leather Factory	Chemical Technology Engineer	United Nations; Asia and Africa

7. Textile and Wearing Apparel	J. Eder Adviser to the Deputy Prime Minister	Industrial Economist	United Nations; Africa
8. Cement	E. Krames Head of R & D Dept.	Silicate Engineer	Latin America; Asia
9. Non-Metallic Products	E. Krames Head of R & D Dept.	Silicate Engineer	Latin America; Asia;
10. Team Leader	A. Holub (Ph.D) Head of Research Project	Development Economist	United Nations; Asia

Note: In addition to foreign assignments of most members of the team in developing countries, all of them have gained professional experience in developed countries of Europe and North America.

ANNEX 2

WORK PROGRAMME - SCHEDULE

- | | | |
|--------|-----------|---|
| 24 May | Friday | - day of arrival;
- hotel EKO Le Meridian; |
| 25 May | Saturday | - morning meeting of the team (introductory briefing);
- meeting of the team with NCID chairman and his staff; revised versions of sub-system and sub-sectoral study reports distributed;
- evening meeting of the team (preliminary work programme); |
| 26 May | Sunday | - sub-system study reports (revised draft) - study;
- NCID chairman and Polytechna team leader on TV; |
| 27 May | Monday | - UNDP office (introduction and informatory meeting);
- NCID, MSG, NC (meeting: SMID progress and short-term schedule)
- press interviews;
- lunch hosted by NCID chairman; |
| 28 May | Thursday | - NCID, NIDB library - study of sub-system study reports; |
| 29 May | Wednesday | - travel to Ibadan - visit of FMI-PAD; meeting PAD director, his staff, UNIDO consultants, NC and other authors of sub-system study reports; |
| 30 May | Thursday | - visits: textile, leather and metal processing factories, Federal Office of Statistics, NIDB; |

- 31 May Friday - meetings (representatives of SCGs in plenary; and the so-called SCG Troikas: chairman, secretary, consultants with international sub-contractors by specialization separately);
- lunch hosted by NCID chairman;
- 1 June Saturday - consultations: CTA and Polytechna team leader;
- desk work: a draft outline and preliminary suggestions;
- meeting of the team: preparations for factory visits and report writing;
- 2 June Sunday - desk work: preparations for report writing and study;
- 3 June Monday - consultations: CTA and team leader; UNDP visit; factory visits: study in the NIBD library;
- 4 June Tuesday - visit of IBRD office in Lagos; factory visits;
- 5 June Wednesday - factory visits;
- 6 June Thursday - factory visits; report drafting; SCGs meetings;
- 7 June Friday - factory visits; report drafting; SCGs meetings;
- 8 June Saturday - factory visits; report drafting and editing;
- 9 June Sunday - reports drafting and editing; evening meeting of the team: specialized contributions;

- 10 June Monday - discussion: CTA and Polytechna team leader;
report drafting and editing;
- 11 June Tuesday - SCGs meetings; report typing and
provereadng;
- 12 June Wednesday - report typing and provereadng; meeting of
the team (preparations for the concluding
meeting with NCID);
- 13 June Thursday - concluding meeting with NCID, SCGs and
UNIDO consultants: sub-system strategies
and international sub-contractors
suggestions;
- 14 June Friday - day of departure;
- 15 June Saturday - arrival Prague.

ANNEX 3

LIST OF VISITED FACTORIES AND INSTITUTIONS

1. Foundry and Forges

J. BENDA

Date	Factory/Institution	Contact person	Accompanying person
30 May	Neptune Construction Ltd., Apapa - Awodi Ora Lagos	Bola Adeleke - Chairman	Mr. N'Kwonta
	Crittall-Hope Ltd. Agege Motor Road, Ikeja, Lagos	J.W. Bill Curry - Chief Executive	Mr. N'Kwonta
4 June	Nigerian Foundries Ltd Ilufejn, Lagos	John Barberopoulos - Managing Director	Mr. Akinbinu
	Masters foundries Otta	---	Mr. Akinbinu
	Adebowale Engineering Services Ltd., Sango Otta	Alhaji A.K. Jaiwo General Manager	Mr. Akinbinu
6 June	Ajaokuta Steel Co Ltd Ajaokuta	I. Mojugbe Assistant General Manager	Mr. Akinbinu
7 June	Delta Steel Co Ltd Orwian - Aladia Warzi	Ifeanyi B. Okeke Assistant General Manager	Mr. Akinbinu

2. Metal FabricationV. SITENSKÝ

Date	Factory/Institution	Contact person	Accompanying person
30 May	Neptune Constructions Ltd., Lagos - Apapa	Bola Adeleke Chairman/Managing Director	Chris C. N'Kwonta
	Crittall-Hope Ltd. Lagos - Ikeja	J.W.Curry Managing Dir./ Chief Executive	Chris C. N'Kwonta
3 June	Peugeot Automobile Nigerian Ltd., Kaduna	Michel Mansuy General Manager Indust. Division Fidel I. Njoku Deputy G. Manager	Chris C. N'Kwonta J.O. Adegun
4 June	Nigeria Machine Tools Ltd., Oshogbo	Eng. I.O.Agboola Manager Eng. Operations M.B.Ibitolu Asst. Production Manager	Chris C. N'Kwonta J.O.Adegun
	Oshogbo Steel Rolling Co. Ltd., Oshogbo	Ayo Oguntomi Asst.Gen. Manager	Chris C. N'Kwonta J.O.Adegun

3. Pharmaceutical ProductsJ. KŘEPELKA

Date	Factory/Institution	Contact person	Accompanying person
4 June	May&Baker, Ikeja Lagos	G.A.O.Bankole Prod. Director	Dr. F.Adenika Mr. Kajogbola
	Pfizer Nigeria Ltd. Ikeja, Lagos	Dr.O.S.Rabiu Prod. Director	Dr. F.Adenika O.D.Kajogbola
	Panpharm Ltd. Ikeja, Lagos	Dr.F.Adenika Managing Director	Dr.F.Adenika
5 June	Toki Dabur Productions Ltd., Lagos	Dr.F.Ademoye Technical Manager	Dr.F.Adenika
	Mopson Pharmaceutical Industry Ltd., Lagos	D.O.Paul General Manager	Dr.F.Adenika
	Glaxo Nigeria Ltd. Badagry, Ogun State	Mrs. T.Adeyemi Pharmac. Prod. Manager	Dr.F.Adenika
6 June	Vitalink Pharmaceutical Industries Ltd., Ibadan	O.A.Alo - Opera- tions Manager	O.D.Kajogbola
	Drug Research&Produc- tion Unit, Ile-Ife (only meeting with Dr. Adesina of the University of Ibadan)	Dr.S.K.Adesina Director	O.D.Kajogbola
4 June	Pharmaceutical Market Audit Group, Sheraton Hotel, Lagos		Dr.F.Adenika Dr.Kajogbola

7 June Pharmaceutical Manu-
facturer's Group of
Manufacturers Association
of Nigeria, Iganmu, Lagos

Dr.Kajogbola

Exhibition: Pharmaceuticals "Made in Nigeria"
(visited 23 exhibition's boxes of local companies)

4. Rubber and PlasticsA.TAUCHMAN, Z. LAITA

Date	Factory/Institution	Contact person	Accompanying person
<hr/>			
RUBBER		A. TAUCHMAN	
3 June	Radco Nigeria Ltd. Surulere, Lagos	R.Okpu Heckesher Chief Executive Officer	Dr.Ayoola B.Fasina/RRIN
4 June	Dunlop Nigerian Industries Ltd. Ikeja	M.A.A.Adekunle Tech. Manager	Dr.Ayoola B.Fasina/RRIN
	Michelin Nigeria Ltd. Ijora, Lagos	Ibukun Akinduro Group Executive Manager	Dr.Ayoola B.Fasina/RRIN
6 June	Bata, Benin City	R.J.Hall Plant Manager	Dr.Ajoola B.Fasina/RRIN S.O.Oladeji/SCG
	Plantation Integrated Ltd., Benin City	Mr.Ogowewo Manager	Dr.Ayoola B.Fasina/RRIN S.O.Oladeji/SCG
	Urhonigbe Rubber Estate, Agbor	Mr.M.O.Okolo Senior Estate Manager	Dr.Ayoola B.Fasina/RRIN S.O.Oladeji/SCG
7 June	Okpe Trading Co. Ltd. Sapele	B.T.Owumi Managing Director	Dr.Ayoola B.Fasina/RRIN S.O.Oladeji/SCG
	Pamol Nigeria Ltd. Sapele	S.E.Kolawole Estate Manager	Dr.Ayoola B.Fasina/RRIN S.O.Oladeji/SCG

Nagro Rubber Industries Sapele	Mr.Ola - Chief Accountant	Dr.Ayoola B.Fasina/RRIN S.O.Oladeji/SCG
Rodco Nigeria Ltd. Sapele	Mr.V.Oicoduva Prod. Manager	Dr.Ayoola B.Fasina/RRIN S.O.Oladeji/SCG
Rubber Research Institute of Nigeria	Dr.E.K.Okaisabor Managing Director Dr.A.B.Fasina Asst Director	Dr.Ayoola B.Fasina/RRIN S.O.Oladeji/SCG

PLASTICS

Z. LAITA

3 June	Bagco, Nigerian Bag Manufac. Co. Ltd. Iganmu, Lagos	S.A.Oluwo Managing Director	Dr.Ayoola B.Fasina/RRIN
	Metalloplastica Ltd. Apapa, Lagos	Nabil Farah Managing Director	Dr.Ayoola B.Fasina/RRIN
	Benco Plastics Iganmu, Lagos	Prince Ben Ukadike owner of the enterprise	Dr. Ayoola B.Fasina/RRIN
	Diamond Plastics Ltd. Apapa, Lagos	Mr.O.O. Johnson Acting Gen. Manager	Dr.Ayoola B.Fasina/RRIN
6 June	Warri Refinery and Petrochemicals Co. Ltd., Ekpan, Warri	M.A.Ajiboye Executive Dir.	Dr.Ayoola B.Fasina/RRIN

5. Food ProcessingP. BROKEŠ

Date	Factory/Institution	Contact person	Accompanying person
3 June	Nigerian Breweries PLC Lagos	F.O.A.Ohiwerei Chairman K.Verduin Technical Director A.Sanusi Technol. Control.	M.R.A.Adeleke ViceChairman Tate Ind. PLC S.A.Ayorinde Deputy Dir. I.P.P.P.T.
	Tate Industries PLC Iganmu, Lagos	Y.O.Odutola Prod. Director O.Tikolo Control. Market.	
4 June	Vegetable Oils /Nig./ PLC, Ikeja, Lagos	V.O.Ola Managing Dir. B.F.Adebayo Executive Dir.	S.A.Ayorinde
	Cadbury Ikeja, Lagos	Ch.H.Morah Operations Dir. T.Bogunjoko Technical Dir.	
5 June	Flour Mills of Nigeria Apapa	F.Y.Alao Personal Asst.	S.A.Ayorinde
6 June	Livestock Feeds Ltd. Ikeja, Lagos	K.Ogunlesi Operations Dir.	S.A.Ayorinde
	Guinness Nigeria Ltd. Ikeja, Lagos	F.A.Okunola Managing Dir.	

6. Leather and Leather Products

K. KUBEC

Date	Factory/Institution	Contact person	Accompanying person
31 May	BATA Nigeria Ltd. Lagos	Managing Dir.	---
	Dauphin Nigeria Ltd. Lagos	Emenyonu K. Chima	O.Y.Fatokun
	Ajalyn Shoe Ltd. Lagos	P.A.Ajayi	---
3-6 June	International Tanners Ltd., Kano	D.Hocke J.N.Okafor	---
	Tanarewa Nigeria Ltd. Kano	Samuel Legziel	O.Y.Fatokun
	The Kano Pickling & Tanning Co.Ltd., Kano	S.Y.Padros	O.Y.Fatokun
	Great Northern Tanning Co. Ltd., Kano	Leo W. Hutchinson	O.Y.Fatokun
	BASF Nigeria Ltd., Kano	N.Williams	---
7-8 June	Federal Ministry of Science and Technology Lagos	Dr.T.I.Obiaga Director of Industrial Techno- logy	O.Y.Fatokun
	CNEICO Nigeria Ltd. Lagos	Ing.J.Jalůvka	O.Y.Fatokun

7. Textile and Wearing ApparelJ. EDER

Date	Factory/Institute	Contact person	Accompanying person
31 May	Nichemtex Industries Ltd., Ikorodo, Lagos	Mr.C.M. Williams Managing Director, Member of SCG Mr.E.A. Fabiyi Deputy General Manager	Miss G.K.Ajayi Assistant General Manager, NIDB, Lagos
3 June	President Industries Nigeria Ltd., Lagos	Mr.M.E. Ibie Executive Dir. Chairman of SCG Mr. J.S.Kalsi Works Manager	Mr.A. Muoka Ag.Asst.Director Policy Analysis Dept., Ibadan
4-5 June	Afprint Nigeria Limited, Lagos	Mr.C.Okuneye Executive Dir. Member of SCG Mr.P.N. Bohra Mill Manager	Mr.A. Muoka
5 June	Nigerian Textile Mills PLC, Ikeja, Lagos	Mr. J.P.Olarewaju Asst.General Manager, Member of SCG Mr. O.Odutela Quality Control Manager	Mr. A. Muoka
6 June	Kaduna Textiles Ltd., Kaduna	Mr.D.B.Ibrahim Member of SCG Mr.F.M. Durlong Interim Managing Director	Mr. M. Hamza Polytechnic, Kaduna

<p>United Nigerian Textiles Ltd., Kaduna</p>	<p>Mr.A.F.Abdullahi General Manager Member of SCG Mr.Y.S. Wong - Joint Managing Director Mr.P.M.Chun-Asst. General Manager</p>	<p>Mr. M. Hamza</p>
<p>7 June Gaskiya Textiles Ltd. Kano</p>	<p>Mr.Z.V. Patel General Manager Member of SCG</p>	<p>Mr.M.Hamza</p>
<p>29 May Nigerian Industrial Development Bank Ltd., Lagos</p>	<p>Mr.G.C. Ehibudu Deputy Controller</p>	<p>Miss G.K.Ajayi</p>

8. Cement

E. KRAMEŠ

<u>Date</u>	<u>Factory/Institution</u>	<u>Contact person</u>	<u>Accompanying person</u>
3 June	WAPCO (West African Portland Cement Co. Ltd.), Sagamu, Ogun	General Manager Technical Man.	Mr. O. Okoye
7 June	Nigerian Cement Co. Ltd., Nkalagu, Anambra	Eng.A.S.O.Ezeoke Engineering Manager	Mr. O. Okoye

9. Non-metallic productsE. KRAMEŠ

Date	Factory/Institution	Contact person	Accompanying person
3 June	Nigerian Brick and Clay Products Ltd. (Nigerian Mining Corporation) Ikorodu, Lagos	Works Manager	Mr. O. Okoye
7 June	Nigerian Brick and Clay Products Ltd. (Nigerian Mining Corporation) Enugu, Anambra	N.C.Okonkwo Works Manager	Mr. O. Okoye
5 June	Porcelain Ware Industries Ltd. Abeokuta, Ogund.	Charles Li Head Office	Mr. O. Okoye
6 June	Modern Ceramics Ind. Ltd., Umuahia, Imo	P.I.Ogbudu General Manager	Mr. O. Okoye
4 June	Oluwa Glass Co. Ltd. Igbokoda, Ondo	C.W.Ludlow General Manager Ing. Antonín Šimeček Prod. Manager	Mr. O. Okoye

APPENDIX II.

F O U N D R Y A N D F O R G E S

Prepared by

J a r o s l a v B e n d a

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A. Basic characteristic of the sub-system

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- (a) Objectives of the Profile Study
- (b) Analysis of existing industrial capacities
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 - (iv) Marketing

B. Identification of main problems and constraints

Introduction

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- (b) Production problems
- (c) Marketing problems and constraints
- (d) Financial problems
- (e) Infrastructural constraints and problems
- (f) Impact of recent economic policies on the structure

C. Strategic directions

D. Suggestions

Foundry and Forges (J. Benda)

A. Basic characteristics of sub-system

Introduction

For an industrial concern to function effectively, it is imperative that the various resources invested and utilized in the production activity should be optimized. To achieve this, the existence and development of auxiliary industries and back-up support facilities required for the development of hand tools, agriculture tools, machine tools, agricultural machinery, municipal demands (sewage, water pipe-lines etc.), tractors, railways, commercial vehicles etc., are foundries, forges and tool-rooms along with heat-treatment shops.

The supply of products equipments and spare parts by foundries, forges and other back-up facilities plays a vital role in promoting accelerated, rational and integrated development of the industrial sector.

However, the existing foundries and forges require upgrading in order to support the integrated development of the industrial sector, since capacity utilization is low and inefficient operations prevail.

(a) Objectives of the profile study

This report is a prelude to the Industrial Master Plan Project Study-Foundries and Forges, April 1991-designed to serve as an overview of the heavy metallurgical sub-sector.

In Nigeria there are about 50 identified functional foundries and 7 identified forge shops. About 28% of the foundries are owned by the Federal Government through government parastatals and institutions, the remaining 72% being private commercial foundries. Four of the seven forge shops are owned by

the Federal Government through the respective corporations or parastatals.

All the foundries belong to the categories of small- and medium-sized foundries with installed capacity ranging from less than 10 to 36.000 mt.p.a. The forge shop in Ajaokuta is the biggest with installed capacity 4.200 t.p.a. of forge components.

According to the above mentioned study, the capacity utilization of some selected foundries is 9,1% for steel castings, 11,6% for non-ferrous foundries and 24,2% for cast iron foundries. Capacity utilization in forging industry is not mentioned.

Objectives of this report are to characterize foundries and forge-shops sub-system and to assess its importance in the industrial development of the economy.

(b) Analysis of existing industrial capacities

(i) Technological dimensions

Since the majority of foundries make gray cast iron products, the type of commonly found melting facilities are cupolas, rotary furnaces, tilting furnaces and crucible furnaces.

In the area of steel castings, there are induction furnaces and arc furnaces.

The technologies for the local fabrication of cupolas, rotary furnaces, tilting furnaces and crucible furnaces are available in Nigeria, although with imported instrumentation and components for control. There is no local capacity for manufacturing steel melting facilities.

Mould making operations are generally carried out using the hand method in sand moulding technique on the bench and/or the floor. About 20% of the foundries have jolt/squeeze machines for

mouldmaking. Some factories have permanent mould or die casting moulds. Small foundries that make ornamental castings also practise rubber moulding in their centrifugal casting operations.

Less than 5% of the foundries practising green sand moulding technique have mechanized sand handling system for sand distribution, preparation and sand reclamation and separation. In the medium-sized foundries synthetic sands and mechanical mulling are adopted to increase the control over the properties of the moulding sand as predetermined in the foundry sand control laboratory. The majority of the small scale foundries use natural sand from tested local deposits.

In the area of cleaning and finishing operations more than 80% of the foundries have only basic cutting and grinding facilities. Less than 10% of the foundries have shot blasting equipment in the fettling section.

Visual inspection and measuring the strength of green sand by feel and temperature of molten metal by eye are the common practise. Only about 10% of all existing foundries have established foundry sand control laboratories and mechanical testing facilities such as hardness tester. The Delta Steel foundry is the only one at present with access to Spectrographic analyses equipment. Many foundries do not have pyrometers to measure the temperature of the melt before pouring.

While it is possible to identify some areas of foundry activities in Nigeria, it is almost impossible to see any serious forging activities. There are available only Steam or Pneumatic Forging hammers with heating furnaces.

The machine tools industry in Nigeria has not been developed yet. Only very few industries exist in this category. The same situation is with the heat-treatment processing.

(ii) Input structure

The metallic charge into the melting furnace is basically metal scraps from local suppliers who have a preference for exporting the scrap metal because of the attractive foreign exchange earnings. Input raw materials and consumables such as aluminium, copper, zinc, pig iron, coke, ferro-alloys, refractories etc. are imported into Nigeria for use by the foundries and other pyrometallurgical industries.

The main input material in the forging shops is the billet of the material from which forged products are made. Since the Ojaokuta Steel Plant has not been commissioned, there is no forging activity going on at Ajaokuta. Forging industry now depends mainly on imports, though some utilize locally cast billets depending on the specifications of the output.

The auxiliary materials for the foundry and forging industries are mainly imported, but there is a lot of possibilities to use the domestic raw materials in other connected sub-systems.

(iii) Quality of the products

It is generally agreed that good quality control at different stages of casting and forging product will reduce scrap and returns, increase equipment productivity and enhance casting and forging quality. The area of inspection and quality control needs considerable improvement in Nigeria. The quality of castings is generally poor compared to the average and this may be attributed to unskilled labour, poor sand control (quality, grain size, strength, etc.), and in the case of the non-ferrous castings to the lack of degassers and fluxes.

The poor level of inspection and quality control has limited the range of products that can be competitively supplied by the local industry to domestic and foreign markets. This limitation

is very glaring in the production of alloyed cast iron products required in the cement and automotive industries.

(iv) Marketing

The analyses showed, that the range of cast metals and forged products varies in size from small castings of less than 1 kg to large ones - off repair castings or jobbing order of over 1.000 kg. The majority of cast metal products are in the small to medium range (between 1 to 200 kg). This is typical of the range of grey iron castings. Range of products covers channel gratings, grills, manhole covers, water pipe fittings, handpumps bodies, components for agricultural equipment and industrial castings.

In the area of non-ferrous castings, there is production of cooking utensils, cutlery, cable clips and other non-ferrous cast components. The smaller companies are serving the many manufacturing industries in the production of maintenance spare parts. At present, forge shop group is incapable of supporting real growth in the engineering industry.

On the other side, the demand for cast metal products can be estimated according to the studies for 200.000 to 250.000 mt for 1990 and 37.000 mt for non-ferrous castings.

In sum, demand for foundry and forge shops can be divided into three items:

- a) demands from the mechanical and electrical engineering industries;
- b) civil engineering;
- c) automotive industry.

The demand for automotive and mechanical industries is only being met in a small part. That of civil engineering is partly being met from domestic sources.

B. Identification of main problems and constraints

Introduction

The foundries and forges sub-system is characterized by poor development as a result of operational constraints, unorganized marketing strategy, poor level of funding and inadequate infrastructure. The lack of effective linkage and independence in metallurgical industry have contributed immensely to that subsector's high dependence on imports for its input materials. The metallurgical industries import their primary input materials because of unavailability of local supplies.

(a) Technical problems

Technical problems which limit production are as follows:

- a) irregular and expensive supply of input raw materials for foundries and forges;
- b) inadequate and irregular supply of refractory materials, necessary for routine maintenance of melting and heating facilities;
- c) non-availability of reliable local suppliers of crucibles for melting operations;
- d) dearth of skilled manpower such as technicians and craftsmen for patternmaking, mould-making and dies and tools production.

(b) Production problems

At the level of production, the following have been identified as the major problems:

- a) poor process control of the melting and casting operations as a result of non-availability of necessary laboratory and

instrumentation (foundry sand control laboratory and thermocouple for temperature monitoring);

- b) poor quality control of cast products as a result of non-availability of necessary equipment and facilities (equipment for metal analysis, equipment for finishing operations, machinery for the measuring of the mechanical properties of products etc.,);
- c) non-availability of machinery and equipment to add value to products during finishing operations (coating facility, electroplating facility etc.);
- d) increasing cost of energy, especially in the steel foundries, where there is now seven-fold increase in the cost of electricity for operating an induction furnace per tonne of melt as a result of the new electricity tariff.

(c) Marketing problems and constraints

The following have been identified as major problems and constraints that affect the marketing of metal products in Nigeria:

- a) inadequate patronage by both the public and private sectors for locally produced available cast metal products and forgings (cement industry, automotive industry, government agencies, contractors on government projects, etc.);
- b) requirement of experienced personnel to market cast products and forgings and more customers;
- c) managements of some foundries and forgeries have limited knowledge of the type of cast metal products and forgings products that can be profitably put into the market;
- d) unfortunately, government agencies are not helping matters to the supply of foundry and forge shop products to the large

machinery and equipment assemblers including the vehicle assembling plants.

(d) Financial problems

All foundries and forges need some form of financial assistance to solve part of the problems and eliminate the constraints, which affect their productivity.

- a) the devaluation of the Naira has its own founding effects on the operation in the industry;
- b) difficulty in obtaining required foreign exchange at official rate;
- c) working capital to cope with increasing cost of stock piling imported raw materials and consumables;
- d) the official interest rate in the banks is too high to encourage growth of the industry;
- e) fluctuation in foreign exchange rate which make long term production planning and new investment planning difficult.

(e) Infrastructural constraints and problems

All foundries and forging shops complain of inadequate infrastructural facilities to support their operations.

- a) energy contributes a substantial proportion of foundry and forge shops production cost. NEPA tariff to industrial consumers add to the cost of Nigerian casting and forgings thus preventing production at competitive costs. Escallation of the energy cost has forced companies to suspend the use of electric furnaces;
- b) lack of main water to the factory;

c) inadequacy in communication services such as telephone, telex and postal, result in high overhead cost;

(f) Impact of recent economic policies on the structure and performance of the foundries and forges sub-system

There is a relatively low level of development in the foundries and forges sub-system. About 80% of the existing foundries are at the level of small-scale foundries and without any form of organized interaction.

In general, the package of economic policies and incentives which affect the sub-system may be grouped into the following categories:

- a) fiscal measures on taxation and interest rate;
- b) effective protection with import tariff;
- c) export promotion of Nigerian products;
- d) foreign currency facility for international trade;
- e) trade liberalization and deregulation of the economy.

