A STEEL PIPE COMPLEX

A Feasibility Study For The Establishment Of

A Steel Pipe Complex In Kano State

March, 1982

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SUMMARY

1. A market study has been carried out to justify the establishment of this project. Of the total current market demand of 730,160 tons only 14% (105,000 tons) is supplied by local manufacturers; the rest is imported from Europe and Japan. By 1985, local production will satisfy only 11% of total projected demand, estimated to reach 957,090 tons at that time. Projected demand for 1990 is 1,342,369 tons. This demonstrates that there is ample market for production from more than one steel pipe complex.

2. The proposed steel pipe complex will have two main production sections: Section A, to produce longitudinal welded pipes from ½"/12mm to 6"/150 mm diameter, with a capacity of 105,000 tons per annum; and Section B, to produce spirally welded pipes from 8"/220mm to 24"/610mm diameter, with a capacity of 14,000 tons per annum.

3. The longitudinal welded process is selected for the production of pipes of ½/12 mm to 6"/150mm diameter, using a high-frequency welding system. For the spiral-welded pipes, the submerged arc welding system for internal and external welding is selected. The welding will be controlled by an ultrasonic unit and tested by X-ray equipment.

4. The process flow of the longitudinal pipe section will be planned so that the heavy coils will be slit to the required width, then the coils will be formed and welded on the main production lines. The pipes produced will be hydrostatically tested and threaded for black pipes. Part of the production

will flow to the galvanizing department. In Section B, the pipes will be formed and welded automatically on the spiral welding machine, then those pipes will flow to the chamfering machine, and on to the hydrostatic testing line. Finally, the pipes will flow to the bitumenizing section for coating. The spiral-welding section also has an X-ray tester and repair stand. The complex will include all auxiliary facilities, such as workshops, laboratories, generating plant, etc.

5. The total investment cost of the project is ₦ 20.134 million. Sales revenue is projected at ₦ 57.414 million. Gross profit is ₦ 18.398 million, representing 91.38%, with a payback period of 1.2 years. The number of employees is 328. Installed power is 2,000 KVA.

At first the raw materials will be imported, but after the start of operation of steel rolling mills in Nigeria, they will be supplied locally. The proposed selling price is 30% less than the current market price, in spite of the fact that the quality will be much higher.

6. The plant will be located in Kano State, in a suitable industrial area, where about 100,000 m^2 is available, close to a good road, and electricity and water supplies.

7. The project will require 24 months for completion between signing of contract with the selected technical partner and the start-up of the plant. There is also a comprehensive programme for technical training of staff, both in Nigeria and overseas.

8. The establishment of the proposed project is strongly recommended : it is viable, profitable, and there is a national need for the industry.

ACKNOWLEDGEMENTS

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Sincere thanks are also due to various steel pipe and machinery manufacturers who supplied us with information.

George A. Makarem.

March, 1982.

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I -

INTRODUCTION

1. INTRODUCTION

The concept of this project originated in 1976 in a proposal from the Department of Mechanical Engineering, Ahmadu Bello University, Zaria, to the Ministry of Trade & Industry, Kano State. The brief report highlighted the main features of this industry. It was followed in 1978 by meetings with Ministry officials to explain various aspects of the project, as a result of which we were officially requested to proceed by preparing and submitting a detailed feasibility study. Machinery manufacturers in Europe were consulted over the technical specification of the project and quotations were later received.

During this period we were also engaged in another industrial project for the Ministry. We were therefore requested to delay submission of this feasibility study until the completion of the other project. That is now successfully completed.

In 1978, an article on manufacturing of steel pipes in Nigeria by the author of this study was published in the Nigerian Trade Journal. It examined various aspects of the project and showed the need to establish such an industry in Nigeria. Through comparison of other types of pipes on the market - for example, asbestos pipes - it showed that steel pipes are superior and cheaper than other types.

During the second half of 1981, all data and prices had to be revised

and up-dated. A detailed market study was also carried out to calculate the demand for this product in the Nigerian market.

Between the first discussions on this project in 1976 and the writing of this report, some local factories started small-scale production of small diameter steel pipes. These plants are located in the northern and southern states of the Federation. This local production satisfies only a small part of the total demand.

It is pertinent to point out that the author (the project consultant) has participated in establishing other plants outside Nigeria and has also worked for six years in a steel pipe and fittings complex. As already mentioned, he published an article on steel pipe manufacture in Nigeria in the Nigerian Trade Journal in 1978. He has also supervised several studies on steel pipes at Ahmadu Bello University. In addition, he has previous experience in establishing industrial projects in northern Nigeria. This wide experience and technical know-how have been combined in the preparation of this study.

George A. Makarem

2 –THE MARKET FOR STEEL PIPES IN NIGERIA

2. THE MARKET FOR STEEL PIPES IN NIGERIA

A study has been conducted to evaluate the market for steel pipes in Nigeria in order to justify the establishment of such a project in the country.

The supply of steel pipes in Nigeria currently comes from two main sources: first, production by local manufacturers (see Figure 1); and secondly, importation from Europe and Japan. These two sources have been carefully investigated in detail as follows:

2.1. Local Manufacturers

At present there is an Association of Steel Pipes Manufacturers (ASPM) in Nigeria, of which all eight local manufacturers are members. These eight manufacturers were visited. They are distributed in various parts of the country as shown in Figure 1. They are as follows:

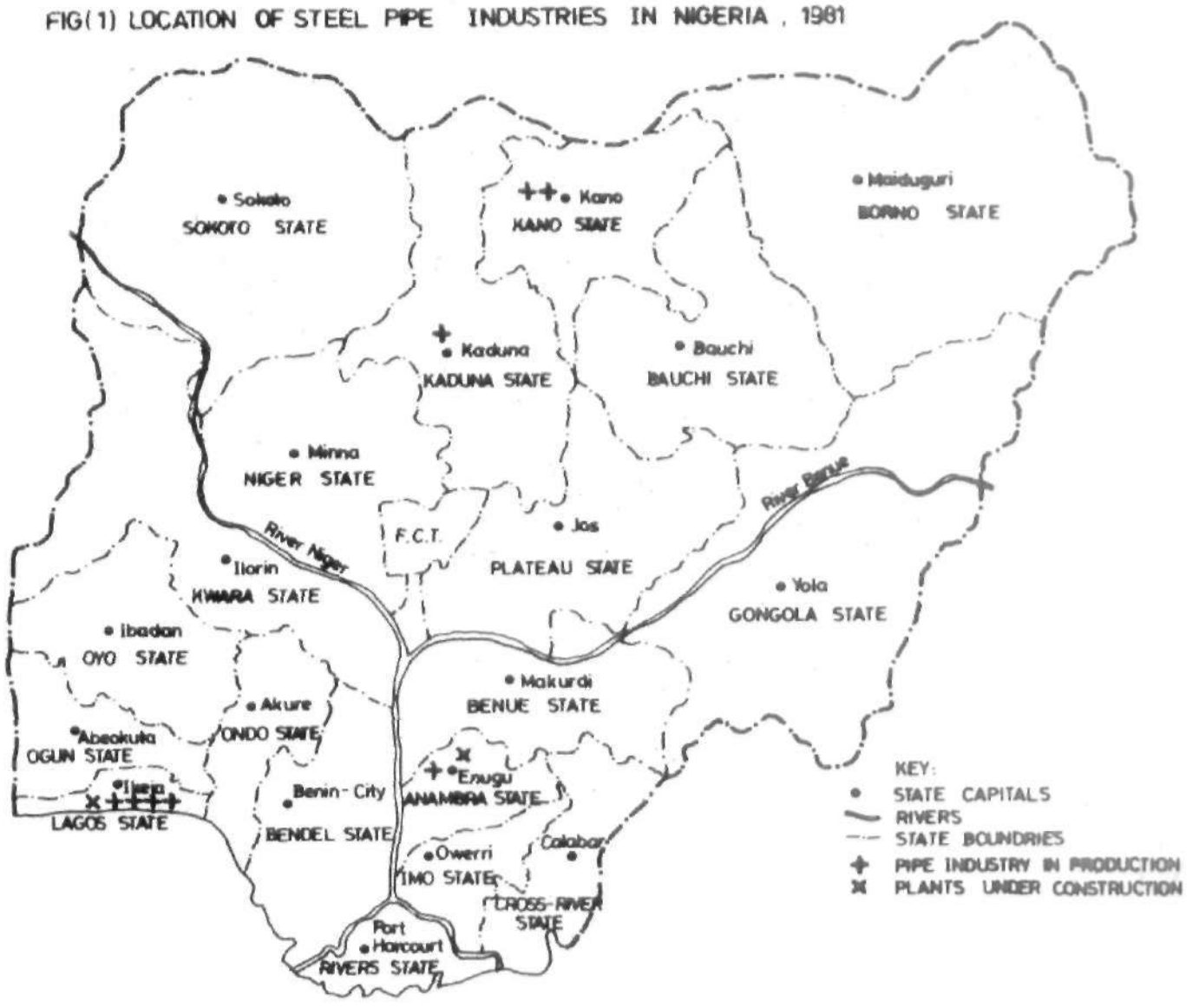
2.1.1. Moukarim Metal Wood Factory Limited

This factory is located in Ikeja, Lagos State, and was visited in November, 1981. It started production in 1976 with two production lines. Capacity is 12,000 tons per annum. The sizes are from $\frac{1}{2}$"/12 mm to 2"/50 mm diameter. They also produce square pipes for furniture manufacture. The pipes are not tested after production according to standard specifications.

