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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

FEASIBILITY STUDY FOR A CENTRAL WORKSHOP FOR THE MANUFACTURE OF SPARE PARTS FOR THE SUDANESE TEXTILE INDUSTRY

(UNIDO CONTRACT No.79/23 - PROJECT No. SI/SUD/78/802)

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1. GENERALITIES

1.1. Scope of the study

Scope of the present study is :

a) to assess the feasibility and the profitability of a new central workshop for the manufacture of spare parts and accessories for the Sudanese textile industry

b) to make recommendations on the rationalization of maintenance equipment in the Sudanese textile industry.

1.2. Methodology

We shall follow this scheme in the present study :

- assessment of the present situation as far as spare parts, accessories and maintenance service requirements in the local textile industry are concerned
- evaluation of the future situation up to 1995
- proposals concerning the improvement of maintenance service
- proposals concerning increase of local spare parts manufacture and commencement of manufacture of accessories
- preliminary project for a new central mechanical workshop with annexed training centre for mechanical workers
- selection of the most suitable location for the new central workshop
- evaluation of investment and internal rate of return on the project.

1.3. Findings

A lot of data were collected both in Milan from the textile machinery manufacturers and in Sudan during a 5 week-stay made by our experts.

The main textile factories in Sudan were visited and meetings were held with the following:

1) Representative of Picanol Loom Manufacturers
2) General Manager of Kosti Weaving Factory
3) EDP Manager and Mechanical Chief Engineering of Sudan Textile Mill
4) Representative of Gardella Loom Manufacturers
5) River Transportation Corporation
6) Representative of Generalimpianti Main Contractors (1st meeting)
7) Cotton Textile Mill
8) Khartoum Central Foundry
9) Khartoum University Workshop
10) International Spinning and Weaving Company
11) Port Sudan Spinning Company
12) Representative of Generalimpianti Main Contractors (2nd meeting)
13) Blue Nile Plastic Company
14) Khartoum Polytecnic Workshop
15) Sudan Railway Corporation
16) Plastic Sacks Company
17) Vocational Training Centre
18) Red Sea Spinning Company
19) Shendi Weaving Factory
20) Mechanical Chief Engineer of Abu-Naama Kenaf Factory
21) Blue Nile Spinning and Weaving Company
22) Wad Madani Spinning and Weaving Company
23) Friendship Spinning and Weaving Factory
24) Earth Moving Corporation Workshop
25) Khartoum University Testing Laboratory
26) Managing Director of Sharaf Group
27) Building and Construction Corporation Workshop
28) Managing Director of Cotton Textile Mill
29) Spinning and Weaving Institute
30) Representatives of Private Textile Sector

2. PRESENT SITUATION OF THE PRODUCTION MACHINERY IN OPERATION AND BEING INSTALLED IN THE SUDANESE TEXTILE INDUSTRY

2.1 Description of the production machinery

2.1.1 Type of machinery in operation

At present there are 17 textile factories in Sudan, which process cotton, Kenaf and manufacture plastic sacks.
Some of themare Government owned (Spinning & Weaving Corporation under the authority of Ministry of Industry), and the rest belong to private groups as is shown by the following figures:

	private factories	Government owned factories	Totale factories
cotton factories	8	7	15
Kenaf "	-	1	1
plastic sack "	-	1	1
Total factories	8	9	17

The cotton sector is by far the most important sector in the Sudanese textile industry.
A great number of small cotton factories have been grouped together.

2.1.1 (cont.)

On going into further detail we have the following share-out of looms:

	n° of looms in private sector	n° of looms in Govt.owned sector	Total n° of looms
cotton factories	5,230	2,420	7,650
Kenaf "	-	60	60
plastic sack "	-	280	280
Total n° of looms	5,230	2,760	7,990

Looms for cotton account for about 96% at the total number of looms in operation. Looms operating in the private factories account for about 65% of the total number of looms in operation.

The corresponding figures concerning spindles are as follows:

	n° of spindles in private sector	n° of spindles in Govt.owned sector	Total n° of spindles
cotton factories	182,900	24,000	206,900
Kenaf "	-	1,200	1,200
plastic sack "	-	-	-
Total n° of spindles	182,900	25,200	208,100

2.1.1 (cont.)

Plastic sack manufacture does not require a spinning department. Spindles for cotton account for about 99% of the total operating spindles.
The spindles operating in the private sector account for about 88% of the total spindles in operation.

Table 1 shows the manufacturers of the most important production machines in the spinning preparation, spinning, weaving preparation, weaving and finishing departments of the operating factories.
Manufacturers are many and from many countries (11 countries)

A wide variety of machinery is utilized: this is a serious handicap as regards our problem of local manufacture of spare parts for the local textile industry (see chapter 7).

2.1.2 Type of machinery under installation

We consider a factory as under installation when at least a contract for supply of production machinery has been signed. Thus, 8 new textile factories and 2 expansion projects for existing factories will have been completed by the end of 1982, at the time when our new central workshop is to commence activity (see table 2)

At that time the situation will be as follows:

a) factories

	private factories	Govt.owned factories	Total factories
cotton factories	11	11	22
Kenaf factories	-	2	2
plastic sack "	-	1	1
Total factories	11	14	25

2.1.2 (cont.)

b) looms

	n° of looms in private sector	n° of looms in Govt.owned sector	Total n° of looms
cotton factories	6,570	2,900	9,470
Kenaf "	-	120	120
plastic sack "	-	280	280
Total n° of looms	6,750	3,300	9,870

Looms for cotton will account for about 96% of the total operating looms. Looms operating in the private factories will cover about 67% of the total operating looms.

c) spindles

	n° of spindles in private sector	n° of spindles in Govt.owned sector	Total n° of spindles
Cotton factories	340,900	213,000	553,900
Kenaf "	-	2,400	2,400
plastic sack "	-	-	-
Total n° of spindles	340,900	215,400	556,300

Spindles for cotton will account for about 99% of the total operating spindles. About 61% of the total operating spindles can be considered as covered by those spindles operating in the private sector.

2.1.3 Location of machinery in operation and under installation

The factories in operation and under installation are shown in Table 3.

It can be easily verified, by means of the above table, that most of the factories in operation and under installation are located in the Khartoum area.

In fact we can say that 13 out of a total of 17 operating factories are located within a range of 300-400 Km. from Khartoum.

Out of the remaining four one is in Port Sudan (1,000 Km. from Khartoum) and the other three are very far from Khartoum (about 2,000 - 2,500 Km.).

The situation is similar for the factories under installation too: 18 out of a total of 25 factories in operation and under installation are located in the above area around Khartoum. Three of them are in Port Sudan, the remaining four are located very far from Khartoum. It is also to be noted that out of the 18 factories in the Khartoum area, 5 are located in the town, 8 along Blue Nile before Khartoum , 2 along the Nile before Khartoum, 2 along the Nile after Khartoum (plus 1 group of small factories distributed uniformly in the Khartoum area).

All these observations will be taken into consideration again in chapter 7.5.3. when the site selection of the workshop is considered.

2.1.4. Detail of spinning machinery both operting and under installation

We have elaborated in a different way the data contained in the preceding tables 1 and 2 (see table 4) to show who are the most important manufacturers of spinning machinery in Sudan.
There are 14 manufacturers but 56% of the installed spindles have been constructed by three of them (SACM, TEXTIMA, PLATT).

2.1.5. Detail of weaving machinery both operating and under installation

We have elaborated the data concerning weaving machinery installed in Sudan in the same way and for the same purpose. There are 10 major manufacturers plus a group of many small manufacturers (most of them are Japanese), 57% of the installed looms have been constructed by three of them (Northrop, Picanol, Toyoda).

2.1.6. Details on the most frequently utilized types of loom

Since looms need a comparatively high number of new spare parts we have concentrated out attention on them.
Therefore we have collected details concerning the models of the most important looms in Sudan i.e. Picanol and Northrop (see tables 6 and 7).

2.1.6. (cont.)

Of the Picanol looms 1,560 machines out of a total of 2,300 are of the same model (President Diplomat). This is a significant piece of data for our study.
Of the Northrop looms, we have to consider that 1,810 machines out of a total of 2,370 were installed in the years 1960-61 and we think they are soon to be substituted.
We do not know whether by looms of the same manufacturer or not.

2.2 Present condition and utilization of production machinery

2.2.1 Running period (years)

More than half of the production machinery in the Sudanese textile industry (52% of the installed spindles and 54% of the installed looms) is 3 years or less than 3 years old. Most of the production machinery is therefore quite new(see table 8).
The remaining installed spindles are shared out as follows: 11% are between 4 and 10 years old and 37% between 11 and 18. Similarly the remaining installed looms are shared out as follows: 8% are between 4 and 10 years old and 38% between 11 and 18.
Hence a large part of the installed machinery (37% of the spindles and 38% of the looms) may also be replaced quite soon.
We shall take this consideration into account when discussing the future development of the Sudanese textile industry (see Chapter 5).

2.2.2 Working Time (Hours/day)

In table 9 we have shown working time (hours/day) of most of the Sudanese textile factories at the time of our visits (April-May 1979)

We noticed:

a) since at present there is a shortage of yarn, due to the delayed implementation of the planned spinning mills, the Friendship Textile factory is not able to run more than 15 hours/day

b) since 1976 the Abu Naama Kenaf Factory has been running only 3.8 hours/day in all its departments (averaging between 7.5 hours/day for 6 months and at a complete stop for the remaining 6 months).
This is due to insufficient supply of raw material (Kenaf).
This situation needs to be resolved as soon as possible by the Government.

c) Four out of the six new weaving factories (El Dueim, Mongalla Nyala, Kadogli) at present are running only 7.5 hours/day.
It is to be hoped that soon they will be running for at least 15 hours/day.

2.2.3 Our evaluation of efficiency in some factories

We performed our evaluation of efficiency for the factories we were able to visit.

These evaluations of efficiency should be compared with the attainable efficiency in spinning (about 95%) and in weaving (about 80%).

2.2.3 (cont.)

Considering an average of the evaluated efficiency, we can say that in spinning, the efficiency is more than 30% below standard and in weaving about 40% below standard.
Efficiency, however, differs greatly from factory to factory. In fact we have seen only 2 really efficient factories, at international standard level. These two factories, belonging to 2 different private groups, are:

- Cotton Textile Mill, which is the most efficient factory we visited in Sudan, and Madani Spinning and Weaving factory.

We have evaluated spinning efficiency of 90% and a weaving efficiency of 80% in the Cotton Textile Mill.
In the Madani Spinning and Weaving Factory, where an open-end spinning system has recently been installed, we have evaluated 70% efficiency in spinning and 70% efficiency in weaving.
If we omit these two factories from the efficiency calculation the average spinning efficiency is no higher than 60% of the standard and the average weaving efficiency is around 40% of the standard.
In general, the situation is worse in weaving than in spinning
In our opinion this is due to greater difficulties as regards maintenance service in weaving than in spinning.
The importance of maintenance service in connection with efficiency would be confirmed by the fact that efficiency in the private sector is good when the factory is new(as is the case of the Cotton Textile Mill and of Madani Spinning and Weaving Factory)& it becomes lower as the plants get older (as is the case for the Sudan Textile Factory, for the Khartoum Spinning & Weaving Factory and for the Blue Nile Factory).

2.2.3. (cont.)

In the Government owned sector efficiency is low both in an old plant like that of the Plastic Sacks Co. (about 35% in weaving) as well as in a new factory like the Shendi Weaving Factory (weaving efficiency not more than 40%).

In our opinion this is due to the fact that in the Government owned sector, besides maintenance, all the other factors hampering efficiency (such as organization and personnel qualification problems etc..) are more serious than in the private sector.

We have discussed all the factors hampering efficiency in Chapter 3.

3. PROBLEMS AND CAUSES CONNECTED WITH THE PRESENT UTILIZATION OF MACHINERY

In this chapter we shall give a brief picture of what we think are the problems, the reasons, and the causes determining the low production efficiency in the Sudanese textile industry.
Our present study will concern only the first five points, which will be fully developed in the remaining chapters.

3.1 Problems

3.1.1 Shortage of spare parts

Everywhere in all the factories visited we noticed many machines that were idle due to shortage of spare parts.
Spare parts at present are mostly imported (see following para. 7.1.1)
Delivery terms are sometimes very long; for instance from some Countries (like China, Czechoslovakia, etc.) where there is a fully centralized planned economy, purchase and production procedures are long and complicated.
It normally takes about two years to get spare parts from China.
Moreover prices of spare parts are in general high in comparison with prices of new machines. Factories have difficulty from an economic point of view in buying all the spare parts they would need considering too the large consumption of spare parts we have found in Sudan in comparison with consumption in the developed Countries. High consumption of spare parts is not so peculiar to Sudan: we have come across this situation in many underdeveloped Countries. It is a direct consequence of low efficiency of the maintenance service and of the poor qualification of maintenance workers (see para. 3.1.3 and 3.1.4).
Finally there are financial constraints, because the Government wishes to limit export of foreign currency which is necessary to pay for spare parts.
We shall give proposals in Chapter 7.

3.1.2 Poor quality of the spare parts manufactured locally

Local production of spare parts has been developed to overcome the aforementioned difficulties (see paragraph 7.1.)
Local production is carried out both in the small workshops annexed to the single textile factories and in other mechanical workshops and foundries.
Unfortunately the quality of this local production is not too good; there are no proper raw materials, no good casting, no correct processing by machine tools.
We have even seen aluminium often utilized instead of cast iron; we have never seen heat treatment being carried out on the metals; machine tools are rarely in good condition (see Chapter 4.).
The lack of availability of the right raw materials is mainly due to financial limitations by the Government; the insufficient technical level of processing is mainly due to the poor qualification of maintenance workers and low efficiency of the maintenance service, specifically of the workshop annexed to the factories (see following paras. 3.1.3 and 3.1.4).

3.1.3 Low efficiency of maintenance service

We were not able to obtain statistics concerning the influence of the bad maintenance service on the production machine shops, but we were able to notice during our visits to the sheds that many machines were not running due to disorganization of maintenance service.
Machines frequently break down and repair work is mostly delayed and, moreover, not done properly.
This is due mostly to insufficient equipment in the local workshop where repair work is carried out (see chapter 4), and to low qualification of maintenance personnel.
This last point will be discussed in para. 3.1.4.
We have indicated remedies for improvement of maintenance service in Chapter 6.

3.1.4 Low qualification of maintenance personnel

Very many maintenance workers have insufficient qualifications. Many of them are even illiterate.
Vocational schools are scarce and train only a few people from the textile industry (see para. 7.5.1.1).
Moreover, practical personnel training by the contractors during installation of the single factories was often not so careful and accurate as necessary.
We have indicated remedies and made proposals to improve maintenance workers' qualifications in para. 7.5.1.
In some private factories we have noticed that the management was obliged, because of shortage of local qualified maintenance workers, to hire foreigners to carry out normal repair work.

3.1.5 Shortage of accessories

In the textile industry there are accessories made of many kinds of material such as metal, plastic, wood, rubber, leather, cardboard, etc.
Accessory consumption is also high.
The consequence of shortage of accessories is similar to that of spare parts: machinery at a standstill and decrease in production efficiency.
We have seen many machines idle due to shortage of accessories.
Proper provision of accessories does not entail, as is the case for spare parts, high expenses.
Shortage of accessories is often due more to poor organization and planning than to economic and financial constraints.

3.1.6 Frequent power failures

During our visits to the factories we have noticed that everywhere there were frequent power failures.
These greatly hinder production because damage is not limited to the production losses during interruption of power supply,

3.1.6 (cont.)

but extends up to re-attainment of standard efficiency.
In Wad Madani power failures amount to a total of 5-6 hours per week during the dry season but they reach 15 hours per week during the rainy season.
The situation is even worse in Port Sudan where there is a permanent shortage of power.
The installation of Port Sudan Spinning Mill, a very large Government owned factory with 72,000 spindles, is almost complete but the power necessary to feed it is not available.
Power station equipment, that should supply the necessary power, has not even been installed.
According to unofficial information power will not be available for another 2-3 years.
We guess that the power availability situation is bad in the distant factories like Abu Naama, Nyala, Kadogli and Mongaila.
We shall not go into further detail on this matter because it is outside the scope of our study.

3.1.7 Low efficiency of transport system

Transportation is a great problem in Sudan, perhaps the biggest problem hampering the industrial development of this Country.
It affects at present, and will negatively affect for many more years, the local textile industry as regards transport of raw materials, transport of finished goods, transport of various materials in particular of spare parts and accessories for textile machinery.
In this paragraph, we shall give a brief description of the present situation as far as the local railway, roads, river and air transport system are concerned as well as information concerning near future, mainly in connection with the case in question.
This information will be utilized in para . 7.5.3 (plant site selection).

3.1.7.1 Railway system.

Table 10 is a map showing the present railway network in Sudan, consisting of about 4,700 kms of single track.
As we can see the railway network passes through all the towns in which textile factories are either in operation or under installation, except four: El Dueim, Kadogli, Tonj, Mongalla (Gadow is near to Shendi).
Railway transport in Sudan is slow and congested. This is partially due to the fact that the network is old and single-track; it is however cheaper than road transport (see railway tariffs in Table 11).
In Table 12 we have shown distance by railway of towns with textile factories from Khartoum and Wad Madani.
On this basis, we shall propose and discuss Khartoum and Wad Madani for location of our new workshop for local manufacturing of textile industry spare parts.

3.1.7.2 Road network.

3.1.7.2.1 Highway network

The highways in Sudan are really only normal asphalted roads, which have a total width of 7-8 m, are practicable throughout the year and are quite suitable for fast traffic.
Table 13 is a map showing all the existing highways which total about 1,000 km as follows:

1)	Khartoum - Wad Madani	170 kms
2)	Wad Madani - El Gedaref	230 kms
3)	El Gedaref - Kassala	220 kms
4)	Port Sudan - Haiya	210 kms
5)	El Deleng - Kadogli	120 kms
6)	Khartoum - Geteina (in direction to El Dueim and Kosti)	50 kms
	TOTAL	1,000 kms

3.1.7.2.1 (cont.)

By 1981 the follwoing sections of highway, now under construction, should be completed:

1)	Kassala - Haiya	350 kms
2)	Wad Madani - El Damazin	330 kms
3)	Sennar - Kosti	120 kms
4)	Khartoum - Kosti (remaining part; via Geteina - El Dueim)	260 kms
	TOTAL	1,060 kms

Transport tariffs by truck vary from 6 to 8 piastra/ton per km.

3.1.7.2.2. Track network

Tracks are not asphalted roads and some are practicable throughout the year, whereas others only during the dry season.
Table 14 shows both kinds of track marked differently in the regions neighbouring to Khartoum (Khartoum, El Gezira, Blue Nile, Kassala, White Nile, Northern Kordofan and Southern Kordofan).

3.1.7.3 River transport system.

Table 15 shows the present river transport system in Sudan. Although rivers in Sudan are generally navigable, the river transport system at present is of minor importance in the Sudanese transport system as a whole.
There are only two sections serviced throughout the whole year:

1)	Kosti - Juba	about 1,400 kms
2)	Karima - Dongola	about 300 kms
	TOTAL	about 1,700 kms

3.1.7.3. (cont.)

The other three sections are serviced only from July to October:

1)	Khartoum - Kosti	about 300 kms
2)	Es Suki - Er Roseires	about 200 kms
3)	Kosti - Gambela (Ethiopia)	about 1,100 kms
	TOTAL	about 1.600 kms

To give an idea of the speed of this service, it can be said that it takes about 10 days to reach Juba from Kosti through the White Nile and then Bahr El Gebel and about 2 days from Karima to Dongola.
Tariffs vary according to the goods carried (and the distance covered) - See table 11.

3.1.7.4 Air transport system.

We shall not be taking the air transport system into account for our purposes, due to the high tariffs.
For example we have for the following typical connections:

1)	Khartoum - Damazin (air distance 480 kms)	tariff 13 PT/kg $\cong$ 27 PT/ton x km
2)	Khartoum - Port Sudan (air distance 660 kms)	tariff 20 PT/kg $\cong$ 30 PT/ton x km
3)	Khartoum - Juba (air distance 1,200 kms)	tariff 34 PT/kg $\cong$ 28 PT/ton x km

Air tariffs are about 10 times higher than railway tariffs and about 5 times higher than road tariffs.

3.1.8 Low efficiency of internal organization

Most of the people concerned, even managers, have no idea of what their duties and responsibilities should be and in general of how their factory should be organized.
This is mostly a matter of training for top level personnel in the factories, so that they can transmit the right concepts to lower levels.
But this matter is not included in our present assignment.

3.1.9 Low qualification of production workers

In Sudan, as in many underdeveloped Countries, there is no stable industrial working class.
People often change their type of job according to small salary increases (see also para. 3.1.11).
They are unable therefore to improve their initial low qualification, fruit of poor schooling, by "on the job" training since they are not properly supported by supervisors (see also para. 3.1.10).
The workers' poor qualification affects, of course, very negatively production efficiency.
This point is also not part of our present assignment.

3.1.10 Scarce supervision in production sector

In Sudanese textile factories supervision in the production sector is scarce.
Supervisors normally do not know what their main duties are.
They should instruct workers as to the right way to operate, give them advice when they have problems and then control that the workers really do follow instructions.
They of course should know their job perfectly and they should spend 90% of their working time near machines and workers.
On the contrary, workers are mostly neglected and supervisors spend most of their time sitting in their offices.

3.1.10 (cont.)

All the supervisors in the only really efficient factory we have visited (Cotton Textile Mill) are expatriates. This is just to demonstrate what the connection between good supervision and good efficiency is.
This point too is not part of our assignment.

3.1.11 High absenteeism and turnover of the personnel

Personnel turnover is very high due to the reasons mentioned in para. 3.1.9.
Absenteeism is also very high, especially in certain periods (during harvesting, after holidays, etc.).
We shall not go into the matter, however, because it is not covered in our assignment.

3.2 Causes

The aforementioned problems are generated by the general situation in Sudan and therefore they can only be solved gradually.
Sudan is an underdeveloped Country. In 1973 per capita income was as follows:

- population (thousands)	14,819	(°°°)
- gross domestic product (million SP)	1,341	(*)
- per capita income (SP per capita)	90	(equivalent to about 180 US Dollars)

Sudan has a very short industrial tradition; in fact the industrial sector was practically non-existent before 1956.
From 1966/67 to 1974/75 the contribution of the industrial sector

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(°°°) Census of Population - Department of Statistics

(*) National Income Division, Ministry of National Planning: Average between data concerning 1972/1973 and 1973/1974

3.2 (cont.)

to the gross domestic product (GDP)was, although on the increase, still very limited.

In fact the contribution of the industrial sector, including manufacturing, mining and quarrying, construction and building, electricity and water, to GDP went from 8.4% in 1966/67 to 15.1% in 1974/75 (see Table 16).

If we consider manufacturing only, the contribution to GDP went up from 4.5% in 1966/67 to 9.2% in 1974/75.

4. PRESENT SITUATION AS REGARDS REPAIR, MAINTENANCE AND SPARE PART MANUFACTURING EQUIPMENT

Repair, maintenance and spare part manufacturing are carried out with the same equipment: almost all the textile factories considered have their own mechanical workshop.

The work of major importance is repair, then maintenance and finally spare part manufacturing.

Only the following three factories have their own foundry (see table 19):

- Khartoum Spinning and Weaving Factory
- Sudan Textile Factory
- Cotton Textile Mill

4.1 Repairing and maintenance work

Most of the textile factories carry out part of their repair and maintenance work in their own workshops and part in other local workshops (see table 17). This is the case in the following factories:

- Sinnar Spinning Mill
- Khartoum Spinning and Weaving Factory
- Sudan Textile Factory
- Blue Nile Factory
- Madani Spinning and Weaving Factory
- Red Sea Factory
- Friendship Textile Factory
- Abu Naama Kenaf Factory
- Plastic Sacks Company

4.1 (cont.)

The Madani Spinning and Weaving Factory utilizes the workshop of Blue Nile Factory, which belongs to the same group (Sharaf Group).
The Cotton Textile Mill constitutes an exception. Its workshop is fully equipped. The Cotton Textile Mill is completely self-sufficient as far as repair and maintenance work is concerned.
We came across a singular situation in the following six weaving factories:

- Shendi Weaving Factory
- Kosti Weaving Factory
- El Dueim Weaving Factory
- Mongalla Weaving Factory
- Nyala Weaving Factory
- Kadogli Weaving Factory

These weaving factories, which are all identical, have their own workshops, but, for many reasons, these workshops are not running (lack of qualified manpower, lack of tools, etc.).

4.2 Spare part manufacturing

Almost all the local textile factories import most of their spare parts (we would say from 70 to 90%).
For details see para 7.1.
The Cotton Textile Mill constitutes an exception also as far as spare parts are concerned because their intention is to import only a minor part of their spare part requirements (we would say only 20%), whilst they will manufacture most of the spare parts they require (i.e. 80%) themselves in their foundry and workshop.

4.2 (cont.)

The rest of the Sudanese requirement for spare parts (from 10% to 30% according to our evaluation) is produced in Sudan. We can divide the local textile factories up into 3 groups (see table 18).

1st group) factories which have their non-imported spare parts all manufactured by their own workshops, such as:-

- Khartoum Spinning and Weaving Factory
- Sudan Textile Factory
- Cotton Textile Mill.

These factories prefer to manufacture spare parts by themselves rather than have them made by other local workshops, for the following reasons: better quality and faster delivery.
Of course these factories have better equipped workshops than the other factories.

2nd group) factories which manufacture part of their spare parts in their own workshops and have the rest made by other local workshops, such as:

- Sinnar Spinning Mill
- Red Sea Factory
- Friendship Textile Factory
- Abu Naama Kenaf Factory
- Plastic Sacks Company.

3rd group) factories which have their non-imported spare parts all manufactured by local workshops, such as:

- Blue Nile Factory
- Madani Spinning and Weaving Factory
- Shendi Weaving Factory

4.2 (cont.)

- Kosti Weaving Factory
- El Dueim Weaving Factory
- Mongalla Weaving Factory
- Nyala Weaving Factory
- Kadogli Weaving Factory

The first two factories in this group have only small workshops for repair and maintenance work.
The remaining factories in this group, as we have already said, each have their own workshop but these workshops are at a standstill.

4.3 Foundry and workshop machinery in operating Sudanese textile factories

4.3.1 Foundries

Only the following three operating Sudanese textile factories have their own foundry:

- Khartoum Spinning and Weaving Factory
- Sudan Textile Factory
- Cotton Textile Mill.

The third is not yet however in operation due to the fact that at present the Cotton Textile Mill is still consuming its initial stock of spare parts (see table 19).
All three foundries are capable of processing cast iron, aluminium, brass and bronze. All three foundries have their own wooden pattern section, but no laboratories.
We reckon their present total production to be about 25 tons/year, which is very limited.

4.3.2 Workshops

In table 20 we have shown details of workshop machinery in the operating Sudanese textile factories.
Considering the most important machine tools such as:

- lathes
- milling machines
- drilling machines
- shaping machines
- grinding machines

a total of No. 90 machines is reached. Only the four major factories (Khartoum Spinning & Weaving Factory, Sudan Textile Factory, Cotton Textile Mill and Friendship Textile Factory) have their own blacksmith shop.
Only one factory (Cotton Textile Mill) has its own heat treatment department for metals.
As we have already said, the workshops in the other six weaving factories are not working.
The remaining workshops are running on one shift, except the Sudan Textile Mill which is running on two shifts.
In only a few cases were we able to find out the number of workers in the workshops.

4.4 Machinery in the most important foundries and workshops serving the Sudanese textile industry

4.4.1 Foundries

We have considered the following five foundries to be the most important foundries serving the Sudanese textile industry (see table 21)

a) - Khartoum Central Foundry in Khartoum North

4.4.1 (cont.)

b) - Sudan Railway Corporation's Foundry in Atbara
c) - River Transport Corporation's Foundry in Khartoum
d) - Earth Moving Corporation's Foundry in Wad Madani
e) - Building and Construction Corp.'s Foundry in Khartoum.

All of them, except River Transport Corporation's Foundry, process cast iron.
Only the first three of them process aluminium, brass and bronze.
Khartoum Central Foundry has a sand laboratory and a metallurgical laboratory, but the latter is out of order.
Sudan Railway Corporation's Foundry might also have a sand laboratory.
All these foundries probably have their own wooden pattern section.
We reckon the present total production of all these five foundries to be about 2,100 tons/year.
Out of this quantity only 5% (about 100 tons/year) is probably set aside for the local textile industry.

a) Khartoum Central Foundry: UNIDO is preparing a project to increase its production from 500 tons/year to 3,000 tons/year.
They are therefore interested in contacting new clients and particularly in working more for the local textile industry.

b) Sudan Railway Corporation's Foundry: they are very busy in satisfying the internal necessities. They have an expansion program to better satisfy the internal requirements. We do not think they can serve the local textile industry more intensively.

c) River Transport Corporation's Foundry: at present they have no cast iron foundry,which is the most necessary for manufacture of spare parts for textile machines.

4.4.1 (cont.)

They plan to install a new section for cast iron for internal needs.
In any case we do not think they are interested in taking on more work for the local textile industry.

d) Earth Moving Corporation's Foundry: they have a small foundry which is suitable only for big pieces according to their requirements (large bushings, large crankshafts, etc.). This foundry is not suitable for our purposes.

e) Building and Construction Corporation's Foundry.
They have at present a very small foundry suitable for heavy work. They have also expansion programs for internal necessities and industrial sectors other than textile.
We do not think this foundry could be of any use for future programs concerning the textile industry.