C. Strategic directions

Following strategic directions are suggested for the future restructuring and development of the sub-system:

- 1) The expansion of the capacity and capability of industry to meet the local demand in relation to the quantity and quality of the present product mix;
- 2) Future development and installation of foundries and forges by the private sector should be targeted to the need of strategic industries - automotive, cement, agro allied, mining and construction, textiles, iron and steel and industry of machine building. This strategy requires some level of standardization in the components and spare parts for plants, equipment and machinery in all the specific industries;

- 3) To establish under one umbrella organization that can foster the peculiar interests of foundries and forging shops:
 - a) this organization would be responsible for importing the essential raw materials and consumables for the collective needs of the both industries,
 - b) to influence positively government decisions and policies on matters affecting foundry and forges sub-system such as tariffs, concessions, etc.,
 - c) to organize foundry and forge information, standardization, racionalization, lectures, workshops, etc.;
- 4) Some of the government regulations and policies which should be ammended to stimulate development and growth in the sub-system include:
 - a) raw material for foundry and forge sub-system should be imported duty free into the country,
 - b) auxiliary materials not yet produced in Nigeria should be imported duty free,
 - c) imports of induction heating and melting furnaces, electric arc furnaces, and production machinery for casting and forging industry should be duty free,
 - d) the importation of all finished cast and forged metal products that can be commercially manufactured in Nigeria should be regulated to protect the local foundry industry;
- 5) Since energy is a dominant cost item in foundry and forging operations, the Federal Government should direct the NEPA and Nigerian National Petroleum Corporation to provide special rebate system for gas, electricity and fuel consumed by the foundries and forging shops;

- 6) The Federal Government should ban on export of metallic scrap (ferrous and non-ferrous);
- 7) The Federal Enviromental Protection Agency should publish the necessary guidelines for the pollution control in the foundries and forging-shops to ensure the necessary provision for a safe working environment;
- 8) The Federal Institutions should give priority to funding research and development investigations in foundry and forging related areas such as:
 - a) the development of refractory ramming mixes from local clay deposits,
 - b) further exploration and mining activities to identify local reserve of deposits for high alumina clay, magnesite, fluorspar, ferro-alloys, etc.,
 - c) utilization of the Cold Briquetted Iron from DSC in the cupola furnace;
- 9) The National University Commission and the Board for Technical Education should identify and equip relevant institution for the training of adequate number of skillful personnel for the foundries and forges sub-system;
- 10) All organizations in the sector should subscribe to the adoption and enforcement of standards prescribed by the SON and should have within their organization good quality control units especially for sand and liquid metal tests. Those organizations that do not have quality control outfits should employ the facilities available of sister organizations to certify the quality of their products for greater product acceptability;
- 11) The firms should intensify their marketing efforts through the use of competent staff and appropriate marketing techniques;

- 12) Government should set up at least three centres of excellence in Engineering Design and Manufacture. These centres should be created in existing Universities;
- 13) The private sector should establish specialized institutions at the lower skill levels where trainees can simultaneously combine theoretical with hands-on practical exposure;
- 14) Government should direct the development banks to target a certain proportion of their loanable funds to the sub-sector;
- 15) Concessionary low interest rate should be put in place for operators in the sub-sector;
- 16) The equipment leasing operations of the bank should be extended to the sub-sector;
- 17) Foreign assistance should be sought from international organizations as UNIDO and UNESCO.

D. Suggestions

- 1) To prepare the feasibility study on installation of die-forging factory for the production of main components of automotive industry, engineering industry, agricultural industry, etc.;
- 2) To formulate foundries and forges industry development strategy including the strengthening of sectoral linkages;
- 3) To work out a more detailed plan of action, estimate financial costs (local and foreign) in order to execute the consolidation and transformation of foundries and forges industry;
- 4) To develop the foundries and forges industry on step-by-step basis and in connection with intended and realized projects in the other sub-systems;

- 5) To define the rules for market research and to adopt the aggressive strategy for export.

M E T A L F A B R I C A T I O N

Prepared by

Vladimír S i t e n s k ý

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Metal Fabrication (V. Sitenký)

Introduction

As a part of the preparation of the Industrial Master Plan for Nigeria, the metal fabrication sub-system study, completed by a national team of experts with Mr. Chris C. Nkwonta as UNIDO Consultant, was submitted to the international sub-contractor. The purpose of this study, prepared as a working document for the Strategic Consultative Group, is to outline policies and measures that can be applied at the national, sectoral and plant level in order to bring strategic plan for future growth, competitiveness and profitability.

The purpose of the present report is to provide a brief review of the metal fabrication industry in Nigeria in the context of capital structure strategy. The report also provides an overview of the existing situation, linkages to other sectors, obstacles to increased production and an outline of available policy on the basis of consultancy with SCG members and field visits.

A. Basic characteristics of the sub-system

The metal fabrication sub-system, as a significant part of the Metallurgical and Engineering sub-sector, plays a very important and, in a way, even vital role in the process of development of the manufacturing sector in Nigeria.

It is closely linked with the primary fabrication and capital goods industries. The study provides a fairly comprehensive analysis of the current state of the sub-system and its role in the industrial development of the country. It also indicates gaps and weak linkages within the sub-system, formulates main goals and strategies, and suggests a number of development scenarios.

B. Identification of major problems and constraints

The major problems and constraints of the sub-system were identified well by the authors of the study. They emphasized that these problems and constraints are a reflection of the policy failures that historically characterized Nigeria's industrial sector, particularly with respect to manpower development and training, raw materials, planning, external dependence, inefficient infrastructures and weak linkages with other sectors.

In the opinion of the international sub-contractor the ranking of the major problems is as follows:

- (a) Practically, all the raw material inputs for this sub-system have to be imported (flat sheets, alloy steel, aluminium).
- (b) The vast majority of spare parts for the machinery in use in the country must also be imported.
- (c) Low capacity utilization and low local value added.
- (d) About 80% of the production technology in use are obsolete.
- (e) Inadequate and inefficient infrastructure, particularly electricity, water, transportation and communication.
- (f) The shortage of designers and workers at lower skill levels in areas as welding and machinery.
- (g) Market orientation of industry is largely towards the Nigerian market; hence, there is practically no export.
- (h) Low maintenance capacity and inability to import the required intermediates as a result of foreign exchange shortages.

The factors which have hindered the growth of production in the sub-system such as scarcity of raw materials, spare parts and machinery are, of course, important. All of them could be improved, however, through rehabilitation and modernization mainly on the basis of investment in this sub-system. This

implies that Nigeria's prospects for growth in the metal fabrication industries heavily depend of thoughtfully selected investment and investment policies.

Economic rehabilitation and growth depends not only on internal efforts, but also to an increasing extent on external forces. In this regard, the role of private direct foreign investment can hardly be over estimated. In the view of international sub-contractor, direct private foreign investment, brings about new technologies, new management, progress in organization and provides new employment opportunities. In this connection it is encouraging that a system of incentives to attract the inflow of foreign capital has been issued.

(Investor's Guide to Nigeria by UNIDO and Federal Republic of Nigeria).

C. Technology

The metal fabrication industry has the greatest number of firms within the metallurgical and engineering sub-sector. A good number of the metal fabrication/metalworking firms are in the informal sector.

In general, this sub-system employs relatively standard and traditional technologies by using mostly imported machines and devices and has many firms either as captive firms or jobbing firms (shops). Non-traditional processes have not been used mainly due to high costs of equipment and lack of adequate knowledge in this area.

In order to be internationally competitive, efficient, profitable and also in order to increase capacity utilization and improve local value added, there is the need of creating a conducive atmosphere for promotion of technology:

- by upgrading and improving traditional technologies;
- by acquiring new technologies, improving and domesticating them;

- by encouraging patronage of locally produced goods by government agencies;
- by reviewing tariff structure to make products internationally competitive;
- by reducing the rate of interest for investments in the public and private sectors.

D. Marketing

The metal fabrication sub-system is oriented largely towards the local market. The prices of the products are not competitive with world market prices due to high cost environment. In terms of product mix, the aluminium industry presently produce a good range of products for use in domestic application, construction, manufacturing and packaging industries.

In order to make the economy more independent of imported raw materials and goods, the following strategies for market orientation are recommended:

(a) Iron and steel industry:

- to increase plant capacity utilization in the public sector mills to satisfy domestic market demand;
- to initiate and sustain Research and Development activities on local input raw materials (iron ore, coal and refractory clay deposits);
- to regulate unrestricted exports of scrap in order to increase supply for local industry;
- to focus on penetrating the subregional (ECOWAS) and regional (AFRICA) markets for long products;
- to provide additional facilities to enable Ajaokuta to produce flat steel products.

(b) Non-ferrous industry:

- Federal Government should stockpile some strategic materials including copper and aluminium ingots to meet the need of local industry;
- to encourage private sector plants for copper and aluminium products and to expand both product mix and plant capacity in order to satisfy domestic demand;
- to initiate plants for the acquisition of local aluminium smelting capacity;

(c) Engineering:

- to concentrate on the development of an efficient industrial base in the areas of foundry, forging, heat treatment, machinery and tools fabrication, metal coating and other finishing operations;
- to establish more functional and effective quality control outfits for industrial products;
- to specify Nigerian Standards for all the spare parts and components required for use in the Vehicle Industry in the country.

E. Strategic directions

(a) Steel Production Plants

The metal fabrication industry basically transforms steel into various products for both household and industrial uses. All the raw materials are imported, some of them, especially angles, channels, joists, bars and rods from carbon steel are locally available. Other steel types, like the cold rolled sheets and alloying steel are still being imported. For further development, it is necessary to build-up the second phase at Ajaokuta, to produce sheets and strips (spiral welded pipes), including deep-drawing steel by continuous casting of slabs technology HDR (Hot Direct Rolling) or CSP (Compact Strip Production). The following firms: Schloeman-

Siemag (Germany), Danielli (Italy) and Vöst Alpine (Austria) can supply the needed technology and equipment.

In respect of alloying steel, its production in the arc furnace requires imported ferro-alloys. The world prices from May 1991 are as follows:

FeCr	-	1,1	-	1,67	USD/kg
FeMn	-	0,69	-	1,2	"
FeMo	-	6,95	-	7,3	"
FeW	-	6,4	-	6,5	"
FeV	-	14,0	-	14,2	"

It is necessary to make a choice between imports of alloying steel, on the one hand, and its local production, dependent, of course, on imported ferro-alloys. Such a choice has to be made on the basis of a detailed cost-benefit analysis.

(b) Aluminium Industry

The Nigerian aluminium industry comprises about ten post-smelting enterprises engaged essentially in transforming imported ingots into finished products.

The anticipated growth in demand foreseen for aluminium can be solved by aluminium smelting plant at Ikot-Abasi with annual capacity 180,000 tons. About four tons of bauxite (Bayer process) are needed which, in turn, yields one tone of aluminium. The production of aluminium from alumina is highly energy (15-16 MWh/t Al only electrolysis) and capital intensive. Another possibility is to import alumina and built-up rectifiers, anodes plant and electrolysis cells. This possibility should be taken in consideration particularly in view of environmental damage caused by red mud.

In order to utilize local deposits of raw materials, there are a number of processes for the preparation of alumina from clays, kaolinite and low-grade bauxite which due to their

high silica content are not suitable for processing by the Bayer method. Available methods are Lime-Sinter process and Acid processes utilizing sulphuric acid and sulphates as a means of recovering alumina from clay. These processes consume large quantities of material and energy. Possibly these processes could be economically integrated into a strategically situated cement plant where at least the dicalcium silicate and calcium carbonate residue from the alumina process could be utilized as raw materials for their products.

The world market of aluminium is dominated by big companies (Alcoa, Alcan, Pechiney) and the updating price of aluminium is 1,320 - 1,340 US Dollars per ton (purity 99,7%). There is a surplus of aluminium on international market at present. The local production of aluminium gives a possibility to increase production of such products as varnished foils for food industry and AlSi foundry alloys for precision casting with grain refinement and modification using Al-Ti-B and Al-Sr alloys. (Kawecki-Billiton, the Netherlands).

A small grain size results in:

- improved feeding;
- reduced/redistributed porosity;
- reduced internal cracking;
- improved mechanical properties;
- improved homogeneity.

Arguments supporting the use of Strontium (in the form of AlSr master alloys) are:

- effectiveness over a wide range of concentrations;
- retained effect over a long period;
- 50% survival on remelting;
- low oxide formation;
- predictable yield;
- no reaction with refractories;
- no environmental problems.

(c) Spare parts

One of the major problems, accompanying also other sub-systems, is lack of spare parts. More than 75% of the metal ones are imported. Spare parts represent a strategic commodity with linkage on foundries and forges. It is therefore advisable to joint forces and create conditions for production of big series of spare parts without necessarily constructing new plants and/or halls.

The following types of castings can be made:

- industrial and agricultural spares;
- manhole covers;
- railway spares (brake blocks);
- non-ferrous bearings, bushes.

The different components that can be forged are as follows:

Machine Tools:

- bolts and nuts;
- main spindles;
- gear blanks;
- hydraulic cylinder blocks;
- levers, shafts, cams.

Parts for tractor and transport vehicle:

- leaf springs, coil springs;
- overhaul of engine;
- railway spares;
- connecting rods;
- crankshaft;
- hubs, levers, valves, axles.

There is a chance to consider the building-up a forge shop with annual capacity of about 2,000 tons forging components at Oshogho, Nigeria Machine Tools Limited.

In order to modernize effectively the spare parts and allied industries, powder metallurgy technology should be introduced. This technology enables to reach high efficiency and utilization of metals (up to 98%) with relatively low production costs. In the first stage, the iron powder could be imported with expansion programme to produce 10,000 - 20,000 tons of details as gears, bushes, sliding bearings, etc. per year. Available facilities require presses with feeders, sintering furnaces and calibration presses (e.g., Mannesmann, Dorst, Germany; YOSHIKAWA Industries, Japan). It would be suitable to prepare a feasibility study on construction of the powder metallurgy factory for the production of main components for vehicle and agriculture industries.

(d) Scrap Collection

The sub-system suffers from lack of raw materials. By contrast, there is not any systematic collection and separation of ferrous scrap for recycling. Two types of scrap can be identified:

- primary scrap which originates in manufacturing processes;
- secondary scrap, based on used or obsolete products.

If the scrap exists in a metallic form, like steel, aluminium, copper and lead, the scrap metal material (aluminium cans, vehicles, household appliances, lead-acid batteries) can serve rightaway as a feedstock for a significant secondary refining industry.

Recycling of secondary scrap should be encouraged. The costs of collection and separation could be covered by establishing a buy-and-sell network which could be very easily self-financed. Information on the recycling of six non-ferrous metals is given in table 1.

Table 1.
Recycling ratios

Metal	Total production*, 1988 (million tons)	Recycling ratio+ (%)	Direct use of scrap by consumers #
Lead	4,4	48	medium to high
Aluminium	19,3	28	low to medium
Copper	8,0	19	high
Tin	0,18	6	medium
Zinc	5,2	..	high
Nickel	0,5	..	very high

* Smelter/refined production, world excluding the CPEs (centrally planned economies).

+ Defined as the ratio of secondary/total production.

For metals in alloy form which are not refined.

(e) Technological Development

As a supplement to major directions in technological development suggested in the sub-system study, the following technologies are proposed:

- plasma jet (torch) cutting of stainless steels;
- plasma coating, that is, wear, resistance and anti-corrosion surface layers;
- using CO2 lasers (output 1-5 kW) for cutting, welding, heat treatment (hardening)
- using CNC centres with many operations and shapes of products;
- introducing rigid lathes and cutters using tools from sintered carbides, synthetic diamonds and cubic nitride tips or ceramic inserts;

- in gradual stages to introduce new advanced materials -
composites and engineering ceramics.

(f) Appropriate Technology

The metal fabrication industry produces an extensive range of various products while some of them have to be produced in modern capital intensive and large-scale production units, other can be produced in medium and small-scale enterprises. These can operate particularly a number of downstream industries and maintenance/service facilities. Such enterprises can use appropriate devices and labour intensive technologies.

F. Suggestions

In this section some additional propositions are suggested for inclusion in strategic guidelines of this sub-system:

(a) Research and Development

In order to accelerate scientific and technological progress in Nigeria an attempt could be made to introduce medium-term or long-term planning or programming of scientific and technological development.

On the basis of an in-depth-analysis the most appropriate lines of scientific and technological development should be chosen jointly by the representatives of the Government and the private sector, Universities and the research institutes. The Government budget could finance about a half of total expenditure while the other half should come from private sources and from foreign assistance.

(b) Manpower Training

In order to improve technological skills and capabilities in the metal fabrication sub-system it is advisable to promote various on-the-job and off-the-job training courses. It is also advisable to make use of services of expatriates with

extensive foreign experiences in metal fabrication as teachers and instructors in technical courses.

(c) Infrastructural policy

The Government at the federal, state and local levels should promote small- and medium-scale industries by developing water, electricity, transportation, communication and other infrastructural facilities.

(d) African Co-operation

In the long-term development, co-operation among African developing countries should not be lost of sight. In particular, the metal fabrication projects, exceeding the limits given by national frontiers, should be prepared jointly, on regional or sub-regional basis. Such a co-operation has undeniable economic advantages. However, it also encounters a number of various obstacles. For this reason, the possibilities of achieving this objective should be examined in the framework of ECOWAS.

G. Conclusion

The development of metallurgical and engineering industries has an important role to play in Nigeria's future economic development. These industries constitute an industrial base for manufacturing a wide range of intermediate goods and final products for other sectors of the national economy.

Annex 1.

Table 1 shows the possibility of the import bauxite from African countries.

Table 1: Bauxite supply in African countries

(Millions tons)

Country	1982	1985	
		authorized	proved
Ghana	450	450	560
Guinea	5.600	5.600	5.900
Cameroon	800	680	800
Sierra Leone	140	140	160

Lower energy consumption by using powder metallurgy technology is shown in Table 2.

Table 2: Comparison of energy consumption at production of gear

- a) machining of rod
- b) PM technology

	a)	b)
1. Energy of initial material	3.420 kJ	1.723 kJ
2. Pressing	-	44
3. Sintering	-	1.257
4. Calibrating	-	27
5. Machining	488	-
Total	3.908 kJ	3.051 kJ

Annex 2.

Visits to metal fabrication companies

1) **Name:** NEPTUNE Constructions Ltd., Lagos

Ownership: Private

Products: Coach and truck body builders for domestic market on the basis of imported chassis (NISSAN, Japan)

Technology: Current and obsolete machines for shearing, bending and welding

Recommendation:

- to introduce new appropriate and high-duty machines and devices
- to decrease production costs

2) **Name:** CRITTALL - HOPE Ltd., Lagos

Ownership: Federal Government of Nigeria

Products: Steel doors and windows, doorframes for wood doors, collapsible gates; aluminium doors and windows (sliding and casement), stainless steel sinks, parts for air-conditioners.

Technology: The shops are well equipped by foreign machines, the production is very well organized, high level of products fully comparative with the same products in the Western Europe.

Recommendation:

- to increase productivity

3) **Name:** PEUGEOT AUTOMOBILE NIGERIA Ltd., Kaduna

Ownership: Federal Government of Nigeria

Products: Assembly of passenger vehicle Peugeot 504, 505 from imported and locally produced parts; the utilization of capacity is about 30%.

Technology: All manufacturing works are equipped by foreign machines and devices including CNC centre

Recommendation:

- to improve capacity of presses,
- to improve the quality of castings from DELTA Steel,
- possibility to increase the share of locally produced complicated parts (Trim accessories) with higher value added,
- to use robots for final painting,
- state assistance is needed for decreasing taxes and duties,
- to use second hand tools.

4) Name: Nigeria Machine Tools Ltd., Oshogbo

Ownership: JOINT VENTURE

85% Federal Government of Nigeria

15% HMT Ltd. of India

Products: Metal-working machine tools (hacksaw, drilling and grinding machines) and wood-working machines, spare parts - gears, shafts, pulleys.

Technology: Current machines for machining, training centre and heat treatment section (case carburisation, hardening, annealing) and galvanization section (blackening and electroless nickel plating)

Recommendation:

- to build-up a foundry and forgy,
- to build-up a heavy parts assembly shop,
- to establish ancillary shops manufacturing standard parts,
- to use own products as inputs for the production of essential consumer goods to meet local demand of households, industries and offices and also to export to other African countries.

5) Name: Steel Rolling Company Ltd., Oshogbo

Ownership: Federal Government of Nigeria

Products: Carbon steel-wire rod 6-12 mm dia, reinforcing bars (ribbed) 12-25 mm dia, round bars up to 40 mm dia,
20% utilization of capacity

Technology: Current technology using Morgan finishing block with rolls from sintered carbides

Recommendation:

- to prolongate the service-life of rolls by 12-25x regrinding,
- to introduce intensive cooling of rools.

P H A R M A C E U T I C A L P R O D U C T S

Prepared by

Jiří K ř e p e l k a

ABBREVIATIONS

SCG	Strategic Consultative Group
NEDL	National Essential Drugs List
PG-MAN	Pharmaceutical Group of the Manufacturer's Association of Nigeria
NIPMA	Nigerian Indigenous Pharmaceutical Manufacturer's Association
GMP	Good Manufacturing Practice
FDAC	Food and Drug Administration Control
R and D	Research and Development
SMID	Strategic Management of Industrial Development
ECOWAS	Economic Community of West African Countries

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Pharmaceutical Products (Jiří Křepelka)

Introduction

The grounds for the following report are based on the working document for the Strategic Consultative Group (SCG) focusing on the pharmaceutical sub-system, discussions with experts, and field examinations of eight local pharmaceutical companies.

A. Basic characteristics of the sub-system

The health care system in Nigeria is now dependent on imported drugs for about 70% of demand, local manufacturing capacity being utilized at less than 30 - 35%, mainly due to shortages of raw materials. Nigeria has practically no usable raw materials that are of pharmaceutical grade quality and very limited possibilities for the manufacturing of active substances (pharmakons). One of the main issues is a delay in the second and the third phases of Nigeria's petro-chemical projects.

Pharmaceutical companies possess the industrial and technical potential to manufacture most of the drugs covered by the National Essential Drugs List. The development of the pharmaceutical sub-system is adversely influenced by the following problems:

- (i) underutilization of capacity
- (ii) low capacity in injectables and opthalmologics
- (iii) shortages of raw materials
- (iv) inadequate economic policy (tariffs, duties, taxes)
- (v) insufficient incentives for private investors' to support extensive and intensive investment
- (vi) weak linkages of various industrial sub-systems with the pharmaceutical industry and agriculture

Additional factors limiting its development are the underdeveloped infrastructure, concentration of the pharmaceutical industry in urban areas, poor storage facilities and problems affiliated with the distribution of drugs. Moreover,

the pharmaceutical market is penetrated by faked and adulterated drugs from unregistered suppliers which have aborted the new and small exports to the ECOWAS countries. The complete acceptance of NEDL, Decree No. 21 of 1988 and Decree No. 17 of 1989, should improve the confidence of customers in locally produced drugs.

The local producers of drugs are still not prepared for large volume production, due to insufficient inputs of raw materials (chemicals, intermediates, auxiliary materials, glass, plastics). The local production of drugs is primarily dependent on imported raw materials and active substances for the manufacturing of final dosage forms. These factors, together with high operating and overhead costs, mean that prices of domestic drugs are not competitive with those of imported drugs.

Research and Development (R and D) concentrates on practical improvements in commonly used products and processing technologies and lags behind the needs of both the public and private sector.

The present quality of manpower corresponds to the present level of technology. For the future technologies training programmes should be prepared in advance.

Nigeria's pharmaceutical industry is presented by two groups, the Pharmaceutical Group of the Manufacturer's Association of Nigeria (PG-MAN) and the Nigerian Indigenous Pharmaceutical Manufacturer's Association (NIPMA). Both groups accounted for about 70% by value of total local production in 1990 (55% PGMAN, 15% NIPMA); 30% of total local production is not accounted for yet. Both groups raised the issue of specific incentives to local drug manufacturers which should be implemented into strategies of industrial sub-sectors in order to facilitate the existing inter-relationships among producers and regulatory bodies.

B. Identification of major problems and constraints

The total market of drugs in 1990, estimated at about 1.69 billion, was covered only by 30% of local production. Many pharmaceutical companies established in the late 1970's and early 1980's utilize less than 30 - 35% of their installed capacities. Among the factors mainly responsible for these shortcomings, the absence of an integrated industrial policy covering the present as well as future needs of this sub-system, an unsatisfactory distribution network and weak infrastructure facilities should especially be mentioned.

In 1989 the NEDL was enacted into law. The list assembled 304 drugs in 1990 and is going to expand to about 480 drugs in 1991. In 1989 there were about 4.000 drugs in circulation, most of them of dubious origin. Nigeria, with more than 100 million people and the largest single market in developing Africa, including rich natural resources and manpower, has the favourable conditions necessary for building up the pharmaceutical sub-system and for the future exports of drugs. This goal is, at least for the time being, too far away and development strategy should be planned stepwise on the basis of a detailed analyses of the following problems:

(a) Technology

There is no pharmaceutical fine chemical industry on stream and the first multi-purpose plant for the manufacturing of paracetamol and ampiciline is under construction (TOKI DABUR, Lagos). The manufacturing capacities for the processing of final dosage forms, including the level of technologies, are sufficient in tablets, liquid dosage forms (solutions, syrups, suspensions) and powders. The installed capacities in ophthalmologics, vaccines and small-volume parenterals are unable to meet increasing demand. The pharmaceutical companies are producing generic drugs and patent-expired drugs.

(b) Machinery

The technological level of processing machines is appropriate to local conditions and is conveniently combined with the labour intensive technology. Some other serious problems are connected with the shortages of spare parts. Certain differences were observed in the level of technologies and processing machines among multinational companies and indigenous ones.