2.1.2. Hoech Pipe Mills (Nigeria) Limited

This is also in Ikeja, Lagos State, and also started production in 1976 with two production lines. The pipe sizes are from $\frac{1}{2}$"/12 mm to $2\frac{1}{2}$"/62 mm diameter. The annual capacity at present is 12,000 tons per

FIG(1) LOCATION OF STEEL PIPE INDUSTRIES IN NIGERIA , 1981



annum. The pipes are black and galvanized. They also produce square pipes for the furniture and construction industries.

2.1.3. Standard Industrial Development Company Limited

This factory is located in Ogba Industrial Estate, Ikeja, Lagos State. Production started in 1977 with two production lines to produce ½"/12 mm to 3"/75 mm diameter sizes. Annual capacity is 21,600 tons per annum, of black and galvanized pipes. This is the biggest manufacturer in Lagos State.

2.1.4. International Steel Industry Limited

This factory is located in Onitsha and started production in 1977. It has two small production lines, with capacity of about 12,000 tons per annum. It produces black and galvanized pipes from ½"/12 mm to 2"/50 mm diameter for various purposes. This is the only factory in eastern Nigeria.

2.1.5. Tower Galvanized Products Limited

The factory is in Kaduna South, Kaduna State, and also has two lines for production of pipes from ½"/12 mm to 3"/75 mm diameter, with an annual capacity of 17,000 tons. Black and galvanized pipes for various purposes are produced.

2.1.6. Nigerian Industry Steel Irrigation Co. Ltd. (NISICO)

This factory is located in Bompai, Kano State, and produces

pipes for irrigation and construction (scaffolding). The annual capacity is 12,000 tons from two production lines. Its pipe sizes are from 1"/25 mm to 3"/75 mm diameter. Only black pipes are produced.

2.1.7. International Metal Products Limited

This factory is also situated in Kano State, along the Hadejia road. It started production in 1980 with one production line, producing sizes from $\frac{3}{4}$"/19 mm to 2"/50 mm diameter. The annual capacity is 8,400 tons. The pipes are black and galvanized for various uses.

2.1.8. Metal Construction (West Africa) Limited

This factory is in Apapa, Lagos. It is the oldest plant in Nigeria. It was established in 1956 to produce spiral welded pipes, sizes 14"/350 mm to 104"/2600 mm. The production line is very old and the quality of pipes produced is rather low- no standard test is performed. The plant does not work regularly for some technical reasons, therefore, there are no records for specific capacity. The product is used mainly in the manufacturing of tanks and large containers. No coating facilities are available.

From the above, local production can be summarized as follows (Table 1):

TABLE 1:

Manufacturer	Location	Diameter of Pipes (in/mm)	Production Started	Capacity (tons)
1-Moukarim	Lagos	$\frac{1}{2}$/12 - 2/50	1976	12,000
2-Hoech	Lagos	$\frac{1}{2}$/12 - 2$\frac{1}{2}$/62	1976	12,000
3-Standard	Lagos	$\frac{1}{2}$/12 - 4/100	1977	21,000
4- International	Onitsha	$\frac{1}{2}$/12 - 2/50	1977	12,000
5-Tower	Kaduna	$\frac{1}{2}$/12 - 3/75	1978	17,000
6- Nigerian Industry	Kano	1/25 - 3/75	1980	12,000
7- International Metal	Kano	$\frac{3}{4}$/19 - 2/50	1980	8,400
8- Metal Construction	Lagos	14" - 104"	1956	10,000*
TOTAL				105,000

*Estimated production.

The following steel pipe plants are under construction (Table 2)

TABLE 2:

Manufacturer	Location	Diameter of Pipe(in/mm)	Expecting Year of Production	Capacity (tons)
1-Eldorado	Lagos	$\frac{1}{2}$/12 - 2/50	1982	8,000
2-Pipe Mill Ltd.	Onitsha	$\frac{1}{2}$/12 - 2/50	1983	8,000
TOTAL				16,000

Local production during the next three years is expected to be as follows (Table 3):

TABLE 3:

Year	Capacity (tons)/Year	Cost ₦/Year *
1981	105,000	73,500,000
1982	110,000	77,000,000
1983	116,000	81,200,000
1984	121,000	84,700,000

*The cost is based on the present average market price of ₦ 700/ton.

2.2. COMMENTS

2.2.1. It is noted that most local production is only within the range of ½"/12 mm - 3"/75 mm diameter.

2.2.2. Present pipe quality is considered low, as only one manufacturer tests the product to standard specification.

2.2.3. No local manufacturer produces pipes which could be used for oil or gas pipelines, or other high pressure uses.

2.2.4. The prices of locally produced pipes are considered very high- this is due to the scarcity of some pipes on the market.

2.3. IMPORTED STEEL PIPES

The second source of supply of steel pipes in Nigeria is by importation from Europe and Japan. The data on imports were collected from the Department of Statistics of the Federal Ministry of Information, Lagos; the Nigerian Trade Summary; oil companies operating in Nigeria- and pipeline construction companies. The information collected is as follows:

According to the Nigerian Trade Summary, the importation of steel pipes from 1972 to 1979 was as follows (Table 4.a):

TABLE 4.a:

Year	Quantity (tons)	Cost ₦ /year
1972	91,336	16,271,022
1973	137,444	24,293,448
1974	289,179	82,084,450
1975	294,129	144,740,756
1976	170,103	68,591,143
1977	509,046	105,446,025
1978	442,190	102,881,279
1979	516,661	118,832,000 +

+ This cost is estimated value.

This table shows imports up to 1979 only, as no data are available from the last two years. But estimates can be based on an annual increase of 10%, giving the following value (Table 4.b):

TABLE 4.b:

Year	Quantity (tons)	Cost ₦/Year
1979	516,661	118,832,000
1980	568,327	130,715,200
1981	625,160	143,786,720

This shows that the importation of steel pipes increased from 91,336 tons in 1972 to about 625,160 tons in 1981, when the cost in foreign exchange reached ₦ 144 million.

2.4. TOTAL DEMAND

The total demand of the Nigerian market for steel pipes will be the total sum of local production and imports, i.e.

total demand = local production + imports.

Thus from Table 1 and Tables 4.a and 4.b, the total demand could be summarized as shown in Table 5.

TABLE 5: Total Demand for Steel Pipes in Nigeria

Year	Local Prod. (tons)	Imports (tons)	Total Demand(tons)
1972	10,000	91,336	101,336
1973	10,000	137,444	147,444
1974	10,000	289,179	299,179
1975	10,000	294,129	304,129
1976	34,000	170,103	204,103
1977	67,600	509,046	576,646
1978	84,600	442,190	526,790
1979	84,600	516,661	601,261
1980	105,000	568,327	673,327
1981	105,000	625,160	730,160

Table 5 shows that the total estimated demand is 730,160 tons in 1981. By estimating a minimum increase in the total demand of 7% per annum, projected demand for the next nine years will be as follows (Table 6):

TABLE 6: Projected Demand For Steel Pipes

Year	Quantity (tons)
1981	730,160
1982	781,271
1983	835,960
1984	894,477
1985	957,090
1986	1,024,087
1987	1,095,773
1988	1,172,477
1989	1,254,551
1990	1,342,369

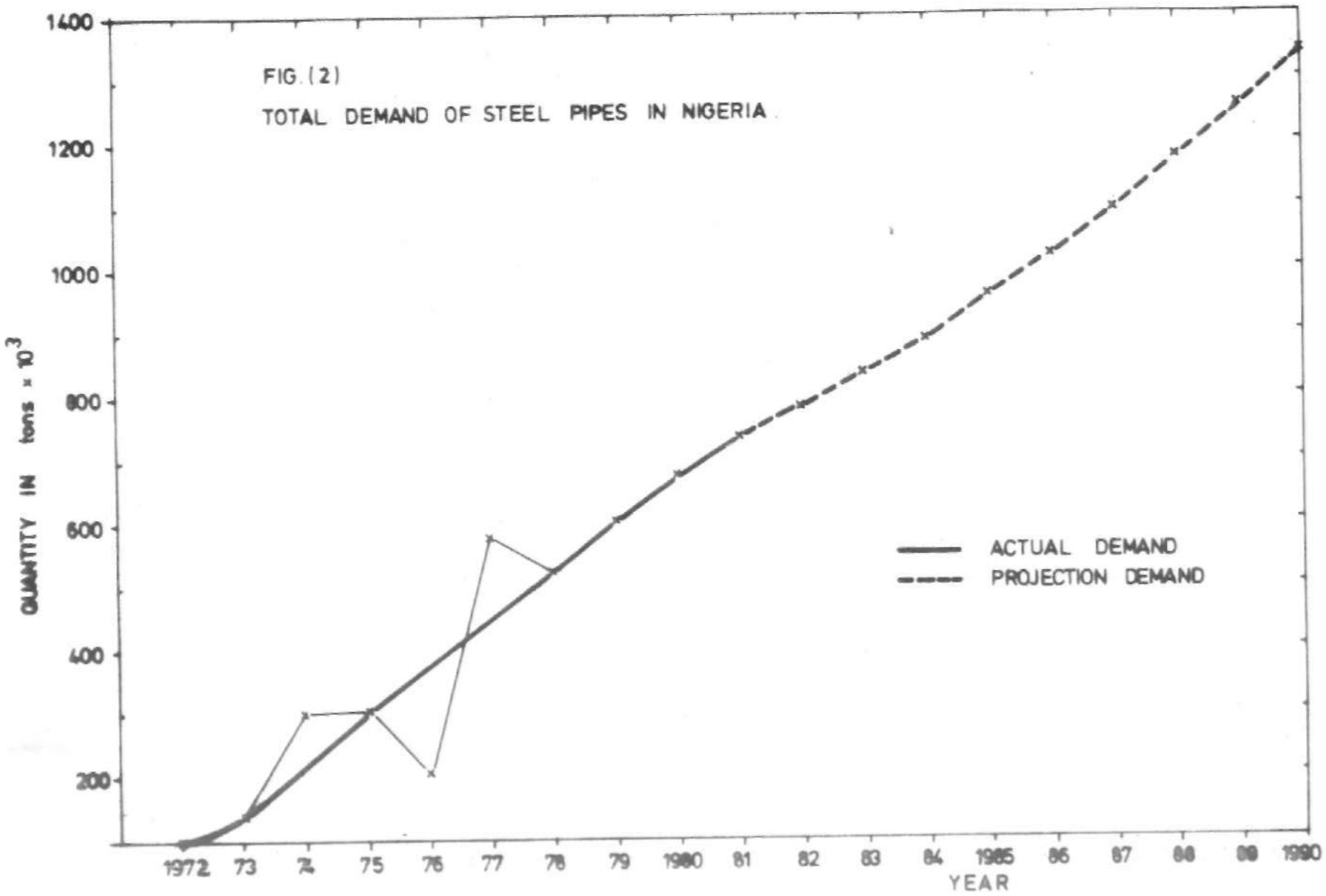
Actual demand and projected demand are shown graphically in Figure 2.