4.4.2 Workshops

We have considered the following eight workshops as the most important workshops serving the Sudanese textile industry (see table 22):

a) - Khartoum Central Foundry in Khartoum North
b) - Sudan Railway Corporation's Workshop in Atbara and in Khartoum
c) - River Transport Corporation's Workshop in Khartoum
d) - Khartoum Polytechnic's Workshop in Khartoum
e) - Khartoum University's Workshop in Khartoum
f) - Khartoum University's Laboratory in Khartoum
g) - Earth Moving Corporation's Workshop in Wad Madani
h) - Building and Construction Corporation's Workshop in Khartoum

4.4.2 (cont.)

Considering the most important machine tools such as:

- lathes
- milling machines
- drilling machines
- shaping machines
- grinding machines

a total of No. 234 machine tools is reached.
All these workshops are running on one shift except for Sudan Railway Corporation's Workshop, which is working on three shifts.
We reckon that about 5% of the production of these workshops is their present total production for the local textile industry.

a) Khartoum Central Foundry: the local workshop, connected to the foundry was installed in 1971-72.
It is quite active and efficient, but it is committed to the manufacture of mechanical pieces cast in the local foundry (mainly water valves and fittings).
They have no expansion programs for the workshop, so we do not think that they will take on more work in the future for the local textile industry;

b) Sudan Railway Corporation's Workshop: in Atbara workshop they are kept busy meeting their internal requirements. They have an expansion program, since at present they are running on three shifts, but just for internal needs. Khartoum workshop is equipped with specialized machinery not suitable for our purposes. So we are not of the opinion that future spare part production for the local textile industry will increase.

c) River Transport Corporation's Workshop: most of the workshop is very old (30-40 years old). But the major handicap regarding increase of spare part production for the local textile industry is the bureaucratic attitude of its management. They are absolutely uninterested in making any effort to serve other Corporations.

4.4.2 (cont.)

d) Khartoum Polytechnic's Workshop: the machinery is very old (about 25 year old) and not suitable for industrial work. At present this workshop is kept running only for training activity.
The management of this workshop has no motivation as regards any industrial production;

e) Khartoum University's Workshop: machinery is good and efficient. At present they manufacture parts of a good quality level for the local textile industry (gears). But the amount of machinery is not even sufficient for their teaching activity, so we do not think their spare part production for the local textile industry will increase;

f) Khartoum University's Laboratories: they have only a mechanical testing laboratory and a metallurgical laboratory. These facilities are mostly for teaching activity but sometimes also for tests for the local industry. These facilities can be utilized only as subsidiary in our case;

g) Earth Moving Corporation's Workshop: this workshop is equipped with heavy machinery suitable for manufacture of large parts according to their necessities. On the contrary we need light machinery for small pieces. Moreover their workload permits them to work for outside firms only during the period from October to July. So we do not anticipate any greater support from them in the future;

4.4.2 (cont.)

h) Building and Construction Corporation's Workshop.
This workshop too is equipped with heavy machinery for manufacture of parts for trucks, bulldozers, etc. and therefore not so suitable for our purposes. Furthermore, the machinery is 30-40 years old. They have an expansion program but just for their internal needs and for manufacture of a few specific items to be sold by them on the local market.
So we do not deem this workshop to be of interest in expanding production of our spare parts.

5. DEVELOPMENT FORECAST FOR THE SUDANESE TEXTILE INDUSTRY UP TO 1995

Unfortunately there are no reliable official data concerning the future of the Sudanese textile industry up to 1995 as far as plants and machinery to be installed are concerned.

5.1 Textile firms licensed by the Ministry of Industry

In table 23 we have listed the textile firms who have been granted a license by the Ministry of Industry.
The total number of new looms to be installed over the next few years is about 30,000.
The total new spindles to be installed is about 1,400,000.
This means tripling the present machinery both running and under installation.
But nobody can believe these figures, considering it took about 20 years to install about 10,000 looms and 500,000 spindles.
We do not think these licenses will entail any real committment from the applicants.

5.2 15 year tentative plan for Sudanese cotton textile industries

This plan was carried out in 1972 by the Ministry of Industry with UNIDO's assistance.
This plan is good as regards methodology but it is old. Its correspondence with the actual situation is weak. It can be utilized only for some historical data.
This plan is now under revision but we were unable to obtain any information concerning the latest edition.

5.3 The 6 year plan of economic and social development (1977/78 - 1982/83)

This plan was issued in April '77 by the Ministry of National Planning. It concerns the future of all the aspects of Sudan's life. It gives only a few details regarding the local cotton industry as follows:

a) fabric production: 1971/72....90 million meters
(historical data) 1976/77...152 million meters

b) fabric production: 1982/83...308 million meters
(target)

c) yarn production: 1982/83....29,7 thousand tons
(target)

d) raw cotton consumption: (1990)...234,000 tons
(target)

These data are incomplete and we think also largely over-evaluated. In any case these data cannot help us in making a forecast as to how many looms will be running in Sudan in 1995.

5.4 Analysis of the historical trend of the installed looms and extrapolation

Since there is a lack of reliable official data concerning the textile plants that are to be installed in Sudan in the future, we are obliged to make our own forecast.
What is of most interest for our purposes is the trend concerning installed looms. That is why looms need spare parts more than any other kind of textile machine.

5.4 (cont.)

In table 24 we have reported the number of looms installed and under installation each year in Sudan and the cumulative number of looms installed.

In table 25 we have shown the same data in diagram form.

As we can see from the above diagram, the level is constant from 1961 to 1972.

After this date there is a rising tendency up to 1983, which is the last year with data. The interpolation has been made by the minimum square method.

In 1983 the number of looms installed (10,111) will be three times more than 11 years before, that is in 1972 (3,537) and about twice more than 7 years before, that is in 1976 (about 5,700).

We shall now deal with the problem of extrapolation.

From many meetings with people working in the textile field in Sudan we have received an indication of 20,000 looms installed by 1990.

It seems to be a reasonable forecast, not too high (it is about half of the official datum), achievable because it means approximately doubling the installed looms in 6-7 years as in the preceding period. The market should be able to accept this because the present production is only able to cover about half of the internal market.

Linear interpolation brings to 26,953 looms by 1995.

6. PROPOSALS CONCERNING IMPROVEMENTS IN PRESENT REPAIR AND MAINTENANCE SERVICE AND SUGGESTIONS FOR FUTURE PLANTS

Efficient repair and maintenance must be effected at the right moment to avoid production stops. We deem this to be the first point to be considered.

A new centralized workshop for repair and maintenance work would be negative in this respect, considering the distances to be covered and Sudan's transport system.

Neither can we suggest depending more, in the future than now, on the external local workshops for the following reasons:

a) most of them have no machinery suited to our purposes

b) most of them have a heavy work-load in connection with their own requirements

c) long distances and problematic transport system in Sudan

d) bureaucratic difficulties: all the major workshops belong to different Corporations and there exists a cooperation problem.

So the only possible solution for improvement of repair and maintenance service is to strengthen and to improve efficiency of the existing work shops annexed to the single factories.

6.1 Proposals for the existing government owned factories

The most important point is to put in operation the 6 mechanical work shops annexed to the 6 new weaving factories (Shendi, Kosti, El Dueim, Mongalla, Nyala, Kadogli) as soon as possible.

6.1 (cont.)

It is not worth installing new foundries by the existing factories for the small foundry work in connection with repair and maintenance service. Local external foundries can be utilized, e.g. Khartoum Central Foundry.
On the contrary it would be worthwhile to install or to render efficient in each factory a small electromechanical section of the workshop for motor-rewinding because it is not difficult. In fact the relative expenditure is very limited and highly qualified manpower is not required. Other specific suggestions are as follows:

a) completion of the 6 mechanical workshops annexed to the 6 new weaving factories with proper tools, blacksmith shop, heat treatment facilities, welding sets and welding machine for filler powders. The relevant expenditure is limited;

b) to install in the workshops of the remaining Government owned factories small blacksmith shops, simple heat treatment facilities, welding sets and welding machine for filler powders. The relevant expenditures are limited;

c) to provide for training of the personnel of the workshops in the 6 weaving factories as soon as possible through the existing vocational centers;

d) to improve the qualification of the personnel of the remaining workshops in the Government owned factories by a systematic training program once the new central workshop, proposed in para 7.5, is running;

6.1 (cont.)

e) to utilize the right raw materials in the correct way.
We suggest that raw material purchasing from abroad, for all the necessities of the whole Sudanese textile industry, be concentrated in the new central workshop. This new central workshop will have, of course, special permission from the Government to import raw materials.
Moreover it will be able to negotiate prices, quality and deliveries with suppliers better than can the single small units. This, in our opinion, would be the right solution for raw material availability but practicable only once the new central workshop is in operation.

6.2 Proposals for the existing private factories

The workshops in the private factories are in general well equipped for repair and maintenance work.
Only Blue Nile Factory has an undersized workshop. It also serves the Madani Spinning and Weaving Factory. In our opinion it should be enlarged but only for repair and maintenance work.
The major problems concern manpower qualification and raw material availability. We would like to suggest, as in the previous para. that:

a) a systematic training of the workshop personnel in the new central workshop be provided;

b) the right raw materials be utilized in the right way. Raw material purchasing could be centralized in the new central workshop.

6.3 Proposals for the future plants

Proposals for the future plants are as follows:

a) to install completely equipped workshops for each new plant with a complete assortment of machine tools, including motor-rewinding department, blacksmith shop, welding sets (with welding machines for filler powders);

6.3 (cont.)

b) a foundry is advisable only in the case of very large plants (e.g. more than 1,000 looms and 50,000 spindles);

c) technical assistance from the contractors is absolutely necessary during the starting period also in the maintenance field. Technicians supplied by the contractors should be present in the shed for at least one year (better if 1 ½ - 2 years) for the main purpose of training the local maintenance people. This should be irrespective of any other following maintenance service supplied by the contractors.

Complete technical documentation from the contractors is also required.

It would also be advisable to have the highest level maintenance personnel trained abroad by the manufacturers of the machinery.

7. PROPOSALS CONCERNING INCREASE IN LOCAL MANUFACTURE OF SPARE PARTS AND COMMENCEMENT OF MANUFACTURE OF ACCESSORIES

Official data concerning present total consumption of spare parts in the Sudanese textile industry, as well as official data regarding present spare parts importation and production in the local annexed workshops, unfortunately are not available. That is mainly because most of the factories are new and they have no proper records concerning spare parts consumption.

A lot of information concerning spare parts consumption and production in each single factory was collected, but it is incomplete and not very reliable. This information is useful for partial indications but not for an exhaustive picture of the whole problem of spare parts in the Sudanese textile industry.

Of course we found the same to be applicable also as regards forecasts on the future consumption, importation and production of spare parts in Sudan.

The only clear point is the common willingness, both in the Government owned and private textile sectors, to become gradually independent of foreign countries as far as production of spare parts is concerned.

In the light of the above situation, many assumptions and evaluations will necessarily have to stand in lieu of the information which is lacking.

7.1. Present situation of spare parts

7.1.1. Quantity

Assuming that :

a) average loom weight = 1.2 tons

b) percentage of weight of the yearly spare parts consumption in relation to loom weight = 2%

c) ratio of the loom spare part consumption to the local spare parts consumption = 1 : 1.5

since about 8,000 looms are running at present,

7.1.1. (cont.)

- spare parts consumption in 1979 is:

  $8{,}000 \times 1.2 \times \frac{2}{100} \times 1.5 \simeq 290$ tons (rounded off)

- spare parts production in the local annexed workshops in 1979 is evaluated as 20% of the total consumption (see preceding table 18) and it is therefore:

  $290 \times \frac{20}{100} = 58$ tons

- spare parts importation in 1979 is the difference between total consumption and local production:

  290 - 58 = 232 tons

7.1.2 Value

Assuming that:

a) spare parts for textile industry are exempt from custom duties

b) average international price of spare parts for textile industry = = 13,500 SP/ton

c) average price of spare parts for textile industry delivered in Khartoum = 15,000 SP/ton

- the value of the spare parts consumed in 1979 is:

  290 x 15,000 = 4,350,000 SP

- the value of the spare parts manufactured in 1979 in the local annexed workshops is:

  58 x 15,000 = 870,000 SP

- the value of the imported spare parts in 1979 is consequently:

  232 x 15,000 = 3,480,000 SP

7.1.2. (cont.)

Two verifications of the value of the spare parts consumed in 1979 can be made.
The first consists of an extrapolation of a few factories' present expenditures in this field, as follows:

- Sudan Textile Factory	1,880 looms	900,000 SP
- Blue Nile Factory	790 looms	400,000 SP
- Madani Spinning Weaving Factory	420 looms	300,000 SP
Total	3,090 looms	1,600,000 SP

By extrapolating to the 8,000 looms at present in operation we obtain an expenditure of about 4,140,000 SP, which is not very far out as regards the preceding value.
The second can be made assuming that:

a) average cost of one loom = 9,000 SP

b) percentage of value of the yearly spare parts consumption on the loom value = 4% (*)

in fact:

$$9{,}000 \times 8{,}000 \times \frac{4}{100} \times 1.5 = 4{,}320{,}000 \text{ SP.}$$

This last value is also close to the value of 4,350,000 SP obtained previously.

(*) Remark: this means that 1 kg of spare parts costs double that 1 kg of machinery.

7.2 Proposal for increasing the local manufacture of spare parts

Our proposal, the aim of which is to increase the percentage of the locally manufactured spare parts with respect to the total consumption of spare parts in the Sudanese textile industry, consists of three main points:

1) to continue manufacturing in the present local annexed workshops an average 20% of the total present spare parts consumption;

2) to manufacture in the local annexed workshops of the future plants an average 20% of their spare parts requirements;

3) to build a new central workshop and to start manufacturing spare parts with the main purpose of gradually reducing imports of spare parts to 15% by 1995.

The third point will be discussed in all its aspects. The first and second points need no special discussion.

7.2.1 Kinds of spare parts to be manufactured locally

We deem it better that some categories of spare parts continue to be imported from abroad. We would estimate these spare parts to be 15% of the total consumption.
These are:

a) sophisticated mechanical parts, obtained through special technologies (e.g. some parts of Schlafhorst autoconer);

b) electrical and electronic parts

c) ordinary mechanical parts, that are consumed in very small quantities; it would not be economically worthwhile to manufacture these parts locally.

7.2.1. (cont.)

We suggest local manufacture of widely used mechanical parts, such as:

1) shafts
2) gears
3) supports
4) levers
5) connecting rods
6) springs
7) parts obtained by automatic lathes (non-standard washers, bushes, screws and bults)
8) pulley
9) rolls and girts
10) cast body components
11) welded body components
12) plain bearings

The Raw Materials for the above parts will be:

1) cast iron
2) malleable cast iron
3) steel
4) aluminium alloys
5) brass and bronze

We can consider the following sizes:

a) very light parts from 0 - 1 kg an average 0.6 kg
b) light parts " 1 - 3 kg " " 2 kg
c) medium parts " 3 - 10 kg " " 6.5 kg
d) heavy parts over 10 kg " " 12 kg

7.2.1. (cont.)

On the basis of our experience in textile machinery and of the information collected concerning spare part consumption in the local textile industry, a suitable weight partition in the different mechanical groups would be as follows:

1) shafts	14%
2) gears	15%
3) supports	10%
4) levers	15%
5) connecting rods	5%
6) springs	2%
7) parts from autom. lathe	7%
8) pulleys	7%
9) rolls and girts	7%
10) cast body components	10%
11) welded body components	5%
12) plain bearings	3%
Total	100%

A further partition in the different raw materials and in the different sizes is contained in table 26.
The percentage of the different raw materials is as follows:

- cast iron	32.75%
- malleable cast iron	10%
- steel	51.25%
- aluminium alloys	3.5%
- brass and bronze	2.5%
Total	100%

7.2.1. (cont.)

Significant samples (1 or 2) for each of the different groups were chosen as follows (for rolls and girts and welded body components samples are not necessary):

1) shafts	samples are shown in table 27 and 28
2) gears	" " " " " 29 and 30
3) supports	" " " " " 31
4) levers	" " " " " 32
5) connecting rods	" " " " " 33
6) springs	" " " " " 34
7) parts from automatic lathe	" " " " " 35
8) pulleys	" " " " " 36
9) rolls and girts	no samples
10) cast body component	samples are shown in table 37
11) welded body component	no samples
12) plain bearing	samples are shown in table 38

In the above working schedules all the necessary technical specifications for manufacture are given.
Machining time (in decimal hours) is for one piece.
Setting up time (also in decimal hours) is for one lot of pieces.
Indications concerning the number of items to be produced and average production lot are contained in para 7.5.2.

7.3 Forecast of spare parts situation up to 1995

7.3.1 Quantities

7.3.1.1 Consumption

We assume consumption of spare parts in the local textile industry to be proportional to the number of looms installed. Considering the development forecast in para 5.4 and the consumption of spare parts in 1979 (= 290 tons), the consumption over the next years will be as follows:

1983 :	360 tons
1990 :	720 "
1995 :	977 "

Figures for each year up to 1995 are given in table 39 and in the diagram of table 40.

7.3.1.2 Local production

7.3.1.2.1 Local production by workshops annexed to the factories

We assume that 20% of the total consumption will continue to be manufactured by the local workshops annexed to the factories. The quantity will increase gradually from the present 58 tons (1979) to the final figure 195 tons (1995) according to the increase in the number of installed looms (see detail in tables 39-40-41).

7.3.1.2.2 Local production by the new central workshop

A tentative, realistic schedule of the project could be as follows:

1.7.1980:	tender issue
1.1.1981:	contract award
1.7.1981:	starting point of equipment installation (1st phase)
31.9.1982:	completion of mounting; taking over tests
31.12.1982:	commissioning (1st phase)
1983:	production at 50% efficiency (40 tons/year)
1984-1985-1986: (1st phase production)	production at standard efficiency (80 tons/year - 1 shift)
1.1.1985:	starting point of equipment installation (2nd phase)
30.6.1986:	commissioning (2nd phase)
1987-1988-1989: (2nd phase production)	production at standard efficiency (160 tons/year - 1 shift)
30.6.1987:	starting point of equipment installation (3rd phase)
31.12.1988:	commissioning (3rd phase)
1990-1991-1992: (3rd phase production)	production at standard efficiency (320 tons/year - 1 shift)

7.3.1.2.2. (cont.)

1993: (implementation of 4th phase production)	production at 50% efficiency of the 2nd shift (480 tons/year - 2 shifts)
1994-1995: (4th phase production)	production at standard efficiency (640 tons/ year - 2 shifts)

The above schedule is shown in table 42, together with a training schedule for supervisors and manpower, which will be discussed in detail in para 7.5.6.
Production is shown in tables 39-40-41.
Production is gradually increasing and will reach in 1995 640 tons/ year, that is 65% of the total consumption of spare parts.
The proposed schedule entails building the new central workshop step by step.
We suggest this solution be adopted instead of starting off with a big central workshop for the following reasons:

1) technical reasons:

1.1 know-how: the new central workshop must accumulate gradually the technical documentation necessary for the manufacture of spare parts.

1.2 personnel training: it is not so easy to find suitable personnel locally, so workers will have to be trained gradually on the spot.

1.3 internal organization: it is easier to start with a small workshop than with a large one.

7.3.1.2.2. (cont.)

2) commercial reasons:

sales: it will take time to demonstrate to the management of the local textile industry, especially as regards the private sector, that the new central workshop is able to supply good quality spare parts at reasonable prices and on time.

3) financial reasons: it will be easier for the new project to acquire the funds necessary to start if the size of the workshop is not too large

4) risks: risks are limited if we start with a small sized workshop and enlarge it according to the real development of the local textile industry.

7.3.1.3 Importation

Importation is the complement of local production as regards total consumption.
Import figures are given in tables 39-40-41 (tons/year).
They go from 232 tons/year and 80% of the total consumption in 1979 to 142 tons/year and 15% of the total consumption in 1995.
In 1995 the situation concerning spare parts will be as follows:

- production in the new central workshop	640 tons/year	65%
- production in the local annexed workshops	195 tons/year	20%
- importation	142 tons/year	15%
total consumption	977 tons/year	100%

In 1995 the importance of local production and of importation will be reversed with respect to 1979.

7.3.2 Values

The values of the total consumption of spare parts importation and local production are indicated in table 43.
The values have been calculated for spare parts delivered to Khartoum and are at constant prices (at 1979's level).
The trend of the values is therefore the same as the tonnage trend in tables 40-41.

7.4 Situation as regards the most important accessories

At present all the accessories are imported from abroad.
Many kinds of accessories were considered for a local production, e.g.:

a) shuttles: local consumption is about 30,000 pieces/year for 10,000 looms. It would be necessary to import all the parts and to mount them locally, because manufacture of the parts is critical. But in this way the added value is low and production is not economical.
It is advisable to reconsider this possibility in 1995 when the consumption will be higher.

b) travellers: minimal economical production is 250,000,000-300,000,000 pieces/year (the big manufacturers in this field produce about 1,000,000,000 pcs/y). The local consumption is about 60,000,000 pieces/year for 500,000 spindles and therefore it is only $\frac{1}{4}$ / $\frac{1}{5}$ of the minimal economical production.

c) healds: the consumption for 10,000 looms is about $\frac{1}{3}$ - $\frac{1}{4}$ of the minimal economic size of a plant for manufacturing healds.

7.4. (cont.)

d) metallic accessories: the number of items is high and the average number of pieces for each lot is low and non-economic.

e) wooden accessories: consumption for each item is too limited.

At present the only accessories advisable for local manufacture are plastic accessories. A certain number of them have been selected. Their quantities for 10,000 looms and 500,000 spindles are indicated in table 44.

7.4.1 Quantities to be manufactured

It is suggested, especially at the beginning, that the number of items to be manufactured be limited as far as possible.
So it is advisable to start with spinning tubes and cones with 10 moulds and then to gradually add other accessories from those selected.
The production program could be as follows:

- 1984	- spinning tubes	15 tons
	- cones	15 tons
	Total	30 tons
- 1985	- spinning tubes	15 tons
	- cones	15 tons
	- other accessories (from those selected)	10 tons
	Total	40 tons

7.4.1. (cont.)

- 1990	- spinning tubes	30 tons
	- cones	30 tons
	- other accessories (from those selected)	20 tons
	Total	80 tons

- 1995	- spinning tubes	40 tons
	- cones	40 tons
	- other accessories (from those selected)	25 tons
	Total	105 tons

The detailed yearly program is shown in table 45.

7.5 Preliminary project of a new central mechanical workshop with annexed training center

7.5.1 Necessity of a training center for mechanical maintenance workers

As was stated in paragraph 3.1.4, the qualification of the maintenance workers in the local textile industry is very poor.
A proposal to meet the requirement of skilled workers for mechanical job in the local textile industry is given in this paragraph.
These workers should become able to run machine tools properly and to carry out mechanical work in the workshops annexed to the local textile factories through upgrading courses by the new central workshop.

7.5.1. (cont.)

This means meeting only partially the requirement for mechanical maintenance workers in the local textile industry, because the present proposal does not involve training of mechanical assembly workers.
In fact we have rejected the idea of training mechanical assembly workers in the new central workshop for the following two reasons:

a) it would be necessary to have in the central workshop at least one textile machine for each model installed in Sudan. This is very difficult since the models are many (see para. 2.1);

b) training necessities concerning mechanical assembly workers are about twice as many as those relative to machine tool workers. More than a certain number of people cannot be trained in the central workshop without hampering production.

Mechanical assembly workers will be trained better in the single factories.

7.5.1.1 Present situation concerning training of mechanical maintenance workers

In Sudan there are only two schools involved in training of technical people for the local textile industry:

a) Vocational Training Center: it has full time courses (3 years' duration) for young people to worker level and upgrading courses (6 months' duration) for workers.
But this Center serves the whole Sudanese industry and so the number of people trained for the local textile industry is very limited.

7.5.1.1. (cont.)

We reckon this yearly output to be as follows:

- 6 skilled workers/year from the upgrading courses
-30 young workers/year from the full-time courses

in the following specializations:

- general fitting
- machine shop
- plating section
- welding section
- blacksmith shop

It is of interest for our purpose to note the output of only 6 skilled workers/year, which is a very negligible figure compared with the needs (see following para. 7.5.1.2).

b) Spinning and Weaving Institute: it holds 3 year full-time courses for young people who will become supervisors and foremen in the local textile industry. The output is 25 technicians/year. They have good equipment and a good laboratory for testing textile materials. But this school is not of interest in our case because it trains production people not maintenance people.

7.5.1.2 Present and future necessities for training of mechanical maintenance workers

No official data are available in this field. Our evaluation, obtained by extrapolating data from some factories, is as follows:

- 1983 (about 10,000 installed looms):

- machine tool workers	60 persons/year
- mechanical assembly workers	120 persons/year
Total	180 persons/year

7.5.1.2. (cont.)

- 1990 (about 20,000 installed looms):

- machine tool workers	120 persons/year
- mechanical assembly workers	240 persons/year
Total	360 persons/year

- 1995 (about 27,000 installed looms):

- machine tool workers	160 persons/year
- mechanical assembly workers	320 persons/year
Total	480 persons/year

As we have already stated our proposal will involve only machine tool workers. The training necessities have been detailed in table 46.

7.5.1.3 Characteristics of the new training center

The new training center will train nearly the total yearly requirement of machine tool workers, except during the first year, i.e. 1983 (see table 46).
Upgrading courses of 3 months' duration will be held.

a) Training facilities will be:

a.1) from 1983 up to 1989 (with a maximum of 27 workers attending courses at the same time):

a.1.1) - 1 lecture room (about 50 m^2)

7.5.1.3. (cont.)

a.1.2.) - 1 small training workshop (about 50 m2) with the following machine tools :

- . one 300 x 1500 mm parallel lathe;
- . one 250 x 1000 mm parallel lathe;
- . one universal milling machine with 280 x 1200 mm bench;
- . one diam. 10 mm bench drill.

Moreover production machine tools operating at that time will be engaged for 10% of their time for training activities. We can consider the consequent production loss as only 5%.

a.2) <u>from 1990 up to 1995</u> (with a maximum of 40 workers attending courses at the same time) :

a.2.1.) - 2 lecture rooms (total about 100 m2)

a.2.2.) - 1 training workshop (about 100 m2) with the following machine tools :

- . two 300 x 1500 mm parallel lathes;
- . two 250 x 1000 mm parallel lathes;
- . two universal milling machines with 20 x 1200 bench;
- . two diam. 10 mm bench drills.

Production machine tools operating at that time will be engaged for 10% of their time for training activities with a consequent production loss of 5%.

7.5.1.3. (cont.)

b) Trainers will be as follows :

b.1) from 1983 up to 1989 : total N° 4.
They will, in turn, be trained abroad during the second half of 1982.

b.2) from 1990 up to 1995 : total N° 8.
The four additional trainers will be trained abroad during the second half of 1989.

c) Housing facilities

It is foreseen that trainers (with their families) and trainees will live on the spot.
Therefore housing facilities must be provided as follows :

c.1) from 1983 up to 1989 : N° 8 small houses (about 100 m2 each). Four of them will be occupied by the four trainers and their families, the remaining four by the trainees.
The above N° 8 small houses will be built between 1/7/81 and 31/12/82 by the Government without any expense being incurred by the central workshop.

c.2) from 1990 up to 1995 : the preceding N° 8 small houses plus apprentices' quarters (about 1,300 m2 on 2 floors) with services (canteen, bar, meeting room for an additional 400 m2 approximately).
The 8 small houses will be occupied by the 8 trainers with their families.
The trainees will occupy the apprentices' quarters, which will be built between 1/7/1987 and 31/12/1988 by the Government without any expense being incurred by the central workshop.

7.5.2. Plant dimensioning criteria and production program

7.5.2.1. General concepts

The following general concepts have been adopted :

a) Step by step construction : the reasons have been explained in paragraph 7.3.1.2.2. The different steps have been shown in table 42.

b) Construction without disturbing production : construction is foreseen in 3 steps (see table 42 and paragraph 7.5.2.5.). The first step is to be taken before beginning production. The second and third steps are foreseen during production but without hampering same. Production should be interrupted only for a few days for the shifting of some machine tools.

c) Investment limitation: first of all no foundry is foreseen in the new plant in order to limit the investment. Cast pieces can be supplied by Khartoum Central Foundry, which is to be expanded and reorganized by the implementation of a UNIDO project before the end of 1982. An agreement should be signed with the above foundry as soon as possible. The only problem concerns steel casting because the new project does not foresee the installation of steel casting equipment.
Should it be impossible to change the UNIDO project the problem could be resolved partially by utilizing ductile cast iron instead of steel and partially by importing cast steel pieces (see following paragraph 7.5.2.3.).

7.5.2.1. (cont.)

d) Easy technical implementation : it is suggested to start with a limited number of items (see paragraph 7.5.2.2.) and to foresee supply of technical know-how (mainly technical drawings, technical specifications of the spare parts and training of technical people) by a qualified mechanical manufacturer.
Initially forged pieces should be bought, probably from abroad.
The wooden patterns necessary for the cast pieces to be manufactured in the first phase should be bought from abroad. The patterns are to be available before the end of 1982.