(c) Product quality and quality assurance

The system of the GMP is implemented in all visited or contacted companies, including in-process quality control. The highest quality has been achieved in multinational companies and several large-scale indigenous ones. In most indigenous companies, the conditions for the GMP rules and quality control will have to be improved stepwise, strictly meeting the guidelines issued by the PG-MAN in 1991. The case of the poisoning and death of 109 children in 1990 created doubt in the real implementation of quality control of final dosage forms prepared in hospitals and dispensed to patients. A strict system of controls should be ensured by the Food and Drug Administration Control (FDAC) directed by the Federal Ministry of Health.

(d) Availability of raw materials

About 90% of raw materials are still imported. Locally obtainable materials do not meet reliability standards and pharmaceutical grade quality. There are weak possibilities of self-sufficiency in petro-derived fine chemicals and vital auxiliary materials for the processing of final dosage forms.

(e) Industrial linkages

Linkages of the pharmaceutical industry with the key sectors (petrochemical, engineering and agro-allied industries, infrastructure) are weak and unreliable. They are not able to ensure an adequate supply of raw materials for the

manufacturing, storage, transportation and distribution of drugs in rural areas.

(f) Marketing of drugs

There is probably no official body making periodic analyses of the evolution of drug consumption in the most important therapeutical classes, including forecasts of future needs in connection with the statistical occurrence of the most serious illnesses. Private pharmaceutical companies are planning the Pharmaceutical Market Audit Group for monitoring sales and marketing research of drugs.

(g) Manpower and personnel

The quality of manpower corresponds to the present level of technologies used in processing plants but probably is unlikely to be sufficient for more modern technologies and the future expansion of pharmaceutical sub-system. It is advisable to meet the future requirements in advance and set up the system of training plans corresponding to the various stages of development of the pharmaceutical industry. Attention should be paid to the implementation of the GMP rules, mainly in manufacturing processes of indigenous private medium-size companies. The intended development of pharmaceutical sub-system needs a sufficient number of specialists and skilled personnel not only for production but also for education of specialists for marketing, trade, management and investment.

(h) Research and development

R and D exists in both the public and private sectors. Its goal includes practical improvements of processing technologies. Research projects are scattered on too many research problems suffering from lack of funds and still without marketable results. The research projects organized by universities and research institutes and supervised under the promotion of the Raw Materials Research and Development Council should be profitable for the future expansion of the

pharmaceutical sub-system. The National Institute for Pharmaceutical Research and Development in Abuja is collecting data on traditional medicines and raw material prospects for local development.

(i) Bureaucracy

The real position of the pharmaceutical sub-system in the National Drug Policy is not clearly specified. A significant endeavour can be observed in the initiative of both the PG-MAN and the NIPMA which are making great efforts to facilitate the relationships and procedures among producers and government officials.

C. Strategic directions

This part undertakes a proposal of basic scenarios:

(a) Higher utilization of installed capacities

The presently installed capacities of pharmaceutical companies are sufficient in the processing of final dosage forms of tablets, liquids and powders. In order to exploit the remaining capacity, a reliable supply of raw materials of pharmaceutical grade quality (for the processing of final dosage forms) and packaging materials (glass, plastics, foils) is urgently needed. Under the present conditions, this objective can be achieved only through imports because the local production in Nigeria is not yet prepared to meet high quality requirements of raw materials needed and the whole self-sufficiency goal cannot be achieved in a short time and without establishment of inter and intrasectoral linkages. The gradual substitution of imported raw materials for locally produced ones (starch, granulated sugar, alcohol, inorganic salts, talc, glass, plastics, cellophane, etc.) in sufficient quantities could be attained in the course of 2 - 3 years at best.

(b) Step-by-step expansion of small capacities

The low disposable capacities of small-volume parenterals, ophthalmologics, hard and soft gelatine capsules can be increased only on the basis of building up new facilities or operating units meeting the strict requirements of GMP, especially for sterile drugs. Similarly, it is possible to increase the capacities for topical drugs (ointments, creams, gels).

These strategies could probably reduce the dependence of the local drug market on imported drugs to about one-half of the present needs by increasing the utilization of installed capacities to 60 - 70% within 2 - 3 years and building up new units for sterile drugs. This goal requires well-planned investment and the purchase of new machines and technologies.

(c) Growth of local production of raw materials

Local production of auxiliary materials and active substances has to be analyzed from the point of view of necessary investments and possible economic effects, including a real time schedule for putting new facilities and technologies on stream. Prior to a final decision, a thorough marketing research should be made not only to determine the needs of local pharmaceutical companies but also to estimate the future exports possibilities. The best conditions can be expected for the following items:

- (i) maize starch
- (ii) granulated sugar
- (iii) inorganic salts (NaCl, KCl)
- (iv) alcohol
- (v) glycerin
- (vi) petroleum jelly
- (vii) kaolin
- (viii) talc
- (ix) acacia gum

The above mentioned raw materials are usable in other industrial sub-systems (food-processing, agro-allied

industry, textile industry) and that is why detailed feasibility studies for each of the selected materials ought to be prepared.

In the case of the bulk production of active substances (pharmakons), the progress can be planned only in relation to the future production of petro-chemicals and fine chemicals to decrease the dependency of local production on imports. The pioneer construction of the multi-purpose plant for paracetamol and ampiciline production (TOKI DABUR, Lagos) is paradoxically based on imports of nearly all necessary chemicals and intermediates. The convenient technologies for bulk production of raw materials (pharmakons) will have to be purchased abroad if local R and D has not been able to ensure local supply of these technologies.

(d) Utilization of local raw materials

The future development of the pharmaceutical sub-system needs its own production of new drugs on the basis of antibiotics and vitamins. Nigeria ought to have favourable conditions for fermentation processes from local sources (sugar, starch, maize corn-steep, proteins from food industry). The high-productive technologies are available in both the developed countries as well as in developing ones (Brazil, India).

Prospective attention should be paid to the utilization of raw materials and active principles from traditional medicinal plants used in ethnopharmacology and traditional Nigerian medicine. Nigerian flora has great medicinal potential and rich sources of wild growing, herbs for development of antimalarial, anticancer, antiinflammatory and antiinfective drugs. Some herbs are valuable sources for the preparation of steroid hormones, digitalis glycosides, alkaloids, etc. The R and D of herbal drugs has to be affiliated with the characterization of active principles and the formulation of modern dosage forms (tablets, capsules) instead of traditional non-standardized crude extracts. Processes for large-field cultivation, standardization of

active principles and their pharmacological testing are the basic projects for the specialized research facility of the pharmaceutical sub-system. Nigeria ought to consider its own orientation on the development of African traditional medicines and transform the traditional forms into modern ones for the benefit of health care and for exports.

(e) Machinery and spare parts for the pharmaceutical industry

Pharmaceutical machines have to be produced from the best quality materials to maintain the highest quality of final products. For the fabrication and production of pharmaceutical equipments and processing machinery, highly specialized conditions are required. These problems should be evaluated by an appropriate process engineer. The local production of machines should consist of the construction of multi-purpose devices usable in various kinds of industry (food processing, chemicals, pharmaceuticals), e.g. sterilizers, mixing vessels, driers, extractors and accessories, including the local manufacture of spare parts and services for producers.

(f) Formulation of industrial policy in the pharmaceutical sub-system

Heavy dependence on imported inputs, low level of inter- and intra-sectoral linkages, lack of engineering and basic chemical industries could be improved if SMID becomes operational. A comprehensive action plan should be prepared including financial costs, distribution of organizational and institutional responsibilities and measures to achieve the consolidation and transformation of the pharmaceutical sub-system.

(g) Quality assurance of drugs

The national guidelines of the GMP have to be focused on the thorough checking of various stages of the manufacturing processes and the distribution of drugs to protect the local drug market from inadequate and faked drugs delivered by

unregistered manufacturers and importers. The quality control laboratories ought to be established in all parts of the country and moreover, their significance should be supported by legislation as a frame of the National Drug Policy.

(h) Marketing

Nigeria has a vast drug market which is influenced by the strong competition of imported drugs (70%). The local production outputs are limited due to the above mentioned constraints. This market is able to accept the output of local producers at their full installed capacities. Of course, the producers are only prepared to cover one third of the remaining market share. The distribution network and geographical location of producers in urban areas are further factors complicating the regular supply of drugs to customers. These factors cannot be changed in a short time period. The National Drug Policy should have an impact on government officials to form acceptable conditions for local producers in order to increase the capacity utilization in their factories.

Market strategy should be well-articulated and connected to the increase in the efficiency of production (lower prices). The pharmaceutical companies need more detailed market research for their successful development.

(i) Investment and funding

The step-by-step development of the pharmaceutical sub-system, the purchase of highly-sophisticated technologies, machines, instruments and the construction of new facilities may be ensured under the financial supports of local producers. Attractive incentives for investment in local private companies should be formulated, as well. A healthy investment policy in the pharmaceutical sub-system, supervised and managed by the state, should be seriously considered in connection with the rapid development of the petro-chemical, iron and steel industries, paper mills, the fabrication of plastics and the agroallied sub-sector.

(j) Labour intensive technology and employment

High requirements on the quality of pharmaceutical products call for a precise repetition of every step in the manufacturing process of final dosage forms. The best quality is ensured if the influence of subjective factors of manpower is minimized or excluded from key operations. From the economic point of view, the combination of labour intensive technologies with high-productive full-automatic equipment in such phases of manufacturing processes where higher employment of unskilled and semi-skilled personnel cannot adversely influence the quality of products, manufacturing capacity, etc., should be supported. The convenient combination of high productive filling machines with hand-packaging of finished strips, blisters, bottles, bags, vials and tubes can increase employment and thus contribute to the solution of social problems.

D. Suggestions

The analysis of the pharmaceutical sub-system revealed basic external and internal constraints in this industrial field, as well as realistic scenarios for its step-by-step development in order to reach its important position in the industrial sub-sector. This period will probably take about 5 - 10 years, with significant improvements within 5 years. The main objectives should be planned on the basis of a detailed analyses of the following suggestions:

- a) To formulate the pharmaceutical industry development strategy, including the strengthening of inter- and intra-sectoral linkages, e.g. petrochemicals, food processing, engineering, textile industry, rubber and plastics industry, glass industry, agro-allied sector.
- b) To work out a more detailed plan of action, estimating financial costs (local and foreign), in order to execute the consolidation and transformation of the pharmaceutical industry.

- c) To designate responsibilities; what body and individuals, specifically, are responsible for the day-to-day execution of the pharmaceutical industry plan of actions, including the most important linkages.
- d) To develop pharmaceutical manufacturing on a step-by-step basis and in connection with intended and realized projects in other sub-systems:
- (i) increasing the utilization of installed capacities in the processing of final dosage forms by improving conditions for more advantageous imports of raw materials and their gradual substitution for locally produced materials;
 - (ii) expansion of low capacities in small-volume parenterals, vaccines, ophthalmologics, hard and soft gelatine capsules and topical drugs (ointments, creams, gels);
 - (iii) expansion of the local production of basic raw materials:
 - for the processing of final dosage forms (starch, sugar, talc, lactose, glycerine, alcohol, salts in pharmaceutical grade quality) and their packaging (glass and plastic containers, foils, etc.),
 - for bulk production of active substances (pharmakons) in multi-purpose pilot plants,
 - for exports to the ECOWAS countries;
 - (iv) construction of new multi-purpose plants meeting up-to-date levels of technology. Four plants could probably be sufficient for covering the needs of pharmaceutical processing companies in Nigeria. The investment costs will be high (about 200 - 300 million USD for each one) with participation of local and foreign capital. The multi-purpose plants should be combined with the manufacture of final dosage forms.

- e) To ensure the local production of spare parts and multi-purpose devices usable in various industries (food processing, chemicals, pharmaceuticals), e.g. sterilizers, driers, mixing vessels for powders and liquids, extractors and accessories.
- f) To appraise the economic possibility of the construction of a fermentation plant for the manufacture of basic antibiotics (penicillins, cephalosporins, tetracyclines, aminoglycosides, macrolides) and/or vitamins, relying on the utilization of local sources of inputs (sugar, starch, corn-steep, soya grit, herbal proteins, etc.). The local production of basic antibiotics should ensure the local production of highly-effective semi-synthetic antibiotics in multi-purpose plants and decrease the imports of these bulk drugs.
- g) To prepare a feasibility study on using traditional plant medicines in modern dosage forms for treatment of cancer, malaria, infective and fungal diseases, etc., based on domestic herbs as a supplement of chemically produced drugs. Realistic suggestions for the commercialization of traditional African medicines have already been prepared. Nigeria could be the first country in developing Africa producing standardized traditional medicines in modern dosage forms, including the possibility of exports, as well.
- h) To define the rules for market research and to adopt an aggressive strategy for exports of raw materials, active pharmaceuticals and final dosage forms primarily to the ECOWAS countries.
- i) To formulate research projects aimed at collecting data on raw material prospects for local development. The National Institute for Research and Development in Abuja could be considered as a coordinator and auditor of these projects.

- j) To expand labour intensive technologies in combination with high-productive ones in such phases of technological processes in which subjective factors of manpower cannot influence the quality of products.
- k) To formulate a system of training in advance to ensure full implementation of the GMP rules for manufacturing processes in pharmaceutical companies, particularly indigenous and smaller ones.

The specific position of the pharmaceutical sub-system and its linkages with the other industrial sub-systems, agriculture and health care, require the establishment of a special body (department) for the coordination of the interests of the state, local producers, importers and customers.

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9. Pharmaceutical Manufacturer's Group of Manufacturers Association of Nigeria: Exhibition - Pharmaceuticals Made in Nigeria, June 7, 1991, Lagos (brochure)
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11. A.A. Egboh: Report on a Visit to Ghana, May 1991
12. F.B. Adenika: Developing Traditional Medicine in Nigeria, Panpharm Ltd., 1991, Ikeja, Nigeria.

F. Annexes

Visits to pharmaceutical companies

1. **MAY & BAKER NIGERIA PLC: Ikeja, Lagos**
G.A.O. Bankole - Production Manager
About 80% of its products are produced locally. Utilization of installed capacities is about 40 - 50 %. Very good level of GMP. The factory has capacities for the following operations: granulation, tableting, liquid manufacture and liquid filling. Leading products are based on paracetamol and sulfonamides.

2. **PFIZER PRODUCTS LTD.: Ikeja, Lagos**
O.S. Rabiou - Managing Director
Utilization of installed capacities is about 30 - 40 %. Very good level of GMP. Main capacities: tableting, capsulation, liquid manufacture and filling, sterile production of ophthalmologics. Leading products: Visine, Unasyn, Combantrin, Trosyd.

3. **GLAXO NIGERIA PLC: Agbara**
Mrs. T. Adeyemi - Production Manager of Pharmaceuticals
Utilization of installed capacities is about 30 - 35 %. High level of GMP. Main capacities in tablets and liquids. Manufacture of baby food. Leading products: Glucose-D and additional 8 drugs.

4. **TOKI DABUR PRODUCTION LTD.: Lagos**
F. Ademoye - Technical Manager
Utilization of installed capacities is about 30 - 40 %. Medium level of GMP. Main capacities: syrups, capsules, tablets, suspensions. Leading programmes: analgesics base on paracetamol, cough syrups, anti-malarials (23 items). The multi-purpose plant for paracetamol and ampicilline is under construction.

5. MOPSON PHARMACEUTICAL IND. LTD: Lagos
D.O. Paul - General Manager
Wholly indigenous company. Utilization of installed capacities is about 80%. Manufacturing programme consists of 65 items mainly in liquid forms and ointments. Leading programmes: anti-malarials, anthelmintics, sedatives, antihistamines, antitussives and antibiotics.
6. VITALINK PHARMACEUTICAL IND. LTD.: Ibadan
O.A. Ale - Operations Manager
The product range includes tablets, oral and external liquids, ointments, creams and powders. High level of GMP. The present manufacturing programme consists of 12 products. Own research group for formulation of final dosage forms.
7. DRUG RESEARCH AND PRODUCTION UNIT: Ile-Ife
S.K. Adesina - Director
Research projects in phytochemistry, biology and formulation of final dosage forms. Manufacture of tablets in experimental pilot unit.
8. PANPHARM LTD.: Ikeja, Lagos
F.B. Adenika - Managing Director
Private company for sale of OTC drugs.

Participation in marketing sessions

1. PHARMACEUTICAL MARKET AUDIT GROUP, June 4, 1991, Sheraton Hotel, Lagos
Role of research in marketing, importance of audit in contemporary marketing, benefits of syndication of pharmaceutical producers.
2. EXHIBITION: "PHARMACEUTICALS MADE IN NIGERIA", June 7, 1991, Lagos
Exhibition of products of 35 Nigeria's pharmaceutical companies concentrated on the practical aspects of GMP and

in-process quality control and formation of conditions for exports of locally produced drugs in the ECOWAS countries. About 23 exhibitors were contacted and questioned on the level of technology, main constraints and leading manufacturing capacities, including the level of installed capacity utilization.

RUBBER AND PLASTICS SUB-SYSTEM

Prepared by

Adolf T a u c h m a n and Zdeněk L a i t a

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2. Plastics and Foam

A. Basic characteristics of plastics and foam industry

B. Identification of major problems and constraints

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Rubber and Plastics (A. Tauchman, Z. Laita)

Introduction

Two studies on the Rubber and Plastics Industrial Sub-system prepared by a national experts team, with Dr. Ayola B. Fasina as UNIDO Consultant and Team Leader, were submitted to the international sub-contractors. The Study A called Industrial Master Plan Project Studies, Rubber and Plastics, 42 pages, was prepared as a Working Document for the Strategic Consultative Group, the Study B called Profile of Rubber and Plastics Sub-system, Final Report, 112 pages, 4 Annexes, was prepared for the Federal Government of Nigeria.

Both studies analyse the sub-system, its role in the national economy, its capacity to develop both the home market and export activities, its problems and constraints, and, finally formulate its strategic directions. All these topics are dealt with in greater detail in the Study B, which is more extensive. While only general strategic directions suggested are presented in the Study A, strategic directions suggested in the Study B express the needs of the sub-system in width and depth. There are also some differences in strategy suggested for the petrochemical industry development. The Study B strongly recommends to develop petrochemical production at rapid rates, especially to produce raw materials for plastics and foam manufacturing. The Study A warns that it is not in Nigerian best economic interest to put too much emphasis on rapid development of petrochemical industry. Economic indicators like output, labour remuneration, income and employment, total multipliers and leakage multipliers of the rubber and plastics sub-system were used to support these conclusions.

A number of market surveys and feasibility studies, sponsored by both the Federal Government and the Nigerian National Petroleum Corporation, led, by and large, to the same conclusions as the Study B. On 9th January 1991 fundamental stone

of the world-scale Eleme Petrochemical Complex was laid. When all three stages of this petrochemical complex are completed, 545 ktonnes/year of polymers (polyethylene, polypropylene, polyester, polyvinyl chloride) will be produced. This quantity will be more than twice higher than present import of all polymers in primary forms.

In concluding this introductory section, two notes related to all industries included in the sub-system are presented below. The first one concerns marketing and the other one strategic directions:

First, rubber and plastics goods are imported to Nigeria and West Africa in large amounts. To keep the sub-system profitable and to ensure high capacity utilization after enough raw materials have been made available, the authors of this report suggest to work out a detailed marketing study, special attention being paid to Nigeria and the West African region. Such a study would help to discover Nigeria's export chances.

A good marketing study is a pretentious task and can be worked out seriously by an experienced marketing specialist only. Preparing such a study will take one year. Mr. Antilla Ahomed from Finland can be recommended as an expert on international marketing. He worked on behalf of UNIDO and worked out a complete marketing study of a West African country during the year 1990. He is familiar with problems and needs of the West African Region.

Second, a fairly detailed and exhaustive survey of suggested strategic directions for the 1990s and further is given in the study Profile of Rubber and Plastics Sub-system, Final Report prepared for the Federal Government of Nigeria. It is beyond the possibilities of international sub-contractors to comment on individual recommendations made in this study because it would require intimate knowledge of the domestic policy environment and business climate. A short period of three weeks stay in Nigeria

and the busy programme there did not enable international sub-contractors to get acquainted with the local business in detail. Only a general agreement with basic principles and goals of the suggested guidelines can be expressed here.

1. Rubber (Adolf Tauchman)

A. Basic characteristics of the rubber industry

Manufacturing of rubber goods and parts is characterized by a highly deversified internal structure. It consists of 24 groups which contain 250 sub-groups and these represent about 1.000 kinds of rubber goods and parts. Most of them have their own special chemical formulas, technologies and machinery. According to the latest information there are only 15 formal and 29 informal manufacturers of rubber goods and parts in Nigeria. Many rubber products are still imported. Nigeria is only at the beginning of manufacturing rubber goods and parts made from its own sources of raw materials at a large scale. The same situation is in all West African countries.

(a) Scope of rubber products

The groups and sub-groups of rubber goods and parts are listed below:

Group	Number of sub-groups
1. Belts	6
2. Hoses	21
3. Sealing sheets	11
4. Containers	7
5. Sealing parts	13
6. Connecting pieces	5
7. Vibration damping parts	5
8. Protecting of machinery parts	7
9. Wheels	3
10. Other group of moulded parts	8
11. Cutted rubber parts - flat and rotational	9
12. Extruded parts	7
13. Parts made from hard rubber	8
14. Foamed rubber	10
15. Microporese rubber	5
16. Rotational shaft sealing	36

17. Rubber coated parts including vessels	6
18. Combinated rubber-textile products	8
19. Dipped goods	17
20. Other rubber products for use in medical branche	34
21. Tyres	28
22. Tubes for tyres	11
23. Technical tubes	2
24. Membrane	6

(b) Special characteristics of technology for manufacturing of rubber goods and parts

"Manufacturing of rubber goods and parts is partly a science and partly an art". This is a definion of the rubber industry suggested by a rubber specialist after 30 years of experience at a recent international rubber conference. And it is really the truth.

The rubber manufacturing technological process is influenced by a number of factors - by chemical reactions of manufactured components, by manufacturing machines, by changes in temperature, prevulcanization, vulcanization, etc. In some cases the number of influencing factors reaches up to 200. During the whole manufacturing process these factors and their values are all the time changing, sometimes even over the prescribed limit (see Fig. 1). The technologist must be so experienced as to be able to rectify the values (see Fig. 1 - points A,B,C,D,...) back into prescribed limits to reach the required quality. Otherwise, the quality may drop sharply and the amount of rejects increases.

Graduation from a polymer or chemistry college or university is valuable, but it is only a starting point. All college or university graduates have to go through long years of manufacturing practise to become experienced rubber professionals. The art of successful handling the complicated manufacturing technology is not possible to learn at school. It is possible to learn it only by taking an active part in various

manufacturing processes in gradual stages, e.g. as a worker, operator, technologist. One must get the experiences "under the skin".

B. Identification of major problems and constraints

Agriculture production of rubber and upstream rubber processing

The author of this report visited a number of rubber plantations and upstream rubber processing factories in the Bendel state.

The upstream primary rubber production suffered from the mid-60s. The Federal Government programme through the Commodity Board system did not help. The Standard Adjustment Programme in 1986 did not solve too many problems. For example, it led to the establishment of 36 crumb rubber factories producing now at about 40% of their capacity. It is very hard problem to create new rubber plantations because of financial problems (high interest rates) coupled with long gestation periods.

The main constraints in agriculture production of natural rubber are as follows:

- most plantations are old;
- clones suffer from root disease, wind gale and bush fire;
- shortage of skilled rubber tapers and other rubber farm workers;
- scarcity of hand tools and utensils;
- scarcity of fertilisers, herbicides, coagulants and other chemicals;

The main problems faced by upstream rubber processing plants are:

- poor quality control of raw material;
- low capacity utilization arising from low supply of raw rubber from rubber plantations;
- obsolete and worn out machinery, scarcity of spare parts.

The following problems and constraints in downstream rubber processing - manufacturing of rubber goods and parts - have been identified:

- obsolescent machinery;
- underutilization of production capacity arising from scarcity of raw materials and other causes;
- scarcity of spare parts;
- scarcity of polymer technicians, technologists and other skilled factory personnel (often must be hired from abroad);
- low level of technological capability;
- scarcity of indigenous applied research and development;
- poor quality control of raw materials and products;
- unstable foreign trade relations.

C. Strategic directions

- a) On the basis of consultations with interviewed top managers of all plantations, upstream rubber processing factories and manufacturing factories visited in Nigeria, it is suggested that the development of proper infrastructure facilities should receive a top consideration by the Government. Without adequate infrastructure the manufacturing industry and its market cannot function properly, efficiently and competitively.
- b) The development of rubber plantations including the expansion of their size should be encouraged to increase production of natural rubber as basic raw material for the rubber processing industry from local sources.
- c) To reach a higher economic efficiency and international competitiveness, indigenous Nigerian applied research and development capacities for rubber manufacturing technologies should be created and/or expanded. In view of great diversity in rubber manufacturing technologies this suggestion is vital.
- d) In the field of spare parts for manufacturing machinery used in the sub-system, it is recommended to build up an

indigenous centre for production of these spare parts. Simultaneously, it is needed to educate and train mechanical engineers - designers to be able to work out technical documentation, and skilled toolmen to produce new machinery and spare parts in acceptable quality. The experience of international sub-contractors based on factory visits in Nigeria shows that all manufacturers concerned support fully this suggestion.

- e) To reach a higher economic efficiency and competitiveness in rubber manufacturing, it is suggested to upgrade the quality of management at all levels, to stimulate motivation of all workers, to strengthen working discipline including the technological discipline.
- f) In connection with foreign trade experiences in the field of rubber it is pertinent to mention that the image of Nigeria abroad has somehow deteriorated. In order to renew this image it can be recommended that all exporters should pay increased attention to greater reliability, seriousness and continuity of trade relations with abroad.