2.5. COMMENTS

2.5.1. Local production in 1981 represents only 14½% of the total demand in the Nigerian market for steel pipes. In 1984 it will represent only 11.7% of total demand. This means that several projects should be planned from now to fill this gap.

FIG. (2)

TOTAL DEMAND OF STEEL PIPES IN NIGERIA



2.5.2. Up to date, no manufacturer produces pipes suitable for pipelines or high pressure uses.

2.5.3. Local manufacturers produce pipes only up to 4"/100 mm diameter, and there is need to produce up to 40"/1000 mm pipes for pipelines and other uses.

2.5.4. The prices of local pipes are vey high in comparison with the international market. This is due to a shortage of pipes on the market.

2.5.5. The quality of local pipes is low because manufacturers do not have testing facilities.

2.5.6. The actual demand for steel pipes in the future is expected to be much higher than that presented in Table 4.b, due to some major projects planned to start construction in the near future. These projects will use steel pipes as their main raw material, as for example:

(a) Sewage systems (closed type). Open gutters will be replaced, at least in the state capitals. At present each state is undertaking a study for such projects. The minimum estimate for the requirement of steel pipes will be about 20,000 tons for each state. This will cost about ₦ 10 million for each state, i.e. for 19 states, some 380,000 tons will be needed at a cost of about ₦ 190 million.

(b) Street lighting and major electrification projects. Steel pipes are considered best for lighting poles and conduits owing to their great strength and durability. At least 20,000 tons will be needed for each state, at a cost of about ₦ 10 million. For the 19 states, about

380,000 tons will be required, at a cost of about ₦ 190 million.

(c) Pipelines. This is the main use of large diameter pipes, of 6"/150 mm upwards. For example, a pipeline of 16"/400 mm diameter, between two cities about 200 km apart, would require a production line of spiral welded plant to work at full capacity for about 10 months. This is naturally considered a short distance by comparison with distances between the northern and southern states of the Federation. At present most petroleum and oil products are transported by lorry, which is both risky and expensive. In fact, Nigeria needs hundreds of pipelines to convey all oil products to all major cities in the country. Pipelines are used not only for petroleum products but also for water, sewage, edible oils, coal and mineral ores. Such schemes would require several steel pipe complexes in many states in the country.

2.5.7. It is also pertinent to mention here that Nigeria is the only member of the Organisation of Petroleum Exporting Countries (OPEC) that does not produce pipes for the oil industry. This is in spite of the fact that Nigeria is the largest in population within this group and is developing fast.

2.5.8. Some industries incorporate steel pipes in the manufacture of their finished products. This group is not included in the Nigerian Trade Summary data. These industries include:

(a) Automotive industries. The pipes are used in the manufacture of certain auto parts. There are now several vehicle plants in the country.

(b) Bicycle and motorcycle manufacture. These industries use steel pipes in the manufacture of the main body and some parts.

(c) Processing industries. Large quantities of steel pipes are used in the construction processing plants, such as refineries, rolling mills, steel mills, and for the processing of petrochemicals, fertilisers, sugar, etc.

2.5.9. All oil and pipeline construction companies in Nigeria were contacted during this study. They import 100% of their steel pipe requirements from abroad. This costs Nigeria millions of Naira in foreign exchange annually. They recommend strongly the establishment of such an industry in the country as soon as possible.

2.6. CONCLUSION

There is ample market for steel pipes in Nigeria. This justifies the establishment of several steel pipe complexes in the country. The present market and its future prospects show that there is urgent need to start the planning of these projects as soon as possible.

3 -

PLANT LOCATION

3. PLANT LOCATION

The following location factors have been considered in the course of the project in order to locate a suitable site in Kano:

(a) availability of raw materials

(b) transport services

(c) cost and availability of land

(d) availability of fuel

(e) electricity supply

(f) watter supply

(g) disposal of effluent

(h) availability of labour

(i) market for the finished products.

It must be borne in mind, however, that not all these factors are critical to the location of the proposed plant. Some of these factors are fairly constant in most industrial towns in Nigeria, e.g.labour cost, fuel cost, electricity and water rates. Regarding the availability of the raw material - which in this case is coiled rolled steel - this will be imported from abroad until the Nigerian steel mills produce their own steel. With regard to electricity supply, water and availability of labour, as well as other facilities, they are readily available in Kano.

It is therefore recommended that the factory should be established in

any industrial area in Kano where the required area of land is available. The total area needed for this project is about 100,000 m^2. One specific location which should be considered is along the Zaria road, or near Bagauda, where there is electricity, water, a good road and proximity to Kano metropolitan area.

In conclusion, any available land near Kano, with good road access, water supply and electricity (high tension line) is suitable for this project. The plant will also have its own power-generating plant but this should work in conjunction with the main electricity line (NEPA).

4 -

SELECTION OF MANUFACTURING PROCESS

4. SELECTION OF THE MANUFACTURING PROCESS

The longitudinal welding process is selected for the production of pipes of ½"/12 mm to 6"/150 mm diameter and the spiral welding process is selected for pipes of 8"/220 mm to 24"/610 mm diameter. The selection of the welding process is based on the following:

4.1. LONGITUDINAL SEAM PIPES

Selection of the appropriate tube welding machine is based on the following factors: the type and application of the tubes to be manufactured, their diameter and wall thickness, their material, and the requisite capacity of the plant.

Tubes of steel, steel alloys, non-ferrous metals and their alloys, with diameters from 12 mm to 220 mm, and wall thickness from 1.25 mm to 9.5 mm can be manufactured by continuous longitudinal seam welding. Their main uses include:

- threaded pipes for water steam and gas
- boiler tubes and line pipes with plain ends
- oilfield pipes to API standards, i.e. line pipes for horizontal conveying, casings and tubing for drilling
- precision tubes, e.g. furniture tubes, bicycle tubes
- conduits for electric lines
- structural tubing.

Longitudinal seam pipe machines can be equipped with one of the following welding processes:

- resistance welding at frequencies of 50 - 400 cycles
- resistance welding using DC
- inductive high-frequency welding
- induweld process
- conductive high-frequency welding
- argon-arc welding (especially for high-alloy steels)
- electron beam welding
- laser welding.

Almost all longitudinal tube-welding machines are equipped with high-frequency welding units, as this process has proved to be the most effective and most economical in this particular field to date. Therefore the high-frequency welding process is selected for the longitudinal seam production lines.

4.2. HIGH-FREQUENCY WELDING

Almost all modern tube-welding plants are supplied with high-frequency equipment in the welding section. The main feature of the high-frequency currents used is generally described by the term 'skin effect': as the current increases, the current passing through a conductor is forced towards the surface to a more pronounced degree. In more simple terms, it may be said that with the HF welding process only the 'skin' of the tube edges being welded are brought to welding temperature. Thus the heating zone of the weld seam is extremely narrow in comparison with other welding processes,

and undesirable metallurgical changes in the material are avoided. Modern tube generators are available with ratings of up to 1,000 kW, and permit welding speeds of up to 100 m/min and more. A further advantage of the HF welding process lies in the fact that the tube plant can easily be changed over to the production of tubes using non-ferrous metals, e.g. aluminium.

4.3. SPIRAL-WELD PIPES

The spiral-weld process is selected to produce pipes of 220 - 610 mm diameter for the following reasons. The production of spiral-weld pipes is usually considered when and if:

(a) the proposed capacity will not exceed 200,000 - 300,000 tons a year

As a rule, up to this capacity (depending on the pipe dimensions) capital expenditure is low compared with other manufacturing processes

(b) depending on the market situation, it will be necessary to limit production costs, and therefore a frequent changeover to other pipe dimensions will occur. Short changeover periods without tool changes are advantageous

(c) pipes of varied dimensions and lengths are to be produced continuously

(d) the starting material store is to be kept as small as possible. From hot-rolled wide strip of one dimension, pipes of a whole series of diameters can be manufactured without waste material resulting from cutting. The pipe-forming machines are so designed as to make it possible to choose a ratio ranging from 2:1 to 1:1 between strip width and pipe diameter

(e) the properties of properly manufactured spiral-weld pipes are permitted for all purposes by all international acceptance and consumer organizations.

4.4. SPIRAL-WELD PROCESSES

Almost all spiral-weld pipe machines use the submerged-arc welding process.

Details of the selected production processes for longitudinal and spiral seam pipes are discussed in detail in Chapter 5.