7.5.2.2. Production

a) Weight of the spare parts production : the quantities of spare parts to be manufactured from 1983 up to 1995 in the new central workshop are given in tables 39-40. The break-down of the different raw materials and sizes is given in table 26.
If we consider a production of 320 tons/year, that is production in 1990-1991-1992, the total weight is divided among the different kinds of spare parts and among the different raw materials and sizes as is shown in table 47. The breakdown for the other years is proportional to the total production.

b) Number of pieces to be manufactured : considering the average weight of each column, we obtain the number of pieces to be manufactured in 1990-1991-1992 corresponding to 320 tons/year and divided into the different categories (see table 48)
The total number of pieces is 325,370, i.e. an average weight of about 1 kg/piece.
The number of pieces for the other years may be considered as proportional to the total weight.

c) Number of items to be manufactured as spare parts should be limited as far as possible. We assume as follows :

production	N° of pieces (rounded off)	N° of items	average lot
80 tons/y	80,000 p/y	800	100 pieces
160 "	160,000 "	1,600	100 "
320 "	320,000 "	3,200	100 "
640 "	640,000 "	6,400	100 "

The cycles are less than the items because similar pieces of similar machines from different manufacturers have the same cycle.

So the 800 items of the first phase should not be more than 80-100 cycles.

To be on the safe side, we have assumed that the number of items will increase in proportion to the tonnage, although this is not necessarily so since the number of items is consequent to the type of machinery which will be installed in the future.

Of course it is necessary to select the items carefully to obtain an average lot of 100 pieces.

It is advisable to start initially with the spare parts of Picanol and Northrop looms, then the spare parts of the other looms and lastly the spare parts of the other machines.

d) Plastic accessories : details concerning plastic accessories are given in tables 44-45.

7.5.2.3. Raw materials

A preliminary picture as regards raw materials, has been given in paragraph 7.2.1. It is however necessary to take the assertions made in paragraph 7.5.2.1. point c) into account. In this paragraph further details are given on quality, quantity and supply of raw materials, considering two hypotheses :

1) first hypothesis : Khartoum Central Foundry will supply also cast pieces of steel;

2) second hypothesis : Khartoum Central Foundry will not supply cast pieces of steel. In this case 20% of the cast pieces can be made from ductile cast iron instead of steel and they can be supplied by Khartoum Central Foundry. The remaining 80% of cast steel pieces must be bought from abroad since we have seen no steel foundry in Sudan.

In the first hypothesis, quality and supply details of raw materials are as follows :

Material	Supplier
a) cast iron: a.1 cast pieces	Khartoum Central Foundry
b) malleable cast iron: b.1. cast pieces	" " "
c) steel : c.1 cast pieces	" " "
c.2. forged pieces	from the market either local or international
c.3. wire	" "
c.4. spring wire	" "
c.5. rolled bars	" "
c.6. plates	" "
c.7. sections	" "

7.5.2.3. (cont.)

Material		Supplier
d) aluminium alloys:	d.1.cast pieces	Khartoum Central Foundry
	d.2.rolled bars	from the market either local or international
	d.3.plates	" "
	d.4.sections	" "
e) brass and bronze:	e.1.cast pieces	Khartoum Central Foundry
	e.2.forged pieces	from the market either local or international
	e.3.rolled bars	" "
	e.4.plates	" "
	e.5.sections	" "

In the second hypothesis, quality and supply of raw materials is as follows :

Material		Supplier
a) cast iron:	a.1.cast pieces	Khartoum Central Foundry
b) malleable cast iron:	b.1.cast pieces	" " "
c) ductile cast iron:	c.1.cast pieces	" " "
d) steel:	d.1.cast pieces	from the market either local or international
	d.2.forged pieces	" "
	d.3.wire	" "
	d.4.spring wire	" "
	d.5.rolled bars	" "
	d.6.plates	" "
	d.7.sections	" "

7.5.2.3. (cont.)

Material		Supplier
e) aluminium alloys:	e.1.cast pieces	Khartoum Central Foundry
	e.2.rolled bars	from the market either local or international
	e.3.plates	" "
	e.4.sections	" "
f) brass and bronze:	f.1.cast pieces	Khartoum Central Foundry
	f.2.forged pieces	from the market either local or international
	f.3.rolled bars	" "
	f.4.plates	" "
	f.5.sections	" "

Detailed quantities (tons) of the required raw materials are shown in tables 49-50.
The above quantities have been obtained from the tonnage of finished goods considering scrap to be 30%.
Raw materials for the plastic accessories are also shown in the same tables(49-50)on the basis of the tonnage of finished goods considering a scrap of 5%.

7.5.2.4. Production machinery

7.5.2.4.1. Machinery for manufacturing of spare parts

Taking into account the number of spare parts to be manufactured per year corresponding to 320 tons/year (see table 48) and the working schedules from table 27 to table 38, we obtain the work load for each machine group of the central workshop in hours/year (see table 51).

7.5.2.4.1. (cont.)

Setting time has been obtained considering an average lot of 100 pieces (see preceding paragraph 7.5.2.2., point c).
The total workload for each group of machines has been divided by the following coefficient :

300 x 8 x 0.75 = 1,800 hours/year x machine.

Where :

300 days/year	is the number of working days during one year
8 hours/day machine	is the number of working hours of one machine during one day
0.75	is the total efficiency, that takes into account machine tool efficiency, worker efficiency, stops due to any whatsoever reason. Loss of efficiency due to the utilisation of the machine tools for training (5% of the total working time) has also been taken into account in the total efficiency.

The number of each group of machinery is thus obtained in table 32, rounding off to the next higher whole number. There are 6 welding sets instead of 5 due to the necessity of having an assortment of different kinds of welding.
The total production machine figure for the third step (320 tons/year of spare parts)so obtained is 147.
The number of each group of production machines for the first step (80 tons/year), for the second step (160 tons/year) and for the third step (320 tons/year) is as follows:

7.5.2.4.1. (cont.)

Production machine	1st.step (80 t/y)	2nd.step (160 t/y)	3rd.step (320 t/y)
- 500 mm parallel lathe	14	30	60
- 600 mm parallel lathe	4	8	16
- 600 mm parallel lathe with distance between centres 4000 mm	1	1	1
- precision capstan lathe	1	1	2
- internal grinding machine	1	2	4
- external grinding machine	1	2	5
- universal milling machine	6	9	17
- 300 mm vertical milling machine	2	3	6
- bench drill	4	7	13
- floor standing drill	1	2	2
- slotting machine	2	2	3
- gear cutting machine	2	3	5
- threading machine	1	2	4
- spring making machine	1	1	1
- welding sets	3	4	6
TOTAL	44	77	147

The total number of production machines for the first step is 44. For each group, the number of machines is not exactly in this case a fourth of the preceding case due to the necessity of having a proper assortment of machines in the first phase too.
The total number of machines for the second step is 77.
Auxiliary machines, fixtures and facilities are of course necessary to back up the production machinery. They are mentioned in the description of the single shops in paragraph 7.5.4.

7.5.2.4.2. Machinery for manufacturing plastic accessories

Types and quantities of plastic accessories to be manufactured are shown in tables 44-45.
Two injection moulding machines are foreseen as follows :

a) N° 1 machine for maximum accessory weight of 300 gr. Manufacture of all the 100 gr. and 200 gr. accessories and a part of the 70 gr. accessories is foreseen by means of this machine.

b) N° 1 machine for maximum accessories weight of 100 gr. Manufacture of all the 10 gr. and 20 gr. accessories and a part of the 70 gr. accessories is foreseen by means of this machine.

The total practical capacity of these two machines is 135 tons/year, i.e. their utilization is 11% initially with 15 tons/year production and 78% finally with 105 tons/year production.
The necessary moulds are as follows :

- from 1983 to 1986 : N° 10 moulds
- from 1987 to 1989 : N° 20 moulds
- from 1990 to 1995 : N° 40 moulds

7.5.2.5. Plant areas

Plant areas for the first phase are shown in drawing 1373-MX-001 and in table 53. A total area of 16,848 m2 should be acquired right from the beginning.
The shed must be extended for the second phase in order that new machine tools may be installed without having to extend the service and office areas. The whole shed (including the service and office areas) will be doubled for the third phase.
No expansion is foreseen for the fourth phase, but a second shift will be enforced in the shed, after phase three is completed.

7.5.3. Plant site selection

We are of the opinion that the first point to be taken into account with regard to the locating of a plant in Sudan concerns reliability of the plant. The selected site must therefore guarantee the maximum possible facilities to the plant.

Considering the various factors influencing the selection of the site for the new central workshop (availability of skilled manpower, materials and utilities, as well as its having to be close to market, etc.), Khartoum and Wad Madani have been taken into consideration.

But Wad Madani has only the two following advantages with respect to Khartoum :

1) Its position is more central than that of Khartoum with respect to the textile factories. Although this means saving on finished goods transportation costs, this saving would be very limited. Considering cutting transport down by 150 km, about 10 SP/ton would be saved. Since the selling price of spare parts is 15,000 SP/ton this figure is equivalent to 0.07% of the selling price.

2) It would be a better location, from a sociological point of view, since in Khartoum there is a danger of congestion. But at present we believe this point to be of minor importance with respect to the problem of plant reliability which, in fact would prove to be a greater problem in Wad Madani than in Khartoum.

Khartoum has all the remaining advantages, amongst which we mention only the major ones :

1) nearness to suppliers : many material and service suppliers are located in Khartoum; first of all raw material and cast pieces suppliers (we have suggested that the cast pieces be acquired from Khartoum Central Foundry). Nearness to suppliers means reliability of our plant.

7.5.3. (cont.)

2) Availability of better qualified manpower and staff : such personnel is more easily available in Khartoum than in Wad Madani.

3) Availability of electric power : the power supply situation is much better in Khartoum than in Wad Madani, as already stated in paragraph 3.1.6.

Our plant could be located either in Khartoum North Industrial Area or somewhere far from Khartoum,no further than 10-20 kms, preferably in the Wad Madani direction.

7.5.4 Plant lay-out, equipment and utilities

7.5.4.1 Plant lay-out and equipment.

The factory will be divided up as follows:

a) storage area for raw materials and semi-finished pieces
b) shop for preparation of semi-finished pieces
c) turning shop
d) milling, gear making and grinding shop
e) drilling and threading shop
f) spring making machine
g) heat treatment and welding shop
h) finishing and checking department
i) plastic moulding shop
j) maintenance shop
k) finished products storage area and shipping department
l) handling equipment.

a) Storage area for raw materials and semi-finished pieces

In this area will be stored a sufficient quantity of round, square and hexagonal bars of various sizes and materials to cover three months' production (approx. 30 tons) plus another 10 tons as replenishment for workshops in the various plants. The bars will be stored on special, heavy duty sectioned stock racks of the double-fronted cantilever type.
Part of the storage area will be set aside for the semi-finished pieces which are consigned by foundries.
Transfer of materials from the unloading area to the storage area will be done by means of 1000 kg capacity bridge crane of the double-beam, suspended 3 path runaway type with direct drive electrically operated chain hoist.

7.5.4.1 (cont.)

b) Shop for preparation of semi-finished pieces

This section will be equipped with disc and belt sanding machines, each provided with a suction device for the powdered metal.
Castings (semi-finished pieces) will be trimmed by means of the afore-mentioned machines before being sent to other shops for subsequent machining. The whole shop shall be provided with an adequate dust intake system.

c) Turning shop

The shop will be equipped with a series of single pulley, parallel lathes with 500 mm swing over bed and 1000 mm distance between centres. Said lathes will be used to turn small and medium sized parts.
Other, bigger lathes - 600 mm swing over bed and 1500 mm distance between centres, equipped (besides normal accessories) with large face plates and quick change turret, will be used to turn medium-large and/or particularly complicated pieces.
It shall be possible to fit taper attachments and copying attachments to all and any of the above lathes.
One of the lathes shall be already complete with the afore-mentioned attachments.
A hand turret capstan lathe will be provided for large scale production of small pieces such as: screws, pins, etc. this lathe will have the following characteristics: bar capacity in collet 32 mm dia., height of centres 130 6 station turret head, thread chasing device, bar holder.
The turning shop will also be provided with a lathe to turn very long shafts and, in particular, crankshafts (in this case machining will consist of preparation for welding and subsequent removal of excess filler metal). Swing over bed shall, for this lathe, therefore be at least 600 mm and the distance between centres 4000 mm.

7.5.4.1 (cont.)

d) Milling, gear making and grinding shop

The parts to be machined in this section of the workshop will mainly be cast semi-finished pieces such as lever stirrups, supports, gear wheels, etc.
The following types of machines will therefore be provided: universal and vertical medium power, precision milling machines with a working surface of approx. 270 x 1250 mm, equipped with standard accessories.
The universal milling machines will be equipped with copying attachment and dimension visualizer.
The milling shop will also be equipped with a universal milling machine with higher power and higher capacity than the other machines to mill particularly large parts. The working surface shall be at least 400 x 800 mm.
Two gear hobbing machines will be provided for the production of gears of up to 280 mm in diameter from bars and for gear cutting on semi-finished pieces.
The following machines will also be located in the milling shop:

- a slotting machine to cut slots and grooves, with a ram stroke of 200 mm, 130 strokes per minute
- an internal grinding machine for diameters of 3 to 20 mm.
- an external grinding machine with max. grinding capacity of 250 mm. diam. - distance between centres 450 mm.

e) Drilling and threading shop

All drilling and threading work will be carried out in this section of the workshop which will therefore be equipped with the following machines:

7.5.4.1 (cont.)

- a set of bench drills with steel drilling capacity of 10 mm; two of the drills will be fitted with a multiple head for sequence drilling
- automatic threading machine - threading capacity up to 16 mm diam.
- pillar drill with steel drilling capacity up to 20 mm, tilting vice bench, chilling pump, multiple head and standard accessories
- radial drill with steel drilling capacity of 30 mm, working range of 900 mm, base with tilting table, chilling pump and standard accessories.

f) Spring making machine

An automatic machine for the production of springs using 0.3 - 1.7 mm. wire will be installed in the drilling and threading shop. It will be complete with winding reel, right and left winding device, hook forming device and accessories for production of cylindrical clock-wise and and anti-clockwise springs.

g) Heat treatment and welding shop

Besides normal production work, repair of parts sent back from the textile factories will also be carried out in this shop (which is to be provided with an adequate dust suction system).

In fact, owing to the high cost of new parts, certain pieces are worth repairing, at least at the first breakage; e.g. crank shafts.

Yet another operation that can be carried out is that of the building-up of worn shafts with metallic powders by means of a torch.

The following will therefore be installed in this shop:

7.5.4.1. (cont.)

- oxyacetelyne welder
- 200A MIG welder
- D.C., 400A arc welder
- welding bench with exhaust system.

The shop will also be equipped with an electric furnace for heat treatment and a quench tank.

h) Finishing and Checking Department

All the parts produced in the whole workshop will be sent to this department for finishing , assembly and checking. Work benches equipped with tools and measuring instruments will be installed. This department will also comprise:

- a laboratory in which will be carried out hardness tests, measurement and setting of the measuring instruments. It will therefore be equipped with the following instruments :
  . a universal semiautomatic, direct reading hardometer which can test a wide range of metal pieces of various shapes and dimensions, able to carry out Brinell and Rockwell tests; it will be complete with the necessary accessories.
  . a complete set of parallel gauge blocks, block squares and V-blocks.
  . a complete set of thickness gauges, screw-pitch gauges etc.
  . a set of sensitive dynamometers with a capacity of up to 250 gr. for testing and gauging of cylindrical springs.
- a room , equipped with fume-exhaust system, in which paint-work will be carried out.

i) Plastic moulding shop

During the first stage of factory operation, about 30 tons of plastic parts are expected to be produced. The shop will be equipped with 2 thermoplastic injection presses; one with injecting capacity of 100 grammes and the other of 300 grammes.

The following machines will also be provided:

- a granulator to grind the feedhead and rejects to recover same,
- a drier for dehumidification of material before moulding,
- a mixer for any dyes that are to be added to the plastic,
- a chiller (chilling unit + water recycler) to cool the presses,
- a closed circuit boiler for production of hot water to heat moulds to right temperature at the beginning of each production cycle.

7.5.4.1 (cont.)

j) Maintenance shop

The maintenance shop will be equipped with the necessary machinery and tooling for routine and special maintenance work and for maintenance of tools, production machine tooling and of the factory in general.
The maintenance shop will therefore contain:

- a belt saw for metals with vertical cutting capacity of 200 mm and distance between blade and upright of 400 mm.
- an alternative saw for metals with cutting capacity for rounds of 220 mm
- parting tool, blade diam. 250 mm
- bench shear, blade length 200 mm
- fly press - 4 ton. pressure
- tool sharpener with max working diameter of 220 mm and distance between centres of 400 mm.
- properly equipped work benches
- forging station.

k) Finished products storage area and shipping dept.

Many of the parts produced will be fairly small in size and can therefore be stored in plastic containers whilst others will be placed directly either in racks or on pallets as the case may be.
For storage of the latter parts, sectional racks will be provided; part will be fitted out with shelves and part will be suitable for the storage of pallets.
Part of this storage area will be set aside for the preparation of parts to be shipped.

7.5.4.1 (cont.)

1) Handling equipment

Transfer of materials from storage areas to the sh , s and vice versa will be by means of a 2000 kg capacity electrically operated fork-lift truck and an electrically operated "transpallet".

7.5.4.2 Electrical system.

a) Electrical supply

The electrical supply to the plant will be made from the medium voltage distribution system through a standard overhead line.
At the fence of the factory a short cable trunk will connect the last line mast with the transformer substation.

b) Transformer sub-station

The trasnformer sub-station will be composed of:
- 1 MV switchgear
- 2 MV/LV transformers located in transformer vaults ventilated from outdoors
- 1 LV general switchgear
- 1 DC power supply.

c) MV panel

The MV switchgear should be metal clad type and should be composed of an incoming cubicle with an isolating switch, a measurement cubicle with PT and CT, 2 feeder cubicles with low oil circuit breaker, an isolating switch and CT. The switchgear shall be clad in such a way to ensure safe entrance to the circuit breakers cubicles when the busbars are alive.

7.5.4.2 (cont.)

All the interlocks necessary to avoid incorrect operation of the equipment should be provided.
The circuit breakers shall have a motor driven operating mechanism and opening and closing coils.
Protective relays will be secondary type and will be placed in a separate compartment.
They will allow the protection from short circuits and from earth faults.
The following measurements shall be supplied:
- busbars voltage
- total current
- active power and power factor
- meters for active and reactive powers.

d) Transformers

The transformers are natural cooled type and for external installation.
Rated power will be 400 KVA. Rated primary voltage will be stated at a later stage.
The transformers will be supplied with the usual accessories as follows:
- oil tank with levels
- Buccholtz relays
- thermometer
- wheels, etc.

Each transformer will have sufficient power to be able to feed, by itself, 70% of the max. load foreseen, without exceeding its rated performance.

e) Low voltage main switchgear

A metal clad type prefabricated switchgear made of steel sheet with withdrawable circuit breakers, shall be provided.

7.5.4.2 (cont.)

The circuit breakers shall be moulded case type, hand operated and with direct electromagnetic releases.
The main circuit breakers of the transformer shall have a shunt opening coil to obtain the opening of the circuit breaker, should the high voltage switch open.
Controls for medium voltage circuit breakers shall be placed in a separate compartment of the low voltage main switchgear.
Number and sizes of feeder will match with the distribution network and will have at least a 20% spare capacity for each size.

f) Direct current power system

An ancillary generating station with rectifier and nickel-cadmium battery shall be installed in the MV sub-station for feeding the direct current auxiliary systems, such as signalling lamps, trip coils, relays, etc.
The ancillary station will be composed of a steel sheet cubicle, containing the battery charging and the storages battery.
The battery capacity will be at least 10 Ah at discharge in 5h and the rated output voltage will be 48 Vcc.

g) Power factor improvement

In order to obtain a 0.9 plant power factor, a suitable power condenser battery having the following characteristics shall be provided:

- indoor installation in a cubicle containing also the unit regulation
- rated voltage 415 V 50 Hz
- breaking down in 3 units
- the regulator will connect the units to obtain 4 steps.

7.5.4.2. (cont.)

The regulator will be suitable to work by means of a hand control.
The battery shall be formed by modular units to allow further additions.
The regulator will be supplied with the current and voltage signals coming from the P.T. and C.T. located on MV switchgear.

h) Electric power distribution

The electric power distribution system will be radial type and will be from the low voltage switchgear.
The lighting loads will be generally fed by cables different from those provided for the machinery to avoid flickering.
Distribution in machine tool area will be made by using prefabricated modular busbars in order to allow easy changes in lay-out and further additions.
General purpose distribution will be by means of cable trays.
Cable sizing will take local high room temperature into consideration.
Distribution in offices and living areas will be through concealed PVC pipes with flush mounted devices.
Local boards will be provided for feeding HVAC loads, power outlets, etc.

i) General lighting levels

The average lighting levels, measured at 0.8 m from the ground after 100 hours operation will be as follows :

- working areas	400 lux
- utilities storage	150 lux
- technological rooms	250 lux
- corridors and passages	150 lux
- offices	300 lux
- living areas	150 lux
- external area	20 lux

7.5.4.2 (cont.)

The ratio between minimum and average level for all the internal areas shall not be less than 1 : 1.5.

j) Plant lighting system

The lighting system of the plant will be carried out by means of the open type lighting fixtures, with reflectors, with fluorescent or mercury vapour lamps.
The switching on will generally be carried out from the local panels.
Circuits for the night lighting of the passages shall be provided.

k) Office lighting

The office lighting system will be carried out by means of lighting fixtures with fluorescent tubes and with acrylic protection.

l) External lighting

The external lighting system will be similar to that used for street lighting with metal poles and mercury vapour lamps of 250 W.
The external lighting system will be controlled by a photo-electric cell and by a time control which will control lighting during the night.

m) Safety lighting

The safety lighting system will be by means of lamps with incorporated battery and battery charger for 2 hrs. service placed along the corridors and at the exits. The obtained lighting level must be sufficient to allow orderly exit of the personnel.

7.5.4.2 (cont.)

n) Lighting fixtures

All the lighting fixtures for discharge lamps shall have individual power factor corrected ballasts and protecting fuses.
The ballasts shall be suitable to operate at the maximum specified temperature and the internal wiring shall be insulated for high temperatures.

o) Earthing

A complete earthing system such as to avoid every danger to persons in case of faults in the electric plant shall be installed .
The system will comprise of a copper cable ring covering the whole area of the plant connected with grounding rods.
The earthing system will be connected with:
- all metallic parts of the electric equipment
- the neutral of the transformers
- the metallic structures of the buildings
- the piping and conduits networks.

The earth and neutral wires will be separated at every point.
Precaution to protect the buildings from lightning shall be taken, according to VDE Standards (Blitzschutz und Allgemeine Blitzschutzbestimmungen, latest edition published by VDE-Verlag, Berlin).

p) Telephone installation

The telephone system shall be composed of a switchboard for two external lines and 25 extensions.
Telephone sets for the offices, the main departments and the warehouse shall be provided.
The distribution telephone network will be independent from every other electric distribution network.
Incoming telephone lines shall terminate at the switchboard.

7.5.4.2 (cont.)

q) Time clocks

Four printing time clocks shall be supplied.
Three of them will be installed in the workers main entrance to the production building, the fourth one outside the gatekeeper lodge.
One of the above mentioned time clocks shall be the master clock and shall be interconnected with all the others.
Each time clock shall be equipped with a double container for time cards.
The time clock located at the gatekeeper's lodge shall be equipped with a device, capable of preset timing, for activating a clear audible siren or bell.

7.5.4.3 Heating, ventilation, air conditioning system.

7.5.4.3.1 Production area HVAC system.

a) Technical design data

- climatic conditions:
  summer : 42°C, 25 % rh
  winter : 13°C
- indoor temperature:
  summer : 35°C max
  winter : 18°C min

b) Plant description

The plant in question shall be such as to ensure continuous ventilation throughout the building as well as to compensate for the air extracted through hoods with which some work-benches are equipped; said plant will also keep the production area cool during the summer and provide the necessary

7.5.4.3.1 heating should the outdoor temperature drop below 15°C. Two heating ventilation units shall therefore be provided which shall let air into the building through a system of ducts complete with relative air inlet registers; the two units shall be located inside the building on a platform overlooking the laboratories and factory offices.

The units shall be equipped with a humidification section to effect evaporative cooling of the air and with an electric heating battery should heating be required. Some areas of the building will be provided with roof extractors to ensure elimination of fumes and vapours; those areas will obviously be kept at a lower pressure than the rooms giving on to same.

The canteen and kitchen area will be equipped with its own separate heating-ventilation system which will function, however, in the same way as that installed for the production area; i.e. evaporative cooling of the air and heating by means of an electric battery. To ensure air extraction through hoods in the kitchen an axial fan will be connected to the hoods by means of an external duct running across the kitchen roof.

The changing rooms, bathrooms and toilets will have an air extraction system consisting of ducts, suction valves and roof extractor; the changing rooms will be provided with electric heaters should any heating be necessary.

c) List of main components of HVAC plant, with relative characteristics of each

- n° 2 air conditioning units for the production area, each complete with:
  - . fresh air inlet complete with sand filter of the "Dust louvre" type or similar with air delivery capacity of 15,000 m^3/h

7.5.4.3.1 (cont.)

. mixer for fresh air and recirculation air complete with gate valve on each inlet and sized for:

fresh air	15,000 m^3/h
recirculation air	30,000 m^3/h

- extractable multi-cell for filtering section with air flow capacity of 45,000 m^3/h
- humidification section complete with double row of nozzles, water tank, spray pump, drop separator
- ventilation section complete with double suction centrifugal fan coupled to an electric motor by belts and pulleys, capacity 45,000 m^3/h and suitable pressure
- electric heating battery - air flow capacity 45,000 m^3/h 100 kW
- duct system for air distribution complete with air inlet registers
- automatic electric regulation system with two room thermostats for each unit: one will act on the washer pump and the other on the electric heating battery, respectively for summer and winter operation of the system
- n° 1 air conditioning unit for the canteen and kitchen, identical to that installed for the production area but with the following capacity:
  5,000 m^3/h conditioned fresh air
- n° 1 axial fan connected to kitchen hoods - capacity 5,000 m^3/h
- duct system for air distribution to canteen complete with circular air inlet diffusers
- automatic electric regulation system for canteen air conditioning unit, analogous to that described for production building

7.5.4.3.1 (cont.)

- n° 3 roof extractors located in correspondence to the trimming, painting and welding shops, each with a capacity of 3,000 m^3/h
- n° 2 roof extractors for the toilets in the workshop building, each with a capacity of 500 m^3/h
- n° 5 roof extractors for the whole area covered by the workshop building, each with a capacity of 3,000 m^3/h
- n° 1 roof extractor for changing rooms, each with a capacity of 2,000 m^3/h

7.5.4.3.2 Office air conditioning system

a) Design data

. outdoor temperature

summer : 42°C
winter : 13°C

. indoor temperature

summer : 30°C
winter : 20°C

b) Description of system

Each office will be provided with its own "window installation" type air conditioner. The conditioners will be of adequate capacity and, by operation of a heat pump, will also provide heating when necessary.
The office area toilets will be provided with an air extractor which will provide continuous air exchange.
Electric heating plates will be provided should heating be necessary.

7.5.4.4. Water supply and distribution network

a) Water supply

It has been assumed that the water required for technological, production and sanitary uses as well as for drinking, will be available in quantities as indicated hereunder and at a suitable pressure (approx. 3 kg/sq.cm) from a normal acqueduct; it has also been assumed that said water will be drinkable and sand-free.

Should there be no aqueduct, a well, complete with 2 submersible pumps (one in operation and one on stand-by) shall be sunk.

Our estimate however has taken only the former case into consideration (i.e. water available from an aqueduct) and the sinking of the well and supply of the relative pumps are not therefore included.

b) Water consumption

- for technological uses:

  1,000 lts/h x 8 working hrs = 8,000 lts/day

- for sanitary and drinking purposes:

  100 employees x 70 lts/person per day = 7,000 lts/day

- for air conditioning plant:

  750 lts/h x 8 hrs = 6,000 lts/day

  total = 21,000 lts/day

The above calculation takes account neither of water consumption relative to the housing facilities near the workshop nor of housing with supply direct from the aqueduct.

c) Water distribution piping

The plant will have a single water distribution network, designed for delivery of 4 m^3 water per hour, which will meet both production and sanitary requirements.

7.5.4.4 The distribution network will be of the closed ring type:
Piping will be:

- when exposed: dip galvanized, welded gas pipe with anti-condensate insulation
- when running underground: welded steel piping with tar and jute external protection.

Each bathroom and toilet unit will be provided with a 1,000 lts. capacity asbestos cement tank for W.C. flushing located on the roof above the unit.
Water supply to said tanks will be by ½" dia. branch pipes and float valve. Water supply to all other sanitary fixtures will be direct from the distribution network.
The following sanitary fixtures shall also be provided:

- vitreous china wash basins with heavy chrome plated taps (cold water only) and drain trap
- porcelainized grès shower tray with single lever hot and cold water mixer, swivel type spray and bottle trap
- porcelainized grès squat type W.C. with instant flushing device and drain trap
- vitreous china, bowl type W.C. with instant flushing device
- vitreous china bidet with hot and cold water taps and drain trap (only for employees' housing)

Hot water for kitchen use shall be provided by a suitable sized electric or L.P.G. gas water heater, into which cold water is fed as hot water is drawn off.

7.5.4.4 (cont.)

Hot water for the workshop sanitary facilities shall be provided by 100 lts. capacity electric water heaters installed in each bathroom.

7.5.4.5 Kitchen and self-service counter equipment.

The kitchen shall be able to cater for 100 meals at one sitting only.