D. Suggestions

- a) The Government should consider the possibility of granting direct subsidy to support the development of rubber plantations.
- b) A rehabilitation programme should be prepared to replace obsolescent machinery in crepe and crumb rubber processing factories.
- c) It is recommended to build up and/or strengthen indigenous Nigerian applied research and development capacities for manufacturing technology and machinery. The best solution can be seen in expanding the Rubber Research Institute of Nigeria at Benin City.
- d) For the purpose of gaining some practical experiences already during the study at colleges and universities a rubber manufacturing pilot plant should be built up.

- e) It is suggested to arrange, in cooperation with UNIDO, practical training of Nigerian technologists at reputed rubber manufacturing factories abroad. This should be exercised mainly by practical on-job-training in rubber processes.
- f) In order to improve the quality of rubber products, it is suggested to transform the Standard Organization of Nigeria into a powerful state quality control authority. This authority must be able to enforce the valid international quality standards in the production of both, processed rubber, and rubber goods and parts.
- g) It is suggested to introduce progressive technologies in manufacturing of automobile spare parts made from domestic natural rubber. The huge market for these parts exists in Nigeria and also in other West African countries. Until now the demand for spare parts in this part of Africa is covered mostly by imports. Automobile spare parts for passenger cars, trucks and various utility vehicles are mainly: tyres, belts, hoses, various sealings for water, oil and petrol, rotational shaft sealings, sealing profiles for windows, vibration damping parts, etc. In all these cases advanced technologies of injection moulding and extruding can mostly be used. These technologies are highly productive, efficient and competitive.
- i) It is suggested to initiate and/or develop manufacturing of dipped rubber goods made from domestic natural latex, such as: surgical gloves for heavy-duty works, condoms, soothers and toothers and balloons for children. These goods are produced at automatic lines in mass quantities. The production is economical, efficient and highly competitive at international markets.
- k) It is suggested to start or expand manufacturing of rubber threads made from domestic rubber latex. Rubber threads are manufactured at automatic lines by extrusion technology. Rubber threads are used as intermediate material for textile industry.

- l) Before the approval of the Industrial Master Plan (for the rubber and plastics sub-system) basic decision concerning the development of new manufacturing capacities, based on domestic raw material - natural rubber should be made. Based on this decision, the next step should be the preparation of pre-feasibility and feasibility studies which would specify, inter alia, all technical, constructional, material, human, energetic, financial and other inputs and outputs for each kind of manufacturing facility. The author of this report is willing to take part and cooperate in the implementation of this phase of the development programme.
- m) In concluding the analysis of the development of rubber industry in Nigeria the following scenario is suggested:
To work out a comprehensive marketing study including market research for Nigeria and West Africa for all rubber products.
On this basis to select economically optimum programmes.
To prepare a prefeasibility and feasibility studies to this programme.
To implement selected projects possibly in cooperation with foreign assistance.

E. Small and medium scale rubber processing enterprises

In view of the increasing role of small- and medium-scale enterprises in industrial development of many developing countries, due attention should be also paid to these enterprises in the rubber industry in Nigeria. Such enterprises, using a simple technology and providing more labour opportunities, can operate already in an early stage of rubber processing, e.g. in centrifuging natural rubber latex.

Referring to the early stage of rubber processing, the small-scale manufacturing units in question can be established to produce the concentrated latex from tapped raw natural latex. The needed facilities, including machinery and equipment comprise:

- a simple building;
- 2 storage vessels for fresh tapped latex (of concentration 16-20%);
- 1 centrifuge machine (to concentrate latex to 60%);
- 2 storage vessels for concentrated latex;
- 2 pumps;
- some other facilities.

With regard to the later stage of rubber manufacturing, various small-scale manufacturing units can be established, producing rubber goods and parts made from the concentrated rubber latex. The machinery used in these small and medium-scale manufacturing units is simple. Also, the technology is simple with larger amount of manual work involved. In these units, it is possible to manufacture the following rubber goods and parts:

- surgical gloves;
- examination gloves;
- household gloves;
- technical gloves;
- industrial heavy duty gloves;
- condoms;
- teats for children;
- soothers for children;
- balloons for children;
- breathing bladders for surgery;
- bladders for sport balloons (football, volleyball);
- special rubber parts for the health sector;
- special rubber parts for technical use (machinery parts), etc..

For manufacturing of dipped rubber goods and parts, it is essentially needed to have:

- a building, consisting of raw-material storage rooms, one room for the preparation of latex blend, one manufacturing room, one inspection and packing room and one storage room for goods and parts;

- simple dipping units;
- vulcanising ovens;
- desks for inspection and packing;
- some other appropriate facilities.

The capital investments (machinery and technology) represent about 20% of capital in comparison with capital needed to finance automatic production lines and appliances.

Some scope for small-scale rubber processing exists also in other branches of this industry. For instance, a number of products and parts can be produced from another raw material, a solid natural rubber (crepe, crumb rubber). This rubber is produced by Nigerian rubber factories. By using quite simple one position mould presses it is, e.g., possible to manufacture:

- car mats;
- rubber carpets;
- sealing sheats;
- sealing rings;
- sealing washers;
- stoppers;
- covers;
- damping parts;
- handles for tools;
- rubber hammers;
- cut out flat rubber parts.

For manufacturing of the above mentioned rubber parts, the following devices are required:

- a building, consisting of storage rooms for raw materials, one rubber mixture preparation room, one manufacturing room, one inspection and packing room, one storage room for rubber parts;
- position mould packing;
- desks for inspection and packing;
- some other appropriate facilities.

The necessary training of workers is not difficult. However, a more advanced training of specialized rubber operators and technologists, which is more ambitious and costly can be organized in cooperation with some companies, producing dipped rubber goods and parts and compression moulded parts, in Europe or South-East Asia. The international sub-contractor is also willing to cooperate in the process of implementation of various programmes supporting the development of small- and medium-scale manufacturing units.

2. Plastics and Foam (Zdeněk Laita)

A. Basic characteristics of plastics and foam industry

There are more than 1000 firms active in this industry, ranging from the small ones in the informal sector to the large ones with about 2000 employees. At present, when high capital investments are necessary to install modern equipment and to introduce new technologies, only rich large firms can afford to replace their worn out machinery and to keep their plants up-to-date. Moreover, the industry depends almost entirely on imported polymers and raw materials, such as toluene diisocyanate, polyeter diols and additives, high price and scarcity of which cause low capacity utilization and low profits. The import dependence is the main problem of this industry and most other problems are to smaller or larger extent derived therefrom.

However, Nigeria is rich in natural hydrocarbon resources, such as gas and crude oil, but petrochemical industry is not yet sufficiently developed. Large amounts of crude oil are exported, used as fuel for power production and transport, part of accompanying gases is even flarred. Only a very small portion of these hydrocarbons is used as feed stock for petrochemical production. It is in Nigeria's vital interests to develop the petrochemical industry, preferably in a relatively short time horizon so that the country will not only be able to replace imports and cover local demand with home-made polymers, but also to export petrochemical products with high value added instead of raw materials as crude oil.

Relatively cheap domestic polymers are available in sufficient quantities, further development of the downstream processing industry can be facilitated and markets developed. This will enable the plastics and foam firms to become efficient, competitive and to reach profits high enough for financing new machinery and modern technology.

The first step - a world-scale petrochemical plant - is just under construction in Eleme Petrochemical Company with planned start-up at the end of 1993. It will produce 250 ktonnes/year of polyethylene and 80 ktonnes/year of polypropylene, i.e. approximately twice as much as present imports of these polyolefins.

Polyethylene resins will be manufactured using the SCLAIRTECH linear polyethylene technology licenced from Du Pont, Canada. Polypropylene resins will be manufactured by using the SPHERIPOL process licenced from Montedison/Himont of Italy. Both these technologies belong to the most modern ones. They are characterized by high efficiency, low energy consumption and high versatility enabling to produce a broad range of linear low density polyethylene, high density polyethylene, polypropylene homopolymer, propylene heterophasic copolymer and propylene random copolymer grades, respectively.

B. Identification of major problems and constraints

The plastics and foam industry is characterized by many problems and constraints which are common with the rubber industry and also with other sub-systems. To name the most important ones:

- scarcity and high costs of imported raw materials and machinery;
- lack of essential machine spare parts;
- underutilization of plastic processing and foam manufacturing capacities and high production costs;
- worn out machinery and obsolete technology;
- insufficient indigenous applied research and development in the field of plastics technology;
- shortage of experienced mechanical engineers-designers and shortage of production facilities and materials to produce moulds, machinery and spare parts;
- absence of systematic market research;

- high additional production costs owing to the necessity to build up own infrastructural and social facilities by many enterprises themselves.

Many other problems and constraints are mentioned in two studies quoted earlier. Experience from the field-trips and results of consultations with top managers operating in this industry are in accordance with conclusions presented in these studies.

C. Strategic directions

For further development of this industry, the most important thing is to build modern, competitive and highly efficient, home raw material based polymer production units.

Polymers producing companies of the most developed countries (e.g. the USA, Japan, Germany) change their production programmes and turn from commodity plastics to more sophisticated and special polymers with high value added. These companies have experience, high level technical service and efficient marketing service. Commodity plastics production moves to countries with own hydrocarbon resources, mainly to the developing countries.

In accordance with these trends, it is suggested that Nigerian should develop big polyolefin industry and improve its foreign trade balance by selling polymers rather than crude oil. World market for polyolefin is steadily growing and if good marketing service is secured, there should be no big problem to sell all polyolefin surpluses. It is advisable to support further development of petrochemical industry and finance construction of new petrochemical plants in industrial cooperation with foreign companies with good international reputation. Such companies own top-level technologies and have good knowledge of potential markets. Production-sharing as an advantageous method of capital investment repayment can at the same time help to penetrate otherwise hardly penetrable markets within or/and out of Africa. As we noticed during the field-trips, this kind of industrial

cooperation was applied by Eleme Petrochemical Comp. Ltd. in the Eleme Petrochemical Complex project.

In the first stages of Nigerian chemical industry development, domestic production of such polymers, as e.g. nylon and polycarbonates or basic materials for polyurethane foams would not be probably competitive because of lack of upstream chemical industry and relatively low domestic demand. As soon as domestic production of most of the necessary chemical raw materials, as nitric acid, phosgene and others, starts, imports of these polymers and components can be lowered substantially and substituted for locally produced materials.

In the downstream plastic products and foam products manufacturing, a serious problem of machinery and technology obsolescence needs to be solved. It is probable that many enterprises and nearly all small ones will not have enough finance for modernizing their machinery and technology before they start to utilize their production capacities to a reasonably high degree. We suppose that this favourable situation in plastic products industry can come in 1994, after starting up of polyolefins production in Eleme Petrochemicals Complex. In the meanwhile, however, the foam products manufacturers will still depend on imported raw materials, availability of which will be determined by their prices, i.e. by the strength of Naira and by import duties and tariffs.

Till better times for the downstream processors come, they should try to keep their machinery and technology going. It is not advisable to ask for loans if the situation allows to run business with low profits only.

As follows from the analysis of present situation of this industry, there is not too much room left for the development of small-scale enterprises. Production of polymers and polyurethane foam components is a typical domain of large-scale production units. Downstream activities (plastic products and foam products

manufacturing) suffer from lack of financial means that could be spent in modernizing their machinery and technologies. Further development of small-scale enterprises with relatively high capital investment demands is not probable under these conditions. This situation will be changing probably in the mid-nineties, as it was shown in the foregoing paragraphs. Governmental support (e.g. tax and import duties relieves) can help present small enterprises to survive but cannot ensure their further development.

As far as the financial support from the Government is concerned, priorities should be given to finance infrastructure and to reduce import duties on basic raw materials. Solving these problems will help the local industry to compete not only on domestic markets but also to export. Further steps like tax reduction, interest-free loans etc. should be implemented gradually, taking in account the nation's financial position. Excessive money spending may accelerate rate of inflation.

Other suggested strategic directions are described in detail in the first part of this Report.

D. Suggestions

To keep licenced technologies for polyethylene and polypropylene production up-to-date and to ensure their further development, applied research in olefin polymerization should be started and/or strengthened as soon as possible. It is necessary to form a group of top-level scientists and engineers and to ensure the necessary equipment. Experimental work in the field of olefin polymerization using highly productive stereospecific coordination catalysts is very pretentious and the necessary equipment for laboratory and pilot plant research expensive. But it is worthwhile to invest both scientific potential and financial resources in this field because the results can be capitalized in near future. In this way, the production technologies can be prevented from getting either obsolete within

the next fifteen years or fully dependent on further imports of know-how.

Top chemists and technologists who are to take care of the polyolefins manufacturing process should practise at least 6 months in production facilities at, e.g. Du Pont, Canada and Montedison/Himont, Italy, respectively, to get necessary experience.

The range of polyolefin grades produced can be extended by additional modification, e.g. by blending, compounding, degradation, crosslinking. Mineral raw materials for filler production (mica, limestone, talc) can be gained from local resources if their known deposits prove to possess adequate quality and purity. Utilization of mineral fillers in polyolefin compounding is efficient and the technology is not capital intensive. Composites of polyolefins and mineral fillers extend the application possibilities of polyolefins and enable them to replace more expensive imported polymers (ABS, polyamides, polycarbonates) in some applications. High quality fillers are suitable for export to European markets. As we mentioned earlier, some research institutes in Czechoslovakia are well experienced in this field and could help to develop these technologies in Nigeria.

Eleme Petrochemical Company is planning to establish Plastics Technology Development Centre with the assistance of UNIDO. Facilities to be installed in and services to be provided by this Development Centre will be very useful for the whole industry and will help to solve present technological problems. The activities of the Development Centre will prepare new markets and initiate implementation of new modern processing technologies. For instance, introducing of the modular system of mould construction (e.g. HASCO or less expensive DANUVIA, DME and similar systems) could be an advantage and could help to overcome a shortage of mould construction capacities. It is therefore advisable to

support this idea and to establish this important Plastics Technology Development Centre as soon as possible.

F O O D P R O C E S S I N G

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Food processing (P. Brokeš)

A. Basic characteristics of the sub-system

The Nigerian Food Processing Sub-system Study, prepared by the national specialists team, characterizes in some detail the present state of the Nigerian food processing sub-system, provides the general overview of economic policy environment in which the sub-system operates, analyses the structure of its markets, compares the structure of demand and supply in both domestic and foreign markets, describes the level of technologies used, identifies the problems faced and obstacles encountered, indicates the gaps that can be filled. Four food products groups have been selected for a detailed study: grain and milling products, vegetable and fruit products, vegetable oils and fats, beverages.

The sub-system is presently characterized by uncompetitive production, large imports, and negligible exports. The main goal of the sub-system is to attain food self-sufficiency and initiate export of some food products. The strategies to achieve this goal, suggested in the study, include almost all possibilities of upgrading the current traditional raw material base, technologies and products of the sub-system. However, according to the comparison of the projected demand and supply for selected food products, given in the study, the goal of food self-sufficiency for Nigeria does not appear to be realistic, at least in the course of the 1990s.

B. Identification of major problems and constraints

The major problems and constraints of the Nigerian Food Processing sub-system are as follows:

- Lack, uncompetitive costs and poor quality of raw materials. Causes: Overcultivation, non application of fertilizers, insecticides, herbicides, intense leaching under tropical

rainstorms, droughts, lack of suitable mechanical harvesters, post harvester losses, inappropriate storage facilities.

- Old and obsolete technological equipment. Causes: Lack of capital to procure suitable processing machinery, unsuitable types of equipment, lack of spare parts, maintenance problems.
- Inefficient technologies. Results: Losses of valuable nutrients, vitamins, flavors and colour during the technology process. The possibility of contamination and infestation, high energy and water consumption.
- Inefficient packaging lines. Causes: Lack of capital to procure suitable, efficient, modern packaging lines, lack and uncompetitive costs of packaging materials, e.g. cans, glass and plastic bottles, caps and labels. Lack of spare parts for packaging lines.
- Lack of skilled and educated manpower.
- Underutilization of by-products and wastes.
- Problems of energy and water supply.
- Transport problems.
- Uncompetitive food products as a result of all these problems and constraints.
- Lack of marketing information.

In the opinion of international sub-contractor, influenced to some extent by discussions with his counter-parts and contact persons on his field trips in Nigeria, the main problem of the food processing sub-system is too rapid introduction of some restrictive measures (bans) in the food processing industries. The bans on some basic raw materials imports increased their prices, contributed to the creation of black market and smuggling. It made the food production very uncompetitive. The

results are discouraging: market distortions, underutilization of capacities, growing unemployment, lack of capital in food production, decreasing interest of foreigners to invest in Nigerian food processing sub-system. The bans should be introduced gradually on the basis of consultations with the producers. The food producers should react on these inevitable economic policy changes more flexibly by introducing modifications in production programmes. These programmes should seek new ways and means to increase the utilization of domestic raw materials and to promote the production of these raw materials.

Serious consideration should be given to the overall organization of the food processing sub-system. One of the greatest problems is viewed in uncertainties in the availability of raw materials and food products at given prices. Oversized plants suffering from high import dependency, e.g. Nigerian flour mills, are extremely underutilized. At least in some of them, new production programmes should be introduced. The medium- and small-scale plants seem to have adjusted more flexibly to the changing economic climate. Small- and medium-scale entrepreneurs should be encouraged in their production efforts in order to achieve a more dynamic and competitive environment. For example, small- and medium-scale mills could be built up in the countryside in order to minimize high transport costs.

Another problem of the food processing sub-system is seen in the shortage of well-trained and highly qualified manpower. Specialized personnel should be trained in various food technologies, machinery maintenance, quality and hygiene control, marketing and management methods. The training should involve short-term courses, with emphasis on practical orientation. While management appears to be technically qualified, lack of real managerial skills is deeply felt. Management training should be organized for managers at higher levels with accent on financial management.

C. Strategic directions

The Nigerian food processing sub-system study, prepared by national specialists, suggests to achieve the food self-sufficiency for Nigeria as the main goal. This strategic direction has been rightly chosen and should be accomplished as soon as possible. The technical progress in agriculture, improvement in postharvester storage, modernization of food processing equipment, technologies, packaging lines, training of manpower, solution of energy, water supply and transport problems are important. However, the rapid population growth, limited sources of local raw materials and lack of capital question the validity of the assumption that traditional strategic directions are good enough to achieve the food self-sufficiency goal. The international sub-contractor visited a number of factories equipped mainly with high level technologies and imported machinery. However, their utilization was rather low. Main causes of this shortcoming should be sought in the shortage and poor quality of local raw materials and poor sales of processed food products due to low purchasing power of consumers. The Nigerian food markets are price sensitive and many local food products are too expensive and so uncompetitive. Raw material input shortage, while contributing to high prices, also limits the level of capacity utilization in the food industry. The domestic production of important raw materials should therefore be supported. It is difficult to produce, for example, cheap soft drinks, stewed fruits, jams, marmelades or jellies without sufficient domestic production of cheap basic raw materials such as sugar and citric acid.

Due attention should be paid to improvements in nutritional standards of the population through the growing consumption of food containing all essential aminoacids, vitamins and proteins. For example, there are problems with utilization of large soybean meal stock in Taraku. In Nigeria the soybean meal is used practically only for livestock feed production. In the USA and Europe, the fabricated food based on soyprotein concentrates,

isolates or texturated soyprotein are very popular as meat substitutes for their excellent sensoric and nutritional quality. Also, the food, fortified by lysine, vitamins, proteines or hydrolysates of proteins, are relatively cheap and have great nutritional and sensoric value.

For this reason, the international sub-contractor recommends to complement the proposed strategic directions by some non-traditional approaches to resolve some of the food processing problems. These non-traditional approaches comprise inter alia: the utilization of non-traditional sources of raw materials for food processing, application of non-traditional food processing technologies and development of non-traditional food products.

Some Nigerian companies have already introduced such non traditional approaches into practice. The international sub-contractor visited two Nigeria breweries (Nigerian Breweries PLC, Guinness Nigeria Ltd.). These breweries embarked on partial technology modifications to substitute imported barley for local raw materials. The quality of beer produced from local raw materials in these breweries is of very good quality. The production of beer in this breweries proves that a successful introduction of modern high level biotechnologies in Nigerian conditions is not only possible, but brings also excellent results. Another example of successful high level biotechnology in Nigeria is production of glucose syrup by enzymatic hydrolysis of sorghum starch in Cadbury Nigeria Ltd. The international sub-contractor is ready to collaborate with these and other companies. He suggests the introduction of production of protein concentrate from waste brewery yeast or application of ultrafiltration by enzymatic hydrolysis to save imported enzymes and improve the quality of the product.

(a) Utilization of non-traditional sources of raw materials for processing

(i) Application of biotechnologies

Biotechnologies enable by activity of selected microorganism to convert the non-traditional sources into valuable raw materials for food processing. Such non-traditional sources include wood waste hydrolysates, solid and liquid wastes and also crude oil and its derivatives. However, the most common raw material for biotechnology is molasses.

The products of biotechnologies are proteins, aminoacids, organic acids, fats, enzymes, flavors, thickeners. Most of these valuable food processing raw materials are imported at high prices at present. Again, at least some of these technologies should be introduced into food processing industry in Nigeria. One of the advantages of this proposal is that sources available in Nigeria, such as crude oil and derivatives or various wastes, will be utilized for production of some abovementioned food processing raw materials.

Yeast production

Yeast is a single cell plant. It is one of the most common sources of proteins in the world. It can be added to various types of food products and animal feeds to improve their nutritional value. Yeast are grown on carbohydrates, and also on crude oil and its derivatives, hydrocarbons, waxy crude oil, gas oils or n-alkanes usually in the C_{12} - C_{18} range. Candida yeast can be grown on n-alkanes. The estimated production costs for production Candida utilis yeast on n-alkanes given in Tables 1. and 2. indicate that yeast can be produced economically only in a large-scale plant of minimum capacity of 50 t/day (about 15.000 t/year).

There are many large-scale production plants, especially in Japan (for example Dainippon Chemical, Tokyo, Japan-scale 20.000 t dried yeast/year; Konega, Koba Japan - scale 60.000

Table 1.

Production Costs for Yeast on n-Alcanes
(capacity 200 t/year)

	USD/t	Depreciation 20% PA USD/t	USD/t
Capital costs			
Prime coast	134,520	182,2	
Piping etc	72,480	68,6	
Instruments	24,000	22,8	
Electricals	9,416	8,9	
			228,5
Operating costs			
Substrate		108,0	
Minerals		48,0	
Vitamins		2,4	
Antifoam		36,0	
Labour		204,0	
Electricity		76,0	
Fuel oil		22,8	
Water		5,0	
Packaging		15,0	
Maintenance		10,0	
			527,2
Total costs			755,7

Table 2.

Production Costs for Yeast
on n - Alcanes

(capacity 50t/day = 15.000 t/year)

	USD/t	USD/t
Prime cost	22,8	
Medium	194,4	
Labour	20,4	
Electricity	76,0	
Fuel oil	9,6	
Water	5,0	
Packaging	15,0	
Total costs		343,2

t/year or Kuyava Hakko Tokyo - scale 20.000 - 50.000 t/year). Yeast can be also grown on waste. Symba process involves the two-stage production of yeast on waste potato starch effluent. In the first stage, the starch is hydrolyzed to sugars with amylase enzymes. The sugars produced then serve as growth medium for Candida yeast. The symba process is an excellent example of effluent treatment combined with producing animal food. Profitable production of yeast for animal feed can be developed using such waste sources as spent sulphite liquor, spent grapes, distillers solubles etc., where the cost of the carbohydrate is very low.

Protein hydrolysates and autolysates production

The usage of hydrolysates and autolysates of proteins has increased greatly. They are present in many food products including: soups, stews, broths, bouillons, fish, gravies, scrapple, headcheese, mince meat, sausage meat, pancake flour, salad dressings, mayonaise. These products, prepared by carefully controlled hydrolysis, have much stronger flavor and useful flavoring applications. Induced autolysis yeast cells enables simultaneous preparation of various yeast products (yeast extract; invertase, biosorbents, ergosterol, phospholipids, manoproteins, and (1-3)-beta-glucan). The principle of induced yeast cell autolysis lies in exploiting the endogenous lytic potential of the cell (proteinases, polysaccharidases, nucleases, phosphatases, etc.) to destroy the permeability barriers for extraction of intracellular components. The induction of autolysis is achieved by employing relatively safe chemical agent, such as ethanol and sodium chloride.

Aminoacids production

Fermentation production of essential aminoacids is important for supplementation of grains with limiting aminoacids (table 3). It is a technological advance of great benefit to all, but especially to the developing countries. In these

Table 3

Nutritional score sheet of selected proteins
(FAO Report 24, 1970)

	Protein (Gm/100)	Chemical Score	Limiting Amino Acid	Physiological problem
Maize	9,5	41	Lysine	
Opague 2	11,6	48	Isoleucine	None
Millet	9,7	53	Lysine	Fiber
Rice				None
IR-8	7,3	56	Isoleucin	
Milled polished	6,7	56	Lysine	
Sorghum	10,1	31	Lysine	
Wheat (whole)	12,2	44	Lysine	
Potato	2,0	34	Sulphur cont.	
Groundnut	25,6	43	Sulphur cont.	Aflatoxin
Soybean (seed)	38,0	47	Sulphur cont.	Flatulence
Coconut	6,6	55	Lysine	Fiber
Cottonseed	20,2	50	Isoleucine	Gossypol
Palm kernel	6,6	58	Isoleucine	
Safflower	12,6	42	Sulphur cont.	Fiber and oxalate
Sesame	18,1	42	Lysine	Fiber
Sunflower (seed)	12,6	56	Lysine	
Whole egg	12,4	100	None	
Cow's milk(whole)	3,5	60	Sulphur cont.	
Casein	13,3	58	Sulphur cont.	
Hunan milk	1,2	53	Sulphur cont	
Brewer's yeast	38,8	45	Sulphur cont.	nucleic acid
Yeast algae				
gqs process	70,5	45	Sulphur cont.	nucleic acid
Parafin process	65,3	63	Sulphur cont.	nucleic acid
Spirulina maxima				
dried	62,0	32	Sulphur cont.	Chitin
Chlorella		49	Sulphur cont.	Chitin

countries, people depend for their nutrition upon one or at most a few kinds of grain.