5 - GENERAL DESCRIPTION AND LAYOUT OF PLANT

5. GENERAL DESCRIPTION AND LAYOUT OF PLANT

5.1. DESCRIPTION OF LONGITUDINAL WELDING LINE

The black and galvanized steel pipe plant (with two welding lines) is designed for the production of high-frequency longitudinal welded steel and galvanized pipes, made from hot-rolled strips in grades according to British Standards specifications (BS 1387/1967) or equivalently to other international standards (DIN and API).

5.1.1. Process Flow (See Layout Plan, Figure 3)

Coiled up to maximum weight will be put on the coil feeding ramp of the slitting line by a crane. After checking on the weighbridge, the coils will be slit tne required width according to the slitting programme. Slit coils will be put in intermediate storage by crane. Coils of required width will be fed to the coil feeding ramp.

Strips will be uncoiled and joined in a continuous strip. For continuous operation both the tube mills will have an underground loop system, of 3 - 6", with a vertical accumulator for the $\frac{1}{2}$ - 2" mill. The tube mills will form, weld, size and straighten tubes and the flying-cutoff will cut the endless tube to commercial lengths.

There will be visual inspection of tubes between the final sizing group and the flying-cutoff, and further inspection on the racks after the tubes are ejected. From the tube mill, tubes will roll automatically into the finishing machines, and from there the tubes will be carried by forklift trucks or trolleys to intermediate storage for black pipes. (Any scrap or rejected

tubes will be collected in separate troughs).

It is recommended that sufficient space be provided for this intermediate storage, as it will act as a reserve in case of technical difficulties or stoppage on the tube mills or finishing machines.

To permit production of any size of tube, a fully automated finishing line is recommended: a combination consisting of a pipe straightening machine and chamfering plant hydro tester, all connected with automatic tube transfer devices.

Pipes will be collected in an intermediate store in front of the galvanizing plant, and black pipes will be carried by roller table for collection in troughs, thus remaining in the finishing bay. By means of a crane, pipes will be put on the feeding rack in front of the pre-treatment plant and, through an entry-point in the wall, will roll inside. The pre-treatment plant consists of an HCL pickling installation- it will be completely closed by solid walls to avoid any noxious fumes escaping.

Pickled pipes, after hot/cold rinsing, will pass through a dryer furnace, and from there they will be conveyed to one or both zinc furnaces. The pipes will be taken out of the zinc baths by tube extraction machines, they will be blown out by steam and then dropped in quenching. Galvanized pipes will be kept in further intermediate storage until a crane feeds them to the racks of the straightening machine or to the automatic threading plant.

Tube-threading plants work fully automatically, including socket

wrenching-on. The tubes will then be laid out for further inspection, marking, bundling and packing. They will then be stored on special stands, ready for shipment.

5.1.2. Auxiliaries

Besides the galvanizing plant, outside the main factory shed will also be installed a steam boiler, acid storage, fuel oil storage, a chimney and acid regeneration plant. Some portions will be covered and closed; other areas will remain in the open.

There will be a surfaced road to this area, which will also contain mechanical workshops, room manufacturing and roll manufacturing, repair shops, stores, and will have its own overhead crane. Material testing will be carried out in physics, chemistry and materials laboratories. Offices for engineers, maintenance and storage departments, despatch and other offices will be constructed on the outside wall of the shed.

5.2. DESCRIPTION OF THE SPIRAL PIPE MILL

The spiral pipe plant is designed for the construction of spirally welded steel pipes, made of hot-rolled strip in grades according to DIN 1626 (January 1965) standards for gas and water pipes, and according to API specification 5LS.

5.2.1. Process Flow (See Layout Plan, Figure 3)

From the coil store, the coils are transported by a travelling crane to the spiral-welding machine where production of pipes starts.

From the spiral-welding machine the pipes are transported to the pipe cleaning machine, where cinder, welding powder and scale are removed by blowing out. Then the frontal area, the inside and outside of the pipe are controlled visually. If defects are found, the pipes can be conveyed in a secondary flow of production to two repair stands where the defects are eliminated manually. Final welding of the cross-seam is done on a further stand. The non-destructive testing of the repair welding is executed on an X-ray stand. From there the pipes are fed into the main flow to the pipe-end chamfering machine.

Pipes which have passed the continuous ultrasonic control in the pipe-welding machine and visual control without objection are conveyed in the main process flow to the pipe-end chamfering machine.

After chamfering and testing, the pipes are forwarded to a further X-ray stand for control of the pipe-ends. Defective parts of the pipe-ends can be cut off manually by an autogenous pipe-cutting device.

Pipes which have been found faultless during X-ray control are still visually controlled: the geometrical pipe measurements and the measurements of the welding seam are checked. After these processes the pipes can be transported via roll conveyor to a pipe-coating and-wrapping plant if required.

It is essential that, before entering the coating plant, all pipes are free from oil and grease. They must also be dry and free from any moisture before abrasive blast cleaning. It is possible that no form of pre-heating will be required because of the prevailing high air temperature in Nigeria.

The pipes are abrasive blast-cleaned and primed externally, internally lined, and then externally coated and wrapped. The arrangement of the equipment is in line with current practice for stationary thermal fluid systems. The thermal fluid heat generator and the enamel melter should be in a separate room so that, in the unlikely event of fire, it would be easily containable within the walled area. Loading and maintenance can be serviced by a fork-lift truck or mobile crane, and all pumps and ancillaries are positioned for ease of maintenance.

The enamel is applied to the internal surface of the pipe by means of a boom-and-flood system, propelled through the pipe by a hydraulically-powered trolley. The coating is applied as the boom retracts. The pipe is rotated to ensure a smooth coating, of the specified thickness. The enamel is fed into the boom trolley hold tank from the enamel storage system. The correct application temperature is maintained by recirculating the enamel in the hold tank around a heat exchanger within the machine. The coating and wrapping material is applied to the external surface of the pipe whilst it is rotated longitudinally through the coating and wrapping machine on powered carriages.

Enamel is flooded into the pipe from an overhead flood-box, whilst an inner wrap of glass fibre tissue is applied together with an outer wrap of impregnated fibre tissue. The enamel flood is maintained at its correct temperature, and the flow is varied by a control valve in front of the flood-box.

Lime-washing of the pipes after external coating is essential, and it is proposed that this should be carried out by manually brushing the finished pipe after removal from the machine. The mixture can be prepared in tanks of local supply.

5.3. GENERAL LAYOUT (See Figure 3)

The total area of the plant is 19,200 m^2, comprised as follows:

10,400 m^2: longitudinal plant, two bays of 260 m x 20 m

3,400 m^2: spiral plant

2,400 m^2: coating plant

3,000 m^2: extension building for transformer, switch-gear station, electrical/mechanical maintenance department, generator room, sanitary installations, laboratory, boiler, workers' canteen, factory offices, etc.

19,200 m^2: total area.

Delivery of coils and shipment of finished pipes will both be located on the same side of the factory.

It is also recommended that an area of approximately 1,500 m^2 be provided for storage of coils, and approximately 500 m^2 for intermediate storage of slit coils.

It is proposed to have an area of approximately 2,200 m^2 for stores and the despatch department for finished pipes. Ancillaries for the galvanizing plant will be partly covered and partly open. The coating plant will be similar. There will also be a separate administration building of approximately 500 m^2.

6 – PROJECT SPECIFICATION

6. PROJECT SPECIFICATION

6.1. PRODUCTION SECTIONS

The proposed steel pipe complex will have two main production sections, as follows:

6.1.1. Section A

- to produce longitudinal welding tubes from ½"/12 mm to 6"/150 mm diameter.

This section consists of the following major equipment:

(a) Slitting line for heavy coils.

(b) Longitudinal tube welding plant, to manufacture tubes from ½"/12 mm to 2½"/62 mm diameter, of wall thickness from 1.25 mm up to 4.85 mm, with a strip preparation plant.

(c) Longitudinal welding plant to manufacture tubes from 3"/75 mm to 6"/150 mm diameter, of wall thickness from 3 mm to 9.5 mm.

(d) Longitudinal welding finishing line, including end-chamfering machines, twin pipe testing press, threading machines, socket wrenching-on machines and tube straightening machines.

(e) Tube galvanizing plant, consisting of:

- tube pre-treatment (degreasing)
- HCL pickling plant
- neutralization with water recovery
- dry galvanizing
- accessories.

6.1.2. Section B

- to produce spirally welded pipes from 8"/220 mm to 24"/610 mm diameter.

This section consists of the following major equipment:

(a) Spiral-welding plant to manufacture pipes from 8"/220 mm to 24"/610 mm diameter.

(b) Ultrasonic test installation for testing by submerged arc spirally or longitudinally welded tubes.

(c) Industrial X-ray equipment for radiographic inspection of spirally welded large-size pipes.

(d) Pipe testing press.

(e) End facing machine.

(f) Pipe-wrapping and-coating plant.

The detailed specifications, technical data and list of machines for these two sections are discussed in Chapter 7.

6.2. PRODUCTION CAPACITY

6.2.1. The Longitudinal Welded Pipe Plant

The annual capacity of the plant will be 105,000 tons, with 280 working days/year, two shifts per day and 8 hours per shift. The production capacity to be covered by two production lines and as per production programme is shown in Table 7.

TABLE 7:

Production Line	Pipe Diameter in/mm	Wall Thickness mm	Galvanized Pipes (tons/Year)	Black Pipes (tons/Year)	Total (tons/Year)
1	$\frac{1}{2}$/12-2$\frac{1}{2}$/62	1.25-4.85	24,000	6,000	30,000
2	3/75-6/150	3 - 9.5	40,000	35,000	75,000
(1 + 2)	$\frac{1}{2}$/12-6/150	1.25-9.5	64,000	41,000	105,000

6.2.2. The Spiral-Welded Pipe Plant

The annual capacity of the plant will be 14,000 tons with 280 working days/year, two shifts per day and 8 hours per shift. The production programme is shown in Table 8 below.