The kitchen shall be divided up into the following areas:

a) checking and storage of provisions
b) food preparation
c) cooking
d) dish washing
e) self-service counter

and shall be equipped with the following:

a) Area for checking and storage of provisions

n° 2 650 lts capacity freezer for storage of frozen foods
n° 1 2300 lts refrigerating cabinet
n° 3 storage shelves
n° 1 work table complete with drawers
n° 1 300 kg platform balance with dial
n° 1 trolley

b) Food preparation area

n° 2 worktables
n° 1 table type double sink
n° 1 electric potato peeler, capacity 2 - 2½ kg/min of peeled potatoes
n° 1 electric meat mincer/grater/liquidizer with 1.5 HP motor
n° 1 meat board
n° 1 storage bench
n° 1 slicer-blade diam. 300 mm.
n° 1 automatic scale to weigh 9 kg max.

7.5.4.5 (cont.)

c) Cooking area

n° 1 gas or electric cooker with oven
n° 1 150 lt. gas or electric cooking pot
n° 1 30 lt. gas or electric frier
n° 1 hood installed above the cooking unit complete with suction type extractor
n° 2 work tables
n° 1 1500 lt. refrigerator.

d) Dish washing area

n° 2 work tables
n° 1 table type deuble sink
n° 1 300 plates/hour electric dishwasher

e) Self-service counter

n° 1 cash desk and register
n° 1 cold storage food container
n° 1 display unit for food at room temperature
n° 2 hot food containers (temperature maintained by means of hot water bath)
n° 1 tray holder with bread and cutlery dispensers
n° 2 trolleys for canteen area
n° 1 chilled water drinking fountain.

7.5.4.6 Sewerage waste pipes and waste treatment plant.

The waste pipes, as far as the drain traps of each sanitary fixture, shall be in PVC as per UNI 7443-75 or equivalent (pipes suitable for fluids up to 70°C) with ball and spigot joint. Ventilation will be by means of risers leading to the roof where air extractor will be installed; water proofing at these exit points on the roof will be by means of lead-plate, thickness 20/10.

7.5.4.6 (cont.)

The waste pipe networks will be provided with PVC inspection tees complete with plugs, enclosed in brickwork trapswhich, when located inside the building, will have a cover (supported by a brass frame) of the same material as the flooring itself and when located outside the building, will have cement covers.
Before entering the sewers, grease and oil in kitchen waste will be removed by means of special traps.
All sewerage shall be treated in an activated sludge type treatment plant with the following characteristics:

- average daily capacity:

  100 employees x 70 lt/day per person = 7000 lts/day

- total BOD content:

  100 employees x 23 gr/day per person = 2300 gr/day

- BOD concentration in waste:

$$\frac{2300 \text{ gr/day}}{7000 \text{ lt/day}} = 328 \text{ mmgr/lt}$$

Waste liquid, which on leaving the treatment plant shall have a residual BOD content of no more than 40 mmgr/lt (providing local regulations do not prescribe a lower content), shall be let into the rainwater drainage piping and taken as far as boundary fencing.

7.5.4.7 Rainwater drains.

a) Downpipes

The downpipes shall be in PVC as per UNI 7443-75 or equivalent; jointing shall be with bell and spigot joints and suitable adhesive.
Downpipes shall be complete, at roof level, with 20/10 thickness lead plate pipe unions and a galvanized wire mesh leafguard

7.5.4.7 (cont.)

and, at the foot, with drain pits having internal dimensions 45 x 45 cms. and made of precast concrete rings (2 or 3 rings). These pits shall also be used for inspection of the underground drainage pipes.

b) Underground drainage network

This network shall be used for collection of rainwater draining off roofs since rain falling on roads and paved areas will drain off directly into the ground.
The rainwater drainage piping will extend only as far as the boundary fencing (drainage beyond this point is not included at this stage).
The drainage network will be of PVC piping, as per UNI 7447-75, or equivalent with bell and spigot joint complete with rubber ring.
The pipes shall be laid on a 10 cm. thick bed of sand with screened earth covering.
Inspection manholes shall be installed along the network covers for same, according to location, shall be as follows:

- "vibrocast" concrete covers for manholes in pavements, gardens or lawns
- heavy-duty cast iron covers for manholes inside the production area and in roads and yards.

7.5.4.8 Compressed air station and distribution network.

Compressed air consumption for technological purposes will be 2500 lt/min.
The compressed air station will be equipped with two reciprocating, normal lubrication, air cooled, motor driven compressors, each with a capacity of 2800 lt/min., pressure 7 kg/sq. cm., automatic regulation by means of pressure switch.
Each compressor will be equipped with aftercooler (air circulation type).

7.5.4.8 (cont.)

The compressed air station will also be complete with:

- 2000 lt capacity; 8 kg/sq.cm pressure, storage tank equipped with safety valve, pressure gauge, pressure switch and automatic condensate trap
- chilling cycle drier for dehumidification of air.

The compressed air distribution ring will be in dip galvanized weldless gas pipe along which will be installed ball valves for line sectioning.
The distribution network shall be such as to ensure a pressure drop of no more than 0.3 kg/sq.cm at consumer points.
Since the compressed air is to be dried distribution piping will not need the slope.
Compressed air service supply points shall be provided with plug cocks with quick-coupling attachment for hoses.
Instrument air supply points shall, on the contrary, be equipped with an air cleaner filter/pressure reducer (with pressure gauge) unit.

7.5.4.9 Fire fighting system.

The fire fighting system will consist exclusively of the following extinguishers :

- in the workshop:
  50 kg trolley mounted powder and foam extinguishers and 6 kg portable powder extinguishers complete with hose and nozzle
- in the offices:
  5 kg carbon dioxide (CO_2) portable extinguishers complete with support for wall mounting.

7.3.3. Building and other civil works specifications

Before making a final decision as to the type of structure to be used for the building in question, investigations were made and a thorough comparative analysis of solutions adopted in similar cases were carried out.

In view of the type of work to be carried out in the building and the flow of workers it has been decided that the most suitable solution would be that of grouping the various function (operational, administration and social) together in one building as is shown on the attached drawings.

The plan of the building infers a regularly shaped construction, built on a flat ground close to a public highway connecting same to one or more towns.

The design of the plant takes into account the principal rules and regulations in force in Italy which govern the construction of industrial building.

A partially blind enclosure will surround the area to be built on during the first stage and a strip of ground outside, running along the public highway, will be set out as a car park for employees and visitors, besides serving as a safe entry and exit area for trucks.

The road network in the grounds of the plant will consist of a stretch of road which, branching off orthogonally from the main highway, will serve as means of access to the industrial plant.

An internal ring road will run right round the building, widening out into loading and unloading yards at certain points.

The industrial plant is housed in the building shown on the attached drawings.

It has been sized to accommodate the processing machinery, the necessary storage areas and the offices changing rooms for the personnel.

7.5.5 (cont.)

The internal arrangement of the building has been studied with a view to functionality, rationality and thrift at the same time, however, paying great attention to the external appearance of the building which can be rendered pleasing and decorative.

Description of the building:
The building will be rectangular and its structure will be entirely in steel.
The pillars will be erected on a 12 mt x 8 mt grid in the 2,000 sq. mt. covered area of the workshop and on a 6 mt x 6 mt grid for the 860 sq. mt two storey area which will house the offices, the changing rooms and the canteen.

Roofing will be of two different types: shed type for the workshop and flat for the office area. The material used for roofing will be sandwich type, corrugated sheet steel with a suitable filler-layer of insulation.

The external walls will be of full-height sandwich-type metal panels; metal window frames will be mounted in special openings in the panels where light and ventilation are needed for those rooms located along the perimeter of the building.

The gatekeeper's lodge will be located in a separate building near the main entrance and connected to the plant by a roof going across the access road to the plant, thus creating a check point and weighing station for the goods entering and leaving the plant.
Housing areas: the construction of a group of bungalows (each to house one family only) is foreseen on the opposite side of the public highway to the industrial building.
These houses will serve as accommodationfor the instructors for the whole duration of the training course which will be attended by the workshop apprentices.

7.5.5 (cont.)

The bungalows will each have an area of about 100 sq. mts. and will be built with traditional materials.
They will each have a small garden in which will be planted shrubs suited to the climate thus giving the bungalows a pleasant, restful appearance.

Later an apprentice's quarter with services will be built for 40 trainees. The apprentice's quarter will have a 1,300 sq.mt two storey area. Service zone will include canteen, bar, meeting room and will have and additional 400 sq.mt area.

7.5.6. Personnel requirements and training

The personnel required for the different production phases is as follows :

1) Production personnel	1st prod. phase (80 tons/ year 1984-85-86	2nd prod. phase (160 tons/ year 1987-88-89	3rd prod. phase (320 tons/ year 1990-91-92	4th prod. phase (640 tons/ year 1994-95
1.1 Machine workers	46	89	178	356
1.2 Auxiliary workers	23	29	39	78
1.3 Supervisor	1	1	1	1
1.4 Foreman for turning drilling and threading shops	1	1	1	2
1.5 Foreman for the remaining mechanical shops.	1	1	1	2
1.6 Foreman for plastic moulding dept.	1	1	1	1
1.7 Foreman for maintenance	1	1	1	2
1.8 Storekeeper	1	1	1	2
1. Sub-total of production personnel	75	124	223	444
2. Sub-total of trainers	4	4	8	8
3) Staff and Management				
3.1 General Manager	1	1	1	1
3.2 Sales Manager	1	1	1	1
3.3 Admin.Manager	1	1	1	1
3.4 Technical Manager	1	1	1	1
3.5 Admin.& Secretary Clerks	6	6	8	12
3.6 Draftsmen	2	2	3	4
3.7 Prod.planning clerks	2	2	3	4
3.8 Nurses	1	1	2	4
3. Sub-total of staff & Management	15	15	20	28
Total personnel	94	143	251	480

7.5.6. (cont.)

Of course people must be hired in advance because of training necessities according to the preliminary schedule in table 42.
The number of people required is defined year by year in tables 54-55.
It is advisable that the supervisor and the foreman be present during the plant installation in the second half of 1982.
A six-month training course abroad should be included in the installation contract as follows :

a) training abroad in the 1st half of 1982 for the following people:

a.1) - supervisor
a.2) - foreman for turning, drilling and threading shop
a.3) - foreman for the remaining mechanical shops
a.4) - foreman for plastic moulding department
a.5) - foreman for maintenance

b) training abroad in the 1st half of 1992 for the following additional people :

b.1) - foreman for turning, drilling and threading shop
b.2) - foreman for the remaining mechanical shops
b.3) - foreman for maintenance

c) training abroad in the 2nd half of 1982 for the following people:

c.1) - N° 4 trainers (see preceding paragraph 7.5.1.3. point b)

d) training abroad in the 2nd half of 1989 for the following additional people :

d.1) - N° 4 trainers (see preceding paragraph 7.5.1.3 point b)

7.6. Economical study for the new central workshop

7.6.1. Investment requirements

7.6.1.1. Fixed capital expenditures

The following estimates are based on prices in force in mid 1979. At the time of award of contract and erection of the plant an escalation in fixed capital expenditures is expected. No prevision has been made as to this escalation, since the present inflation rates in the most industrialized countries are greatly influenced by many factors and it is very difficult to make a forecast.
We have assumed that the plant be ordered on a "turn-key" basis.
All the figures are expressed in Sudanese Pounds and are rounded off.

a) Land and building :

- Land acquisition, cleaning and grading		30,000 SP
- Site works: parking areas, roads, yards, fencing		60,000 SP
- Production area : (see table 56)	1st phase	305,000 SP
	2nd phase	260,000 SP
	3rd phase	550,000 SP
- Office and service area : (see table 56)	1st phase	215,000 SP
	2nd phase	-
	3rd phase	205,000 SP

7.6.1.1. (cont.)

Total cost of land and building are therefore 1,625,000 SP, out of which approx. 1,000,000 SP are to be paid in foreign currency.

As we have already stated in the preceding paragraph 7.5.1.3., point c), the cost of the housing facilities for the new training centre is not to be charged to the present project because these housing facilities are to be provided by the Government. Their estimated cost is as follows :

- N° 8 small houses (installation from 1/7/1981 to 31/12/1982)	170,000 SP
- apprentices' quarters and services (installation from 1/7/1987 to 31/12/1988)	335,000 SP

b) Installed equipment :

- 1st phase	1,915,000 SP
- 2nd phase	1,170,000 SP
- 3rd phase	2,760,000 SP
Total	5,845,000 SP

For details see table 57.

The above costs include main Contractor's fee, transport to site, erection, spare parts and maintenance materials for two years service, local taxes and contingencies. Customs duty has not been taken into consideration since this is a new plant.

7.6.1.1. (cont.)

c) Consultant's fee. Consultant's fee is foreseen for preparation of tender documents and supervision of work (for 30 man-months) (1st phase) 130,000 SP

d) Pre-operational expenditures :

d.1. legal matters connected with the constitution of the Company, authorization, etc. (1st phase) 10,000 SP

d.2. expenses for personnel hired before production is commenced as follows (see preceding tables 54-55 and following table 61) (1st phase):

- for the first year (1981) 3,000 SP
- for the second year (1982) 41,000 SP

d.3. other expenditures relative to personnel (travel and living expenses for personnel trained abroad including supplier's fee for training and provision of technical documentation)

(96 man-months x 1,000 $\frac{\text{SP}}{\text{man-month}}$) 96,000 SP

The break-down is as follows :

- 1982 (1st phase) : 54,000 SP
- 1989 (2nd phase) : 24,000 SP
- 1992 (3rd phase) : 18,000 SP

The total pre-operational expenditures are therefore 150,000 SP, out of which approx. 100,000 SP are to be paid in foreign currency.

7.6.1.1. (cont.)

e) Total fixed capital expenditures : total fixed capital expenditures can be summarized as follows (see also table 58):

Description	Sum to be paid in foreign currency (thousands of SP)	Sum to be paid in local currency (thousands of SP)	Total (thousands of SP)
Land & building	1,000	625	1,625
Installed equipment	5,145	700	5,845
Consultant's fee	100	30	130
Pre-operational expenditures	100	50	150
TOTAL	6,345	1,405	7,750

7.6.1.2. Technical know-how and managerial assistance

We deem it necessary to reach an agreement with a qualified spare parts manufacturer in order to obtain technical know-how and assistance for the whole period of activity in the following fields:

a) technical know-how concerning technical specifications of the spare parts and plastic accessories and processing

b) managerial assistance.

We estimate that this agreement will entail an expenditure of 1% of the gross revenues (see following paragraph 7.6.6.)

7.6.1.3. Working capital

Working capital requirements are described in paragraph 7.6.7.

7.6.2. Service life of the plant, depreciation and phasing of investment

Process equipment has an industrial life span of about 15 years or more. As a precautional measure we have assumed an industrial life of 13 years for this plant.

The equipment will be used from 1983 up to 1992 on 1 shift. Only from 1993 up to 1995 will it be used on 2 shifts.

As a precautional measure the industrial life has not been increased.

We have assumed a uniform depreciation during each phase.

As a precautional measure the salvage value of the plant has been considered only 50% of the investment of the 3rd phase (3,557,000 SP), that is 1,778,500 SP.

The total capital expenditure of 7,750,000 SP and their depreciation is divided up as is shown in tables 58-59.

The phasing of investment (payment values) concerning land and building, equipment and consultant's fee is assumed to be as follows (see also preceding paragraphs 7.3.1.2.2. and 7.6.1.1.) :

a) 1st phase:	20% at award of contract	(1.1.1981)
	30% after six months	(1.7.1981)
	20% after twelve months	(31.12.1981)
	15% after eighteen months	(1.7.1982)
	5% at commissioning	(31.12.1982)
	10% after one year's operation (guarantee period)	(31.12.1983)

7.6.2. (cont.)

	50% at the starting point of equipment installation	(1.1.1985)
	20% after six months	(1.7.1985)
b) 2nd phase:	15% after twelve months	(31.12.1985)
	5% at commissioning	(30.6.1986)
	10% after one year's operation (guarantee period)	(30.6.1987)
	50% at the starting point of equipment installation	(1.7.1987)
	20% after six months	(31.12.1987)
c) 3rd phase:	15% after twelve months	(30.6.1988)
	5% at commissioning	(31.12.1988)
	10% after one year's operation (guarantee period)	(31.12.1989)

As far as pre-operational expenditures are concerned payment times are given in paragraph 7.6.1.1.

The payment values year by year are shown in table 60.

7.6.3. Expenditure for personnel

The personnel required is described in paragraph 7.5.6.

Assuming the following wages and salaries :

a) production personnel :

a.1. workers	900 SP/year
a.2. supervisor	2,500 SP/year
a.3. foremen	1,800 SP/year

7.6.3. (cont.)

b) training personnel :

b.1. trainers	1,800 SP/year

c) staff and management :

c.1. general manager	6,000 SP/year
c.2. other managers	3,500 SP/year
c.3. clerks and nurses	1,200 SP/year

The total personnel expenditures will be as shown in table 61.

7.6.4. Operational expenditures

7.6.4.1. Cost of raw materials

The quantities of raw materials, both metal and plastic, are shown in table 49.

Considering the following average prices of the raw materials, all inclusive

- metal 1.50 SP/kg = 1,500 SP/ton
- plastic (PVC, Polythene, etc.) 0.40 SP/kg = 400 SP/ton

The following costs for the raw materials are applicable :

Year	Cost of metal (thousands of SP)	Cost of plastic (thousands of SP)	Total cost of raw materials (thousands of SP)
1983	78	6.3	84.3
1984	156	12.6	168.6
1985	156	16.8	172.8
1986	156	20.2	176.2
1987	312	23.5	335.5
1988	312	26.9	338.9
1989	312	30.2	342.2

7.6.4.1. (cont.)

Year	Cost of metal (thousands SP)	Cost of plastic (thousands SP)	Total cost of raw materials (thousands SP)
1990	624	33.6	657.6
1991	624	35.7	659.7
1992	624	37.8	661.8
1993	936	39.9	975.9
1994	1,248	42.0	1,290.0
1995	1,248	44.1	1,292.1

The total cost of raw material is shown in table 62 together with the remaining operational expenses.

7.6.4.2. Cost of utilities

a) Electric power : energy consumption and cost are as follows :

Year	Energy consumption (kWh)	Cost (thousands of SP)
1983	200,000	14
1984	360,000	22
1985	360,000	22
1986	360,000	22
1987	680,000	42
1988	680,000	42
1989	680,000	42
1990	1,300,000	75
1991	1,300,000	75
1992	1,300,000	75
1993	2,000,000	105
1994	2,600,000	120
1995	2,600,000	120

7.6.4.2. (cont.)

b) Water : water consumption and cost are as follows :

Year	Water consumption (m3/year)	Cost (thousands of SP)
1983	4,000	0.3
1984	6,000	0.4
1985	6,000	0.4
1986	6,000	0.4
1987	9,000	0.6
1988	9,000	0.6
1989	9,000	0.6
1990	15,000	1.0
1991	15,000	1.0
1992	15,000	1.0
1993	25,000	1.7
1994	30,000	2.0
1995	30,000	2.0

The total cost of utilities is shown in table 62 together with the remaining operational expenses.

7.6.4.3. Maintenance, spare parts and other consumption materials

The cost of spare parts, maintenance and consumption materials, considering the costs of equipment to include spare parts, maintenance and consumption materials for two years' service, is as follows :

1983	-	(thousands of SP)
1984	-	" "
1985	38,300	" "
1986	38,300	" "
1987	61,700	" "
1988	61,700	" "
1989	61,700	" "
1990	116,900	" "
1991	116,900	" "
1992	116,900	" "
1993	175,400	" "
1994	233,800	" "
1995	233,800	" "

7.6.4.4. General expenses

The break-down is as follows :

- telephone
- bank charges
- legal expenses and insurance
- office supplies
- contributions to industrial associations and Public Relations
- use of company cars, maintenance and spare parts included, transport expenses.

The general expenses are as follows :

- from 1983 to 1989 : 40,000 SP
- from 1990 to 1992 : 50,000 SP
- from 1993 to 1995 : 70,000 SP

The general expenses, together with the expenditures for personnel and with the remaining operational expenses, are shown in table 62.

7.6.5. Inventory values

7.6.5.1. Inventory value of finished goods

The inventory value of finished goods has been calculated assuming:

a) industrial cost as the sum of cost of raw materials plus expenditures for production personnel plus cost of maintenance, consumption materials and of utilities.
The industrial cost has been calculated separately for spare parts and for plastic accessories.
Production personnel for plastic accessories consists of only 1 foreman, 4 machine workers and 1 auxiliary worker. All the remaining production personnel is for spare parts manufacture.
Cost of maintenance, consumption materials and of utilities for plastic accessories has been considered as 15% of the total from 1983 to 1992 and constant from then on.
Total industrial costs and unitary industrial costs are shown in tables 63-64.
The unitary industrial costs are more or less constant (for spare parts and for plastic accessories) since only proportional costs have been considered.

7.6.5.1. (cont.)

b) The increase in inventory value has been calculated according to the F.I.F.O. (First In, First Out) method.

c) Finished goods stock is as follows :

	Spare parts (tons)	Plastic accessories (tons)
1983	10	5
1984	20	10
1985	20	10
1986	20	10
1987	40	16
1988	40	16
1989	40	16
1990	80	20
1991	80	20
1992	80	20
1993	80	20
1994	80	20
1995	80	20

For spare parts stock tonnage takes up 3 months of the production from 1983 to 1992 and then is constant (up to 1.5 month production in 1994, due to better organization).
For plastic accessories tonnage is about 3-2 month of the production.
The unitary value is the unitary industrial cost.

7.6.5.2. Inventory value of raw materials

Raw material stock is as follows (to cover the same production time as contemplated for finished goods) :

	Raw materials for spare parts (tons)	Raw materials for plastic accessories (tons)
1983	15	5
1984	30	10
1985	30	10
1986	30	10
1987	60	16
1988	60	16
1989	60	16
1990	110	20
1991	110	20
1992	110	20
1993	110	20
1994	110	20
1995	140	20

The unitary values are 1,500 SP/ton for spare parts and 400 SP/ton for plastic accessories.

7 6.5.3. Inventory value of maintenance and consumption materials

The stock has been assumed sufficient to meet one year's consumption as follows : (thousands of SP)

1983	-
1984	38.3
1985	38.3
1986	38.3
1987	61.7
1988	61.7
1989	61.7
1990	116.9
1991	116.9
1992	116.9
1993	175.4
1994	233.8
1995	233.8

The total inventory values and the inventory increase values are shown in table 65.

7.6.6. Selling prices and revenues

We have assumed selling prices to be the following :

15,000 SP/ton	for spare parts
1,300 SP/ton	for plastic accessories

Moreover we suppose the single industries will pay each trained worker 200 SP.

We can obtain the quantities sold from production figures (see tables 39-44) together with the corrections concerning inventory variations (see preceding paragraph 7.6.5.1. point C.).
Taking the above selling prices we obtained the gross revenues shown in table 66. Payments for training are also included in the gross revenues.
We consider 1% of the gross revenues as expenditure for technical know-how and managerial assistance (see preceding paragraph 7.6.1.2.). By deducting this amount from the gross revenues we obtain the net revenues (see table 66).

7.6.7. Working capital and project financing

In order to compute the working capital the following assumptions have been made :

a) payment for spare parts, plastic accessories and training fees will be made 30 days after date of invoice

b) payments for raw materials will be made 30 days before the arrival of materials at the plant (we have assumed that the materials will be paid for by means of letters of credit).
Working capital and working capital increase are shown in table 67.

7.6.7. (cont.)

The financial cost has been calculated as follows (see table 68) :

a) interest on capital expenditures has been assumed to be 8% of the cumulative capital payments from 1981 up to 1995

b) interest on working capital has been assumed to be 12% of the working capital from 1983 up to 1995.

A minimum interest-free equity of 349,600 SP should be guaranteed for payment in 1981 and 1982 of the interest concerning capital payments over the first two years.

Total financing required is shown in table 69.

7.6.8. Profit and loss account

Profit and loss account is shown in table 70.
It is to be noted that the project will be profit making from the first operative year (1983).

7.6.9. Discounted cash flow analysis

The cash flow and the cumulative cash flow are shown in table 71.
It is supposed that at the end of the last operative year (1995) all activities will have been concluded. So the project will receive the payments equal to 50% of the third phase investment, that is the salvage value of the plant (1,778,500 SP) and the demobilization of the working capital (1,590,300 SP).
From the above data we have calculated the D.C.F. rate of return for this project to be approximately 24.3% (see table 72).

8. ECONOMICAL SOCIAL AND POLITICAL EVALUATIONS CONNECTED WITH THE CONSTRUCTION OF A NEW CENTRAL MECHANICAL WORKSHOP

8.1. Evaluation of foreign currency savings

We can roughly evaluate foreign currency savings as the difference between the net revenues and the cost of raw materials since raw materials will continue to be imported.
The saving in foreign currency will be as follows (thousands of SP):

Year	Net revenues	Cost of raw materials	Savings of foreign currency
1983	466.3	84.3	382.0
1984	1,085.1	168.6	916.5
1985	1,254.5	172.8	1,081.7
1986	1,266.4	176.2	1,090.2
1987	2,161.6	335.5	1,826.1
1988	2,478.2	338.9	2,139.3
1989	2,490.0	342.2	2,147.8
1990	4,279.6	657.6	3,622.0
1991	4,886.7	659.7	4,227.0
1992	4,894.8	661.8	4,233.0
1993	7,278.8	975.9	6,302.9
1994	9,662.8	1,290.0	8,372.8
1995	10,884.6	1,292.1	9,592.5
TOTAL	53,089.4	7,155.6	45,933.8

The total savings in foreign currency can be roughly evaluated as 46,000,000 SP.

8.2. Economical evaluations

Shortage of spare parts and accessories is one of the most important factors influencing low efficiency in the Sudanese textile industry (see preceding paragraph 3.1.1.).
Local production of spare parts and plastic accessories means easier availability of these materials and consequently better efficiency.
This efficiency increase is not easy to calculate but it is certainly important.

8.3. Social political evaluations

8.3.1. Qualification of manpower

Over the period 1983-1995 the training centre annexed to the new central workshop will train from 40 to 160 mechanical workers per year making a total of 1,408 persons over this period.

8.3.2. Creation of new job opportunities

The new central workshop will create the following new job opportunities :

a) from about 100 to about 500 persons will be employed in the workshop from 1983 up to 1995.

b) other job opportunities will be created in the factories supplying materials and services to the new workshop.

8.3.3. Autonomy of the sudanese industrial development

The new central workshop will promote both the development of the textile industry which is the most important Sudanese industry and the growth of the mechanical industry, which is the start-off sector for every industrial development plan.

9. CONCLUSIONS AND RECOMMENDATIONS

At the end of our study we can conclude that the present project is feasible and profitable.

In fact the following advantages shall be obtained if the new central workshop is put into operation :

a) gradually increasing the rate of substitution of imported spare parts by locally manufactured parts, with a consequent saving in foreign currency. At the end of the period (1995) 85% of imports will have been substituted by local production.
The total saving in foreign currency during this period will be about 46,000,000 SP.

b) efficiency increase in the local textile industry due to the easy availability of spare parts on the local market

c) qualification during the whole period of about 1,400 mechanical workers for maintenance

d) creation of new job opportunities (from about 100 to about 500 at the end of this period)

e) promotion of the local mechanical industry

f) satisfactory profit-making ability of this new activity (the internal rate of return is about 24%).

We would like to underline the importance of the following factors, already analyzed in the present study :

a) technical assistance during the initial period 1982-1983 by the machinery suppliers

b) agreement with Khartoum Central Foundry for the supply of the necessary cast pieces, also steel cast pieces

c) technical know-how and managerial assistance during the whole activity period by a qualified mechanical manufacturer who must be an expert in textile machinery.

borghi e baldo ingg.
s.p.a.