Lysine, methionine or threonine can be produced by fermentation process. Especially lysine is used for fortification of various foodstuffs. Lysine is produced by submerge fermentation of *Brevibacterium flavum*, *Corynebacterium* species of *Micrococcus glutamicus*. The main source of carbon in fermentation broth is sucrose and glucose. Fermentation broth contains also the protein hydrolysate, corn-steep and ammonium salts. Cultivation takes 20 hours at temperature 29°C under the intensive agitated and aerated conditions. The cells of the production microorganism are removed after the fermentation process by centrifugation. Lysine is crystallized from the supernatant. Glutamic acid used for flavoring can also be produced by fermentation process.

Organic acids production

Organic acids are one of the most important raw materials for production of soft drinks, food preserves, jellies, marmelades, etc. Citric acid is used most frequently. Also, lactic acid or acetic acid are used for production of foodstuffs.

Citric acid produced by submerge fermentation of *Aspergillus Niger* on molasses or starch hydrolysate. In table 4 there are given the basic data related to citric acid production on sucrose and on maize starch. Technological process of citric acid production consists of two parts: fermentation and isolation. The fermentation process takes 48-51 hours under the intensive agitated and aerated conditions. According to the study of K.O.Esuoso, R.A. Oderinde and J.I. Okogun from University of Ibadan, potentially good substrates for production of citric acid in Nigeria are *imu* (*Cyperus esculentus*) and maize (*Zea mays*). *Imu*, although a weed, has

a tuber which is rich in carbohydrate and has a high productivity.

The lactic acid production is based on sucrose. A natural isolate of a lactic acid bacteria is able to convert substrate into product with the average productivity of 1,5-2,0g s LA.dm⁻³. h⁻¹ and conversion between 92-95%.

Table 4.

Data related to citric acid fermentation process
on sucrose and maize starch

a. sucrose:	initial sugar concentration	150 kg m ⁻³
	fermentation time	120 h
	conversion	90 kg CA/100 kg
	isolation losses	6%
	production time	144 h
b. maize starch:	initial starch concentration	120 kg m ⁻³
	initial hexoces concentration	122 kg m ⁻³
	fermentation time	144 h
	conversion	93 kg CA/100 kg
	isolation losses	6%
	production time	168 h

Enzyme production

Along with the advances in food technologies the application of enzymes in the food processing industry has developed. In the baking industry, amylases are used to achieve partial hydrolysis or breakdown of sugars, amylose, starch and other such compounds. Amylases are used also for conversion of starch into sweet syrups. Invertase is used to effect sugar hydrolysis in confectionery to improve sweetness. Pectinases are used to facilitate and improve

the extraction of juices and their clarification and are also employed in green coffee processing. Cellulases are employed in cereal industry for partial hydrolysis of cellulose, hemicellulases are used to degrade the gums in coffee concentrates in order to prevent gelling. The most interesting application in Nigeria is the application of brewery enzymes (glucoamylase, α - amylase, protease) to replace malt by domestic cereals/sorghum, rice, etc). The enzymes are produced in special fermentation processes or isolated as by-products from fermentation medium from other productions (for example pectinase from citric acid production, protease from lysine production).

(ii) Isolation of valuable nutrients from by-products and wastes

Some by-products and wastes of food processing contain valuable nutrients which are not yet fully utilized. For instance, whey, animal blood, waste water from starch industry contain proteins. Orange, apple peels and pomace contain peel oils, flavonoids and pectine. These valuable substances can be isolated by means of modern separation methods (for example ultrafiltration) and used for fortification of food products.

The main by-product of cheese production is whey. Although the whey contains important nutrients, such as lactoalbumins and lactoglobulins (about 1%), it is usually underutilized. The proteins of whey can be concentrated by ultrafiltration (table 5) to concentration 10 - 20% and this concentrate is suitable for food fortification. Animal food presents about 7% of animal body weight. It contains very valuable proteins which can be concentrated by ultrafiltration to concentration about 20 - 25%, spray dried and applied to fortificate food products.

Similarly, the waste water from potato or casava starch production contains about 0,5 - 1% of proteins, and

Composition of whey and whey products, and the quantity produced per 1,000 kg whey.

Composition	Whey	Retentate	Permeate	Whey protein powder	Conventional whey powder
Total dry matter %	5,75	21,70	4,85	95,0	95,0
Protein %	0,80	12,45	0,14	54,5	13,2
Lactose %	4,40	7,50	4,23	32,8	72,7
Ash %	0,50	0,80	0,48	3,5	8,3
Fat %	0,05	0,95	0	4,2	0,8
Production kg	1000	53,5	946,5	12,0	59,4

polysacharides and can be concentrated by ultrafiltration and used for animal feeds. Also some fatty waste water, bouillons or "stick water" from fish treatment can be concentrated by ultrafiltration and utilized.

Some important food industry raw materials can be materials can be isolated from apple citrus peel and pomace. In figure 1. the production of pectine from orange peels is illustrated. Cold-pressed peel oil may be recovered and used for flavoring juice or sold for use in manufacturing carbonated beverages, candy, baked goods, soap, or in any other products where a citrus flavor or aroma is desired. In vegetable oil production, the solvent extraction of the press cake can substantially increase the yield of vegetable oil.

(iii) Promotion of soybean cultivation and its modern complex processing

Soybean received a great commercial attention during the last 20 years for its good nutritional value relatively high yields. Oils, protein concentrates, protein isolates and texturated proteins produced from soybeans by modern complex technologies are important source of raw materials, especially for fortified and fabricated food products as well as for soybean beverages. The international sub-contractor suggests that the soybean cultivation and its modern complex processing should for this reason be promoted and widened in Nigeria. Flow of soybeans through a modern processing plant is presented in Figure 2. It illustartes the major products of soybeans processing. Solvent extraction is the major processing method, because it efficiently separates the higher priced oil from the lower priced defatted flakes. These defatted flakes are used for production of protein concentrates and protein isolates. Protein concentrates are prepared from defatted flakes by removing watersoluble sugars, ash, and other minor constituents including compounds giving raw-soy,

Fig. 1

Pectin production processes

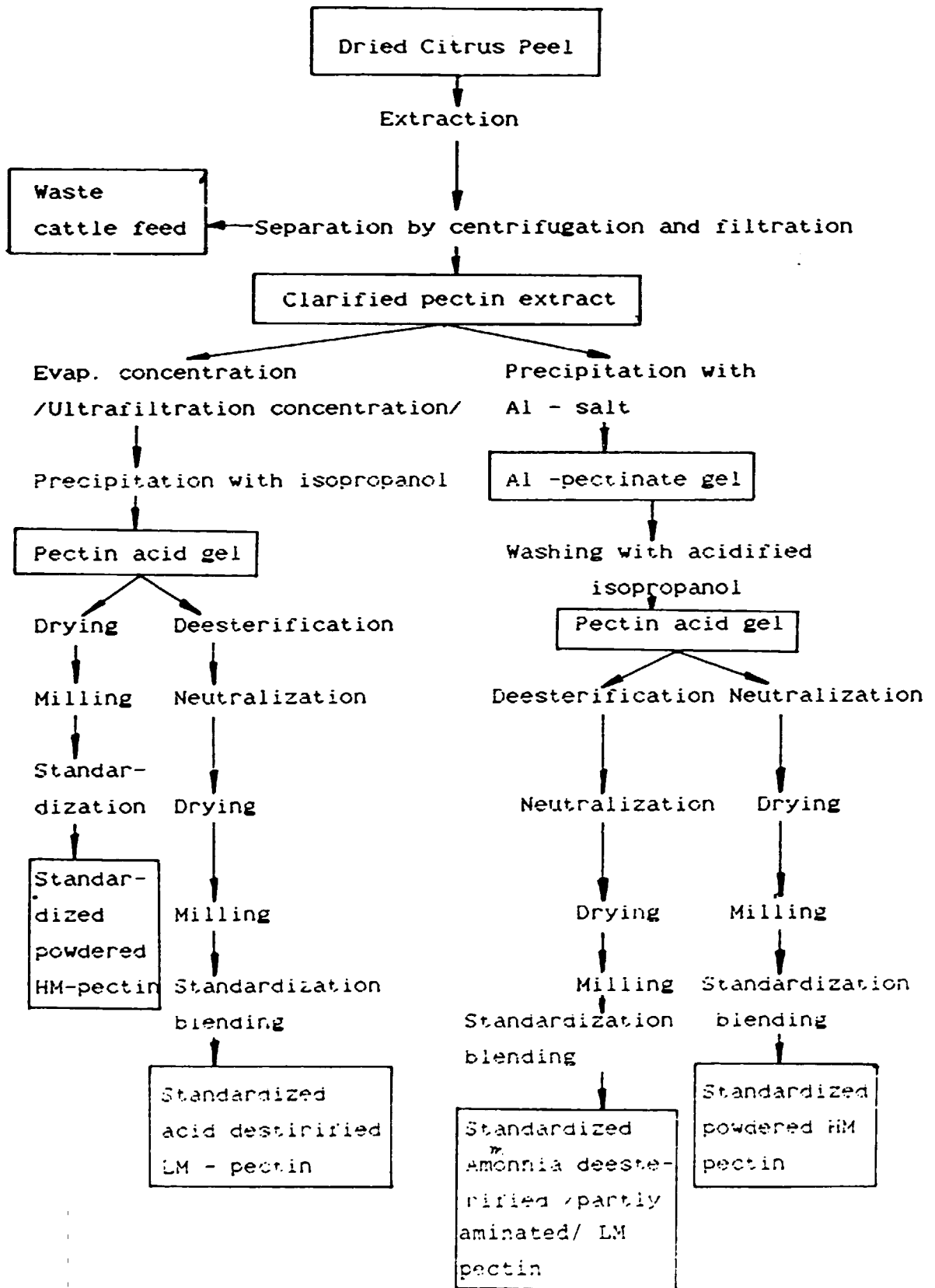
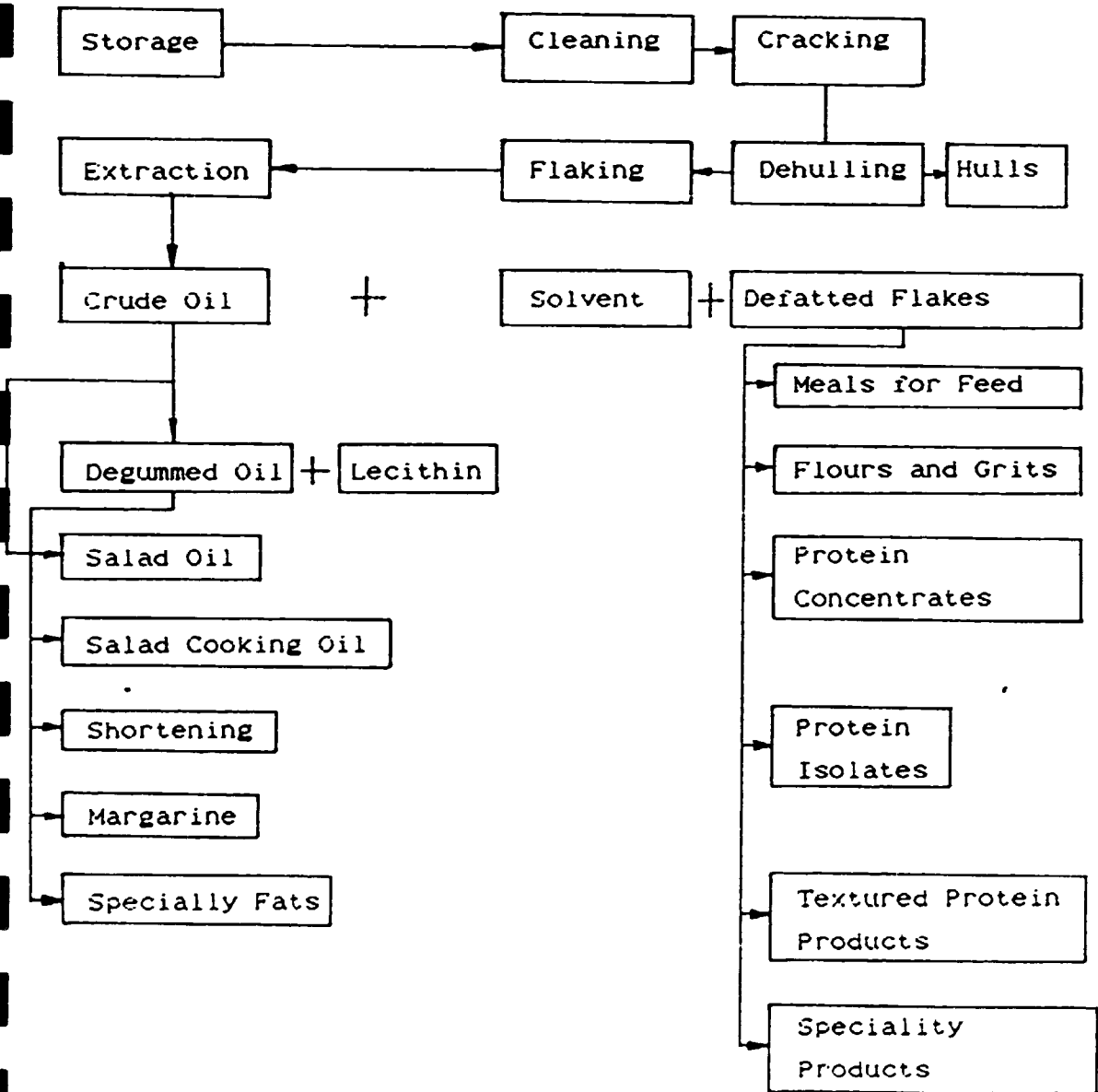


Fig. 2

Flow of soybeans through a modern processing plant



beany, acid bitter flavors. Protein isolates are prepared by removing all water insoluble polysaccharides, as well as water soluble sugars and other minor constituents.

(b) Application of non-traditional food processing technologies

Application of modern technologies enable to develop new quality products, save energy and utilize by-products and waste.

(i) Application of mebrabe processes

The separation of fluid mixtures by membrane processes has many merits. There are no temperature or phase changes involved, and so, the valuable vital and nutrient substances such as vitamins or flavors are not damaged during the separation process. The energy consumption in mebrane processes is extremply low. The energy consumption for separation of volume unit by ultrafiltration is about 100 times lower than by evaporation (table 6). Also, the capital costs are relatively low. The position of various membrane processes (microfiltration, ultrafiltration, dialysis, reverse osmosis) within the spectrum of separation processes is illustarted in Figure 3. Microfiltration in used for cold sterilization of water and fluid food. Ultrafiltration is used for concentration and purification of proteins from milk, white eggs, soybeans and alpha-alpha extracts, water and waste water treatment. Reverse osmosis and electrodialysis are used for demineralization of water and juice concentration.

(ii) Application of new drying methods

Spray drying of milk, yeasts, protein concentrates or fruit juices as well as fluid bed drying of vegetable and combination of membrane processes with spray of fluid bed drying are the finest dehydration methods.

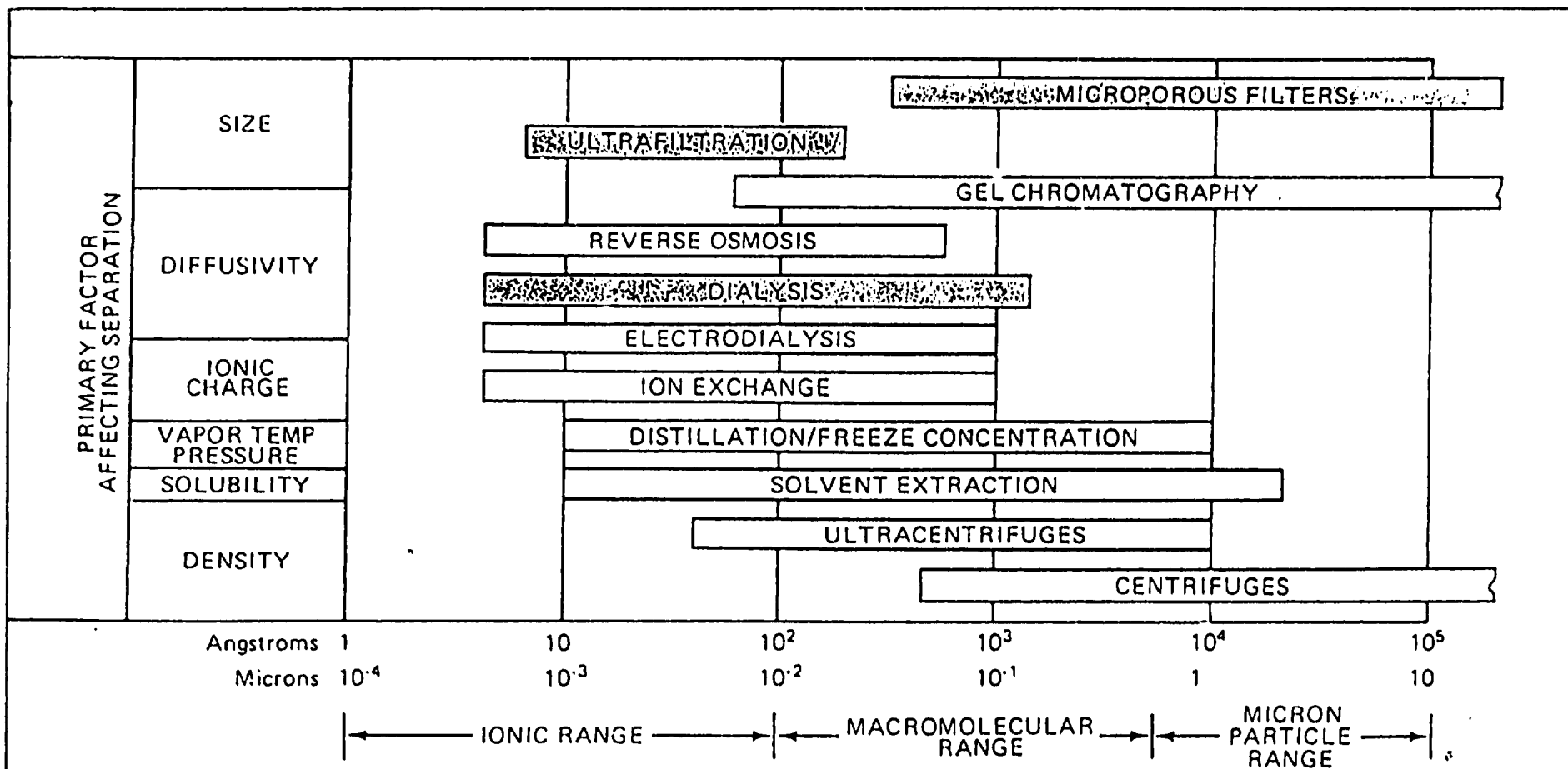
Table 6.

ENERGY CONSUMPTIONS OF CONCENTRATION PROCESSES EXPRESSED IN TON STEAM
EQUIVALENTS PER TON WATER REMOVAL

<i>Process</i>	<i>Steam equivalents (tons)</i>
Ultrafiltration efficiency ^a 75% pressure 2.5 atm	0.001
Reverse osmosis efficiency 75% pressure 75 atm	0.028
Freeze-concentration efficiency 80% ΔT (difference between condensor and evaporator) = 20°C	0.090
$\Delta T = 40^\circ\text{C}$	0.196
$\Delta T = 60^\circ\text{C}$	0.386
Pervaporation efficiency 90%	1.111
Evaporation efficiency 90%	
single effect	1.111
double effect	0.555
triple effect	0.370
single effect	1.257
double effect	0.701
triple effect	0.510

Fig. 3

Spectrum of separation processes



(iii) Application of extrusion methods

Extrusion technologies are used for mixing, dispergation, gelanination, plastification and texturization. They enable to produce new types of fortified food products, with the possibility of modifying their composition and structure.

(c) Development of non-traditional food products

(i) Fortified food products

The food products can be fortified to improve their nutritional and organoleptic properties. They are fortified by limiting essential aminoacids (lysine, methionine, threonine), by proteins (yeast, soya protein, milk protein), by flavors (protein hydrolysate, yeast autolysate, sodium glutamate, 5-ribonucleotides, organic acids) or by vitamins (A, B, C, F).

(ii) Fabricated food products

Interest in fabricated foods has been heightened by the threat of critical food shortages in the foreseeable future and the need to alleviate these shortages by advanced engineering and technological techniques. Production of meat, poultry and sea food substitutes is already a big business and will probably get bigger. Soybean is the principal raw material for the vast majority of meat substitutes. Soy grits or soy flour contains about 50% of protein, soy protein concentrates 70% of protein, and isolates soy protein about 90% protein.

These proteins can be used as substitutes for meat in two ways:

(1) They constitute a minor part of the finished product where small amounts of soy protein are added to meat as an extender to reduce costs and/or to increase the quality and stability of products. Products fortified with soy protein include, e.g. sausage mixtures, patties, meatballs, and others.

(2) Soy protein constitutes the bulk of the product to simulate meat items in appearance, taste and texture. These meat analogs are manufactured by spinning isolated soy proteins into fibers which can be colored, flavored, and formed into slices, chunks, cubes, chips, or any desired form and size.

(iii) Top quality concentrates

The products of fluid foods concentration by membrane processes or powdered foods produced by fluid bed or spray drying are characterized by the high contain of vitamins and excelent organoleptic properties, for example, tomato concentrates produced by reverse osmosis.

D. Suggestions

In addition to the recommendations made by Nigerian food specialists the international sub-contractor suggested the following propositions:

(a) Introduction of biotechnologies into Nigerian food processing industries:

- (i) citric acid production on starch, capacity 5 000 t/year;
- (ii) lysine production on Nigerian raw materials, capacity 5 000 tons/year;
- (iii) yeasts production on n-alcanes, capacity 15 000 t/year;
- (iv) enzymes production and their application, feasibility study;
- (v) production of protein hydrolysates and yeasts autolysates;

(b) Utilization of by-products:

- (i) ultrafiltration and spray drying of whey animal blood;
- (ii) spray drying of brewery yeasts;

(iii) solvent extraction of oil from press cake in oilseed processing;

(iv) pectine production from orange peels.

(c) Promotion of soybean cultivation and its modern complex progressing.

(d) Introduction of production of ultrafiltration membranes and equipment.

(e) Development and introduction of new food products:

(i) development, production and advertisement of fortified and fabricated food products;

(ii) introduction of tomato concentrates produced by reverse osmosis;

(iii) production of powdered soft drinks.

(f) Increase in capacity utilization:

Modifications in the production programme of large-scale flour mills which are presently underutilized. Partial utilization of already existing buildings and equipment; (for example, complex maize processing: production of starch, modified starch, citric acid, maize oil, gluten, etc.; complex soybean processing: production of oils, lecithine, proteins concentrates, isolates, textured protein or soybean beverages); feasibility study.

(g) Education and research:

(i) Organization of intensive short-term courses for specialized personnel in various food technologies, machinery maintenance, quality control and assurance.

(ii) Organization of postgraduate management courses.

(iii) Organization of postgraduate courses, and research in the field of biotechnology, waste treatment and membrane processes.

(f) Technical cooperation:

International technical cooperation in the field of biotechnology, waste treatment and membrane processes. The international sub-contractor is prepared to take active part in it.

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LEATHER AND LEATHER PRODUCTS

Prepared by

Karel K u b e c

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Leather and Leather Products (K. Kubec)

A. Basic characteristics of the sub-system

The sub-system "Leather and Leather Products" is characterized by the highest labour intensity in manufacturing. The expansion of this sub-system would contribute considerably to the achievement of the employment objective in Nigeria. The majority of visited managers of leather and leather goods factories expressed their interest in practical recommendations suggested by international sub-contractor, particularly in the field of new technological know-how and low pollution technology for leather production.

B. Identification of main problems and constraints

This assessment is based on international sub-contractor's experience, gained during his visit to tanneries in Kano and Lagos. Also the sub-system study "Leather and Leather Products" has given him some information and analytical material that facilitated his evaluation and formulation of main recommendations.

The contemporary situation in this industry requires immediate practical actions, first of all in leather production technology, necessary for improvement of the quality of intermediary and final products and, consequently, of the economic position of the whole sub-system.

a) The quality of livestock in Nigeria is relatively high:

cattle	20 - 30 mil. pieces
sheep	12 - 14 mil. pieces
goat	16 - 29 mil. pieces

It should be noted that the data concerning absolute numbers of livestock differ in various information sources.

b) The demand for skins and hides and leather exceeds considerably the supply. The main causes are as follows:

- (i) exports of skins and hides;
 - (ii) lots of hides and skins are damaged or completely destroyed, owing to the methods of slaughtering, handling and transporting to tanneries;
 - (iii) in Nigeria, hides and skins are traditionally used as foodstuff by many inhabitants of the country;
 - (iv) leather processed in old traditional tanneries mostly does not mostly reach acceptable quality;
 - (v) the existing methods of processing, stocking and transporting pickled skins and hides cannot eliminate the danger of damage caused by hydrolysis.
- c) Nigeria is the country with comparatively low labour costs. This fact can play an important role in the process of transition of raw material and pickled skins towards wet blue, crust and finished leather exports. In the future, Nigeria could receive much greater export earnings for crust and finished leather exports than it does for raw material and pickled skins exports now.
- d) Owing to their actual quality grain, goat and sheep skins from Nigeria represent a very perspective intermediary product for export.
- e) The method of slaughtering and preservation of skins and hides in Nigeria is rather underdeveloped. Very often this is not only due to the shortage of good slaughtering tools, but also due to the lack of skilled workers.
- f) The technological treatment of skins in the beamhouse is at low level in some tanneries and, in combination with imperfect degreasing, it leads to the creation of "spew" on final leathers.
- g) The applied technology does not make it possible to achieve the maximum yield of leather.