TABLE 8:

Pipe Diameter in/mm	Wall Thickness mm	Bitumenized Pipes (tons/Year)	Uncoated Pipes (tons/Year)	Total (tons/Year)
8/200-24/610	4.78-11.33	10,000	4,000	14,000

7 – EQUIPMENT AND MACHINERY

7. EQUIPMENT AND MACHINERY

The list of equipment is divided into two parts: (7.1) the machinery and installations to be imported; (7.2) those to be procured locally. The imported equipment includes motors, spare parts, all production and finishing lines.

To ensure the safety of the operating staff, all machines are equipped with safety devices as required by the West German and Swiss regulations on accident prevention.

Installations for the generation of electricity have been included in the list of machinery. It has also been assumed that both high-voltage electric current and fresh water will be provided by the public utilities. The machines are adjusted to be suitable for tropical conditions.

The equipment and installations to be imported can be despatched 10 - 12 months after receipt of the order. Six months are required for shipment of of the goods to the site. Assembly and start-up of operation require a further six months. The total length of time elapsing between the signing of a contract and start-up of the plant is therefore 20 - 24 months, depending on local conditions. Guarantees are given on the quality and capacity of the imported machinery and equipment.

7.1. Imported Machinery includes the following groups:

7.1.1. Slitting Line for Heavy Coils

- to cut the strips to the necessary widths, according to the outside diameters of the longitudinal seam welded pipes.

Technical Data

Material to be cut:	low-carbon, hot-rolled, pickled or unpickled steel, or cold-rolled steel, with maximum UTS of about 50 kg/mm^2
Strip before cutting:	about 1,000 - 1,500 mm
Strip thickness:	about 0.6 - 6.35 mm
Minimum strip width after slitting:	about 50 mm
Threading speed:	about 20 m/min; 60, 80, 100 m/min.

Technical Specification

The machine has the following groups:

- coil-feeding ramp
- pay-off reel
- automatic coil-opening device
- combined pinch roll-levelling machine
- cropping shear
- slitting and trimming shear
- recoiler with separating device
- scrap chapper
- guiding tables
- oil/hydraulic installation
- electrical installation.

7.1.2. Longitudinal Tube-Welding Plant

- to manufacture tubes of ½ - 2½" diameter, and wall thickness of 1.25 - 4.85 mm, with strip preparation plant

Technical Data

Tube dimension:	½ - 2½" (65 mm o.d.)
Tube specification:	ISO Standard Light II; BS 1387; DIN 2440
Strip dimension:	60 - 195 mm wide
Wall thickness:	1.25 - 4.85 mm
Material:	Unpickled, pickled, or cold-rolled slitted steel strip
Tensile strength:	approximately 40 kg/mm^2
Coil weight:	12 kg/mm strip width
Coil inside diameter:	500 mm
Mill speed:	0 - 80 m/min
Voltage:	380 V, 50 cycle
Control voltage:	220 V
Voltage for hydraulic valves:	24 V DC
HF welding equipment:	250 kW

The machine has the following groups:

(a) Strip Preparation Installation

- coil feeding ramp

- coil turning device (receiving, turning, discharge)
- automatic coil-opening device
- pay-off reel
- combined pinch roll leveller
- end-squaring shear
- semi-automatic welding machine
- main pinch roll machine
- looping

(b) Tube Mill

- non-driven strip leveller
- edge-scarfing device
- forming section
- horizontal-type drive and guide stand arranged ahead of welding area
- welding unit
- welding method (HF generator 350 kW)
- horizontal-type stand provided behind the welding area
- coil line
- straightening and sizing group
- drive group
- flying pipe cut-off unit
- ream-out roller table with dual ejectors
- electrical drive and controls
- rollers and tools
- turks heads.

7.1.3. Complete Longitudinal Welding Plant

- to manufacture tubes of 3 - 6" diameter and wall thickness of 3 - 9.5 mm

Technical Data

Tube dimension:	3"- 6" (max. 168 mm)
Wall thickness:	3 - 9.5 mm
Material:	hot- or cold-rolled slit steel strip
Tensile strength:	approximately 45 kg/mm^2
Mill speed:	0 - 60 m/min
Welding speed:	max. 60 m/min, according to wall thickness, tube diameter and coil dimension
Voltage:	220/380 V

HF generator data:

continuous max HF output	450 kW
nominal welding frequency	250,000 Hz.

7.1.4. HF Tube Mill

The machine has the following groups:

(a) Strip Preparation Installation

- coil feeding ramp
- coil turning device (receiving, turning, discharge)
- automatic coil opening device

- pay-off reel
- combined pinch roll leveller
- end-square shear
- semi-automatic welding machine
- main pinch roll machine
- looping.

(b) Tube Mill

- non-driven strip leveller
- edge-scarfing device
- forming section
- horizontal-type drive and guide stand arranged ahead of welding area
- welding unit
- welding method (HF generator 350 kW)
- horizontal-type stand provided behind the welding area
- coil line
- straightening and sizing group
- drive group
- flying pipe cut-off unit
- ream-out roller table with dual ejectors
- electrical drive and controls
- rollers and tools
- turks' heads.

7.1.5. Longitudinal Welding Finishing Line

This section will include the following equipment:

(a) Tube-end chamfering machines

Capacity:

Lengths: 5.5 - 8 m

Standard: BS; ISO R65; API

Output: 220 pieces/h of 3"; 150 pieces/h of 6"

(b) Twin pipe testing press

O.D. $\frac{1}{2}$" - $2\frac{1}{2}$" & 3" - 6"

Capacity:

1,000 pieces/h of $\frac{1}{2}$"

400 pieces/h of $2\frac{1}{2}$"

300 pieces/h of 3"

150 pieces/h of 6"

(c) Threading machines: for threading of pipes at both ends in one pass

Capacity:

Nominal pipe size: $\frac{1}{2}$ - $2\frac{1}{2}$" and 3" - 6"

Lengths: 5.5 - 8 m

Standards: ISO R65, BS; DIN

Threads standards: ISO R; DIN 2999

(d) Socket wrenching-on machines: for wrenching-on of pipe sockets at one end of threading pipe:

Capacity:

Nominal pipe size: $\frac{1}{2}$ - $2\frac{1}{2}$" and 3 - 6"

Lengths: 5.5 - 8 m

Standards: ISO R65; BS; DIN

Socket Standards: ISO R50; DIN 2986

(e) Tube straightening machines ; for straightening of black tubes coming from the tube mill or from galvanized tubes:

Capacity:

Two lines with capacity for tubes of $\frac{1}{2}$ - $2\frac{1}{2}$" and 3 - 6".

7.1.6. Tube Galvanizing Plant

consisting of:

- tube pretreatment/degreasing
- hydrochloric acid (HCL) pickling plant
- neutralization with water recovery
- dry galvanizing
- accessories.

Technical Data

Tube diameter: $\frac{1}{2}$ - 6"

outer Ø DIN 2440, 2458

Wall thickness: 1.8 - 5.4 mm

Tube length: 6,000 mm

Capacity: (see Table 7)

Zinc coating:	300 - 600 g/m^2 average
Zinc consumption:	Approximately 35 - 45 kg/ton throughput of tubes for zinc coating; approximately 70 kg/ton throughput of tubes effective with waste products
Pickling medium:	18 - 20% HCL
Fuel:	Light oil HU approx. 18 - 22 kg/ton throughput of tubes
Electro connection value:	approximately 50 kW for the galvanizing equipment: approximately 90 kW for the special equipment for one complete plant
Water consumption:	1.2 m^3/ton throughput of tubes by use of VZ-neutralization, otherwise approx. 2-2.5 m^3
Steam(heating of baths):	approximately 130 kg/ton tubes at 4 atm saturated steam
Steam(blowing-out of tubes):	approximately 40 kg/ton tubes at 10 - 12 atm; 270°C superheated
Compressed air:	approximately 4 atm.

7.1.7. Spiral Pipe-Welding Plant

- to manufacture pipes from 8" to 24" diameter.

Technical Data

Raw material:	coils

Strip width:	450 - 1,020 mm
Camber:	12.7 mm on a length of 25 m
Strip thickness:	4.73 - 11.33 mm
Coil weight:	maximum 16 tons
Coil inside diameter:	minimum 610 mm
Coil outside diameter:	minimum 1,400 mm; maximum 1,830 mm
Steel grade:	hot-rolled steel up to maximum API 5LS 65
Pipe outside diameter:	8 - 24" (219.1 - 609.6 mm)
Pipe wall thickness:	4.78 - 11.13 mm
Pipe length:	infinitely variable from 6 - 12 m
Pipe diameter tolerances:	to API 5LS, 7th edn of March, 1973
Plate feed:	The rate of plate feed is infinitely variable within the range of 0.4 - 2.4 m/min.
Pitch angle:	12 - 45°
Max. pipe weight:	about 2.0 tons
Electric equipment:	380/220 V; 50 cycles

7.1.8. Ultrasonic Test Installation

- the test is to be carried out approximately 1 - 3 turns away from the last welding head. When testing at a central test stand, it is to be carried out under the same conditions, with increased testing speed. A trolley with a tube-rotating mechanism is used for transporting the tubes.