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vol. 2

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

FEASIBILITY STUDY FOR A CENTRAL WORKSHOP FOR THE MANUFACTURE OF SPARE PARTS FOR THE SUDANESE TEXTILE INDUSTRY

(UNIDO CONTRACT No. 79/23 - PROJECT No. SI/SUD/78/802)

VOLUME II

T A B L E S

MILAN, 30TH. NOVEMBER 1979

TABLE 1 : PRODUCTION MACHINERY OPERATING IN THE SUDANESE TEXTILE INDUSTRY (BOTH PRIVATE AND GOVERNMENT OWNED SECTOR - COTTON, KENAF, PLASTIC SACKS)

N°	FACTORY	LOCATION	Management (*)	Manufactured fiber (**)	SPINNING		WEAVING		MACHINERY MANUFACTURERS				
					N°of spindles (x)	Year of installation	N° of looms (xx)	Year of installation	Spinning preparation	Spinning	Weaving preparation	Weaving	Finishing
1	SINNAR SP. MILL	SINNAR	P	C	24,400	1977	-	-	MARZOLI (IT)*	MARZOLI (IT)*	-	-	-
2	KHARTOUM SP. & WEAVING FACTORY	KHARTOUM NORTH	P	C	20,000 3,300	1961 1972	710 200	1961 1972	OSAKA KIKO (JP)* SACO LOWELL(AM)*	OSAKA KIKO (JP)* SACO LOWELL(AM)*	KANAMARU (JP)* SCHLAFORST(WG)* SUCKER (WG)*	SAKAMOTO (JP)* DRAPER (AM)*	-
3	SUDAN TEXTILE FACTORY	KHARTOUM	P	C	56,000 20,000	1961 1970	1,810 70	1961 1971	INGOLSTADT (WG)* PLATT (EN)* RIETER (SW)*	PLATT (EN)* INGOLSTADT (WG)*	SCHLAFORST(WG)* SUCKER (WG)* SCHWEITER(SW)*	NORTHROP(EN)* PICANOL (BG)*	NORTON (EN)* ROBERTS WG)* KLEINEWEFERS(WG)* BUTTERWORTH(AM)* BENNINGER (SW)* SAURESSIG (WG)*
4	COTTON TEXTILE MILL	EL GEDID EL TADA	P	C	17,300	1975	330	1978	SACM (FR)*	SACM (FR)*	SCHLAFORST(WG)* SUCKER (WG)*	PICANOL(BG)*	-
5	BLUE NILE FACTORY	WAD MADANI	P	C	-	-	560 110 120	1978 1963	-	-	....	NORTHROP(EN)* RUTI (SW)* .....(CZ)*	REGGIANI (IT)* PLATT (EN)*
6	MADANI SP.&WEAV.FACTORY	WAD MADANI	P	C	4,000 Notes(*)	1978	420	1978	HERGETH(WG)* .....(EN)*	SKODA (CZ)*	SCHLAFORST(WG)* SUCKER (WG)*	ELITEX (CZ)*	-
7	RED SEA FACTORY	PORT SUDAN	P	C	25,100	1976	-	-	ASHWORTH(EN)* WARNER & SWASEY (AM)*	ROBERTS(AM)*	-	-	-
8	GROUP OF MANY SMALL FACTORIES	-	P	C	-	-	900	....	PLATT SACO LOWELL(AM)*	-	.....	.....	-
SUB-TOTAL PRIVATE SECTOR FOR COTTON					166,100 + 4,000 notes equiv. to act. 182,900		5,230						

NOTES :

(*)G = Gouvernment (spinning and weaving corporation)
P = Private

(**) C = Cotton
K = Kenaf
PS= Plastic Sacks

(x) Approximated to the next hundred

(xx) Approximated to the next ten

* IT = ITALIAN
JP = JAPANESE
AM = AMERICAN
EN = ENGLISH
BG = BELGIAN
WG = WEST GERMAN
SW = SWISS
FR = FRENCH
CZ = CZECH
EG = EAST GERMAN

(*) 4,000 rotes equivalent to about 16,800 spindles

TABLE 1 : PRODUCTION MACHINERY OPERATING IN THE SUDANESE TEXTILE INDUSTRY (BOTH PRIVATE AND GOVERNMENT OWNED SECTOR - COTTON, KENAF, PLASTIC SACKS) - (cont.)

n°	FACTORY	LOCATION	Management (*)	Manufactured fibre (**)	SPINNING		WEAVING		MACHINERY MANUFACTURERS				
					N°of spindles (x)	Year of installation	N° of looms (xx)	Year of installation	Spinning preparation	Spinning	Weaving preparation	Weaving	Finishing
9	FRIENDSHIP TEXT. FACTORY	HASSAHEISSA	G	C	24,000	1976	860	1976	CHINESE	CHINESE	CHINESE	CHINESE	CHINESE
10	SHENDI WEAV.FACTORY	SHENDI	G	C	-	-	260	1977	-	-	GILBOS SUCKER(WG)*	PICANOL(BG)*	-
11	ADSTI WEAV.FACTORY	ADSTI	G	C	-	-	260	1977	-	-	GILBOS SUCKER(WG)*	PICANOL(BG)*	-
12	EL DUEIM WEAV.FACTORY	EL DUEIM	G	C	-	-	260	1978	-	-	GILBOS SUCKER(WG)*	PICANOL(BG)*	-
13	MONGALLA WEAV.FACTORY	MONGALLA	G	C	-	-	260	1978	-	-	GILBOS SUCKER(WG)*	PICANOL(BG)*	-
14	NYALA WEAV.FACTORY	NYALA	G	C	-	-	260	1978	-	-	GILBOS SUCKER(WG)*	PICANOL(BG)*	-
15	KADUGLI WEAV.FACTORY	KADUGLI	G	C	-	-	260	1978	-	-	GILBOS SUCKER(WG)*	PICANOL(BG)*	-
	SUB-TOTAL GOVERNMENT OWNED SECTOR FOR COTTON				24,000		2,420						
	SUB-TOTAL COTTON				206,900		7,650						
16	ABU NAMA KENAF FACTORY	ABU NAMA	G	K	1,200	1976	60	1976	FRASER(EN)* GARDELLA(IT)*	GARDELLA(IT)*	GARDELLA(IT)*	GARDELLA(IT)*	UNION SPECIAL(AM)*
17	PLASTIC SACKS CO.	KHARTOUM NORTH	G	PS	-	-	280	1970	-	-	-	RUTI(SW)*	-
	TOTAL TEXTILE SECTOR				208,100		7,990						

NOTES :

(*)G = Government (spinning and weaving corporation)
P = Private

(**) C = Cotton
K = Kenaf
PS= Plastic Sacks

(x) Approximated to the nearest hundred

(xx) Approximated to the nearest ten

* IT = ITALIAN
JP = JAPANESE
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EN = ENGLISH
BG = BELGIAN
WG = WEST GERMAN
SW = SWISS
FR = FRENCH
CZ = CZECH
EG = EAST GERMAN

* Special spinning frames

TABLE 2 : PRODUCTION MACHINERY UNDER INSTALLATION* IN THE SUDANESE TEXTILE INDUSTRY (BOTH PRIVATE AND GOVERMENT OWNED SECTOR - COTTON, KENAF) - (FORECAST COMPLETION WITHIN 1982)

N°	FACTORY	location	Management	Fiber to be manu-factured	SPINNING		WEAVING		COMMISSIONING FORECAST	
					N° of spindles to be installed	Manufacturer	N° of looms to be installed	Manufacturer	Official	Our evaluation
1°	INTERNATIONAL SP. MILL	PORT SUDAN	P	C	24,000	RIETER (SW)°°	-	-	May 1980	May 1980
2°	GUMARA SP. MILL	KHARTOUM NORTH	P	C	39,000	PLATT (EN)°°	-	-	July 1981	July 1981
3°	GEZIRA & MANAGLE FACTORY	HANTOUB (WAD MADANI)	P	C	25,000	SACM (FR)°°	340	PICANOL (BG)°°	January 1982	January 1982
4°	SUDAN TEXT.FACTORY	KHARTOUM	P	C	35,000	TOYODA (JP)°°	1,000	TOYODA (JP)°°	January 1981	January 1981
5°	BLUE NILE FACTORY	WAD MADANI	P	C	35,000	TEXTIMA (EG)°°	-	-	January 1981	July 1981
	SUB-TOTAL PRIVATE SECTOR FOR COTTON				158,000		1,340			
6°	PORT SUDAN SP. MILL	PORT SUDAN	G	C	72,000	TEXTIMA (EG)°°	-	-	January 1980	January 1982
7°	HAG ABDALLAH SP. MILL	HAG ABDALLAH	G	C	70,000	SACM (FR)°°	-	-	January 1980	January 1981
8°	KHARTOUM NORTH SP. MILL	KHARTOUM NORTH	G	C	25,000	RUMENIAN	-	-	January 1981	January 1981
9°	GADOW SP. & WEAVING FACTORY	GADOW	G	C	22,000	MARZOLI (IT)°°	480	GALILEO (IT)°°	.....	January 1983
	SUB-TOTAL GOVERNMENT OWNED SECTOR FOR COTTON				189,000		480			
	SUB - TOTAL COTTON				347,000		1,820			
10°	TONJ KENAF FACTORY	TONJ	G	K	1,200	GARDELLA (IT)°°	60	GARDELLA (IT)°°	.....	January 1982
	TOTAL TEXTILE SECTOR				348,200		1,880			

°° See preceding table

* We consider under installation a factory when at least a contract for production machinery supply has been signed.

TABLE 3: OPERATING AND UNDER INSTALLATION TEXTILE FACTORIES IN SUDAN

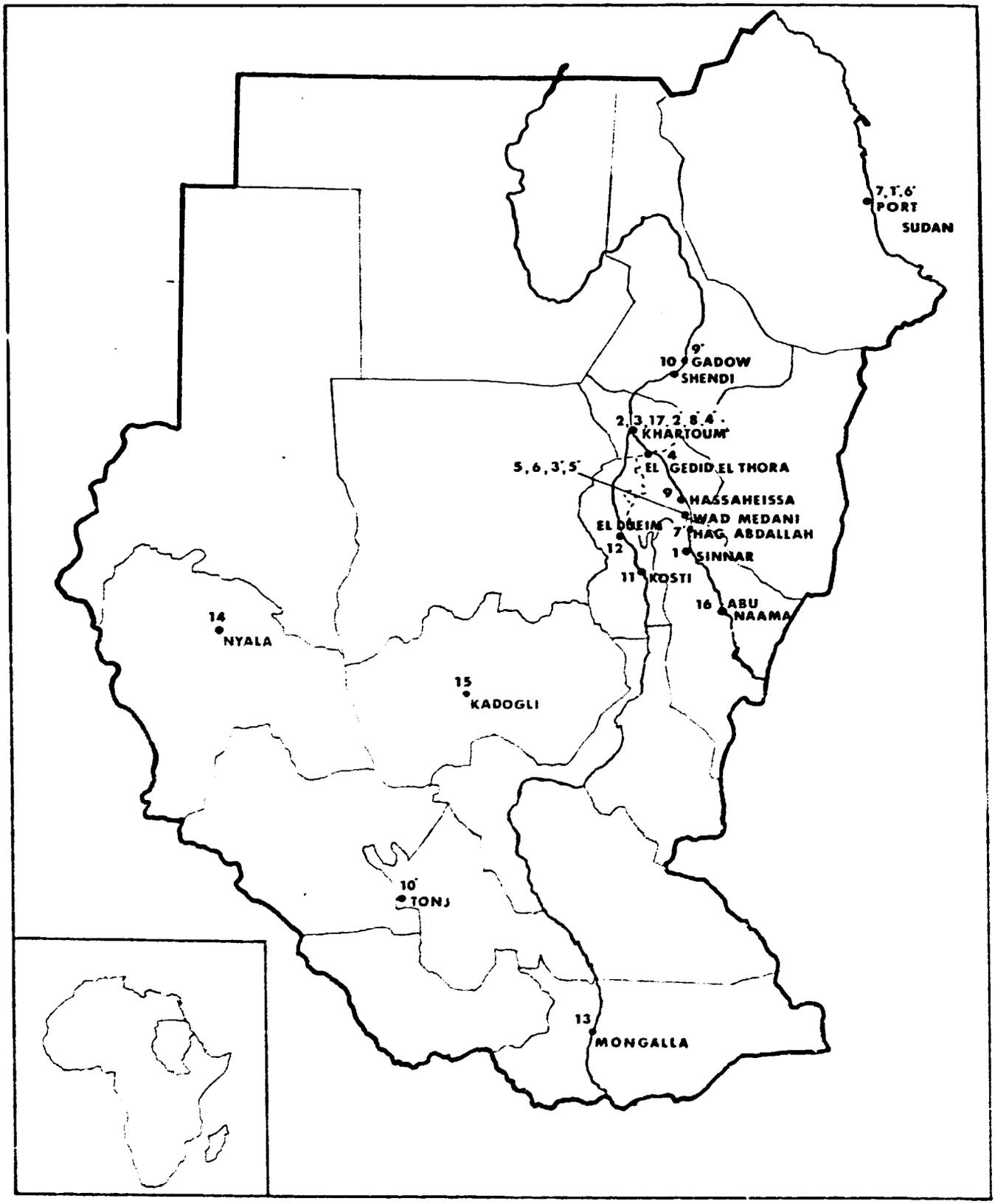


TABLE 4 : DETAILS OF SPINNING MACHINERY USED BY THE SUDANESE TEXTILE INDUSTRY (both in operation and under installation)

MANUFACTURER	SPINDLES			
	in operation N°.	under installation N°.	Total N°.	Total %
1. SACM	17,300	95,000	112,300	20
2. TEXTIMA	-	107,000	107,000	19
3. PLATT	56,000	39,000	95,000	17
4. MARZOLI	24,400	22,000	46,400	8
5. TOYODA	-	35,000	35,000	6
6. ROBERTS	25,100	-	25,100	5
7. RUMANIAN MFGR.	-	25,000	25,000	4
8. RIETER	-	24,000	24,000	4
9. CHINESE MFGR.	24,000	-	24,000	4
10. OSAKA KIKO	20,000	-	20,000	4
11. INGOLSTADT	20,000	-	20,000	4
12. SKODA	16,800	-	16,800	3
13. SACO LOWELL	3,300	-	3,300	1
14. GARDELLA	1,200	1,200	2,400	1
TOTAL	208,100	348,200	556,300	100

TABLE 5 : DETAILS OF WEAVING MACHINERY USED BY THE SUDANESE TEXTILE INDUSTRY (both in operation and under installation)

MANUFACTURER	LOOMS			
	in operation N°.	under installation N°.	Total N°.	Total %
1. NORTHROP	2,370	-	2,370	24
2. PICANOL	1,960	340	2,300	23
3. TOYODA	-	1,000	1,000	10
4. CHINESE MFGR.	860	-	860	8
5. SAKAMOTO	710	-	710	7
6. ELITEX	540	-	540	5
7. GALILEO	-	480	480	5
8. RÜTI	390	-	390	4
9. DRAPER	200	-	200	2
10. GARDELLA	60	60	120	1
11. Many small-scale manufacturers	900	-	900	9
TOTAL	7,990	1,880	9,870	100

TABLE 6 : DETAILS REGARDING PICANOL LOOMS

MODEL	FACTORY				TOTAL
	Six Weaving Factories (S.W.C.)	Cotton Textile Mill	Gezira & Managle Factory	Sudan Textile Mill	
1. PRESIDENT DIPLOMAT					
112 cm reed space	1,560 *	-	-	-	1,560 *
2. PRESIDENT CM-C					
112 cm reed space	-	24	-	-	24
122 " " "	-	-	316	-	316
163 " " "	-	-	-	70	70
176 " " "	-	48	-	-	48
Sub-total	-	72	316	70	458
3. PRESIDENT CC-ST					
112 cm reed space	-	258	-	-	258
4. PRESIDENT CL-C					
188 cm reed space	-	-	24	-	24
TOTAL	1,560	330	340	70	2,300

NOTE: * There are actually 1,536 looms installed.
The figure of 1,560 has been indicated so that the same rounded-up total of 2,300 Picanol looms as shown in Tables 1-2-5 is obtained.

TABLE 7 : DETAILS REGARDING NORTHROP LOOMS

MODEL	FACTORY		TOTAL
	Sudan Textile Mill	Blue Nile Factory	
1 - S 44" (1961)	1,680	-	1,680
2 - LF 44" (1960)	60	-	60
3 - LF 60" (1960)	70	-	70
4 - NARROW LOOM 1975	-	560	560
TOTAL	1,810	560	2,370

TABLE 8 : RUNNING PERIOD OF PRODUCTION MACHINERY IN THE SUDANESE TEXTILE INDUSTRY

	SPINNING		WEAVING *	
	N° of spindles	%	N. of looms	%
3 years or less than 3 years	108,800	52	4,340	54
between 4 and 10 years	23,300	11	630	8
between 11 and 18 years	76,000	37	3,020	38
TOTAL	208,100	100	7,990	100

* REMARKS : 120 CZECH looms + 900 looms in many small factories have been divided proportionally.

TABLE 9 : PRESENT WORKING TIME (HOURS/DAY) ° CONCERNING THE OPERATING SUDANESE TEXTILE FACTORIES AND OUR EVALUATION OF THE EFFICIENCY + OF SOME OF THEM

N.	FACTORY	Present working time (hours/day)			Our evaluation of efficiency	
		Spinning	Weaving	Finishing	Spinning	Weaving
1++	SINNAR SP.MILL	22.5	-	-		-
2x	KHARTOUM SP.& WEAV.FACTORY			-	50%	35%
3	SUDAN TEXT.FACTORY				60%	40%
4xx	COTTON TEXT.MILL	22.5	15	-	90%	80%
5+++	BLUE NILE FACTORY	-	22.5	15	-	50%
6°°	MADANI SP. & WEAV.FACTORY	22.5	15	-	70%	70%
7	RED SEA FACTORY	22.5	-	-	70%	-
8	MANY SMALL FACTORIES			-		
9	FRIENDSHIP TEXT. FACTORY	15	15	15	50%	35%
10--	SHENDI WEAV. FACTORY	-	15	-	-	40%
11--	KOSTI WEAV. FACTORY	-	15	-	-	
12°°°	EL DUEIM WEAV. FACTORY	-	7.5	-	-	
13°°°	MONGALLA WEAV. FACTORY	-	7.5	-	-	
14°°°	NYALA WEAV. FACTORY	-	7.5	-	-	
15°°°	KADOGLI WEAV. FACTORY	-	7.5	-	-	
16≠	ABU NAAMA KENAF FACTORY	3.8	3.8	3.8		
17	PLASTIC SACKS CO.	-	15	-	-	35%

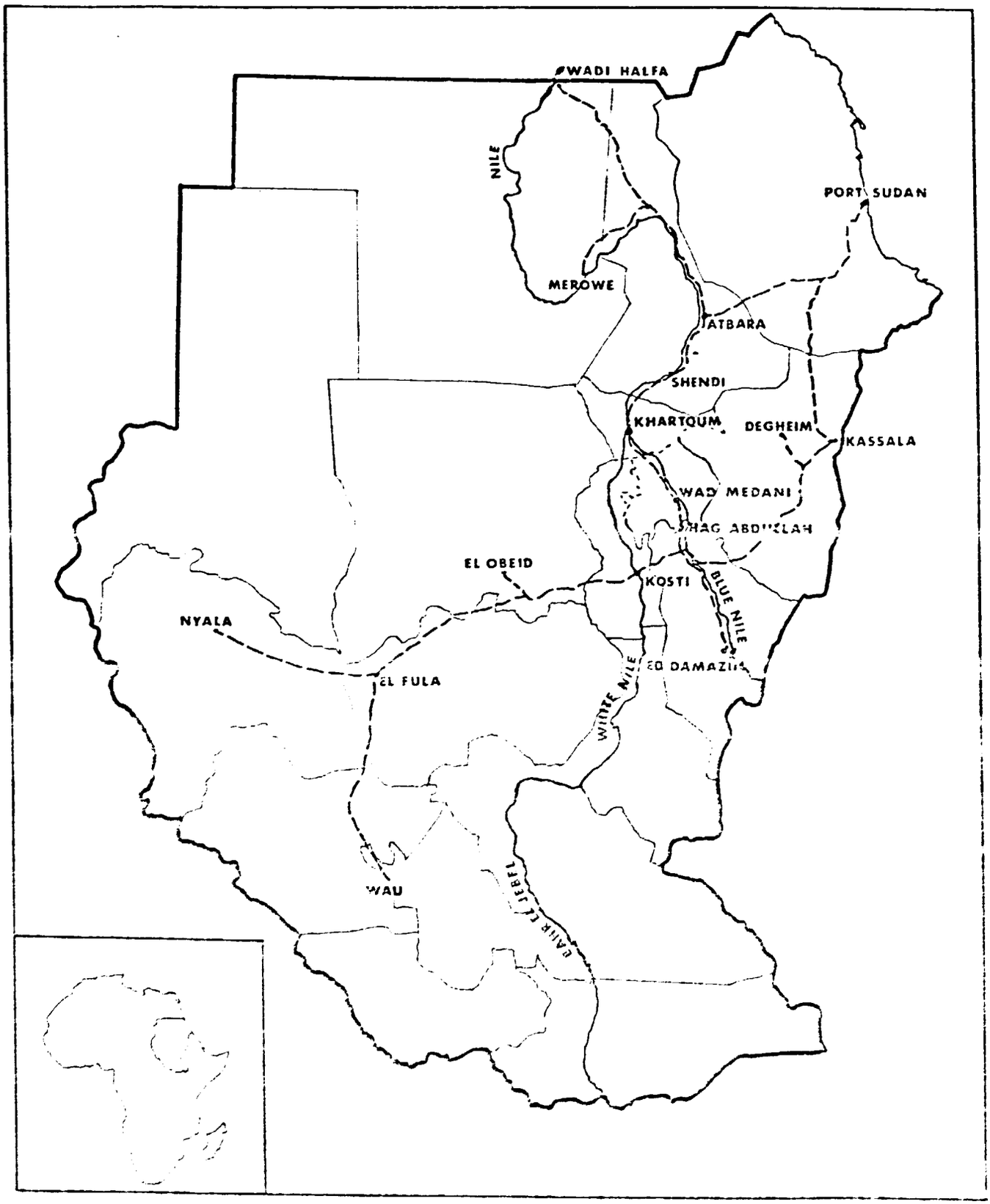
° At the time of our visits (April-May 1979)

+ This efficiency was evaluated during our visits in the factory and must be considered as istantaneous. The reacheable efficiency should be : for spinning 95%; for weaving 80%.

TABLE 9 : REMARKS

++	22.5 hours in spinning only since September 1978.
x	Foreign mechanics are operating in the factory for improving efficiency.
xx	Finishing will start to run the next July 1979
+++	Foreign technicians are operating in the factory for improving efficiency.
°°	The open-end spinning system is running only since 1 year.
--	15 hours in weaving only since October 1978.
°°°	7.5 hours in weaving only since few months.
≠	1 shift (7.5 hours/day) for 6 months in a year since February 1976 due to unsufficient feeding of raw material.

TABLE 10: RAILWAY NETWORK IN SUDAN



---------- rail track

TABLE 11: RAILWAY AND RIVER TRANSPORT TARIFFS IN SUDAN

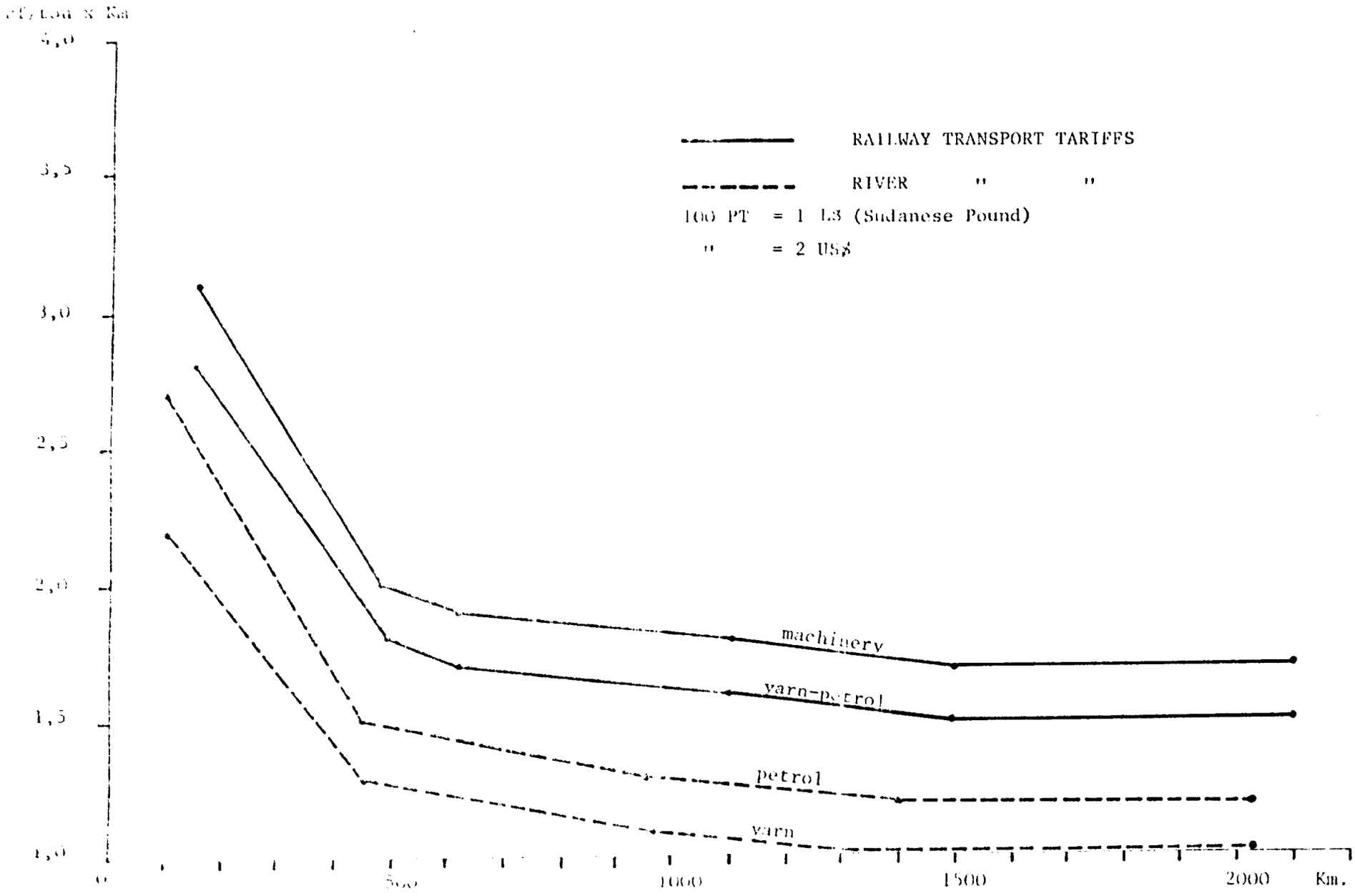


TABLE 12 : DISTANCE BY RAILWAY OF TOWNS WITH TEXTILE FACTORIES FROM KHARTOUM AND WAD MADANI

RAILWAY SECTION	Railway section lenght (km)	Distance of the underlined town from Khartoum (km)	Distance of the underlined town from Wad Madan (km)
KHARTOUM-SHENDI	170	170	340
SHENDI-ATBARA	140	310	480
ATBARA-JUNCTION N.10	270	580	750
JUNCTION N.10-WADI HALFA	330	910	1,080
JUNCTION N.10-KARIMA	220	800	970
KHARTOUM-GEDID EL THORA	40	40	130
GEDID EL THORA-HASSAHEISSA	90	130	40
HASSAHEISSA-WAD MADANI	40	170	-
WAD MADANI-HAG ABDULLAH	60	230	60
HAG ABDULLAH-SENNAR	40	270	100
SENNAR-ABU NAAMA	120	390	220
ABU NAAMA-DAMAZIN	110	500	330
SENNAR-KOSTI	110	380	210
KOSTI-EL OBEID	310	690	520
KOSTI-NYALA	940	1,320	1,150
KOSTI-WAU	1,050	1,430	1,260
SENNAR-EL GEDAREF	230	500	330
EL GEDAREF-KASSALA	220	720	550
KASSALA-HAIYA	350	1,070+	900+
HAIYA-PORT SUDAN	210	1,280+	1,110+
ATBARA-HAIYA	270	580++	750++
HAIYA-PORT SUDAN	210	790++	960++

REMARKS : 1) distances are rounded up to next ten
2) underlined distance concern towns with textile factories
3) + via Sennar
4) ++ via Atbara