- h) The quantity of sulphide used for unhairing is much higher (in most cases) than the technological process requires. Consequently, it causes unnecessary environmental damages.
- i) In some cases, utilization of chrome salts in the process of chrome tanning is not sufficient. This can cause not only financial losses, but has also a negative influence on the environment.
- j) Activities of the National Research Institute for Chemicals (NARICT) are not directly related to practical activities in tanneries.
- k) Shoe-making and leather-goods factories need very urgently supplies of leather of higher quality. The low quality of shoes and other leather products in Nigeria depends first of all on the low quality of leather.
- l) The production capacity of the leather industry in Nigeria exceeds the current raw material supply.
- m) For Nigerian leather products, there appears the potential market in Europe and USA. In order to increase exports of Nigerian leather products, the quality of leather must be improved.

C.D. Strategic directions and suggestions for the improvement of the Nigerian leather industry

- a) It is absolutely necessary to close down (to put a ban on) exports of all skins and raw hides from Nigeria.
- b) It is necessary to improve the quality of raw hides and skins (including better care of the livestock). The treatment of raw hides and the improvement of their quality requires the assistance of the Federal Ministry of Agriculture, specialists from leather factories and from NARICT. Even purchase of better slaughtering knives

can influence remarkably the quality of skins and raw hides.

- c) Weak linkages between grazing animals, abattoirs tanneries and production of leather goods and footwear should be strengthened. This basic recommendation was also written in report "Leather and Leather Products" (p. 160).
- d) The economic position of the leather sub-system in Nigeria can be improved through exports of intermediary products as wet blue or crust. Higher prices can be achieved only if improvements in the quality of products are achieved.
- e) In order to achieve the higher yield and better quality of wet blue and crust, it is necessary to change the tanning technology. The process should proceed in two stages. After careful pretanning with the use of small quantity of Chromitan B or basified aluminium salts, shaving and retanning with chrome salts should follow. In this way, at least 4% yield increase can be achieved along with much smoother grain (Annex A).
- f) In order to improve the ecological situation of tanneries and also the quality of goat leather produced, it is recommended to apply the enzymatic unhairing technology. This technology ensures conservation of hair that can be sold for utilizing in other industries. In addition, there are no problems with water treatment, because the hair, representing highly organized and valuable protein (keratin) is not dissolved in tanner effluents.
- g) Careful weighing of raw material and shaved leather is recommended. On the basis of this simple measure, it is possible to reduce the consumption of chemicals, especially of the toxic sulphide, by 30 - 40 %.

- h) The machinery and equipment of Nigerian tanneries is characterized by the average technical level. With respect to the contemporary economic position of the Nigerian sub-system, it is not recommended to replace the "in-run" tanning drums by more sophisticated mixers. Beside their high price, highly qualified personnel is required and higher maintenance quality for their proper functioning are needed.
- i) For current production of finished leather in Nigeria, it is advisable to use staking machine Mollisa with Lycra conveyer. If the daily production exceeds 2.000 m² of finished leather, it is useful to equip the tannery with Dynavac (Germany).
- j) The content of trivalent chrome in waste waters can be reduced by:
 - a) precipitation of Cr;
 - b) simple recycling of Cr (see Annex B);
 - c) Aluminium salts pre-tanning.

With reference to experimentally gained results, for goatskin- and lambskin- wet blue producing tanneries, the method c) can be recommended (Annex A).

For cow-hides processing tanneries, producing wet blue, crust and finished leather, the method b) can be recommended.

The complex solution of the water treatment is expensive and needs a professional designer's assistance (recommended for the second stage of the process - see Annex D). The Technological Centre in Karlovac (Yugoslavia) can offer high quality projects of this kind.

- k) The shoe and leather goods making factories in Nigeria need urgently supplies of good quality leather. In this

respect, the introduction of the simple system of measurement of the relative elongation under wet condition (100% humidity) can be recommended (Annex C).

- l) The private sector in the Nigerian leather industry is able to operate well, but it needs raw materials of higher quality and implementation of the above mentioned measures.
- m) Until now, Germany, Spain, Italy and Czechoslovakia imported wet blue from Ethiopia, Afghanistan and Iraq. The reduced exports from these countries could be well replaced by Nigeria. However, execution of all above mentioned measures and improvements in the quality of Nigerian leather are necessary preconditions for trade cooperation between these countries and Nigeria in this field.
- n) The National Research Institute for Chemical Technology (NARICT) should cooperate more closely with tanneries. Individual staff members should contribute to the solution of some pressing sub-system problems of practical nature within the leather and leather products. NARICT could thus achieve better credit through the introduction of concrete results of their work into tanneries and leather goods factories.
- o) Most of the existing Nigerian small-scale leather factories have a good hand fleshing system, but in most cases, they use improper vegetable tanning materials of the home origin. In order to improve this situation, it is advisable to apply new methods of tanning technology in selected tanneries.
- p) In view of the international sub-contractor, Nigeria should ask for UNIDO's technological assistance (mainly know-how, low-cost and low-pollution technologies). This activity should be implemented through a "leather

industry cell", created and situated in Kano, which represents the real leather center.

- q) For organization of research and development of leather technologies and of training courses, a small pilot plant should be used, equipped with 3 drums and a simple finishing department including spraying box.

Personnel recommended:

1 worker for the beamhouse

1 worker for the finishing dept.

1 worker (auxiliary labourer)

1 highly qualified UNIDO expert with rich practical experience

E. Conclusion

Further development of the "Leather and Leather Products" sub-system urgently requires a number of improvements, particularly in the field of raw materials, machinery and equipment, and technology and know-how. Besides the necessary increase in both the quantity and quality of supply of skins and hides, it is particularly important to reach an optimum know-how, corresponding to the specific Nigerian conditions and based on solid knowledge of leather technology. Also improvements in shoe and leather goods production are needed.

If the preceding measures are carried out, it is possible to expect that the "Leather and Leather Products Sub-system" will become a highly perspective industry, including both large industrial production units and small-scale family enterprises.

A N N E X A

Practical experience with unhairing of goat skins

The best results have been achieved with use of the enzyme NOVO NUE 6.OS Type 1. The enzyme Nue 1 is an alkali stable proteolytic type, selectively degrading peptide bonds of different non-collagenous proteins and, first of all, avoids the damage of collages itself. The technology was developed for the limited scale production of the gloving, garment and shoe-upper leather.

Soaking: 3 days in drums 2 500 mm x 2 000 mm, 7 rpm

Raw material: dried goat skins - weight 0,5 - 0,7 kg/pc

Test run: 3500 pcs/week

1st soaking: 1000% water 20°C, 50 min. without moving
3 times 5 min. run
60 min. without moving
overnight in the bath

1st washing: with running water, valves open

2nd soaking: 800% water 20°C
4 times 5 min. run
60 min. within moving
overnight in the bath

Deagreasing: 500% water 33°C + AMOLLAN S 1,5
1,5 soda calc. - 40 min. run/draining

2nd washing: batch washing - water 20°C (3 times)

3rd soaking: 500% water 20°C + CISMOLAN BH 0,3%
(% dosage of chemicals calculated on dry weight)

Fleshing with the machine L 1500

Unhairing and liming

in the concrete paddle 6 m³, 750 pcs in the paddle
600 % used lime (from the enzymatic liming)
400% water 35°C
11% powder - lime
0,2% enzyme NUE 1 (NOVO - Denmark)
the density of the lime 2,5°Be
Duration of the liming: 3 days
Rotation: 15 min/day

Note: % of chemicals calculated on the dry weight of the raw materials

The practical unhairing of skins is effected on the machine L 1500 mm, the dose of the enzyme for the new lime bath should be approximately 0,6% Enzyme Nue 1.

The "renovation" of the lime bath effected only twice a year.

Washing and Preheating

in the drum 2500 x 2000 mm
the initial temperature of the water 20°C
the final temperature 38°C

Deliming

all operations from deliming to tanning effected in the drum 2500 x 2000 mm
200% water 36°C
0,7 amonium sulphate (dilluted in water 1:10)
0,4 sodium bisulphate (1:10) - 30 min.
- check deliming with phenolptalein (colourless solution required)

Bating: + 1,4% (Creaton 202) bating agent from Messrs. Zschimmer, Schwarz, Lahnstein - 3 hours.

Washing and cooling with running water (35 - 20°C) open valve - 30 min.

Pickling: 80% water 22°C

8% salt (NaCl) - 5 min.

0,4% Peramit ML for skins with fine grain (for high quality products)

1,3 Formic acid (1:10) - 2 x 15 + 60 min.

Check with BCG (yellow colour)

Pretanning: + 0,8% KORTAN AL (tanning agent with 14% Al₂O₃)

50% Sch

2 x 30 + 60 min. - overnight in the bath

Sammying in the machine

Shaving to 0,5 mm

Rewetting after shaving: 100% water 30°C

9% salt - 20 min.

pH adjustment: 0,4% formic acid - 60 min.

- check - pH value should be 2,8

Chrome tanning: + 9% Chrominat B (tanning agent with 25% Cr₂O₃ - 33% Sch)

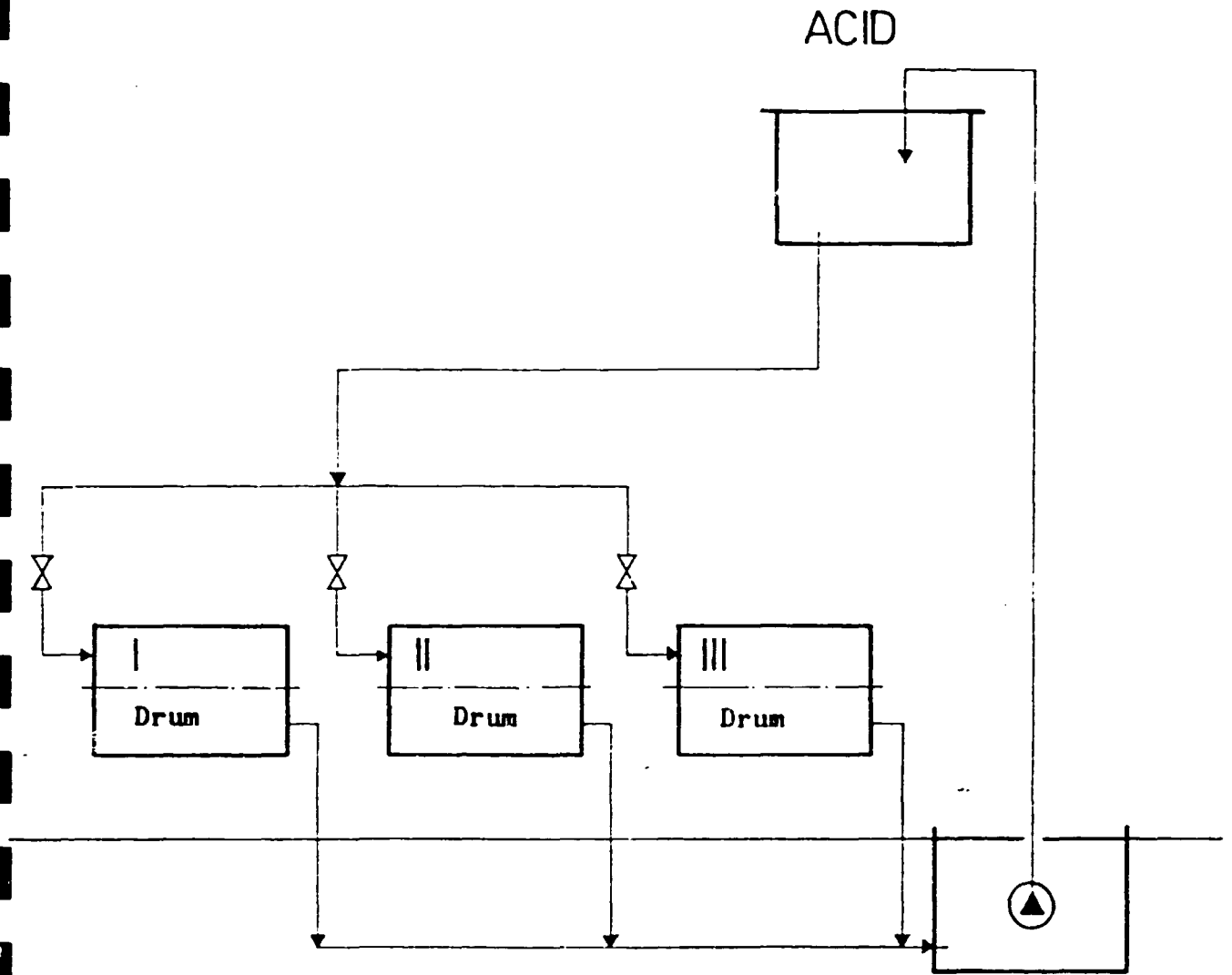
- and with unspecified quantity of dicarboxylic acids

Basification: 0,9 - 1,1% MgO - 2 x 60 + 120 min.

overnight in the bath, pH should be 4,0

Neutralization, dyeing and fat liquoring according to customer's wish.

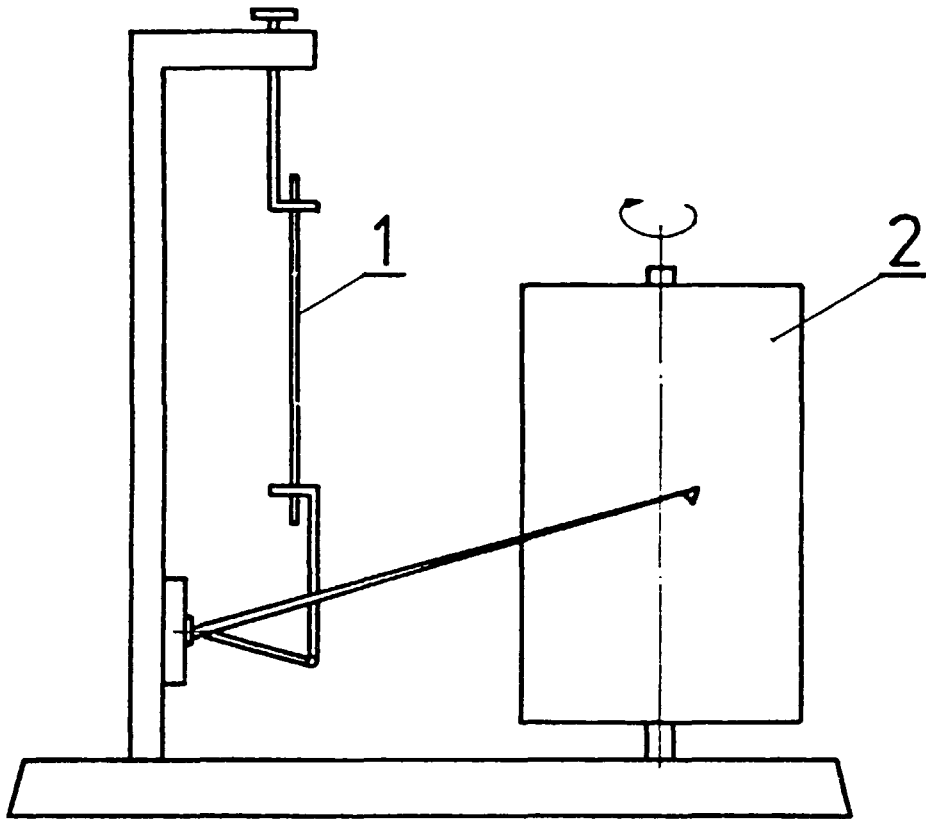
Leather staked on Schoedel machine for gloving leather and with use of Mercier Staking machine for garmet leather.



RECYCLING OF THE TANNING FLOATS

A N N E X C

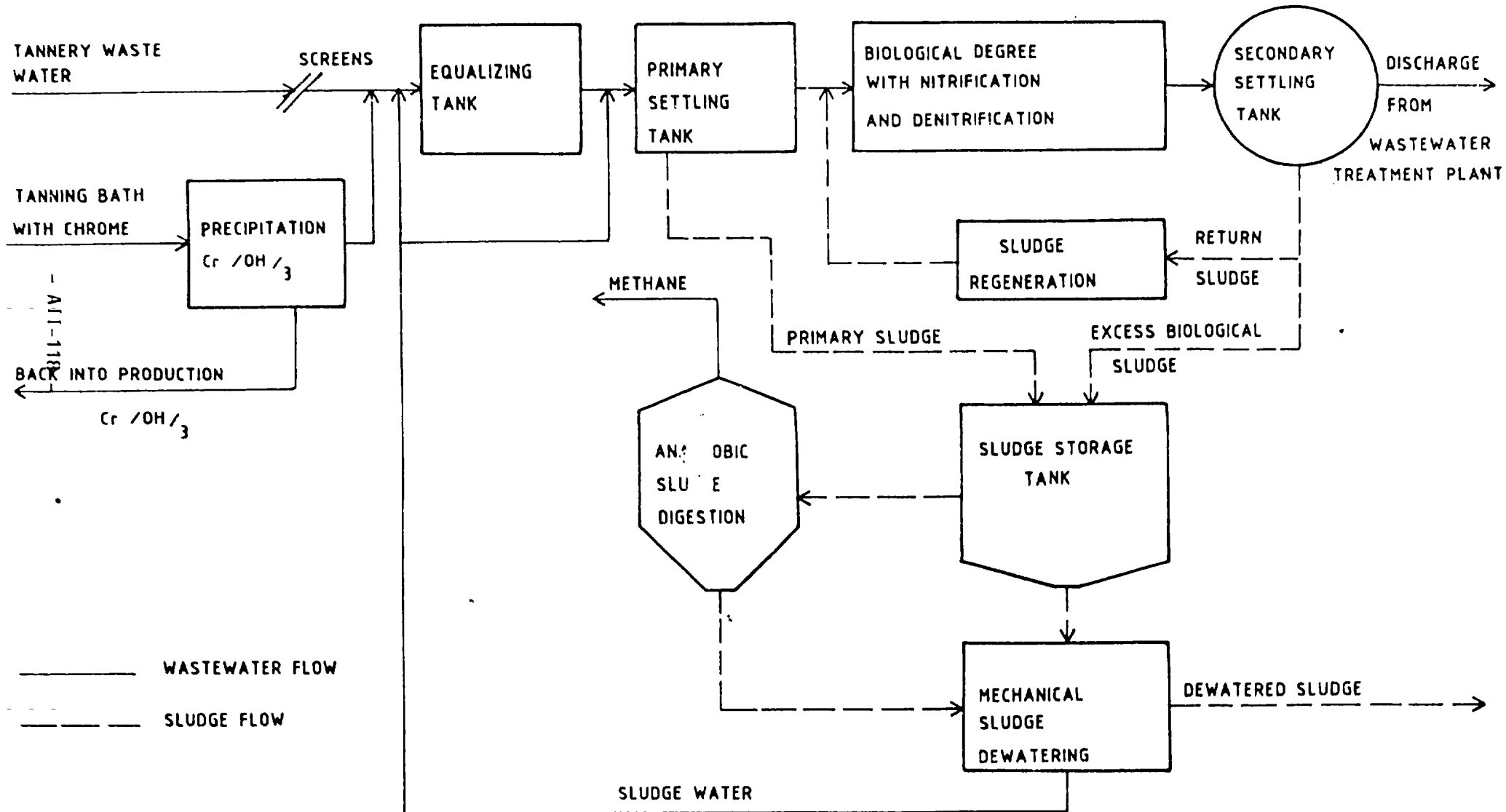
Measurement of the relative elongation



1. Sample of leather
2. Record

A N N E X D

SCHEMA OF TANNERY WASTEWATER TREATMENT PLANT



TEXTILE AND WEARING APPAREL

Prepared by

Jiří E d e r

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Textile and wearing apparel (J.Eder)

Introduction

Nigeria has already attained a good industrial base in the textile and wearing apparel industry which should be utilized to the maximum. It is a labour-intensive industry with relatively well established technology.

The Study on Textile and Wearing Apparel elaborated by the Strategic Consultative Group No.7 is well integrated and comprehensive, includes all major problems of the sub-system, particularly appropriate industrial policy measures. One specifically appreciates the critical approach to the existing insufficiencies and constraints in the textile sub-system, like lack of the technical competence of the part of technical staff, poor maintenance of equipment in some plants, low productivity of existing factors of production (labour, equipment), insufficient product quality control, high level of wastage, etc.. Having a long international experience we have so far not seen such an excellent sub-sectoral study worked out by national experts in Africa.

It seems that the presented report could be supplementary to the SCG's Study. It contains, among others, also international experience in the textile industry. Some new ideas and critical issues could be considered which have emerged as a result of our industrial visits in seven biggest textile mills in Nigeria (Nichemtex Ind. Ltd., President Industries [Nig.] Ltd., Afprint Nigeria Ltd., Nigerian Textiles ltd. and Gaskiya Textiles Ltd., Kano).

As far as the SCG's Study on Textile and Wearing Apparel is concerned, it could be recommended to deepen this study in the second phase of its improvement. For the time being the elaboration of the Integrated Production/Consumption Systems seems to be difficult due to the fact that the statistical data for the last three years are not yet available. Nevertheless, the

scheme of main linkages of textile sub-system is shown in Annex 1.

A. Basic characteristics of the sub-system

The Nigerian textile industry is the largest in West Africa in terms of production capacity and employment. It is a leading manufacturing sub-system of Nigeria accounting for about 14% of MVA in 1985. The contribution of the sub-system to total manufacturing employment was 18,7%, representing about 80,000 employees.

In 1989, the sub-system included 178 registered companies. More than 50 are large- and medium-scale textile enterprises. Most of the textile industry is controlled by private sector, largely as joint ventures of foreign and Nigerian investors (Hong Kong, India, the United Kingdom, the United States of America, Japan, Holland and Lichtenstein). There are only three textile mills with State capital shareholding.

The major product is African prints, accounting for 35 to 40% of cotton fabrics production, followed by shirting, drills, polyester/cotton fabrics, brocades, fancy and java prints and best sheets. Six plants have the capacity to make wax-type fabrics.

The textile sub-system has very high degree of regional concentration. Nearly 50% of the country's capacity is installed in Lagos, followed by Kaduna State with 24%, Sokoto and Kano States with about 7 and 5% respectively.

About twenty enterprises or groups of associated companies are fully or partially integrated, comprising spinning, weaving and finishing facilities. Only five plants cannot fully supply the needs of their downstream weaving units and only three mills sell yarn outside their group.

Nigeria produces only a fraction of the fibre and virtually none of the dyestuffs and chemicals required by its textile industries, except for some starch made from cassava. Various textile companies have gone into seed-cotton production in order to increase their low material resource base. The bulk of synthetic fibres are imported except of polyester fibre produced in several chemical plants in the country on the basis of imported granulates.

The demand for textile goods in Nigeria with 120 million of inhabitants is enormous. The textile sub-system has been identified as having great potentials for growth through import substitution and export promotion.

B. Identification of major problems and constraints

At the first glance, the big Nigerian textile industry with almost 100.000 employees, seems to be running well. However, if an attempt is made to analyse its performance in some detail, several serious problems emerge.

Low productivity level, product quality and competitiveness limit seriously export possibilities of the textile sub-system in Nigeria.

Labour productivity in spinning and weaving operations is not sensibly higher than in other African countries and lags behind productivity levels in Asian developing countries such as Hong Kong, Korea, Thailand and others.

Labour productivity in spinning in 1980's
(kg of yarn per man/hour)

Ghana	2,5	Brazil	8,2
Nigeria	3,1	Hong Kong	10,4
Turkey	5,6	USA	16,7

The disparity in the productivity level in comparison with other countries consists mainly in

- technical levels of various machines and equipment in some plants;
- mastery of technology, technical and managerial skills.

In the close co-operation with the Chief Executives of visited biggest mills in Nigeria the following major problems were identified in the textile sub-system:

(a) Increase in technical level of equipment:

Over 60% of the textile sub-system in Nigeria uses conventional technology. It originates from England (about 40%), Belgium (20%), Italy, Germany and Switzerland. This technology is similar to the technology used overseas. Some equipment and machinery are obsolete and have to be replaced.

All visited mills have their expansion programmes, in which acquisition of the computerized technology is often included. The textile industry seems to be gradually changing from a labour-intensive to a capital-intensive industry, but with the aim to maintain, as a minimum, employment at the present level through expansion of production.

United States experts had calculated that in the year 1900 a textile plant made an investment of about USD 1.300 per working post. The spinning mill built in 1964 required an investment in machinery, auxiliary equipment and buildings of USD 18.000 per working post. Nowadays for ultra-modern automated mill, the expenditures may be as much as USD 40.000 to USD 50.000 per working post.

Under the present international circumstances the Nigerian textile sub-system should not rely on foreign investment only. The regeneration of the sub-system should, to a large extent depend on the rehabilitation and modernization of viable existing textile companies. The Nigerian Industrial Development Bank has major participation in further

development of textile industry and grants substantial loans to the textile mills every year.

(b) Mastery of technology and management skills:

The management styles and technical skills vary from plant to plant. The style is mostly determined by foreign partners (Chinese, Indians). However, there are some factories characterized by unsatisfactorily qualified labour, technical and managerial personnel.

Among the visited mills, the high standard of management appears to be in Nichemtex Industries Limited, President Industries Limited and United Textile Mills Limited.

It seems that some mismanagement was in the past years Nigerian Textile Mills Limited and Kaduna Textile limited. It is proposed that both plants request for UNIDO technical assistance.