Technical Data

Tube diameter:	300 - 1,000 mm

Wall thickness :	4 - 14 mm
Untested ends:	70 mm
Tube surface:	as rolled, but without loose scale or welding beads
Temperature:	less than $80^{o}C$ at the contacting point of the probes on each side of the weld
Testing speed:	20 m/min
when using weld sensor:	max. 20 m/min
Weld width when using weld tracking device (tracking width of the weld):	12 - 32 mm

7.1.9. X-Ray Equipment

- industrial X-ray equipment for radiographic inspection of spirally-welded pipes.

Technical Data

Min. and max. pipe diameters: 8/24" (203/610 mm)

Min. and max. pipe lengths: 6/12 m

6" image intensifier equipment: Philips, MG 160

This equipment has the following groups: wagon for pipe transportation, arm for X-ray tubes and cabin with VDU screen and console.

It also includes the following equipment:

- ray protection equipment

- searchlight with switch and installation material
- light spot projector to position the film on the pipe
- dark-room equipment for processing X-ray films.

7.1.10. Hydrostatic Pipe-Testing Press

Technical Data

Range of dimensions: 8 - 24" (203 - 610 mm)

Pipe lengths between: 6 - 12 m

Pipe specification: API 5LS-X65

Max. pressure of press: 550 tons

Wall thickness of pipe: 4 - 12.7 mm

7.1.11. End-Chamfering Machine

Technical Data

Max. pipe diameter: 24" (610 mm)

Min. pipe diameter: 8" (203 mm)

Max. pipe length: 12 m

Min. pipe length: 6 m

Min./max. pipe thickness: 4/12 mm

Plate diameter: 850 mm.

The complete machine comprises the following units:

- endfacing head
- tightening unit

- lifting bends:
- roller conveyors
- expellers
- rotary table for pipes
- hydraulic unit.

7.1.12. Control, Inspection and Repair Stands

- incorporating a walkway of special steel plates for comfortable transit and ease of access. These devices comprise three rotary supports: two are free, and the third is motorized by a moto-reducer.

7.1.13. Internal Transporting System

- several devices are used for pipe transportation:

(a) Roller conveyors - there are several types: motorized roller conveyors and roller conveyors with lateral butt.

(b) Lifting, lowering and expelling devices - they are designed for the lifting, lowering and expelling operations of pipes during their transportation.

(c) Pipe grates - they are placed for convenient transport of pipes of 6 - 12 m length.

7.1.14. Pipe-Wrapping and -Coating Plant

- bitumen and coal-tar enamels have been applied effectively for many years for the internal and external protection of steel pipes against corrosion.

Technical Data

Coating specification:	A.W.W.A. C203-73
Coating thickness:	4 mm double coat and wrap (external)
	4 mm single flood coat (internal)
Pipe diameter:	8 - 24" (203 - 610 mm)
Pipe length:	6 - 12 m
Wall thickness:	4 - 12 mm
Max. pipe weight:	2.25 tons

The plant includes the following groups:

- external abrasive blast-cleaning and priming machine
- internal abrasive blast-cleaning and priming machine
- internal lining machine
- external coating and wrapping machine
- enamel melting, heating and storage system.

7.1.15. Service and Auxiliary Equipment

(a) Standard mechanical workshop

(b) Standard electrical workshop

(c) Standard laboratory for steel pipe plant

(d) Generators: capacity 2,000 KVA

(e) Boiler for the galvanizing and coating plants

(f) Weighbridge for gate (truck scale)

(g) Transformator stations

(h) Compressors (3 units)

(i) Overhead cranes_ 2 cranes at 15 tons and 6 cranes at 5 tons

(j) Spare parts for one year

(k) Wear parts for one year.

7.2. Facilities and Equipment Supplied Locally

(a) Supporting frames and steel work for mechanical conveyors, gangways, ladders and machine foundation supports, pit and trench covers, guardrails and fume hoods.

(b) External lighting.

(c) Pipelines, with mounting supports, for compressed air, water, drainage and oil supply

(d) Basic water supply, drainage, purification and waste disposal systems.

(e) Silo for stocking dust and other waste.

(f) Fire protection system.

(g) Warehouse facilities.

(h) Storage tank for thermo-oil, pipelines, armatures and filling pump.

General facilities provided locally:

(a) Oil filling for all the machinery

(b) Hand tools, such as axes, cables, chains, shovels, rakes, general cleaning materials, etc.

(c) Various shelves, cabinets, tables, small lifting devices

(d) Complete installation for offices and recreation rooms

(e) Various assembly materials

(f) Vehicles (cars, lorries, etc.)

(g) Telephone installation and checking installation for factory staff

(h) Air-conditioning plant.

8 -
COST CALCULATION

8. COST CALCULATION

8.1. Assumptions

In this study, the cost calculations are based on the following assumptions:

Import duty	5%
Depreciation of buildings	20 years
Depreciation of machinery	10 years
Equity capital	40% of investment
Investment loan	60% of investment
Interest rate	11%
Land requirement	100,000 m^2
Factory buildings	19,200 m^2
Administration building	500 m^2

Sizes:

Longitudinal production line ($\frac{1}{2}$ - $2\frac{1}{2}$")	: 1" diameter
Longitudinal production line (3 - 6")	: 4" diameter
Spiral production line (8 - 24")	: 16" diameter

Working days/year	280 days.

8.2. Investment Costs: Table [12]

The cost of imported machinery and spares is calculated as FOB at supplier's port (Europe). The freight and insurance is 7% CIF Lagos.

Clearing and transport from Lagos to Kano is $2\frac{1}{2}\%$.

The cost of the foundation for the machinery and assembling the plant is estimated to be 10%. This figure has been taken from similar factories established in Asia and Africa.

The engineering cost includes the costs of designs, technical guidance and know-how.

Interest during construction is 11% of the total equipment cost. The cost of land and site preparation includes registration fee, surveyor's fee, compensation, clearing the site, levelling and fencing.

8.2.1. The buildings will be divided as follows:

(a)	Factory building		19,200 m^2
	Average cost per m^2	=	₦ 150/m^2
	Factory building cost	=	₦2,880,000
(b)	Administration building		500 m^2
	Average cost per m^2	=	₦ 250/m^2
	Administration building cost	=	₦ 125,000
(c)	Total building cost	=	₦ 3,005,000.

8.2.2. Vehicle/Office Equipment

(a)	2 heavy vehicles	₦ 50,000
	2 saloon cars	16,000
	1 micro bus	9,000
	1 tractor	10,000
	2 trucks	15,000
	Sub-total	₦100,000
(b)	Office equipment	50,000
	Total	₦150,000

8.3. Materials and Energy Costs: Table 13

8.3.1. Hot-Rolled Coil Steel:

(a) Longitudinal pipes

Annual production = 105,000 tons

The scrap is due to:

- strip edge scrap
- lead- and tail-end scrap on each coil

The total scrap percantage is 3%.

∴ Annual consumption of coiled steel = 108,150 tons

(b) Spiral-welded pipes

Annual production = 14,000 tons

The total scrap percentage is 4%.

∴ Annual consumption of coiled steel = 14,560 tons.

∴ Total annual consumption (a + b) = 122,710 tons.

The rolled coiled steel will be imported until Nigeria's rolling mills start production. The price in the table includes freight and insurance. This is the main material cost.

8.3.2. Welding Materials

(a) Welding Wires:

These are used for spiral-welded pipes and will be imported until local production starts.

Consumption (from ex perience) 2.8 kg/ton of pipes

∴ Annual consumption is 39.2 tons/year.

This is a special welding wire for the submerged arc-welding, and it is imported in coils.

(b) Welding Flux:

This is used for the submerged arc-welding of spiral-welded pipes. It is imported in drums.

Consumption (from experience) 4.2 kg/ton of pipes

∴ Annual consumption is 58.8 tons/year.

8.3.3. Pickling and Galvanizing Materials

Galvanized pipe production = 64,000 tons/year

For a capacity of 16 tons/hour, 2 shifts and 280 days/year, the running annual consumption is:

Devesol	80 tons
HCL	1,920 tons
Suprit	8 tons
Acidol	4 tons
Stop	4 tons
Flux M60	144 tons
Zinc	5,120 tons
Lead	8 tons
Alloy	19.2 tons
ZN800	13.6 tons

The total price of chemicals on site = ₦ 5,713,210.

8.3.4. Bituminizing Materials

Bituminized pipe production = 10,000 tons/year

Diameter of pipes = 16"

. . Metre weight = 62.66 kg/m

Coated pipes = 159,600 m/year (or approximately 160,000 m/year)

List of materials for bitumenizing plant and costs, together with consumption per ton of pipes (based on 100 linear metres of 16" diameter pipe):

(a) For external cleaning & coating 4 mm double coat and wrap

Abrasive (steel shot)	Primer	Coat: Coaltar enamel
1.15 kg	7.79 lit.	779 kg

Inner wrap	Outer wrap
138 m^2	138 m^2

(b) For internal coating and cleaning 4 mm single flood

Abrasive (Chilled iron grit)	Primer	Coat: Coaltar enamel
1.91 kg	7.79 lit.	779 kg

(c) Cost of consumable packed materials, based on current prices

(i) Synthetic primer type b(fast drying), packed in steel 210-litre drums:

Price/litre = ₦ 1.73

(ii) Glass fibre inner wrap packed in cardboard containers:

Price/ 100 m^2 ₦ 13.56

(iii) Outer enamel impregnated wrap packed in fibreboard cylinders:

Price/100 m^2 ₦ 42.13

(iv) White grade coaltar enamel to AWWA C203-78 specification, packed in steel drums:

Price/ton ₦ 217.74

(v) Angular chilled iron abrasive type G05-G25 packed in bags and palletised:

Price/ton ₦ 331.36

(vi) Rolled steel shot type S230-S330, packed in bags and palletised:

Price/ton ₦ 441.2

8.3.5. Electrical Energy

Voltage	:	400 V
Frequency	:	50 cycles/s
Installed power	:	2000 KVA
Electric power rate	:	₦ 2.7/100 kWH
Power consumption (average)	:	3.2 ₦/ton.