TABLE 13: HIGHWAY NETWORK IN SUDAN

existing highways

highways under construction

TABLE 14: UNMADE TRACK NETWORK IN SUDAN

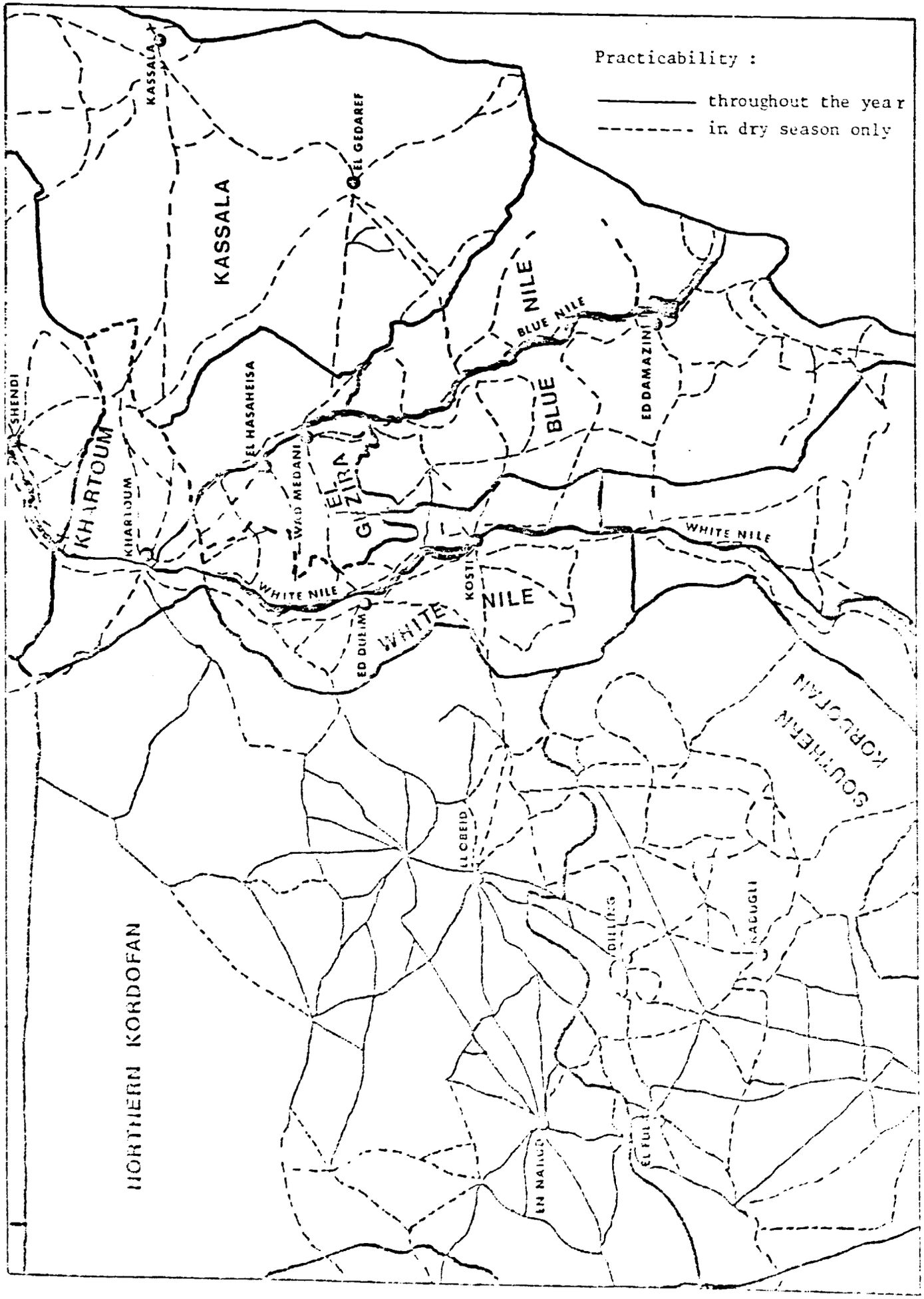


TABLE 15: RIVER TRANSPORT SYSTEM IN SUDAN

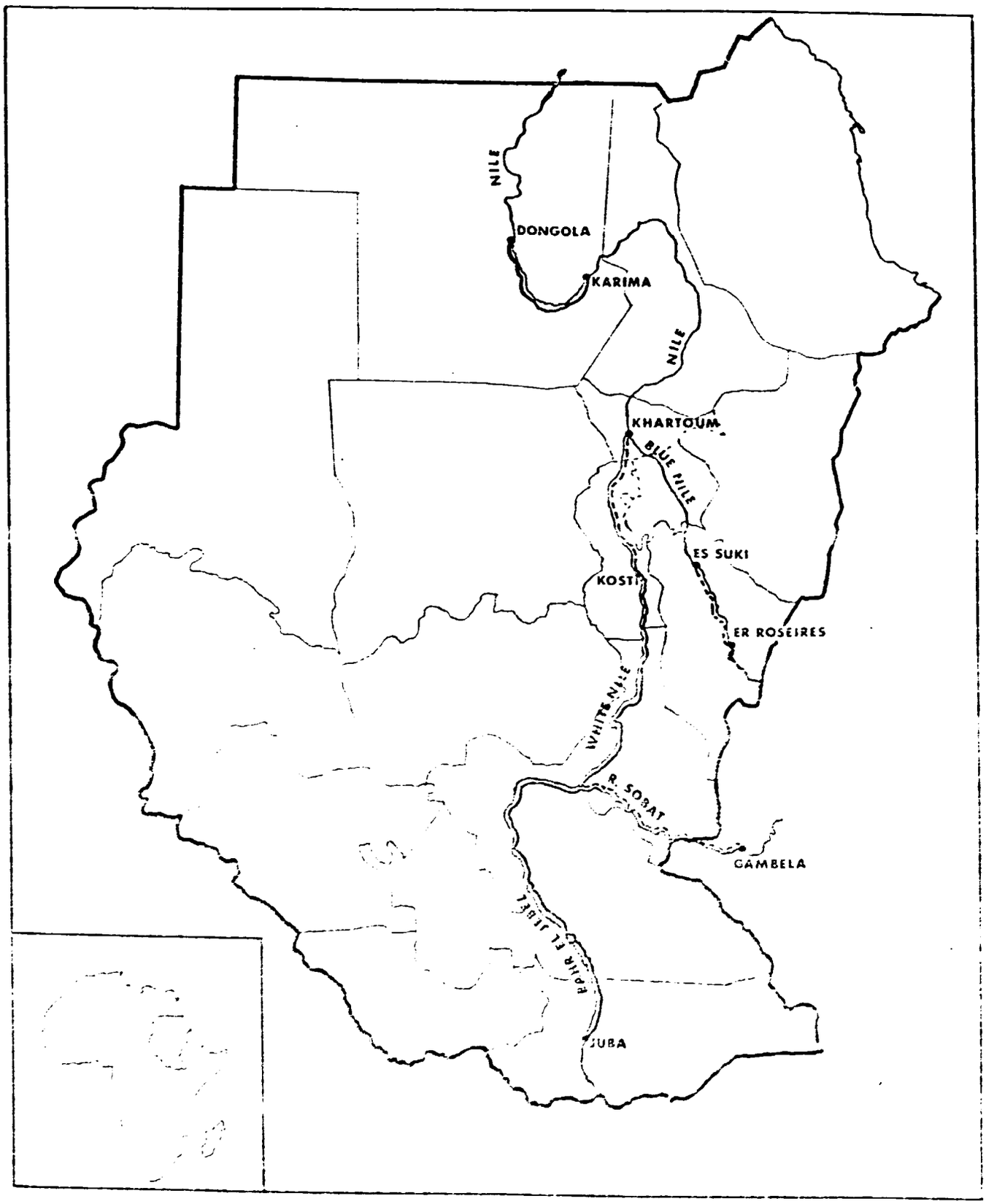


TABLE 16 : CONTRIBUTION OF THE INDUSTRIAL SECTOR TO GROSS DOMESTIC PRODUCT

SP Million.

	66/67	67/68	68/69	69/70	70/71	71/72	72/73	73/74	74/75
Manufacturing	47.5	52.8	55.0	65.0	67.4	73.7	79.4	107.2	138.3
Mining & Quarrying	1.9	2.1	2.3	1.8	1.8	3.1	3.5	4.1	4.6
Construction & Building	23.9	22.8	24.4	24.3	23.3	26.4	31.2	61.0	65.0
Electricity & Water	16.6	16.3	16.6	16.5	16.6	16.9	17.5	18.6	20.9
Total Industrial Production	89.9	94.0	98.3	107.6	109.1	120.1	131.6	190.9	228.9
GDP	1060	1125	1193	1143	1199	1240.6	1307	1375	1510.8
Contribution of the Industrial Sector to GDP %	8.4	8.3	8.2	9.4	9.0	9.6	10	13.8	15.1
Contribution of Manufacturing to GDP %	4.5	4.7	4.6	5.7	5.6	5.9	6.1	7.8	9.2

Source : Department of Statistics, Khartoum

TABLE 17 : OUR EVALUATION CONCERNING REPAIRING AND MAINTENANCE WORK IN THE OPERATING SUDANESE TEXTILE FACTORIES

N.	FACTORY	Repairing and maintenance work is made :			REMARKS
		All by the annected workshop	Partially outside	All outside	
1	SINNAR SP.MILL		X		(°) Their workshop is by Blue Nile Factory, which belongs to the same group (Sharaf Group)
2	KHARTOUM SP.& WEAV. FACTORY		X		
3	SUDAN TEXT. FACTORY		X		
4	COTTON TEXT. MILL	X			(+) They utilize as Foundry Khartoum Central Foundry (Khartoum) and Railway Foundry (Atbara)
5	BLUE NILE FACTORY		X		
6	MADANI SP. & WEAV.FACTORY (°)		X		(x) They utilize as foundries Khartoum Central Foundry (Khartoum) and Ministry of Irrigation Foundry (Wad Madani)
7	RED SEA FACTORY		X		
8	MANY SMALL FACTORIES				
9	FRIENDSHIP TEXT.FACTORY (+)		X		
10	SHENDY WEAV. FACTORY			X	
11	KOSTI WEAV. FACTORY			X	
12	EL DUEIM WEAV. FACTORY			X	
13	MONGALLA WEAV. FACTORY			X	
14	NYALA FACTORY			X	
15	KADOGLI WEAV. FACTORY			X	
16	ABU NAAMA KENAF FACTORY (x)		X		
17	PLASTIC SACKS COMPANY		X		

TABLE 18 : OUR EVALUATION CONCERNING SPARE PART PROCESSING IN THE SUDANESE TEXTILE FACTORIES IN OPERATION

N.	FACTORY	SPARE PARTS				REMARKS
		MANUFACTURED LOCALLY			IMPORTED	
		All by the annexed work shop	Partially outside	Completely outside		
1	SINNAR SP.MILL		20%		80%	+ Without considering the new planned workshop.
2	KHARTOUM SP. WEAV.FACTORY	20%			80%	
3	SUDAN TEXT.FACTORY +	30%			70%	
4	COTTON TEXT.MILL	80%			20%	
5	BLUE NILE FACTORY			10%	90%	
6	MADANI SP. & WEAV. FACTORY			10%	90%	
7	RED SEA FACTORY		10%		90%	
8	MANY SMALL FACTORIES					
9	FRIENDSHIP TEXT. FACTORY		20%		80%	
10	SHENDI WEAV.FACTORY			10%	90%	
11	KOSTI WEAV.FACTORY			10%	90%	
12	EL DUEIM WEAV.FACTORY			10%	90%	
13	MONGALLA WEAV.FACTORY			10%	90%	
14	NYALA WEAV.FACTORY			10%	90%	
15	KADOGLI WEAV.FACTORY			10%	90%	
16	ABU NAAMA KENAF FACTORY		20%		80%	
17	PLASTIC SACKS CO.		20%		80%	

TABLE 19 : PRESENT SITUATION IN THE FOUNDRIES ANNEXED TO THE OPERATING TEXTILE FACTORIES

N.	FOUNDRIES	LOCATION	Year of instal-lation	KIND OF CAST METAL				Present total prod. (ton/year)	ANNEXED FACILITIES				N. of workers *
				Cast iron	Steel	Aluminium	Brass & Bronze		Laboratories			Wooden pattern section	
									Sand	Metal	Mechanical		
1	KHARTOUM SP.& WEAV. FACTORY	KHARTOUM NORTH	1961-72	X	-	X	X	(10)	-	-	-	X	13
2	SUDAN TEXTILE FACTORY	KHARTOUM	1961-70	X	-	X	X	(15)	-	-	-	X	(20)
3(°)	COTTON TEXT. MILL	EL GEDID EL THORA	1978	(X)	-	(X)	(X)	-	-	-	-	X	7
TOTAL								(25)					

REMARKS : (°) Foundry is very well equipped. Now it has not yet started, because they are consuming spare initial stock. They should be able to cast their whole requirement.

* Including management

(X) Our evaluation

TABLE 20 : DETAIL OF WORKSHOP MACHINERY IN THE OPERATING SUDANESE TEXTILE FACTORIES

N.	FACTORY	Year of install.	N° of shifts	WORKSHOP MACHINERY									N° of workers
				N° o. lathes	N° of milling machines	N° of drilling machines	N° of shaping machines	N° of grinding machines	Total machine tools	N° of welding sets	Blacksmith shop	Heat treatment	
1	SINNAR SP. MILL	1977	1	2	1	2	-	2	7	3	-	-	
2	KHARTOUM SP.& WEAVING Factory	1964-70	1	2	1	2	1	-	6	3	X	-	67
3	SUDAN TEXT.FACTORY	1961-70	2	8	2	3	2	1	16	5	X	-	(a
4	COTTON TEXT. MILL	1978	1	5	1	2	1	-	9	2	X	X	35(b
5	BLUE NILE FACTORY	1963-76	1	1	-	1	-	2	4	1	-	-	
6	MAJANI SP.& WEAV.FACTORY	1978	-	-	-	-	-	-	-	-	-	-	(c
7	RED SEA FACTORY	1976	1	1	1	1	-	2	5	-	-	-	8
8	MANY SMALL FACTORIES												
9	FRIENDSHIP TEXT.FACTORY	1976	1	4	1	2	1	-	8	4	X	-	29
10	SHENDI WEAV. FACTORY	1976	-	1	1	1	-	1	4	-	-	-	- (d
11	KOSTI WEAVING FACTORY	1976	-	1	1	1	-	1	4	-	-	-	- (d
12	EL DUEIM WEAVING FACTORY	1976	-	1	1	1	-	1	4	-	-	-	- (d
13	MONGALLA WEAVING FACTORY	1976	-	1	1	1	-	1	4	-	-	-	- (d
14	NYALA WEAVING FACTORY	1976	-	1	1	1	-	1	4	-	-	-	- (d
15	KADUGLI WEAVING FACTORY	1976	-	1	1	1	-	1	4	-	-	-	- (d
16	ABU NAAMA KENAF FACTORY	1976	1	2	1	2	1	1	7	-	-	-	-
17	PLASTIC SACKS CO.	1969-70	1	2	-	2	-	-	4	-	-	-	-
	TOTAL			33	14	23	6	14	90				

REMARKS : (a) They have in program a workshop expansion - (b) Workshop is working only partially because they are consuming pare initial stock
(c) They utilize Blue Nile's workshop - (d) Workshop is not working

TABLE 21 : PRESENT SITUATION IN THE MOST IMPORTANT SUDANESE FOUNDRIES SERVING LOCAL TEXTILE INDUSTRY

N.	FOUNDRIES	LOCATION	Year of installation	KIND OF CAST METAL				Present total production (ton/year)	ANNEXED FACILITIES				N. of workers (•)
				Cast iron	Steel	Aluminium	Brass & Bronze		Laboratories			Wooden pattern section	
									Sand	Metal	Mechanical		
1	KHARTOUM CENTRAL FOUNDRY	KHARTOUM N.	1971	X	-	X	X	500	X	-°	-	X	142(a)
2	SUDAN RAILWAY CORP.'S FOUNDRY	ATBARA		X	-	X	X	1200	(X)			(X)	(b)
3	RIVER TRANSPORT CORP.'S FOUNDRY	KHARTOUM		-	-	X	X	(200)				(X)	16(c)
4	EARTH MOVING CORP.'S FOUNDRY	WAD MADANI		X	-	-	-	(100)	-	-	-	X	
5	BUILDING & CONSTRUCTION CORP.'S FOUNDRY	KHARTOUM		X	-	-	-	(100)	-	-	-	X	

NOTES : (•) including management
(X) our evaluation
° metallurgical laboratory is existing but out of order

REMARKS : (a) Unido is preparing a project for reaching 3000 ton/year AFTER FEW YEARS
(b) They have expansion programs
(c) They cast only big pieces. They are building a new section for cast iron

TABLE 22 : DETAIL OF MACHINERY IN THE MOST IMPORTANT SUDANESE WORKSHOPS SERVING LOCAL TEXTILE INDUSTRY

N.	WORKSHOP	LOCATION	Year of install.	N. of shifts	WORKSHOP MACHINERY						N. of workers	
					N. of lathes	N.of milling machines	N. of drilling machines	N.of shaping and planning machines	N. of grinding machines	Total machine tools		
1	KHARTOUM CENTRAL FOUNDRY	KHARTOUM N.	1971-72	1	7	1	1	1	-	10	30	
2	SUDAN RAILWAY CORP. WORKSHOP	ATBARA		3	30	8	24	6	16	84##		
3	RIVER TRANSPORT CORP. WORKSHOP	KHARTOUM	1930-60	1	25	2	5	1	2	35xx	60	(a)
4	KHARTOUM POLYTECHNIC WORKSHOP	KHARTOUM	1955	1	21	2	6	4	6	39		(b)
5	KHARTOUM [illegible]ITY WORKSHOP	KHARTOUM	(1965-70)	1	6	1	2	3	2	14^^		(c)
6	KHARTOUM [illegible]VERSITY LABORATORY	KHARTOUM	-	-	-	-	-	-	-	-		(d)
7	EARTH MOVING CORP. WORKSHOP	WAD MADANI	(1950-60)	(1)	19	4	5	5	3	36oo		(e)
8	BUILD.& CONSTR.CORP. WORKSHOP	KHARTOUM	(1940-50)	(1)	8	2	3	1	2	16**		(f)
TOTAL					116	20	46	21	31	234		

NOTES : ( ) our evaluation

** in addition they have : 1 hydraulic press
2 slotting machines
1 screwing machine

oo in addition they have : 2 hydraulic press
1 slotting machine

^^ in addition they have : 1 gear cutting machine

xx in addition they have : 5 sawing machines
3 screwing machines

in addition they have: 14 sawing machines

REMARKS :

(a) 60 workers only for machine shop

(b) Very old machinery not suitable for industrial work

(c) Machinery is unsufficient even for teaching activity

(d) They have only mechanical test lab. and metallurgical lab.

(e) Machinery suitable for heavy work. They have expansion program

(f) Very old machinery suitable only for heavy work. They have expansion program

TABLE 23 : LIST OF THE LICENSED TEXTILE FIRMS
(supplied from Ministry of industry)

N.	FACTORY	LOCATION	CAPACITY	
			Spindles	Looms
1.	EL BADREEN SP.& WEAVING	ELGADEED	36480	500
2.	EL JAK SP.& WEAVING	MEDANY	25000	584
3.	TAAH SP.& WEAVING	KHARTOUM N.	25000	600
4.	PETTRY SP.& WEAVING	ELGADEED	17000	240
5.	OMDURMAN EL WATANIA SP. & WEAVING	ELGADEED	36480	360
6.	OMDURMAN	OMDURMAN	18857	300
7.	HASSAN SP.& WEAVING	ELGADEED	3000	869
8.	KARDOUTEX SP.& WEAVING	EL OBIED	6529	200
9.	EL MASEED SP.& WEAVING	EL GADEED	71500	4000
10.	AFRICA BLANKET IND.	MARENGAN	25000	600
11.	GEBREL BLANTKET IND.	KHARTOUM N.	25000	600
12.	ZEEN EL ABEDEN SP.& WEAV.	KHARTOUM N.	15669	480
13.	AFRIC SPINNING	WAD MADENI	35700	-
14.	EL ETTHAD FINE SP.	KHARTOUM N.	12500	-
15.	RAROUTEX IND. FINE SP.	EL GADEED	35700	-
16.	EL TAKA SP.	EL GADEED	35700	-
17.	EL NEELEN SP.	MEDANI	35700	-
18.	DONKOLAH WEAV.	KHARTOUM N.	35700	109
19.	EL BAKEER SP. WEAV.	EL GADEED	15657	480
20.	EL ARRICHIA SP. WEAV.	EL GADEED	22857	700
21.	SOBA SP. WEAV.	EL GADEED	85700	5000
22.	ABD EL KAREEM SP. WEAV.	EL GADEED	25000	512
23.	SAMY SP.	PORT SUDAN	36000	-
24.	EL OMMAL SP.& WEAVING	SHENDI	28570	650
25.	AHMED EL MADY WORKS	ELGADEED	28710	870
26.	EL MANSOU GAT EL ALABIA	ELGADEED	71430	391

(cont.)

TABLE 23 : (cont.)

N.	FACTORY	LOCATION	CAPACITY	
			Spindles	Looms
27.	UNITED TEXTILE INDS.	ELGADEED	18570	130
28.	EL MOUDERBY WEAVING WORKS	ELGADEED	7143	217
29.	ALY ABD EL KARREM SP. & WEAVING	ELGADEED	8571	261
30.	EL MOUFTAH EL ZAHABY SP. WEAVING	ELGADEED	35720	900
31.	MOAWAD COTTON WASTE SP.	ELGADEED	28570	-
32.	EL NISR FINE WEAVING	ELGADEED	13057	400
33.	EL TAKA SP. FACTORY	ELGADEED	25000	-
34.	OMDORMAN NATIONAL SP. & WEAVING	SOBA	36480	366
35.	BUTANA SP. & WEAVING CO. LTD.	NEW HALFA	12500	300
36.	WAD MEDANI TEX.CO.LTD.	MEDANI	25000	500
37.	KARDOFAN TEX.	OBIED	(15000)	300
38.	SUDAN CO.FOR MANUFACT. TRADE	KHARTOUM N.	25000	3000
39.	BUTRI SP.&WEAVING CO.	BUTRI KH.	96480	500
40.	BAMBOS WELCAMMEOS	EL BAGEER	31520	652
41.	OSMAN ISMAIL MUSA	KHARTOUM N.	9140	278
42.	HOHAMED AHMED SERAG	KHARTOUM	4600	136
43.	MOUSTAFA ABD EL KADER	OMDURMAN	7360	-
44.	MOHAMED MOBAREK HASSEN	OMDURMAN	55000	-
45.	DR.ABDEL SADEK	KHARTOUM	10030	238
46.	EL SHOSH COMMERCIAL WORKS	ALGADEED	22000	670
47.	EL KHEER MOHED AHMED	KHARTOUM	17143	522

(cont.)

TABLE 23 : (cont.)

N.	FACTORY	LOCATION	CAPACITY	
			Spindles	Looms
48.	MOHMED AHMED GOHA	BOTRY	21428	652
49.	MOBAREK BEULA EL HAG	SENNAR	25000	600
50.	EL MAKBOUL BROTHERS	ALGADEED EL TH.	18000	-
51.	ALL ABD EL KHAAREM	KHARTOUM N.	7143	217
52.	HOUSNY MOHMED MOAWAD	KHARTOUM N.	-	-
53.	EL ABBASY WEAVING	OMDURAMN	7671	233
54.	EL AHLY WEAVING	KHARTOUM	1000	200
55.	EL WAZZAN WEAVING	OMDURMAN	857	-
56.	MOHMED MANSOUR ABD RAHAMAN MEKAWY	KHARTOUM N.	1370	250
57.	AHMED ABDEL RAHMAN	KHARTOUM & OMDURMAN	.....	...
58.	TAWFIS OSMAN HADRA	.....		
	T O T A L		1,396,792	29,567

TABLE 24 : N° OF LOOMS INSTALLED AND UNDER INSTALLATION IN SUDAN

YEAR	No. of installed looms year by year	Cumulative N° of looms	REMARKS
1961		2,890	
1962			
1963	130	3,020	
1964			
1965			
1966			
1967			
1968			
1969			
1970	320	3,340	
1971	80	3,420	
1972	230	3,650	
1973			
1974			
1975			
1976	1,695	5,345	
1977	590	5,935	
1978	2,055	7,990	
1979			
1980			
1981	1,000	8,990	These looms are under installation
1982	400	9,390	These looms are under installation
1983	480	9,870	These looms are under installation

NOTE : as in table 8, 120 czech looms + 900 looms in many small factories have been divided proportionally.

TABLE 25 : DIAGRAM OF LOOMS INSTALLED IN SUDAN AND FORECAST FOR THE FUTURE INSTALLATIONS

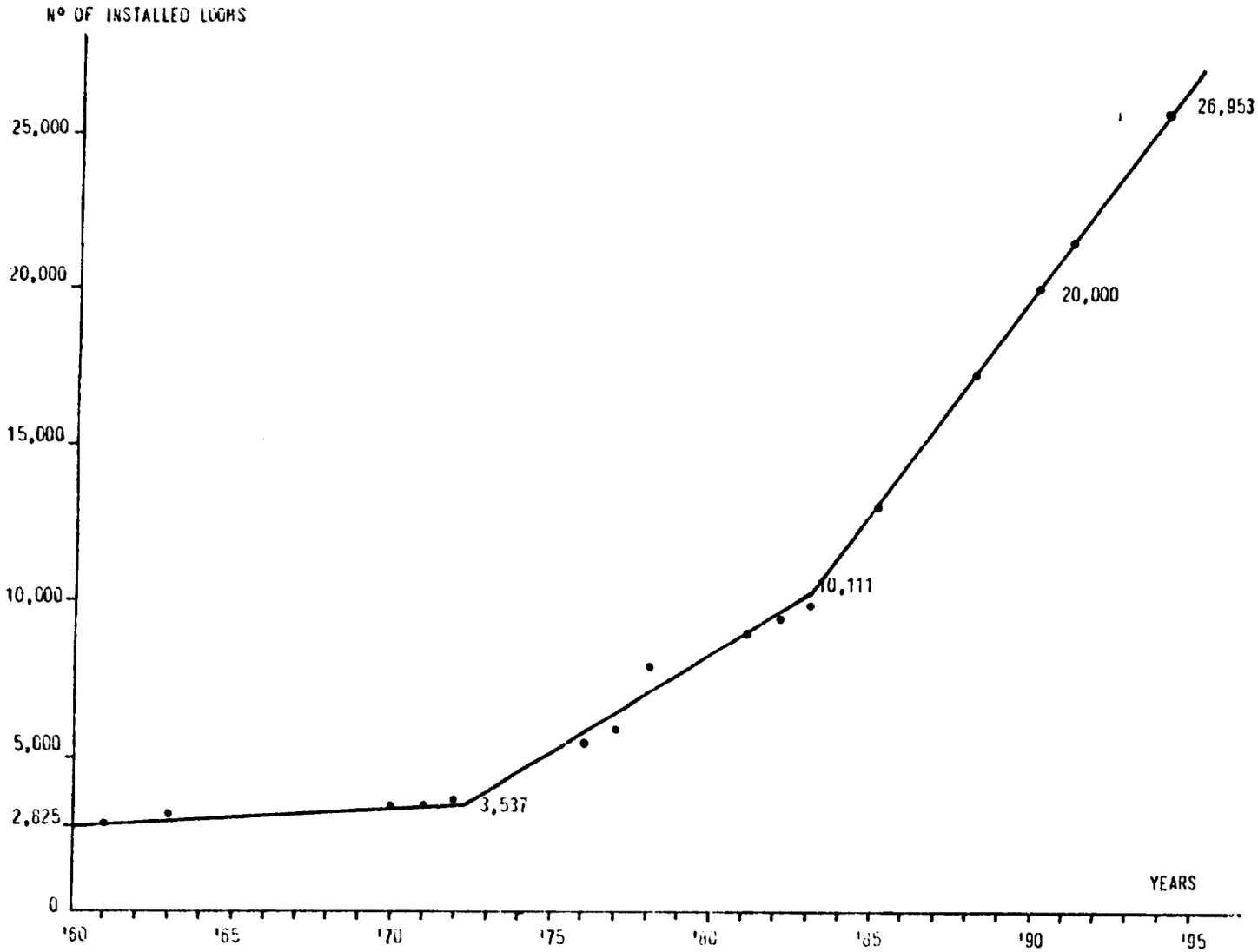


TABLE 26 : PARTITION OF THE SPARE PARTS TO BE MANUFACTURED LOCALLY IN THE DIFFERENT GROUPS, RAW MATERIALS AND SIZES

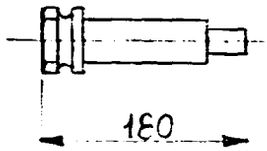
GROUPS	CAST IRON					MALLEABLE CAST IRON					STEEL					ALUMINIUM ALLOYS					BRASS AND BRONZE					TOTAL %
	0,6 kg	2 kg	6,5 kg	12 kg	Tot.	0,6 kg	2 kg	6,5 kg	12 kg	Tot.	0,6 kg	2 kg	6,5 kg	12 kg	Tot.	0,6 kg	2 kg	6,5 kg	12 kg	Tot.	0,6 kg	2 kg	6,5 kg	12 kg	Tot.	
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
1) SHAFTS											7	4	2	1	14											14
2) GEARS						2,7	1,8	0,4	-	5	5,4	3,8	0,8		10											15
3) SUPPORTS	6,2	3	0,8	-	10																					10
4) LEVERS	4,6	0,4	-	-	5	4,6	0,4	-	-	5	4,6	0,4	-	-	5											15
5) STRIP CONNECTIONS											5	-	-	-	5											5
6) SPRINGS											2	-	-	-	2											2
7) WASHERS BUSHES SCREWS & BOLTS											6	-	-	-	6						1	-	-	-	1	7
8) PULLEYS	-	-	1,75	1,75	3,5											-	-	1,75	1,75	3,5						7
9) TUBES AND TRAVERSES	-	-	4,25	-	4,25						-	-	-	2,75	2,75											7
10) CAST BODY COMPONENTS	-	-	-	10	10																					10
11) WELDED BODY COMPONENTS											2,13	2,12	0,75	-	5											5
12) PLAIN BEARINGS											1,5	-	-	-	1,5						1,5	-	-	-	1,5	3
TOTAL					32,75					10					51,25					3,5					2,5	100

TABLE 27 :

WORKING SCHEDULE

JOB N°	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	N° OFF
019	Picker path setting shaft	C 40 steel	650 gr.	
		SIZE: 32 hex. bar	FINISHED WEIGHT: 370 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME decimal hour	MACHINING TIME decimal hour	ATTACHMENT
10	Lathe	Part off to 124.0 mm. length	0.70	0.06	-
20	"	Center-drill	-	0.10	-
30	"	Turn to diam. 25.7	0.70	0.18	-
40	"	Turn groove to diam. 17.0 width 10.5	-	0.15	-
50	"	Turn to diam. 14.7	-	0.10	-
60	"	Turn diam.20.3 and turn groove	-	0.20	-
70	Ext.grinder	Grind to diam. 25.4	0.70	0.15	-
80	"	Grind to diam. 14.4	-	0.10	-
90	"	Grind to diam. 20 h 7	-	0.18	-
		TOTAL	2.10	1.22	

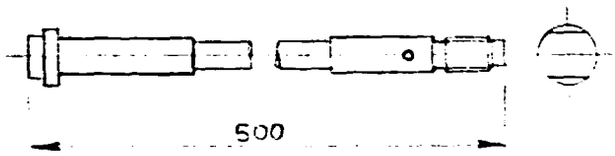
NOTES:

TABLE 28 :