Afprint Nigeria Limited and Gaskiya Textiles Limited suffer also from some deficiencies. One of the most important principles of factory management is to maintain cleanliness and order in factory halls of all spinning mills. However, this requirement is not frequently fully respected, with adverse consequences on productivity and quality of products. Unfortunately, Afprint Limited is poor in housekeeping with cones lying on the floor and lint cotton flying in all directions. The mill has all pre-requisites for better running.

Gaskiya Textiles Limited has the best equipped weaving mill with sophisticated Sulzer Looms in Nigeria. Despite this modern equipment, African prints produced by the plant in Kano are considered to be of inferior quality. Through improvement in management this mill could become an excellent one.

There is permanent need to train workers and technical staff to acquire the skills necessary to operate new sophisticated computerized technology. One of the latest examples in Nigeria is the relatively low level of utilization of 70 rotor spinners Autocoro equipped with Piecer carrier (10 machines in AFLON, 14 in Atlantic Textiles, 16 in Spintex, 5 in Nichemtex). It seems that only Nichemtex Industries Limited use this sophisticated equipment at 95 to 97% of efficiency having one specially trained technician. In other mills where the efficiency seems to be lower, the increased effort of training of appropriate personnel is to be provided. In European countries the usual rate of utilization of this equipment is at 98 to 99%.

After having visited Training Centres of some textile mills one could have impression that some of them do not work efficiently, the training being too theoretical and acquired practical skills relatively low.

(c) Scarcity of foreign exchange

The low exchange rate of Naira after devaluation has raised the cost of imported manufacturing inputs.

The limited availability of foreign exchange resulting in the consequent shortage of imported inputs (raw materials, dyestuffs, chemicals and spare parts) is one of the main causes of the low capacity utilization in the textile sub-system.

The most serious is the shortage of spare parts. In some textile mills, the incidence of the so-called "cannibalism" is a current practice. Some machines, still able to operate, are used as the only source of different spare parts of the last resort instead.

The Chief Executives suggest that this problem is generally attributed to underfunding of the foreign exchange market. In this difficult situation some foreign exchange should be

additionally released to cover the necessary imports of these parts.

(d) Inputs of raw materials-cotton and man-made fibres

The cotton supply is not sufficient in quantity, covering only 45% of the spinning mills consumption.

It will take a long time to increase considerably the production of local cotton. The companies such as Nigerian Cotton Company and AFCOT have been established to take over the functions of the non-efficient Nigerian Cotton Board, liquidated several years ago. There is a lack of permanent cotton markets and adequate facilities for the storage of cotton.

The quality of Nigerian cotton is suitable for processing of English count 20's - 30's cotton used for African prints.

The results of tests carried out on the samples of cotton brought to Federal Institute of Industrial Research, Oshodi, on the 13th December 1990, are the following:

COTTON	GOMBE	BIU	LAMURDE	OG COTTON
Effective length (cm)	2,70	2,35	2,90	3,15
Short fibres (%)	15,57	21,58	14,18	25,70

At it is seen from the table above, the results are positive

The problem is that most of ginneries are old. For this reason the standard of ginning is relatively poor. Complete seeds are often found in the lint cotton.

There are some proposals on Government intervention in the seed-cotton production for ensuring the following operations:

- seed multiplication and improvement;

- discontamination of seeds;
- grading of seed-cotton and lint-cotton in ginneries.

By this way the Government could save a lot of foreign exchange currently spent on cotton imports.

The Cotton Development Fund established as a semi-autonomous organization in Venezuela could serve as an example. It includes cotton growers, ginners, textile industrialists and government authorities concerned with the coordination of agricultural and industrial development. The Fund assists growers in their cultivation plans and in measures taken against insect damage. It recommends appropriate fertilizers, checks ginning practices and has established cotton grading.

At all rate the majority of spinning mills in Nigeria do not consider cotton supply as a serious problem. In spite of prohibition of cotton import the quantity of cotton is imported from all neighbouring countries like Cameroon, Tchad, Benin and others.

The final objective is the real ban on cotton imports. It could be done in a time when high demand will push local farmers and companies in increasing of local production. Government's intervention in this field should be reconsidered because the market economy seems to be unable to solve this problem.

Most of man-made fibres and chemical inputs required in the textile industry still have to be imported due to the non-completion of the Nigerian petrochemical complex.

Nevertheless, there is several producers of polyester fibre and filament in Nigeria such as Integrated Fibre, Kano (filament), Horizon Fibres, Port Hartcourt (polyester fibre), ALKEM, Lagos, United Spinners and Nichemtex, Ikorodo. Polypropylen production with fluctuated quality has been introduced by NNPS in Kaduna.

(e) Improving textile mills quality control system:

Some mills have to complete the equipment of their laboratories and to improve the quality control system which is one of the basic conditions for increasing their products quality. Afprint Limited has to complete some necessary equipment in its fibre laboratory for testing the cotton properties.

(f) Inadequate electricity and water supply:

Many plants in Nigeria cannot rely on public power supply and water supply. Every textile mill has its own diesel generating set fully covering its electricity consumption. Some plants have their own source of water supply.

United Textile Mills Ltd., Kaduna, takes water from the river and makes its own water treatment and cleaning. Gaskiya Textiles Ltd. in Kano, takes water from four holes in the factory.

(g) Accelerated development of the small-scale textile enterprises and cottage industry:

The traditional methods of fabric production were introduced in various parts of Nigeria in the 15th century by the different ethnic groups.

Nowadays, the traditional Nigerian textile industry includes three main sections:

- production of handspun cotton yarns;
- weaving on the horizontal narrow band and vertical broad looms;
- dyeing and finishing of locally woven and imported fabrics, using locally sourced dyestuffs.

Small-scale enterprises represent a vast majority (about two-thirds) of 180 registered companies in the textile sub-system, including an unknown number of artisan or family type of production units. More than 700 small-scale knitting

plants are estimated to work in Nigeria. The small-scale and traditional industry in the textile sub-system plays, therefore, an important role.

The development of small-scale and traditional textile enterprises as a generator of employment should be encouraged by various support programmes, including:

- upgrading traditional technology, and improving product quality;
- marketing services;
- manpower training (even for workers at a low level of technology);
- special training programmes for the managers.

Unfortunately, out of 26 Universities and 27 Polytechnics and Federal Universities of Technology in Nigeria only two Universities offer programmes in textile technology. The Federal Institute of Industrial Research is also involved in upgrading traditional textile technology. This Institute has for example modified the narrow band loom used in Yoruba traditional fabrics production.

The establishment of some Development and Training Units in the main areas of textile industry is essential for solving the day to day technical problems of small-scale and traditional textile enterprises. The main task is to suggest appropriate technologies and machinery corresponding with the country's level of economic development. Setting up of Design centres should also be considered.

C. Strategic directions

(a) Technology:

Over 60% of the textile sub-system in Nigeria uses conventional technology. The growing competition among textile mills leads to gradual modernization of their

machinery. The textile industry is estimated to operate some 617,000 spindles including 4,588 open-end rotor spinners and the above mentioned 70 Autocoro rotor spinners. There are about 17,770 looms and 2,500 shuttle-less looms including 1,300 Sulzer looms with micro-computer control system. The textile sub-system dispose with some 80 printing machines, 282 embroidery machines and around 600 knitting machines.

In the field of choice of technology, the selected equipment should be appropriate not only to the market requirements, but also to the levels of technical and managerial capabilities and the quality of labour force available in the country.

In spinning mills, the introduction of open-end rotor spinners should be encouraged. This technology is suitable for English count 20's - 30's cotton yarn used for African prints. The share of this modern equipment in overall capacity of spinning have to be increased. The use of ring frames should continue for processing long and medium staple fibres in the production of finer cotton yarns.

In weaving mills, the equipment is more modern than in spinning (including air jet weaving, machines, water jet and rapier looms). The weaving mills continue gradually with the installation of modern Sulzer looms equipped with micro-computers. This new equipment required high level of management, especially the efficient forms of organizational planning. This trend of introducing high technology in weaving should be supported mainly because it contributes to the strengthening of the competitiveness of Nigerian textiles in foreign markets.

However, the medium level technology is more appropriate for the country for the following reasons:

- it provides more employment opportunities;
- it is easy to maintain;

- some spare parts could be produced locally.

As an example of suitable technology for Nigeria, the rotor spinning machine BD200 produced in Czechoslovakia characterized by high efficiency and reliability could be considered. This machine is less costly (about 150,000 US Dollars) than highly sophisticated Autocoro rotor spinner (about 1 million US Dollars) and more labour-intensive.

Similarly, the conventional shuttle looms will predominate in foreseeable future for two reasons:

- they represent medium level technology maintaining employment;
- some products can be produced only on this type of looms, such as favorite African Prints.

Special attention should be paid to upgrading traditional textile technology.

(b) Marketing:

(i) Local market:

Nigeria has some undeniable advantages over other developing countries:

- the enormous size of internal market of about 120 million inhabitants and considerable scope for expansion of textile production supported by import restrictions of fabrics;
- the privilege to export textiles to a number of European Countries not limited by any quotas.

For identification of fabric's demand in the country it could be used generally spread estimate, which is in accordance with the United Nations projection, that every Nigerian needs about 10 metres of cloth a year.

(ii) Scenarios of Market Demand/Supply Balance of Fabrics in Nigeria up to 2,000.

Two different scenarios of further development of Demand/Supply Balance of Fabrics were elaborated. The first one by the Strategic Consultative Group of textile Sub-system and the second one by member of the group of international experts charged by assistance to the project "Strategic Management of the Industrial Sector".

- Scenario No.1 (of Strategic Consultative Group)

Projected demand for fabrics is based on 100 million inhabitants only with growing rate of 2 per cent per annum. Under normal conditions, every Nigerian needs about 10 metres of cloth a year.

The actual installed capacity estimated by SCG is 800 million meters with the actual rate of utilization of 50%. In the next years, the modest increasing of capacity utilization at the rate of 4% per annum is envisaged due to the continued shortages of foreign exchange and limitation of raw material supply.

It is assumed that about 20% of Nigerian market is now being supplied through importation and smuggling. The SCG have not taken into consideration the prospects of fabrics exports.

Although one may suggest an alternative and more accurate methods of projections, the prospects suggested in the Strategic Consultative Group's study are, by and large, acceptable:

Scenario No.1

Market demand/supply balance of fabrics in Nigeria in the period
1991 - 2000
(in million metres)

	1991	1992	1993	1994	1995	2000
Local demand	1.000	1.020	1.040	1.060	1.080	1.190
Supply by Nigerian						
Industry	400	416	433	450	468	571
Import/Smuggle	200	204	208	212	216	238
Supply Gap	400	400	399	398	396	381

The difference between the local demand, local supply and smuggling causes the supply gap, which could be easily overcome by increasing local production.

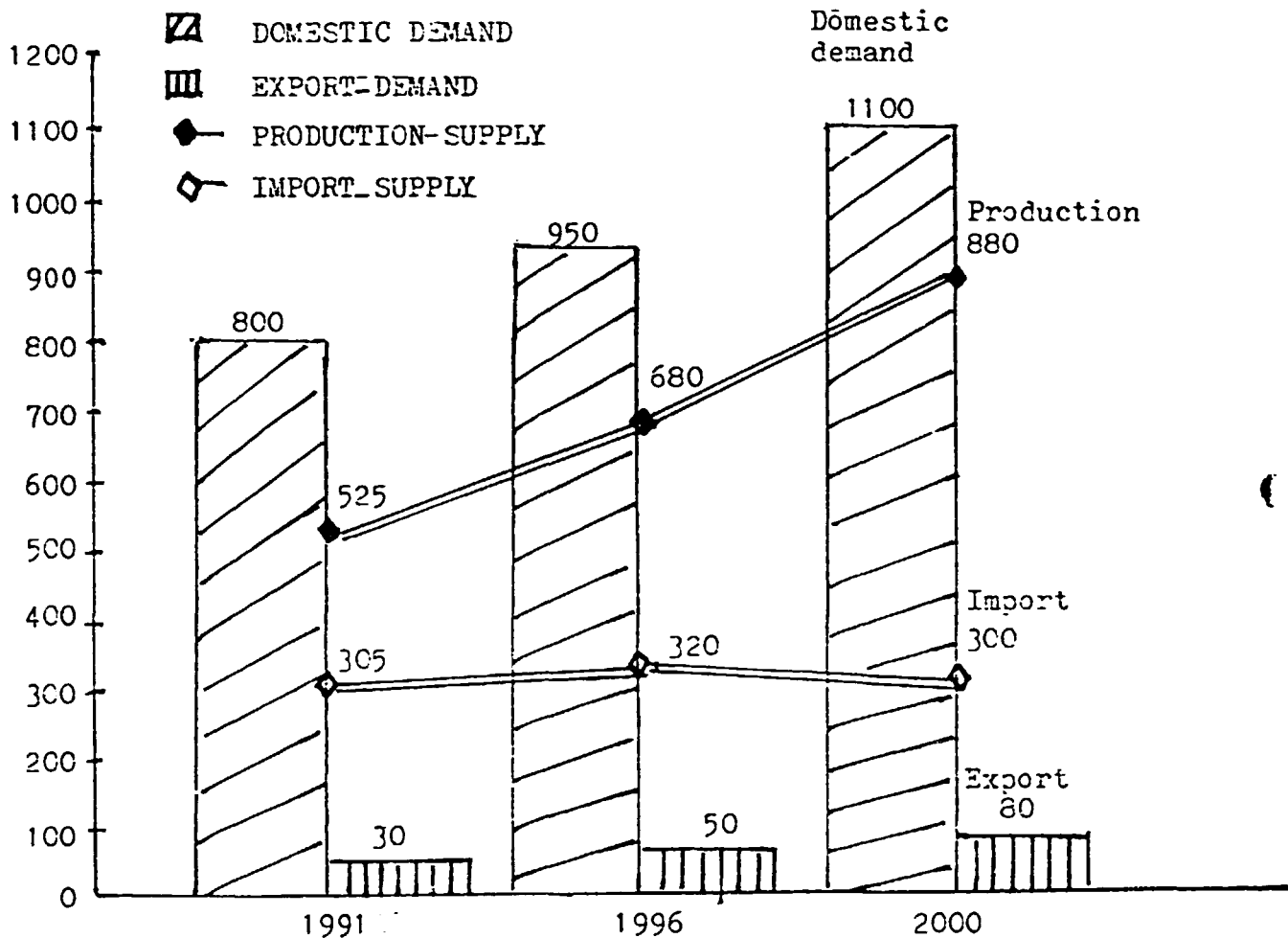
Scenario No.2 (of international consultant)

Based on other sources one may estimate the actual installed capacity of 650 to 700 million of meters and the actual rate of utilization on 75 - 80%.

The actual consumption of fabrics in 1991 by 120 million people including children is estimated 800 million of metres, what means about 6,7 metres per capita. This consumption is projected at about 8 metres per capita in year 2000 for 140 million of inhabitants.

Scenario No.2

Projected growth of textiles/apparel industry in Nigeria
(fabrics in million of meters)



Demand/Supply Balance of fabrics is projected as follows:

Domestic demand	800	950	1100
Export demand	30	50	80
Total demand	830	1000	1180
Production-Supply	525	680	880
Import/Smuggle	305	320	300
Total supply	830	1000	1180

The export would grow to about 50 million of meters by 1996 and 80 million of meters by 2000. The production of fabrics is

expected to grow at the rate of 6 per cent annum up to 2000. It is assumed that there will be some stagnation of importation and smuggling of fabrics at about 300 million of meters a year.

The Nigerian textile market for the years to come is expected to grow in both scenarios. The second scenario supposes lower production capacity in 1991 but its higher utilization, higher imports and smuggling and realistic actual consumption of 6.7 meters of fabrics per capita taking into consideration a weak buying capacity of some social sections of the population. The annual consumption of 10 meters of fabrics per capita remain the objective depending on the general economic situation in the country.

(iii) **Export potential**

Within the Nigerian Strategy for export expansion in the non-oil sector, among others, textiles have been included.

Recent economic policy measures, promoting exports coupled with actual devaluation of Naira, have created a favourable climate for exporting textiles, particularly to ECOWAS countries. While the domestic market is to remain a major customer, the Nigerian textile and garment sub-system can strengthen its position on foreign markets.

The present orientation toward low-priced basic textile goods should be substituted gradually for higher value added goods characterized also by a wider product range. At the same time, their relatively passive marketing attitude will have to be replaced by a more active involvement in foreign markets which will improve overall efficiency of the whole sub-system. It will be necessary to study the potential for exports, especially to ECOWAS countries, Western Europe and the United States.

Some Hong Kong entrepreneurs have established export-oriented textile mills in Nigeria with a view to escaping the strict quota imposed by the Multi-Fibre Agreement on

their country. They are interested in supplementing their country's quotas with quota-free exports from Nigeria.

USA, Italy, Switzerland, Korea and Taiwan import grey cloths and grey yarn from Nigeria. African prints are exported to some ECOWAS neighbouring countries. A possibility exists to export cotton yarn and African prints to other countries in the region, since the Western African Countries are net importers of textile products.

In August 1990, the Nigerian textile industrialists have signed agreement with the USA on the basis of which 48 million of metres of various textile items can be exported from Nigeria (such as duck fabrics, special weave fabrics, cotton sheeting, cotton point cloth, cotton popelin and cotton twil).

It is necessary to mention that in some other countries new possibilities for Nigerian export exist: United Kingdom and Belgium (grey cloth and yarn), Germany (fabrics for ladies dresses and man clothing) and some other countries.

Unfortunately, these opportunities could hardly be exploited because of expensive import of raw materials and other inputs, insufficient quality and high cost of textiles produced in some cases on obsolete equipment.

The medium-term objective in the textile sub-system should be to ensure that an increasing number of firms becomes more effective and internationally competitive.

(c) National textile strategy:

Some of the key development strategies could include:

1. Designation of the textile sub-system as an industry which should grow intensively through modernization and rationalization rather than through building extra production facilities;

2. Production capacity should be utilized to the maximum for gradual covering of the local demand for textile goods;
3. Active promotion of new production capacities for wearing apparel, focussing on the entire product range of low, medium and high value added items. Design is a critical factor, and the concept of a Design Center could be seriously considered to help to make the design resources available for many small- and medium-sized companies;
4. Textile sub-system should take maximum advantage of its export potential by expanding production facilities if necessary, particularly for achieving of high quality and lower costs of export production; to construct a viable export strategy in collaboration with foreign investors with a view to harmonizing the strategy with the regional textile investment and export strategy negotiated within the framework of ECOWAS;
5. To ensure supply availability through schemes aimed at increasing domestic cotton production;
6. To reduce industrial concentration within the textile and apparel sub-sectors through encouraging the growth of subcontracting links between small and large firms (the dominance of the major firms represents the single most important barrier to strengthening of intra-sector linkages and the growth of efficiency) and local integration with cotton growing schemes;
7. To develop a national training programmes for enhancing labour productivity within the textile sub-sector;
8. To encourage the development of domestic textile manufacturing and to develop a technology acquisition policy in this field in accordance with Nigeria's needs and technological and managerial capacities;

9. General system of development measures should provide special incentives, which include measures for:

- inducing companies to export more actively,
- helping the industries requiring modernization and rationalization,
- adapting and developing new technology,
- helping small-scale companies.

D. Suggestions

(a) To reconsider the possibilities of government intervention in the seed-cotton production for ensuring the following operations:

- seed improvement, multiplication and distribution;
- decontamination of seeds;
- check the grading of inputs (seed-cotton) and outputs (lint cotton) in the ginneries.

(b) The priority consideration placed on the textile sub-system requires a considerable increase in foreign exchange allocation to this industry.

(c) To achieve the objective of mastering modern technology, the training centres in textile mills are recommended to focus primarily on on-the-job skill training. As one of the most efficient forms of training a practical training on machinery is suggested. Special attention should be paid to the training of technicians in some plants. Some of them suffer from insufficient technical competence. UNIDO Technical Assistance should be requested for assistance in this field.

(d) In the framework of UNIDO project "Rehabilitation of the textile and leather industries in Nigeria" (envisaged to be executed in the period from July 1991 to July 1992), covering the entire range of:

- technical, managerial and technology issues at the plant level in 4 to 6 selected companies;
- financial, commercial and structural issues at the sub-sector, sector and macro-economic level.

It is proposed to include Nigerian Textile Mills Limited and Kaduna Textiles Limited among selected textile companies.

(e) To inform all textile companies in Nigeria of various Technical Assistance Programmes granted by UNIDO (Textile Unit) to other countries in the following spheres:

(i) Assistance in Establishing a Weaving Productivity System based on introduction of a computerized production/productivity control unit (hardware and software) in selected mills, which should be used:

- to pinpoint the real reasons for low performance of the plant;
- to decide necessary corrective measures.

(ii) Assistance in Establishing a Micro-computer Weaving Quality and Productivity Monitoring System (see Annex 2) including:

- product quality monitoring section (all data come directly from the company's Grey Cloth Inspection sheets);
- productivity monitoring system (data are usually taken directly from loom cards at the end of each shift).

(iii) Assistance in improving management of selected textile mills.

(f) It is recommended to the Government of Nigeria to ask UNIDO for technical assistance in the preparation of the pre-investment study for the marketing and construction of

large-scale wearing apparel factory equipped with modern technology.

(g) In the sphere of industrial policy measures

- (i) in order to improve efficiency of the whole sub-system, including support for export expansion, it is recommended to reconsider the present system of high protection of local textile industry also in connection with the intended rehabilitation and restructuring programmes for this industry, focusing on increasing of the competitiveness of textile sub-system,
- (ii) it is recommended to improve radically the investment climate for attracting new foreign investment for textile sub-system,
- (iii) to relax duties on the essential spare parts of ancillary equipment for the weaving sector as dust filtration, air conditioning, steam and heat generation stations, compressed air plants and specialized work-shops.

(h) Measures in the field of small-scale and cottage industry in the textile sub-system:

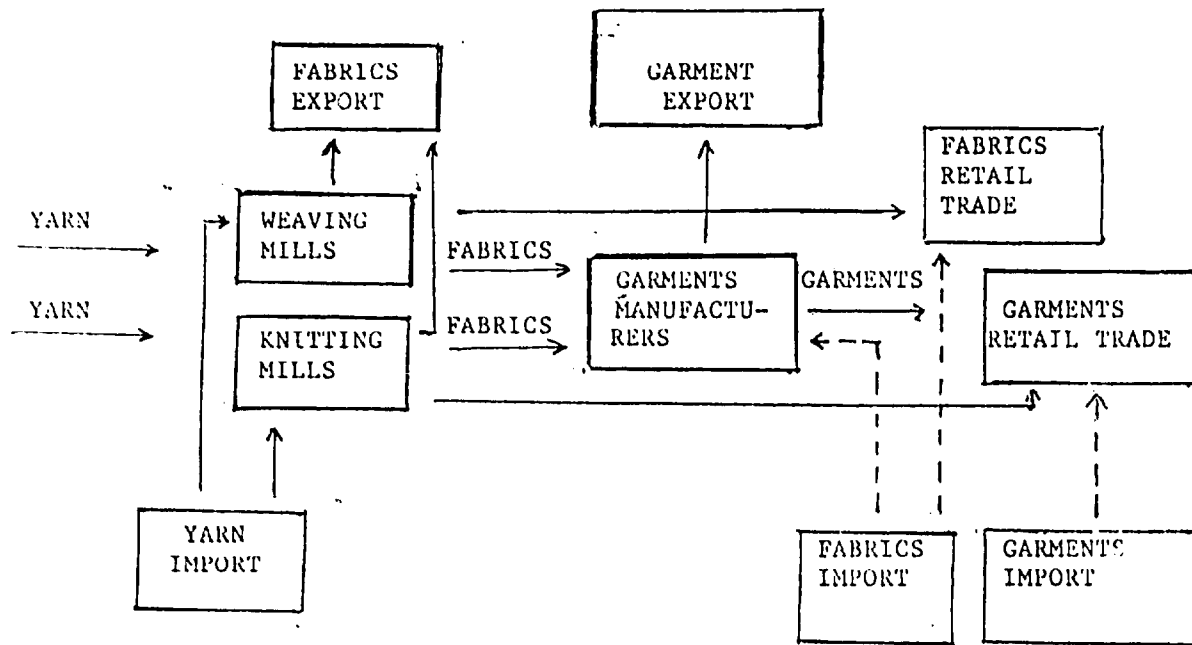
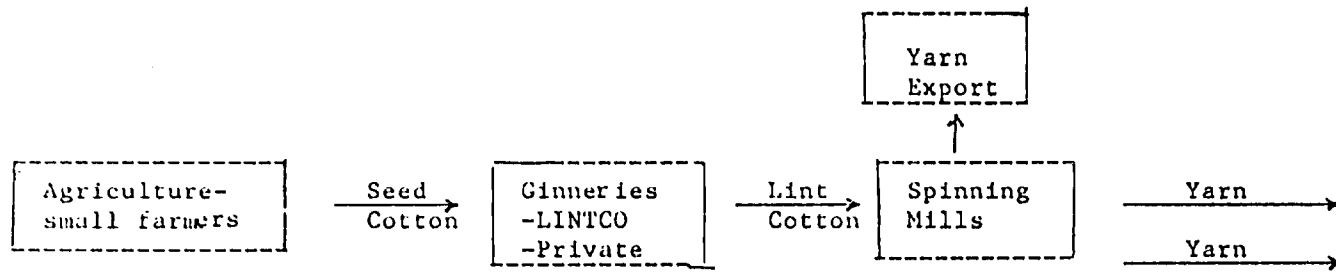
- (i) to prepare a restructuring programme for small-scale enterprises to achieve a higher degree of their product specialization and increasing efficiency on the basis of new investment,
- (ii) to introduce special incentives for small-scale enterprises such as tax-free investment allowances, accelerated depreciation rates, exemptions from profit tax, custom-free imports of equipment and raw material inputs,

(iii) to consider the establishment of the "Development and Training Units of the Small-scale and Traditional Textile Industry" having the following tasks:

- manufacturing of machinery for small-scale textile enterprises adapted to the country's conditions,
- upgrading the traditional cottage spinning and weaving technology in the rural areas,
- providing consultancy services,
- identifying the areas to be improved (quality of products, increased productivity and decreased cost of production),
- establishing market research to identify marketing problems and suggest solutions,
- training workers and technical staff to acquire the skills necessary to operate new improved technology,
- training low and middle level management of small-scale enterprises and co-operatives,

(iv) to organize co-operative groups of weavers to enable them to purchase yarn at lower prices.