8.3.6. Thermal Energy

Thermal oil with the following properties:

Sulphur content	0.3% max.
Calorific value	10,000 K.Cal.

Ash content	0.1% max. (weight)
Carbon content	15% max. (weight)

The thermal energy will be used for the galvanizing plant and the bitumenizing section.

8.3.7. Water

Annual consumption of water will be	224,000 m^3/year
Unit price	₦ 10/100 m^3
Annual cost	₦ 22,400/year.

8.3.8. Tools

A lump sum of ₦ 50,000/year for knives, sanding belts, grinding wheels, etc.

8.3.9. Maintenance Materials

A lump sum of ₦ 50,000/year for grease, oil, mechanical and electrical standard parts and cleaning materials.

8.4. Production Costs (Table 15)

The production costs include the cost of materials, energy, tools, wearing parts, maintenance materials, wages, salaries, depreciation and interest.

The raw materials cost accounts for the largest part of the production costs, followed by depreciation and interest, then wages and salaries.

8.5. Selling Price

(a) Longitudinal pipes:

Table 9 shows the average current factory prices for longitudinal pipes in Nigeria.

Table 9

	ITEM	₦/Pipe *	₦/Ton	₦/Year
1.	- Black pipe 1" diameter	8.14	500	3,300,000
	- Galvanized pipe 1" diameter	10.45	705	16,920,000
2.	- Black pipe 4" diameter	44.07	600	21,000,000
	- Galvanized pipe 4" diameter	51.41	700	28,000,000

* Pipe = 6.07 m.

These prices shown in Table 9 are considered very high, therefore, it is recommended that the sale price should be at least 30% lower than current ex-factory prices. The recommended prices are shown in Table 10.

Table 10

	ITEM	Present Price ₦/Ton	Recommended Price ₦/Ton	Sales ₦/Year
1.	- Black pipe 1" diameter	550	385	2,310,000
	- Galvanized pipe 1" diameter	705	493.5	11,844,000
2.	- Black pipe 4" diameter	600	420	14,700,000
	- Galvanized pipe 4" diameter	700	490	19,600,000
	(1) + (2)	Total Sales		48,454,000

(b) Spiral Pipes:

The 16-inch diameter spiral pipes currently sold in Nigeria have not been tested by X-ray or hydrostatic tests. The ex-factory price is ₦ 800/ton for uncoated pipes. An additional 20% is charged for coated pipes. The selling prices are as follows:

Uncoated 16" diameter pipe = ₦ 800/ton

Coated 16" diameter pipe = ₦ 960/ton.

Again, these prices are rather high and it is recommended that they be reduced by about 30%. The recommended sale price for spiral pipes is thus:

Uncoated 16" diameter pipe = ₦ 560/ton

Coated 16" diameter pipe = ₦ 672/ton

Table 11 SUMMARY-I

ITEM	UNIT	VALUE
Total investment costs	Mill. ₦	20.134
Sales revenue	Mill. ₦	57.414
Production costs without internal depreciation	Mill. ₦	38.245
Gross profit	Mill. ₦	18.398
Gross returns on investment	%	91.38
Number of employees		328
Installed power	KVA	2,000

(Contd.)

Table 11 (Contd.)

ITEM	UNIT	VALUE
Consumption of:		
Hot-rolled coil steel	Tons/Year	122,710
Welding wires	"	39.2
Welding flux	"	58.8
Devosol	"	80
HCL	"	1,920
Suprit	"	8
Acidol	"	4
Stop	"	4
Flux M60	"	144
Zinc	"	5,120
Lead	"	8
Alloy	"	19.2
ZN 800	"	13.6
Synthetic primer	Lit./Year	2,487
Glass fibre	m^2/Year	22,000
Outer enamel impregnated	m^2/Year	22,000
White grade coaltar	Tons/Year	249
Angular chilled iron abrasive	kg/Year	300
Rolled steel shot type S 230-S 330	"	180

Table 12: INVESTMENT COSTS

ITEM	Currency	₦
Imported machinery & spares FOB supplier's port	Foreign	10,600,000
+ Freight/Insurance (7%) CIF Lagos	Local	742,000
Import duty (5%)	Local	530,000
Sub-total		11,872,000
Clearing and transport to site (2½%)	Local	296,800
Cost of local supplies	Local	500,000
Total Equipment		12,668,800
Foundation/Assembly (10%)	Local/ Foreign	1,266,880
Office equipment/Vehicles	Local	150,000
Sub-Total		14,085,680
Engineering	Local/ Foreign	150,000
Mill contingencies		1,000,000
Construction overheads		200,000
Sub-total		15,435,680
Interest during construction		1,393,568
Total Equipment and Engineering		16,829,300
- Land and Site preparation	Local	150,000
- Buildings	Local	3,005,000
- Pre-Operation costs		150,000
Total Investment		20,134,300
Working Capital		6,400,000
GRAND TOTAL		26,534,300

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Table 13 MATERIAL AND ENERGY COSTS

ITEM	UNIT	Longitu-dinal Pipes	Spiral Pipes	Total
Yearly capacity	ton	105,000	14,000	119,000
1-Hot-rolled coil steel:				
Annual consumption	ton	108,150	14,560	122,710
Unit price	₦/ton	250	250	-
Annual steel costs	₦/year	-	-	30,677,500
2-(a) Welding wires:				
Annual consumption	ton	-	39.2	39.2
Unit price	₦/ton	-	1,667	-
Annual costs	₦/year	-	65,346	65,346
(b) Welding flux:				
Annual consumption	ton	-	58.8	58.8
Unit price	₦/ton	-	1,239	-
Annual costs	₦/year	-	72,853	72,853
3-Pickling & Galvanizing:				
Galvanized pipes	ton	64,000	-	64,000
Chemicals:				
Devosol	ton/year	80		80
HCL	"	1,920		1,920
Suprit	"	8		8
Acidol	"	4		4
Stop	"	4		4
Flux M60	"	144		144
Zinc	"	5,120		5,120
Lead	"	8		8
Alloy	"	19.2		19.2
ZN 800	"	13.6		13.6
Total price of Chemicals	₦/year	5,713,210	-	5,713,210
4-Bitumenizing:	ton/year	-	10,000	10,000
- Synthetic primer	₦/year	-	43,125	
- Glass fibre	"	-	29,940	
- Outer enamel impregnated	"	-	93,023	
- White grade coaltar	"	=	542,782	
- Angular chilled iron abrasive	"	-	1,013	
- rolled=steel shot type S230-S 330	"	-	812	
Total			710,695	710,695

(Contd.)

Table 13: (Contd.)

ITEM	UNIT	Longitudinal Pipes	Spiral Pipes	Total
5-Electrical Energy:				
- Installed power	KVA	-	-	2,000
- Power consumption (average)	₦/ton	-	-	3.32
- Total power consumption	₦/year	-	-	395,000
6-Thermal Energy:				
- Fuel consumption	kg/ton	24	14	38
- Total consumption	ton/year	1,536	140	1,676
- Fuel price	₦/ton	-	-	125
Total Fuel Cost	₦/year	192,000	17,500	209,500
7-Water:				
Average consumption	m^3/h	-	-	50
Total consumption	m^3/year	-	-	224,000
Unit price	₦/100 m^3	-	-	10
Annual costs of water	₦/year	-	-	22,400
8-Tools: Consumption of knives tools and wearing parts	Lump sum	-	-	
	₦/year	-	-	50,000
9-Maintenance Materials: Consumption of grease, oil Mechanical and Electrical standard parts and cleaning materials	Lump sum			
	₦/year	-	-	50,000

Table 14: WAGES AND SALARIES

ITEM	UNIT	Longitu-dinal Pipes	Spiral Pipes	Total
Number of shifts	per day	2	2	2
	per year	560	560	560
1-Wages:				
Skilled labour	per day	62	26	88
Semi-skilled labout cost	₦2400/year	148,800	62,400	211,200
Helpers	per day	106	58	164
Helpers wages	₦1500/year	159,000	82,000	246,000
Total Wages	₦/year	307,800	149,400	457,200
2-Supervisory & Technical Personnel Salaries:				
Mill General Manager 1	₦2000/month	-	-	24,000
Production Managers 2	₦1500/month	1	1	36,000
Production Engineers 4	₦1200/month	2	2	57,600
Foremen 20	₦ 800/month	12	8	192,000
Supervisory staff 27		15	11	
Total Supervisory Staff Salaries	₦/year	-	-	309,600
3-Maintenance Wages:				
Mechanics 8	₦ 400/month	-	-	38,400
Electricians 4	₦ 400/month	-	-	19,200
Semi-skilled men 12	₦ 200/month	-	-	28,800
Maintenance Salaries Total Maintenance Salaries	₦/year	-	-	86,400
4-Administrative Salaries:				
Office Manager 1	₦1000/month	-	-	12,000
Commercial Manager 1	₦1000/month	-	-	12,000
Accountants 3	₦ 800/month	-	-	28,800
Accountant Assistants 3	₦ 500/month	-	-	18,000
Clerk/Typists 5	₦ 400/month	-	-	24,000
Watchmen 9	₦ 150/month	-	-	16,200
Drivers 3	₦ 300/month	-	-	10,800
Total Administrative Salaries 25	₦/year			121,800