WORKING SCHEDULE

JOB N°	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	N° OFF
005	Drift pin	C 40 steel	3,500 gr.	
		SIZE	FINISHED WEIGHT	
		40 round bar	2,000 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME (decimal hour)	MACHINING TIME (decimal hour)	ATTACHMENT
10	Lathe	Part off to length	0.70	0.10	
20	"	Turn to diam. 25 h 7 and turn groove	0.60	0.20	
30	"	Turn to diam. 24.5	-	0.10	
40	"	Turn and thread 5/8"	-	0.25	
50	"	Turn to diam. 17.5	-	0.10	
60	Miller	Plane for wrench grip	0.60	0.12	
70	Drill	Drill diam. 10.0 through hole	0.60	0.12	
		TOTAL	2.50	0.99	

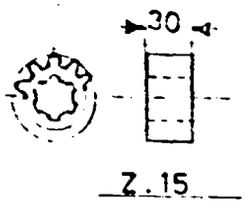
NOTES:

TABLE 29 :

WORKING SCHEDULE

JOB Nº	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	Nº OFF
075	Intermediate pinion	C 40 Steel	320 gr.	
		SIZE: 40 round bar	FINISHED WEIGHT: 200 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME (decimal hour)	MACHINING TIME (decimal hour)	ATTACHMENT
10	Lathe	Turn to diam. 37.5	0.70	0.05	
20	"	Part off to length	-	0.10	
30	"	Face one side	-	0.05	
40	"	Face second side and bore	-	0.20	
50	Slotter	Slot internal hole	0.70	0.15	
60	Gear cutter	Tooth (N. 15)	0.70	0.20	
		TOTAL	2.10	0.75	

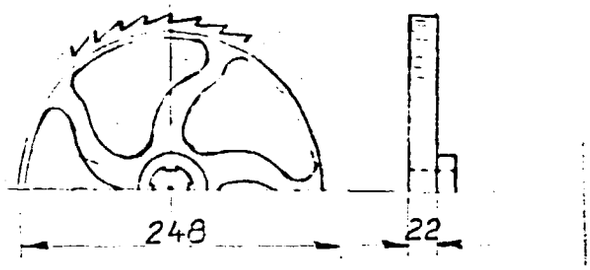
NOTES:

TABLE 30 :

WORKING SCHEDULE

JOB Nº	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	Nº OFF
026	Take-up ratchet wheel	Cast iron	3,800 gr.	
		SIZE diam.255x30 Casting	FINISHED WEIGHT 3,300 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME decimal hour	MACHINING TIME decimal hour	ATTACHMENT
10	Lathe	Turn to diam.38.0 and face	0.70	0.40	
20	"	Turn i.d. 21.0 $^{+\ 0.1}_{\ 0}$	-	0.25	
30	"	Turn to diam.248.0 and face	-	0.30	
40	Miller	Mill N. 41 teeth	1.40	1.20	
50	Slotter	Slot internal hole -	0.70	0.20	
		TOTAL	2.80	2.85	

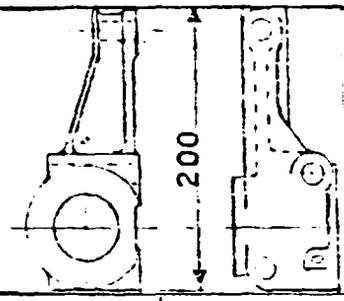
NOTES:

TABLE 31 :

WORKING SCHEDULE

JOB Nº	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	Nº OFF
002	Front box	Cast iron	3,200 gr.	
		SIZE	FINISHED WEIGHT	
		Casting	3,000 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME (decimal hour)	MACHINING TIME (decimal hour)	ATTACHMENT
10	Lathe	Turn to diam.43.0 ^{H7} and face	0.70	0.40	
20	Miller	Face mill	1.40	0.40	
30	Drill	Drill N.3 diam. 14.5 holes	0.70	0.30	Template N.
40	Threader	Tap drill and thread N.1M8 hole	-	0.18	
		TOTAL	2.80	1.28	

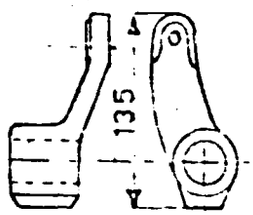
NOTES:

TABLE 32 :

WORKING SCHEDULE

JOB Nº	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	Nº OFF
073	Shipper lever	Cast iron	750 gr.	
		SIZE: Casting	FINISHED WEIGHT: 600 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME (decimal hour)	MACHINING TIME (decimal hour)	ATTACHMENT
10	Lathe	Turn i.d. and face	0.70	0.30	Template N.
20	"	Face N. 2 planes	-	0.15	Template N.
30	Drill	Drill N. 1 hole	0.70	0.10	Template N.
		TOTAL	1.40	0.55	

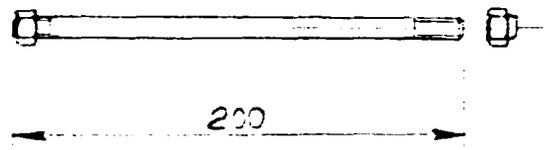
NOTES:

TABLE 33 :

WORKING SCHEDULE

JOB N°	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	N° OFF
009	Stud	C 40 Steel	130 gr.	
		SIZE	FINISHED WEIGHT	
		10 round bar	120 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME (decimal hour)	MACHINING TIME (decimal hour)	ATTACHMENT
10	Lathe	Part off to length	0.40	0.05	
20	"	Thread M 10 both ends	0.60	0.12	
30	D.C.welder	Weld nut onto one end	-	0.18	
40	Handwork	Screw self-locking nut onto other end	-	0.05	
		TOTAL	1.00	0.40	

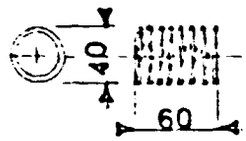
NOTES:

TABLE 34 :

WORKING SCHEDULE

JOB Nº	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	Nº OFF
040	Spring	1.50 mm spring steel wire	15 gr.	
		SIZE	FINISHED WEIGHT	
			14 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME (decimal hour)	MACHINING TIME (decimal hour)	ATTACHMENT
10	Spring machine		0.30	0.02	
20	Grinder	Grind both ends	-	0.02	
		TOTAL	0.30	0.04	

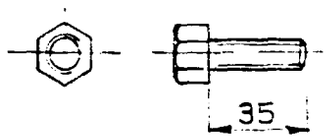
NOTES:

TABLE 35 :

WORKING SCHEDULE

JOB Nº	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	Nº OFF
020	Clutch finger set screw	C 40 Steel	80 gr.	
		SIZE	FINISHED WEIGHT 40 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME decimal hour	MACHINING TIME decimal hour	ATTACHMENT
10	Lathe	Turn and thread 7/16 UNF	0.70	0.10	
20	"	Bevel and part off to length	-	0.05	
30	-	Flame-harden head	0.30	0.05	
		TOTAL	1.00	0.20	

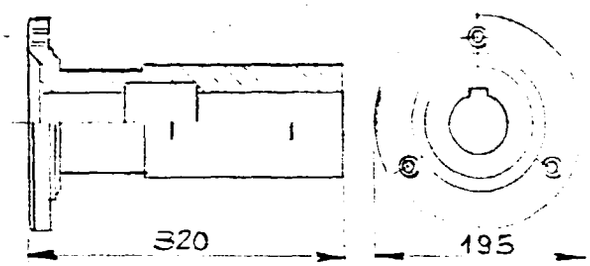
NOTES:

TABLE 36 :

WORKING SCHEDULE

JOB N°	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	N° OFF
008	Shaft driving gear Wheel	cast iron	19,500 gr.	
		SIZE 320x195 casting	FINISHED WEIGHT 18,000 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME decimal hour	MACHINING TIME decimal hour	ATTACHMENT
10	Lathe	Turn to diam. 100.0 $^{h\ 7}$	0.70	0.35	
20	"	Turn to diam. 97.0	-	0.20	
30	"	Turn to diam. 140-120-110	-	0.40	
40	"	Turn to diam. 195.0 and bevel 5x5	-	0.30	
50	"	Turn to diam. 95.0 and bevel to 30°	-	0.20	
60	"	Turn i.d.50.0 ^{H7} and bevel	-	0.44	
70	Miller	Mill external groove	1.00	0.80	
40	"	Mill internal keyway	1.00	0.20	
90	Drill	Drill N.3 diam. 12.5 holes	0.60	0.30	Template N.
100	Threader	Tap drill and thread N. 3 M 14 holes	-	0.35	Template N.
110	Drill	Drill diam. 4.0 oiling holes	0.60	0.30	
		TOTAL	3.90	4.59	

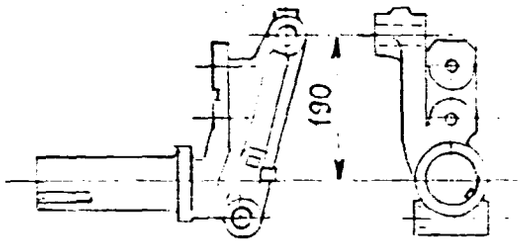
NOTES:

TABLE 37 :

WORKING SCHEDULE

JOB Nº	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	Nº OFF
001	Picker stick stop	Cast iron	12,000 gr.	
		SIZE	FINISHED WEIGHT	
		Casting	10,800 gr.	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME decimal hour	MACHINING TIME decimal hour	ATTACHMENT
10	Lathe	Turn to diam.50.0^{h7} and face	0.70	0.40	
20	Miller	Mill N. 3 planes	1.40	0.60	
30	"	Mill N. 2 planes	-	0.65	
40	"	Mill N. 1 plane	-	0.60	
50	"	Mill 10x60mm length keyway	1.40	0.90	
60	Drill	Drill N.2 diam.10.0 holes	0.70	0.30	
70	Threader	Tap drill and thread N.1 M8 hole	-	0.30	
		TOTAL	4.20	3.75	

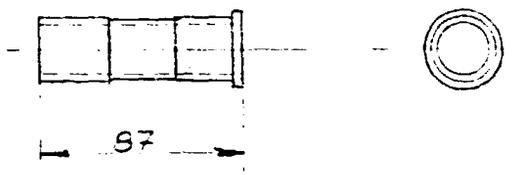
NOTES:

TABLE 38 :

WORKING SCHEDULE

JOB N°	JOB COMMENCED	DELIVERY DATE

CUSTOMER



CODE	DESCRIPTION	MATERIAL	BLANK WEIGHT	N° OFF
001/A	BUSHING	BRONZE	400 gr	
		SIZE 28 round bar	FINISHED WEIGHT 150 gr	

WORK STAGE	MACHINE	MACHINING	SETTING UP TIME (decimal hour)	MACHINING TIME (decimal hour)	ATTACHMENT
10	Lathe	Turn to diam. 26.0	0.70	0.15	
20	"	Turn to diam. 25.0	/	0.05	
30	"	Turn to diam. 30 and part off length	/	0.08	
40	"	Turn i.d. 20.0 ^{H7} and bevel	/	0.18	
50	"	Turn n° 2 oil grooves	/	0.08	
70	Drill	Drill diam. diam. 8.0 oiling hole	0.70	0.10	
		TOTAL	1.40	0.64	

NOTES:

TABLE 39 : EVALUATION OF SPARE PARTS TOTAL CONSUMPTION, IMPORTATION, PRODUCTION BOTH IN THE LOCAL ANNEXED WORKSHOPS AND IN THE NEW CENTRAL WORKSHOP (TONS)

YEAR	Total consumption (tons)	Production in the central workshop		Production in the local annexed workshops		Importation	
		TONS	% of total consumpt.	TONS	% of total consumpt.	TONS	% of total consumpt.
1979	290	0	0	58	20	232	80
1980	308	0	0	62	20	246	80
1981	325	0	0	65	20	260	80
1982	343	0	0	69	20	274	80
1983	360	40	11	72	20	248	69
1984	412	80	19	82	20	250	61
1985	463	80	17	93	20	290	63
1986	515	80	16	103	20	332	64
1987	566	160	28	113	20	293	52
1988	617	160	26	123	20	334	54
1989	669	160	24	134	20	375	56
1990	720	320	44	144	20	256	36
1991	771	320	42	154	20	297	38
1992	823	320	39	165	20	338	41
1993	874	480	55	175	20	219	25
1994	926	640	69	185	20	101	11
1995	977	640	65	195	20	142	15

TABLE 40 : DIAGRAM OF SPARE PARTS TOTAL CONSUMPTION, IMPORTATION, PRODUCTION BOTH IN THE LOCAL ANNEXED WORKSHOPS AND IN THE NEW CENTRAL WORKSHOP (TONS) (EVALUATION)

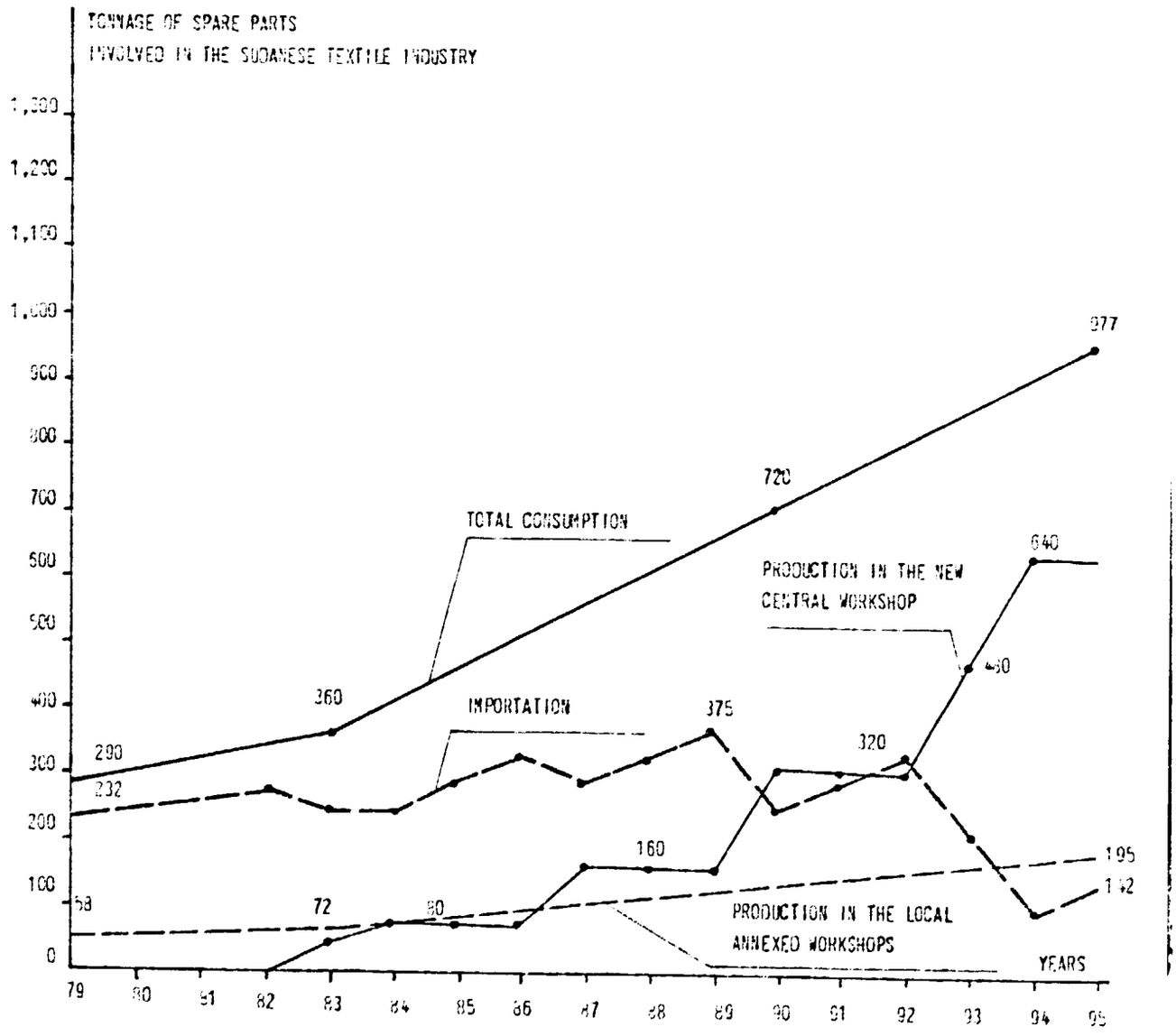


TABLE 41 : PERCENTAGE ON THE TOTAL SPARE PARTS CONSUMPTION (TONS) OF SPARE PARTS IMPORTATION (TONS) AND PRODUCTION (TONS), BOTH IN THE LOCAL ANNEXED WORKSHOPS AND IN THE NEW CENTRAL WORKSHOP

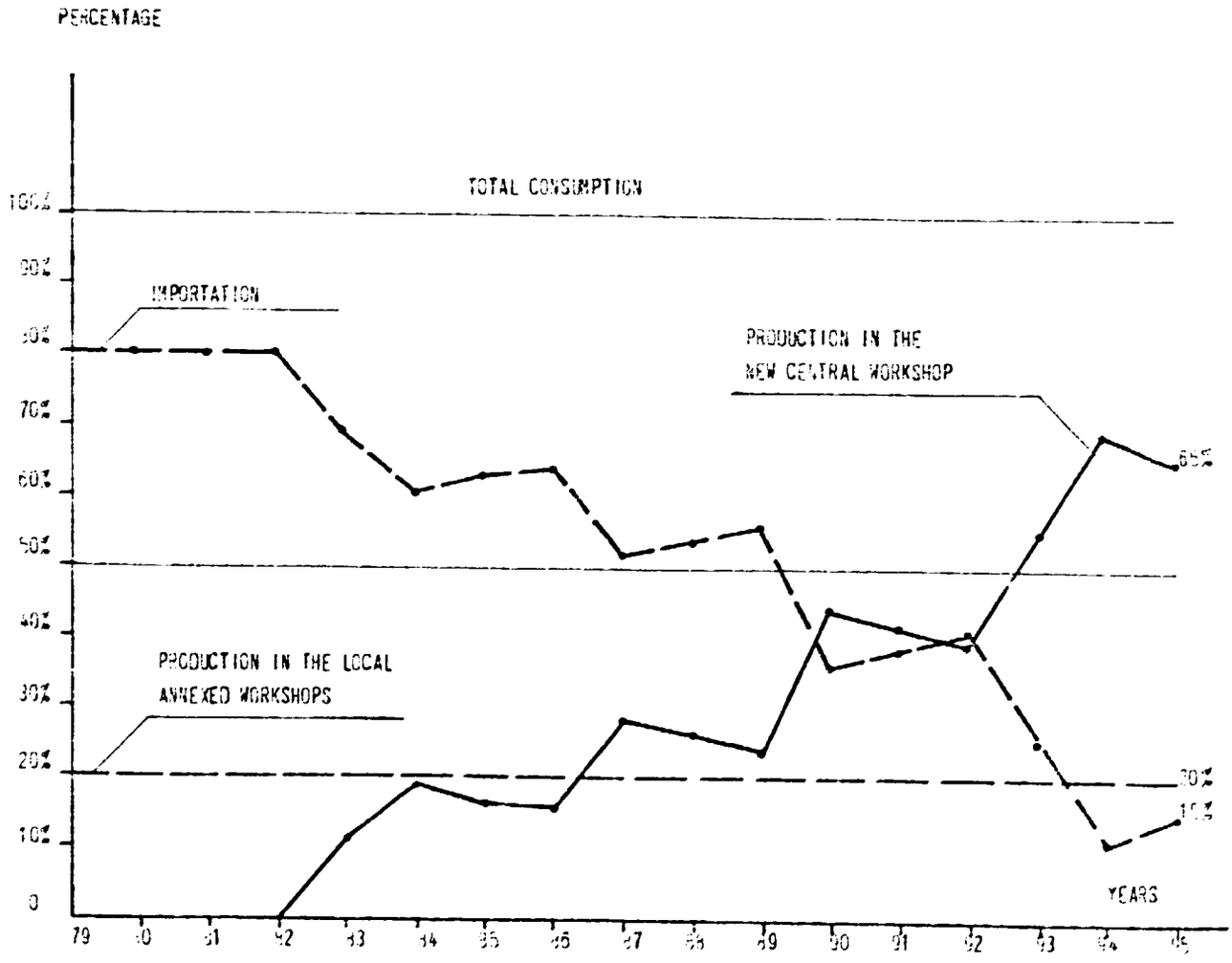


TABLE 42 : PRELIMINARY SCHEDULE OF THE NEW CENTRAL WORKSHOP

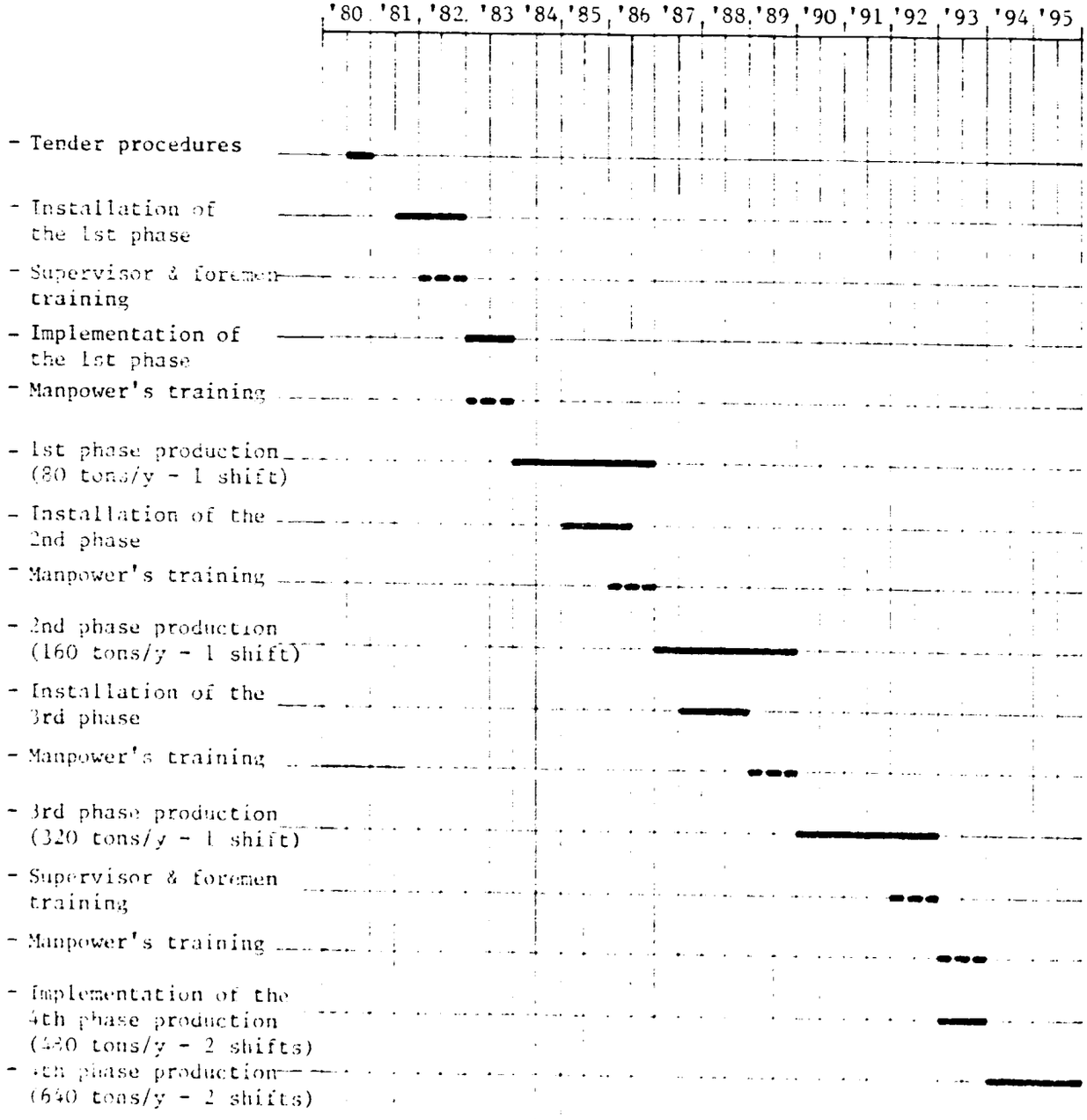


TABLE 43 : VALUE OF THE TOTAL SPARE PARTS CONSUMPTION OF SPARE PARTS IMPORTATION AND PRODUCTION BOTH IN THE LOCAL ANNEXED WORK-SHOP AND IN THE NEW CENTRAL WORKSHOP

(thousand of S.P.) (EVALUATION) (x)

YEAR	Total consumpt. (thousands of SP)	Production in the central workshop (thousands of SP)	Production in the local annexed workshops (thousands of SP)	Importation (thousands of SP)	REMARKS
1979	4,350	-	870	3,480	
1980	4,620	-	930	3,690	
1981	4,875	-	975	3,900	
1982	5,145	-	1,035	4,110	
1983	5,400	600	1,080	3,720	
1984	6,180	1,200	1,230	3,750	
1985	6,945	1,200	1,395	4,350	
1986	7,725	1,200	1,545	4,980	
1987	8,490	2,400	1,695	4,395	
1988	9,255	2,400	1,845	5,010	
1989	10,035	2,400	2,010	5,625	
1990	10,800	4,800	2,160	3,840	
1991	11,565	4,800	2,310	4,455	
1992	12,345	4,800	2,475	5,070	
1993	13,110	7,200	2,625	3,285	
1994	13,890	9,600	2,775	1,515	
1995	14,655	9,600	2,925	2,130	

(x) Values are concerning spare parts in Khartoum and are at constant prices (at 1979's level).

TABLE 44 : QUANTITIES OF THE SELECTED PLASTIC ACCESSORIES FOR 10,000 LOOMS AND 500,000 SPINDLES

ACCESSORIES	CONSUMPTION (N°pieces/year)		Unitary weight (gr/piece)	Total weight (tons/year)
	For 500,000 spindles	For 10,000 looms		
SPINNING TUBES	215,000		70	15
CONES		215,000	70	15
TIE ROD OF THE PICKING STICK		40,000	100	4
SHUTTLE GUARDS		10,000	200	2
LOOM PICKERS		10,000	100	4
ELEMENTS OF THE REVOLVING PIRN CHANGE(in the looms)		40,000	10	0.4
PIRNS		10,000	20	0.2

REMARKS :

Values of the last column have been rounded.