MAIN LINKAGES OF COTTON TEXTILE INDUSTRY



Annex 2

Micro-Computer Weaving Quality and Productivity Monitoring System

The purpose of this system is to give the management of weaving companies a comprehensive range of reports which pinpoint the quality and productivity problems occurring in the weaving shed. There are of course many "on-loom" systems available from machine manufacturers which can also perform this task. They do however suffer the disadvantage of being very expensive to install and maintain. This system is designed to be inexpensive for the company as it has very low running costs, and requires only modest capital investment to acquire the necessary hardware and software. For the equivalent cost of equipping a single weaving machine with an "on-loom" monitoring device this system will control an entire weaving shed.

The system runs on any standard IBM or compatible machine which contains an 80286, 80386 SX or full 80386 processor. As machines of this type are to be found in most medium sized companies today, starting with the system often involves no additional hardware investment whatsoever. The system operates using the widely available dBase IV software, and companies with up to 500 looms will require only one competent individual to operate it.

The principle behind the system is that quality data are entered into the system from the company's grey cloth inspection sheets and the productivity data are entered from loom sheets which record each shift's pick counter reading and lost time. Before the system is installed at a company the programmes are adjusted in a systems analysis phase so that they exactly match the data collection methods used by the company.

Flexibility is an important feature of these programmes, therefore they can fit a wide range of conventional weaving quality and productivity manual data collection techniques. This means that any company installing the system gets a product which

matches their method of operation and they are not expected to make changes to accomodate the programmes.

The system has been designed to be easy to use, and is entirely menu driven. This means that the company does not require to provide specific programming skills in order to start operating the system. All that is required is usually a single operator with keyboard skills to enter the daily data and call the output reports as required by the company management.

Quality Monitoring Section

All data for this section of the system usually comes directly from the company's Grey Cloth Inspection sheets. From these the operator enters information via a customised screen detailing volume of cloth inspected, faults recorded, loom, weaver, inspector code etc. These data are stored by the system and are used to provide a wide range of output reports which analyse the weaving quality from a number of different standpoints, with the aim of showing management exactly what the main quality problems are and where these problems are arising. For instance the system will produce a report analysing the quality recorded by each cloth inspector, the type of faults they detect and the average number of faults per 100 Yards found. This shows whether or not they are all working to the same quality standard and if retraining of individuals is necessary.

Quality can also be looked at from the standpoint of Weavers, Looms, Mechanics Group, Article and Shift to find weaknesses and problem areas. The system can show for each of these grouping the frequency and distribution of faults produced over any time period required. This will show clearly for example looms with a recurring fault, bad weavers, badly trained mechanics and articles which have specific problems, etc. The system will show clearly where management should direct their efforts in order to improve quality and as the system records the

overall quality of the factory it can also be used to gauge the effectiveness of any actions taken.

Productivity Monitoring System

Data for this section of the system are usually taken directly from loom cards which record the pick reading at the end of each shift and any major items of downtime. These are then entered directly into the system via a customised entry screen, and form the basis of the files which are used to create the productivity output reports.

The system works by comparing the actual picks inserted each shift with the theoretical maximum picks possible to arrive at the gross efficiency.

Using this principle it is possible to obtain efficiency reports by:

- (a) Weaver
- (b) Loom
- (c) Loom Group
- (d) Mechanic
- (e) Mechanical Group
- (f) Shift
- (g) Article

When downtime is also recorded the system will produce for each grouping reports showing the reasons for lost time.

These reports will show for any of these groupings areas of low productivity as compared to the factory average and gives management the opportunity to take action to address the problems identified. The system can also predict exactly when a warp is due to be completed on any given loom, this gives management better control of production planning and can help to eliminate warp waiting time and unnecessary article changes.

The system has been designed with a flexible open architecture which allows for the easy addition of other modules which can be run from the data collected as part of the quality and productivity sections. For instance if a company wished to pay its weaver wages based on the volume and quality of cloth produced this can easily be incorporated. Likewise a module could also be included for yarn stock control.

In summary the system can be used to produce a wide range of management information reports in easy to understand formats which offer great potential for increasing the quality and productivity of the factory by quantifying and identifying the areas causing the problems. As the investment cost is extremely modest the system provides a very cost effective method of generating quality management information which should prove attractive for small and large weaving units alike.

N O N - M E T A L L I C P R O D U C T S

Prepared by

Evžen K r a m e š

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Non-Metallic Products (Evžen Krameš)

A. Basic characteristics of the sub-system

Non-metallic industries are generally understood industries exploiting silicate raw materials and producing mainly bricks, ceramics and glass. All these important building materials are characterized by two common features.

Firstly, the common base of silicate raw materials. These exist usually in sufficient quantities and more or less satisfactory qualities in all the world. Rich reserves of these materials in Nigeria make the non-metallic industries highly independent on import. However, some small quantities of very special raw materials have to be imported (e.g. fritts and colours for glazes etc.). The brick industry is fully self-sufficient in raw materials.

Secondly, the necessity to use energy intensive high temperature technological firing or melting processes for reaching technical properties of final products. In the glass production, the high temperature enables to reach a perfect homogeneity of the glass melt which is the basic condition for shaping glass products. In the production of bricks and ceramics, complicated chemical solid-state reactions, occurring during the high temperature firing process, give rise to new compounds and crystal phases which determine the physical and mechanical properties of the products.

Cement, as a building material of vital significance, exploiting as well as the indigenous base of non-metallic mineral raw materials and utilizing the energy intensive firing process for the clinker fabrication, should also be included into the group of the non-metallic industries. However, due to its special importance, a separate sub-system was created in the Nigerian industrial master plan project for this product.

B. Comments on the working document conducted by the Policy Analysis Department of the Federal Ministry of Industries

For the work of the Strategic Consultative Group of the non-metallic sub-system, a fairly detailed technical study was elaborated by a team of Nigerian specialists under conduction of the Policy Analysis Department of the Federal Ministry of Industries.

This study, worked out during the period November 1990 - April 1991, includes basic data concerning the structural characteristics of the sub-system's production branches, their market structure, technological dimensions, analysis of there main problems and constraints, evaluation of recent economic policies and perspective strategic directions. In accordance with the fact, that the sub-system integrates three different branches (bricks, ceramics and glass), the document is rather extensive, including 135 pages of the text and data, and 21 pages of preface and executive summary.

The data brought out in the study were collected either from the statistics (Federal Office of Statistics; Manufacturer's Association of Nigeria; National Association of Small Scale Industrialists) or by means of special questionnaires mailed to selected enterprises of each branch. Finally, some of the factories were personally visited by the members of the team that elaborated the study.

Generally, poor willingness was found in the enterprises to cooperate and answer the questionnaires received. Out of 27 enterprises in the brick production, 17 were questionaired and only 11 answered. In the glass industry this relation was 5 : 5 : 2 and in the ceramic branch even only 39 : 18 : 4. The study does not present therefore fully satisfactory survey-data on the ceramic factories in Nigeria and their production programmes. It is not clear, for instance, how many of the 39 plants existing in the country ceased their production and for what reasons. This

circumstance reduces considerably the possibility of evaluating the causes of the unpleasant situation in the ceramic industry and of suggesting meaningful measures to improve it.

The data referring to the demand for the sub-system's products on the Nigerian market, provided in the study, showed irregular fluctuations (sometimes extreme) through the period of 5 years 1985 - 1989. Also the volumes and values of imported goods reflected similar irregular trends. However, generally low utilization of installed capacities was relatively regular.

In the glass industry, where only 1 of the 5 existing factories is actually operating, the capacity utilization increased from 15% in 1987 (when the plant was set into production) to 49% in 1989. In the brick branch, this value similarly rose from nearly 12% in 1986 to more than 25% in 1989. However, the capacity utilization in the ceramic industry shows an alarming decreasing trend from nearly 56% in 1985 to only 23% in 1989.

As the main reason for the low capacity utilization lack of spare parts is indicated. These have to be imported, because foreign produced technological equipment prevails in these industries. High prices and the non-availability of spare parts (partly due to the obsolescence of the equipment and plants) reduces considerably the maintenance possibilities of the industries. Other negative factors can be seen in the temporary lack of raw materials, inconvenient infrastructural conditions, lack of skilled technical staff and in lower quality and competitiveness of the domestic products in comparison with the imported ones.

C. Observations resulting from visits to the production plants

(a) Bricks

Two brick producing plants were visited: at Ikorodu, Lagos-state (on June 3rd 1991) and at Enugu, Anambra-state, (km 12

Enugu - Port Harcourt express-way, on June 7th 1991), both owned by NIGERIAN BRICK & CLAY PRODUCTS LTD. (a subsidiary of Nigerian Mining Corporation).

Both plants are practically identical, comprising rather reliable and efficient German technological equipment for the raw material preparation (grinding, milling, homogenization) and brick shaping (by vacuum-extrusion), two Keller-type chamber-driers heated by waste heat from kilns, and two light fuel oil fired Hofmann-type circular kilns.

The plants have been very reasonably designed, with the intention to provide employment to a large number of persons. They do not rely on mechanization and automation. As they use good local raw materials, they reach satisfactory quality of their production.

However, neither factory fully utilizes the installed production capacity, which reportedly equals 7,000,000 normal size bricks p/a. Both were actually firing the goods only in one kiln: the Ikorodu plant (which produced 4,5 mil. NS bricks in 1990 = 64% capacity utilization) for the reason of disproportion between shaping & drying and firing capacity, and the Enugu plant due to the construction brake of one kiln in consequence of defective foundations. Moreover, this plant suffers from serious lack of one of its three basic clay raw materials which has not been mined in time during the dry weather period because of absence of mining equipment.

(b) Ceramics

The production plant of MODERN CERAMICS INDUSTRIES LTD. in Umuahia, Imo-state, was visited on June 6th 1991. This factory produces ceramic sanitary and table ware, using a vitreous china-type body which satisfies well all hygienical requirements. According to the contents of the coloured contaminating compounds in the used domestic materials, the appearance of the goods is not fully competitive with the imported articles. The production

capacity of the plant is limited due to the obsolete small-profile oil fired tunnel kiln.

Another department worked in the past in this factory, producing wall and floor tiles. Several years ago a reconstruction of this department was prepared and the installed defective tunnel kilns were demolished with the view to build up new modern kilns. Refractory materials and other parts for those and some equipment for the new plant were supplied but the reconstruction has not yet been implemented. It is advisable to verify the reconstruction idea by a new feasibility study and, if it is positive in economy, to finalize the installation of the plant and renew the tile production.

A visit to the ceramic plant of PORCELAINWARE INDUSTRIES LTD. in Abeokuta, Ogun-state, producing tiles and sanitary ceramics, was planned to take place on the 5th of June 1991. Because of the delayed arrival to the factory, the visit was confined only to a short interview. No comments on the eventual production problems can therefore be presented.

(c) Glass

The visit to the production plant of the OLUWA GLASS COMPANY LTD. in Igbokoda, Ondo-state, was realized on the 4th of June 1991. This factory produces drawn sheet glass, 2 - 6 mm thick. The installed production capacity 30.000 tons p/a is actually utilized by about 55%. The market requirements, although higher, cannot be fully satisfied due to the lack of spare parts and to the temporarily appearing high production losses by brake.

The quality of the produced glass, although a little wavy and greenish (due to the higher contents of iron oxides in the sand), is satisfactory for the domestic market. However, for sophisticated requirements (representative building etc.) certain amounts of special sheet glass will have to be imported.

Actually, only about 78% of raw materials for the glass industry are indigenous. The rest, from which the substantial

part is soda ash, has to be imported. If natron/trona (the deposits of which reportedly exist in Nigeria) is processed to soda ash, the raw material self-sufficiency in the glass industry would increase considerably. In this case the necessary input of raw materials would drop to 3%.

All field trips and visits to the production plants of the non-metallic industries took place in the course of one week, June 3rd - 7th 1991 under conduction of Mr. O. Okoye (PAD FMI), co-ordinator of the non-metallic sub-system study of the Industrial Master Plan Project.

D. Identification of major problems and constraints

While no serious objections can be raised against the conclusions and recommendations of the study and most of them should be supported, only some additional suggestions are proposed by the author of this report for consideration of the Strategic Consultative Group.

a) Better knowledge of the indigenous raw materials is needed as a basis for further development of the non-metallic industries, especially of the ceramic industry. There are references and evidence of deposits and finding-places of many important non-metallic minerals and raw materials, but only few of them have been adequately geologically explored and even fewer have been mined and utilized. High priority consideration should be given to the geological survey activities as a necessary condition for investment decision-making in the sphere of raw material refining, purification and construction of factories for consequent processing of final products.

In this way, the production of high duty refractory materials (on the base of sillimanite and kyanite) or of graphite crucibles for foundries of non-ferrous metals could be

introduced. This would certainly contribute to the achievement of the self sufficiency goal in this branch and would also reduce the Nigerian import requirements.

- b) The promotion of the refractory industries development should be considered as the basic step for reaching self- sufficiency of many important industrial branches, including the non-metallic sub-system itself. The Nigerian government should concentrate earnest attention on the development of this industry.
- c) Another serious problem is the lack of skilled technical staff employed in the non-metallic industries. This shortage is likely to be increasing due to the gradual introduction of advanced technologies. The solution of this problem should be sought in establishing a specialized chair of silicate chemistry and technology at one of the chemical-technological univeristies in the country and another specialized chair of silicate engineering at one of the technical universities. This would help to provide the industries concerned with adequately prepared technical personnel. It is assumed, that both these university chairs would educate engineers for the non-metallic as well as for the cement sub-system.
- d) In housing construction in Nigeria, concrete blocks are usually preferred to bricks, because of their larger size which enables the construction process to move on more rapidly. Larger sizes of the produced bricks could probably promote the popularity of using bricks for building construction, as they would save the consumption of mortar and speed up the brick laying.
- e) Some plants of the brick industry feel a serious shortage of specialized mining machinery of their own. Hiring of bulldozers and other mining and trasport equipment is not very economical and, more over, their absence can cause temporary

lack of raw materials and consequent brakes of production with considerable losses.

- f) The production process in some brick factories is not technologically well balanced. As a result some bottlenecks arise in one phase or another and low capacity utilization appears. If kiln is underutilized, the fuel economy deteriorates and exerts negative impact on production costs.
- g) In the brick production for housing construction relatively favourable possibilities could be found for the development of small- and medium-scale undertakings. Local raw materials of satisfactory quality are abundant. Moreover, the relatively simple production technology can create new employment opportunities for both skilled and unskilled workers.
- h) In the glass industry, attention should be primarily concentrated on upgrading the drawing technology (drawn sheet glass for building purposes) which suffers from considerable temporary production losses at present. The intention to introduce extremely complicated technologies (for instance the production of float glass) would be premature.

Owing to the investment intensity of the sheet glass production, there is only a limited room for small and medium-scale undertakings.

- i) Efficient industrial production of high quality building ceramics (walltiles, floortiles and sanitary ware) also requires considerable capital investment. Therefore, only theoretical chance exists for the development of small and medium-scale enterprises in this branch. However, in well designed factories (without excessive automation) new employment opportunities may be found for both skilled and unskilled manpower.

E. Main strategic directions and suggestion

As to the non-metallic sub-system, the main suggestions for the consideration of the Strategic Consultative Group are as follows:

- a) To concentrate due attention on undertaking and evaluating geological survey of important non-metallic minerals and raw materials as a necessary condition for investment decision-making in the sphere of raw material refining and purification, and construction of factories for consequent processing of final products.
- b) To work out a feasibility study with the objective to build up a factory for refractory products, based on existing Nigerian refractory raw materials. Nigerian dependence on import of refractories would be thus reduced.
- c) To establish at one of the Nigerian chemical-technological universities a specialized chair of silicate chemistry and technology and at one of the technical universities a chair of silicate engineering which would educate skilled technical staff for the non-metallic and cement industries.

C E M E N T

Prepared by

Evžen K r a m e š

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Cement (Evžen Krameš)

A. Basic characteristics of the sub-system

Cement occupies in the group of the Nigerian home produced building materials certainly the most important position. For this very reason a separate sub-system was created for it in the Industrial Master Plan Project, although there are more common features between the cement production and the other non-metallic industries. The cement industry, being one of the heavy and investments intensive industries, is nearly self-sufficient in local raw materials, as non-metallic industries mostly are. Like other non-metallic industries, the cement production requires application of highly energy intensive firing process which is indispensable for completing the decarbonization of the meal and the complicated solid-state reactions during the clinkering process.

In Nigeria, actually 8 cement factories are working, owned by 7 production companies. The basic raw materials (limestone, marl, shale and clay) are indigenous. However, some cement plants are still importing gypsum which has to be added in small quantities to the milling of fired cement clinker as a hardening regulator.

In the Nigerian cement industry, three different production technologies are used. The origin of these different technologies should be sought in different construction periods of the factories and different foreign companies that supplied technology and equipment. The older plants are mostly based on the wet production process, characterized by an extremely high energy consumption but relatively low dust escape, saving environment. The newer factories employ the dry process which is more energy saving. Some plants, after reconstruction from the originally installed wet process technology, are actually utilizing the semi-wet process. Besides economic aspects, the choice of technology for the cement production has to respect the strict requirements on high and constant quality of the final

product according to the valid quality standards. This implies the application of reliable automatic control systems in all parts of the technological process.

As a source of heating energy various types of fuels are used in different plants: pulverized coal, heavy and light fuel oil. For the future, the possibility of using gas is also considered by some companies, if this fuel type is economically advantageous.

B. Comments on the working document conducted by the Policy Analysis Department of the Federal Ministry of Industries

For the work of the cement sub-system's Strategic Consultative Group a rather detailed technical study was elaborated by a team of Nigerian specialists under conduction of the Policy Analysis Department of the Federal Ministry of Industries. This study, worked out during the period November 1990 - April 1991, includes basic data concerning the structural characteristics of the sub-system, its market structure, technological dimensions and the analysis of its main problems and constraints. Its final part consists of the evaluation of impact of recent economic policies and perspective strategic directions.

The study is rather extensive, including 15 pages of preface and executive summary, 86 pages of analytical text with many statistical and comparative tabular statements and 2 supplementing appendices, introducing the profiles of existing cement companies in Nigeria and the inventory of major items of machinery and equipment in cement factories.

The total installed production capacity of the Nigerian cement industry exceeds slightly 5 mil. metric tons p.a., but its utilization in the 1990 reached only 3,05 mil. tons, i.e. about 61%. Two cement producing companies are operating with satisfactory capacity utilization (the Ashaka plant even over 100% of its nominal capacity and two factories reach about 50%. However, the remaining three factories show really very poor

performance, utilizing their installed capacities at a rate fluctuating from 11,5 to 24%. The lack of spare parts is likely to be the main reason for the low capacity utilization. The establishment of a specialized spare parts manufacturing plant for the cement industry is suggested in order to reduce the actual extensive dependence on imports.

During the last decade, the demand for cement on the Nigerian market, oscillating from 6,6 to 7,7 mil. tons p.a., has never been fully satisfied. Due to fairly reduced cement imports a considerable supply gap, fluctuating from 2,5 to 3,7 tons p.a., is reported in the course of the 1984 - 1990 period. This created a special market situation, when prices of cement, influenced by distributors and sub-distributors, rose by 488 per cent between 1985 and 1989.

However, the demand forecast for the period 1990 - 2000, as indicated on the page 34 of the sub-system study, does not seem to be correct. Simple multiplication of real national cement supply in 1990 (4,08 mil. tons) by average annual growth rate of gross domestic product (supposedly 11,7% between 1986 - 1990) for obtaining estimates of the cement demand in the 1990s seems to be misleading. For instance, based on the 1990 real demand (7,7 mil. tons), the demand estimations for the first half of the 1990s lag seriously behind while in the second half of the decade appear to be rather exaggerated. Moreover, it is not clear, why the rate of GDP growth 11,7% annually was taken into consideration. It is known that the actual rate of growth in the second half of 1980s was below 5% (1987: 4,1; 1988: 4,0; 1989: 5,2; 1990: 5,2%).

The demand forecast should be revised prior to planning new investments and reconstructions in the cement industry. The future production capacity extension should therefore be based on a detailed analysis of the market demand and take also full account of the specific infrastructural conditions of the country.

In the paragraph 4.2 "Basic Material Inputs" some small inaccuracies should be corrected. This concerns especially the chemical nature of shale / clays which are to be better defined as hydrated aluminium silicates and alkaline and/or alkaline earths aluminosilicates. Also the firing (see input: fuel) could be more accurately described as "pyrolysis and clinkering" process.

C. Observations resulting from visits to production plants

The production plant of the WEST AFRICAN PORTLAND CEMENT COMPANY in Shagamu, Ogun-state, was visited on June 3rd 1991. In this factory the wet production process is applied and the production capacity of two installed large light fuel oil fired rotary kilns reaches 900.000 tons p.a. According to the management's opinion, this installed output is likely to be obtained this year.

Lack of spare parts is considered to be the most serious constraint which could endanger the production continuity and capacity of this factory. The earlier intention to extend the plant capacity by about 50% through building up the third kiln had to be given up for economic reasons. Lack of finance, mainly caused by the gradual devaluation of the Nigerian currency, does not allow to realize this investment which would actually amount to more than 1,5 bil. Naira.

On the 7th of June 1991, the visit to the production plant of NIGERCEM (NIGERIAN CEMENT COMPANY LTD.) in Nkalagu, Anambra-state, took place. In this factory, using also the wet production process, 6 smaller rotary kilns are installed (95 m long, 300 tons/24 h. each) with the total nominal production capacity 720.000 tons p.a. According to the proximity of coal mines, pulverized coal is used as fuel in this factory.

Due to the absence of spare refractory material for kiln linings two of the six installed kilns do not actually operate. Moreover, the capacities of the four remaining kilns are not

fully utilized and the annual production of the plant reaches only 180.000 tons, what means 25% capacity utilization. Again, lack of spare parts is shown to be the main reason for the unsatisfactory capacity utilization. As spare parts also refractory materials for kiln linings are considered, whereby their rate in the total reaches about 8% of the spare part costs.

Both visits to the cement producing plants were realized with assistance of Mr. O. Okoye (PAD FMI), coordinator of the non-metallic sub-system study of the Industrial Master Plan Project.

D. Identification of major problems and constraints

No serious objections can be raised against the conclusions and recommendations of the study, actually, most of them should be supported. Therefore, only a few additional suggestions are proposed by the author of this report for consideration of the Strategic Consultative Group:

- a) Since the lack of spare parts is shown to be the main reason for the low capacity utilization of most cement producing plants, a top priority should be given to the establishment of a specialized spare parts manufacturing production unit. As suggested in the sub-system study, such a step, could enhance considerably capacity utilization of the Nigerian cement industry, improve the demand/supply balance and reduce the imports of cement. Some special spare parts shall be always imported. Some others, e.g. steel balls for mills, can easily be produced in Nigeria, as soon as the large-scale steel industry, presently under construction, is running. Also, the building up of Nigerian own production of refractory materials, as suggested for the non-metallic sub-system, could partly eliminate the dependence of the cement industry on imports of refractories.
- b) The introduction of other hydraulic compounds (as blast furnace slag) and their mixing with the clinker is sometimes used in countries with well developed ferrous metallurgy

industries to increase cement production while saving energy costs. The so-called "slag-portland" cement may contain up to 35% of slag addition, provided that the slag has been water-granulated and that its contents on calcium oxide does not understep 38%. However, the application of this type of cement production seems to be improbable at present because the country does not possess any appropriate blast furnace slag. In the future, it is nevertheless advisable to verify the quality of slags from the steel mill in Ajaocuta and, if found convenient, to utilize this material in the cement industry, and thus increase the cement production.

- c) Although deposits of gypsum are known in Nigeria, some cement plants still import this material. In order to change this situation and prevent unnecessary losses of foreign exchange, it is necessary to verify the reserves and quality of Nigerian gypsum and, if the answer is positive, it is imperative to start mining activities without any delay. On this basis, the objective of self-sufficiency in gypsum could be promptly achieved.
- d) Another problem relates to the lack of skilled technical staff employed in the cement industry. Similarly as in the non-metallic sub-system, the solution should be sought in establishing a specialized chair of silicate chemistry and technology at one of the Nigerian chemical-technological universities. Another specialized chair, chair of silicate engineering should be established at one of the technical universities. This would help to provide the cement industry with adequately educated technical personnel. It is assumed that both these university chairs would educate engineers for the cement as well as for the non-metallic sub-systems.

E. Main strategic directions and suggestions

As to the cement sub-system, the main suggestions for the consideration of the Strategic Consultative Group are as follows:

- a) To establish a specialized mechanical engineering plant for production of spare parts needed in the cement industry. Thus, the independence of the cement sub-system on imports of spare parts would gradually decrease and higher capacity utilization would be reached.
- b) To verify the reserves and quality of gypsum in Nigerian deposits and, if found satisfactory, to start industrial mining (including eventual processing) of this raw material, with the objective of reaching full import substitution.
- c) To establish at one of the Nigerian chemical-technological universities a specialized chair of silicate chemistry and technology and at one of the technical universities a chair of silicate engineering which would educate well qualified Nigerian technical staff for the cement and non-metallic industries.