TABLE 45 : PRODUCTION PROGRAM FOR THE PLASTIC ACCESSORIES (tons)

ACCESSORIES	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
SPINNING TUBES	7.5	15	15	18	21	24	27	30	32	34	36	38	40
CONES	7.5	15	15	18	21	24	27	30	32	34	36	38	40
OTHER ACCESSORIES (OUT OF THE SELECTED ONES)	-	-	10	12	14	16	18	20	21	22	23	24	25
T O T A L	15	30	40	48	56	64	72	80	85	90	95	100	105

TABLE 46 : TRAINING PROGRAM FOR MACHINE TOOL WORKERS (No. OF PERSONS/YEAR)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
TRAINING NECESSITIES (A)	60	69	77	86	94	103	111	120	128	136	144	152	160
WORKERS TO BE TRAINED FOR EACH COURSE (3 MONTHS) IN THE CENTRAL WORKSHOP (B)	10	17	19	21	23	25	27	30	32	34	36	38	40
TOTAL WORKERS TO BE TRAINED THROUGH-OUT THE YEAR IN THE CENTRAL WORKSHOP (C)	40	68	76	84	92	100	108	120	128	136	144	152	160
PERCENTAGE (C) on (A)	67%	99%	99%	98%	98%	97%	97%	100%	100%	100%	100%	100%	100%

TABLE 47 : PARTITION OF 320 TONS/YEAR OF SPARE PARTS TO BE MANUFACTURED LOCALLY IN 1990-91-92 IN THE DIFFERENT GROUPS, RAW MATERIALS AND SIZES

GROUPS	CAST IRON					MALLEABLE CAST IRON					STEEL					ALUMINIUM ALLOYS					BRASS AND BRONZE					TOTAL
	0,6 kg	2 kg	6,5 kg	32 kg	Tot.	0,6 kg	2 kg	6,5 kg	32 kg	Tot.	0,6 kg	2 kg	6,5 kg	32 kg	Tot.	0,6 kg	2 kg	6,5 kg	32 kg	Tot.	0,6 kg	2 kg	6,5 kg	32 kg	Tot.	
1) SHAFTS											22,15	13,54	8,15	2,96	46,80											46,80
2) GEARS						8,62	6,15	1,23	-	16,00	17,23	12,31	2,46	-	32,00											48,00
3) SUPPORTS	19,20	9,35	2,45	-	32,00																					32,00
4) LEVERS	14,77	1,23	-	-	16,00	14,77	1,23	-	-	16,00	14,77	1,23	-	-	16,00											48,00
5) STEEP CONNECTIONS											16,00	-	-	-	16,00											16,00
6) SPRINGS											8,40	-	-	-	8,40											8,40
7) WASHERS BUSHES SCREWS AND BOLTS											19,20	-	-	-	19,20						3,20	-	-	-	3,20	22,40
8) PULLEYS	-	-	5,60	5,60	11,20													5,60	5,60	11,20						22,40
9) TUBES AND TRAVERSES	-	-	13,54	-	13,54						-	-	-	8,86	8,86											22,40
10) CAST BODY COMPONENTS	-	-	-	32,00	32,00																					32,00
11) WELDED BODY COMPONENTS											8,77	8,77	2,46	-	16,00											16,00
12) PLAIN BEARINGS											4,80	-	-	-	4,80						4,80	-	-	-	4,80	9,60
TOTAL					104,74					32,00					164,06					11,20					8,00	320,00

TABLE 46 : Nº OF SPARE PARTS/YEAR TO BE MANUFACTURED LOCALLY IN 1990-91-92 CORRESPONDING TO 320 TONS/YEAR

GROUPS	CAST IRON					MALLEABLE CAST IRON					STEEL					ALUMINIUM ALLOYS					BRASS AND BRONZE					TOTAL
	0,6 kg	2 kg	6,5 kg	12 kg	Total	0,6 kg	2 kg	6,5 kg	12 kg	Total	0,6 kg	2 kg	6,5 kg	12 kg	Total	0,6 kg	2 kg	6,5 kg	12 kg	Total	0,6 kg	2 kg	6,5 kg	12 kg	Total	
1) SHAFTS											36,920	6,770	950	250	44,890											44,890
2) GEARS						14,366	3,075	189		17,630	20,720	6,155	380	-	35,255											52,885
3) SUPPORTS	32,635	4,925	350	-	38,140																					38,140
4) LEVERS	24,616	615	-	-	25,231	24,616	615	-	-	25,231	24,616	615	-	-	25,231											75,693
5) STAMP CORRECTIONS											26,660	-	-	-	26,660											26,660
6) SPACERS											10,670	-	-	-	10,670											10,670
7) WASHERS (LOCKS, COVERS AND SEALS)											32,000	-	-	-	32,000						5,330	-	-	-	5,330	37,330
8) PULLEYS	-	-	650	620	1,330											-	-	861	466	1,327						2,657
9) TUBES AND SHAFTS	-	-	2,100	-	2,100						-	-	-	740	740											2,840
10) CAST IRON COMPONENTS	-	-	-	2,670	2,670																					2,670
11) [illegible]											11,170	3,385	380	-	14,935											14,935
12) REAR GEAR											8,000	-	-	-	8,000						8,000	-	-	-	8,000	16,000
TOTAL					69,471					42,861					198,381					1,327					13,330	325,370

TABLE 49 : RAW MATERIALS REQUIREMENTS (tons) - (1ST HYPOTHESIS)

RAW MATERIALS	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
CAST IRON	17.0	34.0	34.0	34.0	68.1	68.1	68.1	136.1	136.1	136.1	204.2	272.2	272.2
MALLEABLE CAST IRON	5.2	10.4	10.4	10.4	20.8	20.8	20.8	41.6	41.6	41.6	62.4	83.2	83.2
STEEL	26.7	53.3	53.3	53.3	106.6	106.6	106.6	213.3	213.3	213.3	319.9	426.6	426.6
ALUMINIUM ALLOYS	1.8	3.7	3.7	3.7	7.3	7.3	7.3	14.6	14.6	14.6	21.9	29.2	29.2
BRASS AND BRONZE	1.3	2.6	2.6	2.6	5.2	5.2	5.2	10.4	10.4	10.4	15.6	20.8	20.8
TOTAL METAL	52	104	104	104	208	208	208	416	416	416	624	832	832
TOTAL PLASTIC	15.8	31.5	42.0	50.4	58.8	67.2	75.6	84.0	89.3	94.5	99.8	105.0	110.3

TABLE 50 : RAW MATERIALS REQUIREMENTS (tons) - (2nd HYPOTHESIS)

RAW MATERIALS	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
CAST IRON	17.0	34.0	34.0	34.0	68.1	68.1	68.1	136.1	136.1	136.1	204.2	272.2	272.2
MALLEABLE CAST IRON	5.2	10.4	10.4	10.4	20.8	20.8	20.8	41.6	41.6	41.6	62.4	83.2	83.2
DUCTILE CAST IRON	5.3	10.7	10.7	10.7	21.8	21.8	21.8	42.7	42.7	42.7	64.0	85.3	85.3
STEEL	21.4	42.6	42.6	42.6	84.8	84.8	84.8	170.6	170.6	170.6	255.9	341.3	341.3
ALUMINIUM ALLOYS	1.8	3.7	3.7	3.7	7.3	7.3	7.3	14.6	14.6	14.6	21.9	29.2	29.2
BRASS AND BRONZE	1.3	2.6	2.6	2.6	5.2	5.2	5.2	10.4	10.4	10.4	15.6	20.8	20.8
TOTAL METAL	52	104	104	104	208	208	208	416	416	416	624	832	832
TOTAL PLASTIC	15.8	31.5	42.0	50.4	58.8	67.2	75.6	84.0	89.3	94.5	99.8	105.0	110.3

TABLE 51 : WORKLOAD OF THE CENTRAL WORKSHOP (Nº OF HOURS/YEAR) FOR 320 TONS/YEAR OF SPARE PARTS

Item Code	Nº of pieces/year		LATHE MACHINES		GRINDING MACHINES		MILLING MACHINES		DRILLING MACHINES		SLOTTING MACHINES		GEAR CUTTING MACHINES		THREADING MACHINES		SPRING MAKING MACHINES		WELDING SETS	
			N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P
019	36,920	min/pieces	47'	84'	28'	42'														
		total/hours	28,921	516	15,678	259														
025	7,970	min/pieces	45'	78'			7'	42'	7'	49'										
		total/hours	5,976	104			956	56	956	65										
025	43,036	min/pieces	24'	42'							9'	42'	12'	42'						
		total/hours	17,235	302							6,463	302	8,617	302						
026	5,739	min/pieces	37'	42'			72'	84'			12'	42'								
		total/hours	9,310	69			11,760	137			1,960	69								
032	35,140	min/pieces	24'	42'			24'	84'	18'	42'					11'					
		total/hours	15,256	267			15,256	533	11,442	267					6,992					
073	75,653	min/pieces	27'	42'					6'	42'										
		total/hours	34,081	636					7,569	636										
079	26,650	min/pieces	10'	60'															11'	-
		total/hours	4,444	266															4,888	-
082	10,670	min/pieces															3'	18'		
		total/hours															0	32		
020	37,330	min/pieces	9'	42'																
		total/hours	5,640	261																
038	2,667	min/pieces	113'	42'			96'	120'	57'	72'										
		total/hours	5,034	19			4,251	54	2,524	32										
*	2,640	min/pieces																	5'	10'
		total/hours																	237	474
001	2,670	min/pieces	24'	42'			165'	168'	36'	42'										
		total/hours	1,068	19			7,343	78	1,602	19										
**	14,935	min/pieces																	10'	20'
		total/hours																	489	496
001/A	16,600	min/pieces	32'	42'					6'	42'										
		total/hours	8,533	112					1,600	112										
TOTAL	320,370	TOTAL HOURS	135,410	2,593	15,878	259	39,565	665	25,693	1,151	6,423	371	8,617	302	6,992	-	9	32	7,614	970

NOTES :

* Machining time

** Setting time

* Various items such as tubes and traverses

** Various items such as welded components

TABLE 52 : NUMBER OF MACHINE TOOLS IN THE CENTRAL WORKSHOP
(ACCORDING WITH A WORKLOAD CORRESPONDING TO 320 TONS/YEAR
SPARE PARTS PRODUCTION)

TYPE OF MACHINE	MACHINING AND SETTING TIME (hours/year)	TOTAL WORKLOAD (M.T.+S.T.)(hours/y)	NUMER OF MACHINES
LATHE MACHINES	M.T. 135,410 S.T. 2,593	138,003	79
GRINDING MACHINES	M.T. 15,876 S.T. 259	15,135	9
MILLING MACHINES	M.T. 39,566 S.T. 865	40,431	23
DRILLING MACHINES	M.T. 25,693 S.T. 1,151	26,844	15
SLOTTING MACHINES	M.T. 8,423 S.T. 371	8,794	5
GEAR CUTTING MACHINES	M.T. 8,617 S.T. 302	8,919	5
THREADING MACHINES	M.T. 6,992 S.T. -	6,992	4
SPRING MAKING MACHINES	M.T. 9 S.T. 32	41	1
WELDING SETS	M.T. 7,614 S.T. 970	8,584	6
TOTAL	-	-	147

TABLE 53 : PLANT AREAS (m2)

	Service area (ground floor) m2) (A)	Office area (1st floor) (m2) (B)	Product. area(ground floor) (m2) (C)	Covered area in the main shed (m2) (A+C)	Gatekeeper lodge (m2) (D)	Total covered area (m2)(A+C+D)	Outdoor area (m2) (E)	Total area (m2) (A+C+D+E)
1st PHASE Install.:1/7/1981 - 31/12/1982 Product.:1983-84-85-86	462.5	462.5	2,090.5	2,553	160	2,713	14,135	16,848
2nd PHASE Install.:1/1/1985 - 30/6/1986 Product.:1987-88-89	462.5	462.5	3,886.5	4,329	160	4,489	12,359	16,848
3rd PHASE Install.:1/7/1987 - 31/12/1988 Product.:1990-91-92	912.5	912.5	7,628.5	8,541	160	8,701	8,147	16,848
4th PHASE Install.: - Product.: 1993-94-95	912.5	912.5	7,628.5	8,541	160	8,701	8,147	16,848

TABLE 54 : DETAIL OF PRODUCTION AND TRAINING PERSONNEL (NUMBER OF PEOPLE REQUIRED)

PERSONNEL	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Training	-	-	46	-	-	43	-	-	89	-	-	-	178	-	-
MACHINE WORKERS															
Activity	-	-	-	46	46	46	89	89	89	178	178	178	178	356	356
Training	-	-	23	-	-	6	-	-	10	-	-	-	39	-	-
AUXILIARY WORKERS															
Activity	-	-	-	23	23	23	29	29	29	39	39	39	39	78	78
TOTAL WORKERS	-	-	69	69	69	118	118	118	217	217	217	217	434	434	434
Training	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
SUPERVISOR															
Activity	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1
Training	-	5	-	-	-	-	-	-	-	-	-	-	4	-	-
FOREMEN															
Activity	-	-	5	5	5	5	5	5	5	5	5	5	5	9	9
TOTAL PRODUCTION	-	6	75	75	75	124	124	124	223	223	223	223	444	444	444
Training	-	4	-	-	-	-	-	-	4	-	-	-	-	-	-
TRAINERS															
Activity	-	-	4	4	4	4	4	4	4	8	8	8	8	8	8
TOTAL TRAINERS	-	4	4	4	4	4	4	4	8	8	8	8	8	8	8

TABLE 55 : DETAIL OF STAFF AND MANAGEMENT - (NUMBER OF PEOPLE REQUIRED)

PERSONNEL	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
GENERAL MANAGEMENT	0.5°	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SALES MANAGER	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ADMINISTRATION MANAGER	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TECHNICAL MANAGER	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TOTAL MANAGERS (except G.M.)	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3
ADMINISTRATION SECRETARY CLERKS Training	-	3°°	-	-	-	-	-	-	1+	-	-	-	2++	-	-
Activity	-	-	6	6	6	6	6	6	6	8	8	8	8	12	12
DRAFTMEN Training	-	1°°	-	-	-	-	-	-	+0.5	-	-	-	++0.5	-	-
Activity	-	-	2	2	2	2	2	2	2	3	3	3	3	4	4
PRODUCTION PLANNING CLERKS Training	-	1°°	-	-	-	-	-	-	+0.5	-	-	-	++0.5	-	-
Activity	-	-	2	2	2	2	2	2	2	3	3	3	3	4	4
NURSES	-	-	1	1	1	1	1	1	1	2	2	2	2	4	4
TOTAL CLERKS	-	5	11	11	11	11	11	11	13	16	16	16	19	24	24
TOTAL STAFF & MANAGEMENT	0.5	9	15	15	15	15	15	15	17	20	20	20	23	28	28

REMARKS : ° Forecast arrival at 1/7/1981 ; °° Forecast arrival at 1/7/1982 ; + Forecast arrival at 1/7/1989 ;
++ Forecast arrival at 1/7/1993

TABLE 56 - COST OF BUILDING (thousands of SP)

	1st Phase (Installation 1/7/81-31/12/82)		2nd Phase (Installation 1/1/85-30/6/86)		3rd Phase (Installation 1/7/87-31/12/88)	
	Additional	Total	Additional	Total	Additional	Total
1. Production area	305	305	260	565	550	1,115
2. Office and service area	215	215	-	215	205	420
TOTAL	520	520	260	780	755	1,535

TABLE 57 - COST OF PRODUCTION MACHINERY, UTILITIES AND FACILITIES (thousands of SP)

	1st Phase (Installation 1/7/81-31/12/82)		2nd Phase (Installation 1/1/85-30/6/86)		3rd Phase (Installation 1/7/87 - 31/12/88)	
	Additional	Total	Additional	Total	Additional	Total
1. Machinery for spare parts including handling equipment and tools	845	845	595	1,440	1,330	2,770
2. Machinery for plastic accessories including moulds	190	190	80	270	165	435
3. Air contitioning system	210	210	130	340	330	670
4. Electrical system	455	455	295	750	715	1,465
5. Other utilities (water supply, compressed air system etc.)	160	160	70	230	165	395
6. Machinery and fixtures for training	55	55	-	55	55	110
TOTAL	1,915	1,915	1,170	3,085	2,760	5,845

TABLE 58 - ANALYTICAL DEPRECIATION SCHEME (thousands of SP)

		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total Depreciation ('000 SP)
Land and Buildings	1st Phase	-	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	610
	2nd Phase	-	-	-	-	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	260
	3rd Phase	-	-	-	-	-	-	-	125.9	125.9	125.9	125.9	125.9	125.9	755
1. Sub-total land and buildings		-	50.8	50.8	50.8	79.7	79.7	79.7	205.6	205.6	205.6	205.6	205.6	205.6	1,625
Equipment	1st Phase	-	159.6	159.6	159.6	159.6	159.6	159.6	159.6	159.6	159.6	159.6	159.6	159.6	1,915
	2nd Phase	-	-	-	-	130.0	130.0	130.0	130.0	130.0	130.0	130.0	130.0	130.0	1,170
	3rd Phase	-	-	-	-	-	-	-	460.0	460.0	460.0	460.0	460.0	460.0	2,760
2. Sub-total equipment			159.6	159.6	159.6	289.6	289.6	289.6	749.6	749.6	749.6	749.6	749.6	749.6	5,845
3. Sub-total Consultant's fee (1st Phase)			10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	130
Pre-operational Expenditures	1st Phase	-	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	108
	2nd Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3rd Phase	-	-	-	-	-	-	-	7.0	7.0	7.0	7.0	7.0	7.0	42
4. Sub-total pre-operational expenditures		-	9.0	9.0	9.0	9.0	9.0	9.0	16.0	16.0	16.0	16.0	16.0	16.0	150
TOTAL		-	230.2	230.2	230.2	389.1	389.1	389.1	982.0	982.0	982.0	982.0	982.0	982.0	7,750

TABLE 59 - SYNTHETICAL DEPRECIATION SCHEME (thousands of SP)

		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total Depreciation ('000 SP)
Capital Expenditures	1st Phase	-	230.2	230.2	230.2	230.2	230.2	230.2	230.2	230.2	230.2	230.2	230.2	230.2	2,763
	2nd Phase	-	-	-	-	158.9	158.9	158.9	158.9	158.9	158.9	158.9	158.9	158.9	1,430
	3rd Phase	-	-	-	-	-	-	-	592.9	592.9	592.9	592.9	592.9	592.9	3,557
TOTAL		-	230.2	230.2	230.2	389.1	389.1	389.1	982.0	982.0	982.0	982.0	982.0	982.0	7,750

TABLE 60 - PHASING OF INVESTMENT (thousands of SP)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total ('000 of SP)
Land & building equipment and consultant's fee	1,859	531	265	-	1,216	71	2,604	703	351	-	-	-	-	-	-	7,600
Pre-operational expenditures	13	95	-	-	-	-	-	-	24	-	-	18	-	-	-	150
TOTAL	1,872	626	265	-	1,216	71	2,604	703	375	-	-	18	-	-	-	7,750

TABLE 61 - EXPENDITURES FOR PERSONNEL (thousands of SP)

Personnel	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
a.1.) Workers	-	-	62.1	62.1	62.1	106.2	106.2	106.2	195.3	195.3	195.3	195.3	390.6	390.6	390.6
a.2.) Supervisor	-	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
a.3.) Foremen	-	9	9	9	9	9	9	9	9	9	9	9	16.2	18	18
a) TOTAL PRODUCTION	-	11.5	73.6	73.6	73.6	117.7	117.7	117.7	206.8	206.8	206.8	206.8	409.3	409.3	409.3
b) TOTAL TRAINING	-	7.2	7.2	7.2	7.2	7.2	7.2	7.2	14.4	14.4	14.4	14.4	14.4	14.4	14.4
c.1.) General Mgr	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6
c.2.) Managers	-	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
c.3.) Clerks and nurses	-	6	13.2	13.2	13.2	13.2	13.2	13.2	15.6	19.2	19.2	19.2	22.8	28.8	28.8
c) TOTAL ADMINISTRATION	3	22.5	29.7	29.7	29.7	29.7	29.7	29.7	32.1	35.7	35.7	35.7	39.3	45.3	45.3
GRAND TOTAL	3.0	41.2	110.5	110.5	110.5	154.6	154.6	154.6	253.3	256.9	256.9	256.9	463.0	469.0	469.0

TABEL 62 - TOTAL OPERATIONAL EXPENSES (thousands of SP)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Cost of raw materials	84.3	168.6	172.8	176.2	335.5	338.9	342.2	657.6	659.7	661.8	975.9	1,290.0	1,292.1
Cost of utilities	14.3	22.4	22.4	22.4	42.6	42.6	42.6	76.0	76.0	76.0	106.7	122.0	122.0
Cost of maintenance and consumption materials	-	-	38.3	38.3	61.7	61.7	61.7	116.9	116.9	116.9	175.4	233.8	233.8
General expenses	40.0	40.0	40.0	40.0	40.0	40.0	40.0	50.0	50.0	50.0	70.0	70.0	70.0
Expenditures for personnel	110.5	110.5	110.5	154.6	154.6	154.6	253.3	256.9	256.9	256.9	463.0	469.0	469.0
TOTAL	249.1	341.5	384.0	431.5	634.4	637.8	739.8	1,157.4	1,159.5	1,161.6	1,791.0	2,184.8	2,186.9

TABEL 63 - TOTAL INDUSTRIAL COST (thousands of SP) AND UNITARY INDUSTRIAL COST (thousands of SP/ton)OF SPARE PARTS

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Cost of raw materials	78	156	156	156	312	312	312	624	624	624	936	1,248	1,248
Expenditures for production personnel	67.3	67.3	67.3	111.4	111.4	111.4	200.5	200.5	200.5	200.5	403.0	403.0	403.0
Cost of maintenance, consumption materials and of utilities	12.2	19.0	51.6	51.6	88.7	88.7	88.7	164.0	164.0	164.0	253.2	326.9	326.9
Total industrial cost	157.5	242.3	274.9	319.0	512.1	512.2	601.2	988.5	988.5	988.5	1,592.2	1,977.9	1,977.9
Production (tons)	40	80	80	80	160	160	160	320	320	320	480	640	640
Unitary industrial cost	3.94	3.03	3.44	3.99	3.20	3.20	3.76	3.09	3.09	3.09	3.32	3.09	3.09

TABLE 64 - TOTAL INDUSTRIAL COST (thousands of SP) AND UNITARY INDUSTRIAL COST (thousands of SP/ton) OF PLASTIC ACCESSORIES

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Cost of raw materials	6.3	12.6	16.8	20.2	23.5	26.9	30.2	33.6	35.7	37.8	39.9	42.0	44.1
Expenditures for production personnel •	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Cost of maintenance, consumption materials and of utilities	2.1	3.4	9.1	9.1	15.6	15.6	15.6	28.9	28.9	28.9	28.9	28.9	28.9
Total industrial cost	14.7	22.3	32.2	35.6	45.4	48.8	52.1	68.8	70.9	73.0	75.1	77.2	79.3
Production (tons)	15	30	40	48	56	64	72	80	85	90	95	100	105
Unitary industrial cost	0.98	0.74	0.81	0.74	0.81	0.76	0.72	0.86	0.83	0.81	0.79	0.77	0.76

• Remark: Plastic department personnel has been considered as follows:-
1 Foreman; 4 machine workers and 1 auxiliary worker.

TABLE 65 - TOTAL INVENTORY VALUE (thousands of SP)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Finished goods (spare parts)	39.4	60.6	68.8	79.8	128.0	128.0	150.4	247.2	247.2	247.2	265.6	247.2	247.2
Finished goods (plastic accessories)	4.9	7.4	8.1	7.4	13.0	12.2	11.5	17.2	16.6	16.2	15.8	15.4	15.2
a) Sub Total Finished goods	44.3	68.0	76.9	87.2	141.0	140.2	161.9	264.4	263.4	263.4	281.4	262.6	262.4
Raw materials (spare parts)	22.5	45.0	45.0	45.0	90.0	90.0	90.0	165.0	165.0	165.0	165.0	165.0	165.0
Raw materials (plastic accessories)	2.0	4.0	4.0	4.0	6.4	6.4	6.4	8.0	8.0	8.0	8.0	8.0	8.0
b) Sub Total raw materials	24.5	49.0	49.0	49.0	96.4	96.4	96.4	173.0	173.0	173.0	173.0	173.0	173.0
c) Sub Total maintenance & consumption materials	-	38.3	38.3	38.3	61.7	61.7	61.7	116.9	116.9	116.9	175.4	233.8	233.8
Total inventory value (a + b + c)	68.8	155.3	164.2	174.5	299.1	298.3	320.0	554.3	553.3	553.3	629.8	669 4	669.2
Increase in the total inventory value	68.8	86.5	8.9	10.3	124.6	(0.8)	21.7	234.3	(1.0)	-	76.5	39.6	(0.2)

TABLE 66 - SOLD QUANTITY AND REVENUES (thousands of SP)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Sold spare parts (tons)	30	70	80	80	140	160	160	280	320	320	480	640	720
Sold plastic accessories (tons)	10	25	40	48	50	64	72	76	85	90	95	100	125
Trained persons (N°)	40	68	76	84	92	100	108	120	128	136	144	152	160
GROSS REVENUES ('000 of SP)													
Spare parts	450	1,050	1,200	1,200	2,100	2,400	2,400	4,200	4,800	4,800	7,200	9,600	10,800
Plastic accessories	13	32.5	52	62.4	65	83.2	93.6	98.8	110.5	117	123.5	130	162.5
Training	8	13.6	15.2	16.8	18.4	20	21.6	24	25.6	27.2	28.8	30.4	32
Total Gross Revenues	471.0	1,096.1	1,267.2	1,279.2	2,183.4	2,503,2	2,515.2	4,322.8	4,936.1	4,944.2	7,352.2	9,760.4	10,994.5
Total Net Revenues	466,3	1,085.1	1,254.5	1,266.4	2,161.6	2,478.2	2,490.0	4,279.6	4,886.7	4,894,8	7,278.8	9,662.8	10,884.6

TABLE 67 - WORKING CAPITAL (thousands of SP)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Account receivable	39.3	91.3	105.6	106.6	182.0	208.6	209.6	360.2	411.3	412.0	612.7	813.4	916.2
Inventory value	68.8	155.3	164.2	174.5	299.1	298.3	320.0	554.3	553.3	553.3	629.8	669.4	669.2
Advance payment of materials	7.0	14.1	14.4	14.7	28.0	28.2	28.5	54.8	55.0	55.2	81.3	107.5	107.7
Working capital	115.1	260.7	284.2	295.8	509.1	535.1	558.1	969.3	1,019.6	1,020.5	1,323.8	1,590.3	1,693.1
Working capital increase	115.1	145.6	23.5	11.6	213.3	26.0	23.0	411.2	50.3	0.9	303.3	266.5	102.8

TABLE 68 - FINANCIAL COST (thousands of SP)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Cumulative capital payment	1,872	2,498	2,763	2,763	3,979	4,050	6,654	7,357	7,732	7,732	7,732	7,750	7,750	7,750	7,750
Interest on capital payments (a)	149.8	199.8	221.0	221.0	318.3	324.0	532.3	588.6	618.6	618.6	618.6	620.0	620.0	620.0	620.0
Working capital	-	-	115.1	260.7	284.2	295.8	509.1	535.1	558.1	969.3	1,019.6	1,020.5	1,323.8	1,590.3	1,693 1
Interest on working capital (b)	-	-	13.8	31.3	34.1	35.5	61.1	64.2	67.0	116.3	122.4	122.5	158.9	190.8	203.2
Total financial cost (interest) (a + b)	149.8	199.8	234.8	252.3	352.4	359.5	593.4	652.8	685.6	734.9	741.0	742.5	778.9	810.8	823.2

TABEL 69 - TOTAL FINANCING REQUIRED (thousands of SP)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Total capital expenditures	1,872.0	626.0	265.0	-	1,216.0	71.0	2,604.0	703.0	375.0	-	-	18.0	-	-	-
Increase in working capital	-	-	115.1	145.6	23.5	11.6	213.3	26.0	23.0	411.2	50.3	0.9	303.3	266.5	102.8
Minimum equity	149.8	199.8	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Financing	2,021.8	825.8	380.1	145.6	1,239.5	82.6	2,817.3	729.0	398.0	411.2	50.3	18.9	303.3	266.5	102.8

TABLE 70 - PROFIT AND LOSS ACCOUNT (thousands of SP)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Total operational expenses	249.1	341.5	384.0	431.5	634.4	637.8	739.8	1,157.4	1,159.5	1,161.6	1,791.0	2,184.8	2,186.9
Financial cost	234.8	252.3	352.4	359.5	593.4	652.8	685.6	734.9	741.0	742.5	778.9	810.8	823.2
Depreciation	-	230.2	230.2	230.2	389.1	389.1	389.1	982.0	982.0	982.0	982.0	982.0	982.0
Sub Total	483.9	824.0	966.6	1,021.2	1,616.9	1,679.7	1,814.5	2,874.3	2,882.5	2,886.1	3,551.9	3,977.6	3,992.1
Increase in inventory value	68.8	86.5	8.9	10.3	124.6	(0.8)	21.7	234.3	(1.0)	-	76.5	39.6	(0.2)
Total cost	415.1	737.5	957.7	1,010.9	1,492.3	1,680.5	1,792.8	2,640.0	2,883.5	2,886.1	3,475.4	3,938.0	3,992.3
Net Revenues	466.3	1,085.1	1,254.5	1,266.4	2,161.6	2,478.2	2,490.0	4,279.6	4,886.7	4,894.8	7,278.8	9,662.8	10,884.6
Gross Profit (Loss)	51.2	347.6	296.8	255.5	669.3	797.7	697.2	1,639.6	2,003.2	2,008.7	3,803.4	5,724.8	6,892.3

TABLE 71 - CASH FLOW (thousands of SP)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
ixed pital pendi- ires (a)	1,872	626	265.0	-	1,216.0	71.0	2,604.0	703.0	375.0	-	-	18.0	-	-	(1,778.5)
rking pital crease b)	-	-	115.1	145.6	23.5	11.6	213.3	26.0	23.0	411.2	50.3	0.9	303.3	266.5	(1,590.3)
tal oper- ional penses c)	-	-	249.1	341.5	384.0	431.5	634.4	637.8	739.8	1,157.4	1,159.5	1,161.6	1,791.0	2,184.8	2,186.9
t re- nues(d)	-	-	466.3	1,085.1	1,254.5	1,266.4	2,161.6	2,478.2	2,490.0	4,279.6	4,886.7	4,894.8	7,278.8	9,662.8	10,884.6
fference i-c)	-	-	217.2	743.6	870.5	834.9	1,527.2	1,840.4	1,750.2	3,122.2	3,727.2	3,733.2	5,487.8	7,478.0	8,697.7
sh flow i-c-a-b)	(1,872)	(626)	(162.9)	598	(369)	752.3	(1,290.1)	1,111.4	1,352.2	2,711.0	3,676.9	3,714.3	5,184.5	7,211.5	12,066.5
mula- ve sh flow	(1,872)	(2,498)	(2,660.9)	(2,062.9)	(2,431.9)	(1,679.6)	(2,969.7)	(1,858.3)	(506.1)	2,204.9	5,881.8	9,596.1	14,780.6	21,992.1	34,058.6

TABLE 72

D.C.F. RATE OF RETURN 24.3

-1872	1.545045	-2892.331728
-626	1.245	-778.118
-162.9	0.8045852213	-131.0539019
598	0.6472286654	387.042741
-369	0.5206770845	-192.1376737
752.3	0.4189044455	315.1421889
-1298.1	0.3370[illegible]	-434.7731718
1111.4	0.2711[illegible]	301.3309665
1352.2	0.2181[illegible]	294.9463534
2711	0.1754[illegible]	475.7299443
3676.3	0.1411[illegible]	519.0868027
3714.3	0.1135[illegible]	421.9574196
5164.8	[illegible]	[illegible]
7211.3	[illegible]	[illegible]
17066.3	[illegible]	[illegible]

DEVIATION: [illegible]

D.C.F. RATE OF RETURN 24.4

-1872	1.54[illegible]	-2892.331728
-626	1.244	-778.744
-162.9	0.80[illegible]	-130.540553
598	0.646[illegible]	386.428352
-369	0.51[illegible]	-[illegible]
752.3	0.41[illegible]	314.[illegible]
-1298.1	0.33[illegible]	-431.[illegible]
1111.4	0.26[illegible]	289.[illegible]
1352.2	0.21[illegible]	287.[illegible]
2711	0.17[illegible]	472.[illegible]
3676.3	0.13[illegible]	515.[illegible]
3714.3	[illegible]	[illegible]
5164.8	[illegible]	[illegible]
7211.3	[illegible]	[illegible]
17066.3	[illegible]	[illegible]

DEVIATION: [illegible]