Table 15: PRODUCTION COSTS

ITEM	UNIT	VALUES
1-Raw Materials:		
Hot-rolled coil steel	₦/Year	30,677,500
Welding wires	"	65,346
Welding flux	"	72,853
Pickling and galvanizing	"	5,713,210
Bitumenizing	"	710,695
Total	₦/Year	37,239,604
2-Energy and other Manufacturing Costs:		
Electrical energy	₦/Year	395,000
Thermal energy	"	209,000
Water	"	22,400
Tools	"	50,000
Maintenance materials	"	50,000
Total	₦/Year	726,400
3-Wages, Salaries & Overheads:		
Wages	₦/Year	457,200
Supervisory and technical salaries	"	309,600
Maintenance wages	"	86,400
Administrative salaries	"	121,800
Advertising, sales	"	25,000
General overhead (stationery, travel, Insurance, legal fees, etc.)	"	50,000
Total	₦/Year	1,050,000
Production costs, excluding depreciation and Interest	₦/Year	39,016,000
Depreciation on equipment	"	1,683,000
Depreciation on buildings	"	150,000
Total Depreciation	₦/Year	1,833,000
Interest on loan	"	1,329,000
Total	₦/Year	3,162,000
Total Manufacturing Costs		42,178,000

Table 16: SALES

ITEM	UNIT	VALUE
SALES-VOLUME		
1-Volume of black pipes ø 1"/25 mm	ton/year	6,000
Sale of black pipes ø 1"/25 mm	₦/year	2,310,000
-Volume of galvanized pipes ø 1"/25 mm	ton/year	24,000
Sale of gavanized pipes ø 1"/25 mm	₦/year	11,844,000
Total sales of ø 1"/25 mm	₦/year	14,154,000
2-Volume of black pipes ø 4"/114 mm	ton/year	35,000
Sale of black pipes ø 4"/114 mm	₦/year	14,700,000
-Volum of Galvanized pipes ø 4"/114 mm	ton/year	40,000
Sale of galvanized pipes ø 4"/114 mm	₦/year	19,600,000
Total sales of 4"/114 mm	₦/year	34,300,000
3-Volume of uncoated pipes ø 16"/406	ton/year	4,000
Sale of uncoated pipes ø 16"/406	₦/year	2,240,000
-Volume of coated pipes ø 16"/406	ton/year	10,000
Sale of coated pipes ø 16"/406	₦/year	6,720,000
Total sales of pipes ø 16"/406	₦/year	8,960,000
TOTAL SALES	₦/year	57,414,000

9 - ECONOMICS OF THE PROJECT

9. ECONOMICS OF THE PROJECT

9.1. Returns On Investment

Table 18 shows the profitability and returns on investment for the steel pipes complex. It is noted that the returns on equity is 189% and the payback period is about 1.2 years. The calculation of the profitability has been based on the following:

(a) The estimated selling price is 30% less than the current market price.

(b) All pipes produced are tested according to international standards. The production quality of this complex is expected to be the best in Nigeria, so far.

(c) The production capacity of the complex is based on two shifts per day. This could be partially increased if need be.

9.2. 10-Year Cash Flow Projection

Table 19 shows a 10-year projection of cash flow for the project starting from the day it is launched. Certain assumptions were necessary in order to complete this projection and these were that:

(a) Documentation takes 6 months.

(b) Plant delivery would take 16 months.

(c) Installation would take 6 months.

(d) Production in Year 3 would average out at one shift's capacity.

(e) Full capacity of two shifts would be achieved from Year 4 onwards.

(f) The expenses, income and cost figures have been shown as constant values, i.e. ignoring the effects of inflation on both costs and prices.

(g) The loan would be repaid within 8 years, in five equal instalments between Years 4 and 8 inclusive. Having taken a realistic view on the start-up and the time to reach full capacity, it is evidently possible to repay the loan somewhat more quickly than shown, and could be achieved in Year 3 or Year 6 if necessary.

Allowing for the repayment schedule shown, it is clearly possible to pay up to a 20% dividend on the equity in Year 4, and maintain that level of dividend payment without adversely affecting the accumulated reverses. On the projection shown, it would seem sensible to start planning expansion in Year 5 or Year 6, to take effect in Year 8, all other factors being favourable.

Table 17- PROFITS RETURNS ON INVESTMENT

ITEM	UNIT	VALUE
Sales revenue	₦/year	57,414,000
Minus production costs, excluding depreciation and interest	₦/year	39,016,000
Gross profit before interest and depreciation	₦/year	18,398,000
Total investment	₦	20,134,300
Gross returns on investment	%	91.38
Minus depreciation and interest	₦/year	3,162,000
Net operating profit	₦/year	15,236,000
Equity capital	₦	8,053,720
Net returns on equity capital	%	189.18
Plus depreciation	₦/year	1,833,000
Net cash flow	₦/year	17,069,000
R.O.I. (returns on investment)	%	84.78
Payback period	Years	1.18

- Tax on profit is not included in this table.

SUMMARY-II: Table 18

ITEM	UNIT	VALUE
Total Investment Costs	Mill. ₦	20,134,300
Gross returns on investment	%	91.38
Net returns on equity capital	%	189.18
R.O.I. (Returns on Investment)	%	84.78
Payback period	Years	1.18

Table 19: 10-YEAR CASH FLOW PROJECTION (₦ '000's)

ITEM	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
CAPITAL: FUNDS										
- Equity capital	8,054									
- Loan capital	12,081									
Total Funds Subscribed	20,135									
CAPITAL: EXPENSES										
- Plant & Equipment	9,262	6,174								
- Land & building	2,155	1,000								
- Interest (during construction)	836	558								
- Working capital	-	6,400								
- Pre-costs	50	100								
Total Investment Operation Costs:	12,303	14,232								
OPERATING:										
- Income - Sale of Pipes	-	-	28,707	57,414	57,414	57,414	57,414	57,414	57,414	57,414
- Minus production costs	-	-	19,508	39,016	39,016	39,016	39,016	39,016	39,016	39,016
- Gross trading profit	-	-	9,199	18,398	18,398	18,398	18,398	18,398	18,398	18,398
- Minus interest charges	-	-	1,329	1,329	1,064	798	532	266	-	-
- Depreciation	-	-	1,833	1,833	1,833	1,833	1,833	1,833	1,833	1,83
Net Profit(Loss)	-	-	6,037	15,236	15,501	15,767	16,033	16,299	16,565	16,5
Plus-Depreciation	-	-	1,833	1,833	1,833	1,833	1,833	1,833	1,833	1,8
- Positive Cash Flow	-	-	7,870	17,069	17,334	17,600	17,866	18,132	18,398	18,39
- Less Loan Repayments	-	-	-	(2,416.2)	(2,416.2)	(2,416.2)	(2,416.2)	(2,416.2)	-	-
- Net Cash Flow	-	-	7,870	14,652.8	14,917.8	15,183.8	15,449.8	15,715.8	18,398	18,39
Cumulative Cash flow	-	-	7,879	22,522.8	37,440.8	52,624.4	68,074.2	83,790	102,188	120,586

10 – SCHEDULE OF CONSTRUCTION WORKS

10. SCHEDULE OF CONSTRUCTION WORKS

10.1. The progress of plant construction work is dependent on the ability and skill of workers, and the type of machinery and equipment to be installed, among other factors. In Table 20, we have prepared a general standard schedule for construction.

10.2. The first two months after ordering machinery and equipment will be spent on paper-work, exchange of documents and clarification of all details.

10.3. Building construction will start in the fourth month and will take about 12 months. This should begin with the building of the main hall of the factory to be ready for delivery of machinery.

10.4. Design of machinery and equipment will take about four months, from the second to the sixth months.

10.5. Shipment and transportation will start after 12 months, for about 6 months. It is also recommended to have one clearing agent and one insurance company.

10.6. Civil work will take about four months, from the 9th to the 13th months.

10.7. Installation work will start after delivery of equipment, from the 14th to the 20th months (6 months).

10.8 Test run will take place from the 20th to the 24th months (4 months).

10.9. Training of workers and staff will take place from the 10th to the 24th months, but this will continue later in the factory for improvement of professional qualifications. The first group of trainees will return to participate in the installation of the machines.

10.10. Start-up will take place after 24 months.

Table 20: SCHEDULE OF CONSTRUCTION WORKS

DESCRIPTION	MONTHS 2 4 6 8 10 12 14 16 18 20 22 24
- Building Construction	XXXXXXXXXXXXXXXXXXXXXXXX
- Design of Machines & Equipment	XXXXXXXX
- Manufacturing of Machinery & Equipment	XXXXXXXXXXXXXXXXXXXXXX
- Shipment & Transportation	XXXXXXXXXXXX
- Civil Work	XXXXXXXX
- Installation Work	XXXXXXXXXXXX
- Delivery & Test-Running	XXXXXXXX
- Training of Staff	XXXXXXXXXXXXXXXXXXXXXXXXXXXX
- Start-Up	

II -

TECHNICAL TRAINING

11. TECHNICAL TRAINING

A comprehensive and thorough training of the engineers and operators will be provided by the manufacturer and affiliated companies in order to grant experience of the manufacturing units, plant operation, plant maintenance, quality control and production planning and control. Training will take place under the supervision of the machinery manufacturer and will consist of lectures, group discussions and training on the pipe plant (the various production machines and control equipment). Apart from technical instruction, the staff will also be trained in aspects of production, maintenance, quality control, stores accounting, manufacturing technology and know-how, to enable them to achieve optimum efficieny in the operation of the plant.

The following programme is recommended for this training:

No.	Description	Period/ Months	Man-month
3	Forming line supervisors	3	9
3	Maintenance technicians	3	9
2	Production technologists	1	2
1	Quality controller	2	2
1	Galvanizing technologist	2	2
1	Pipe-coating technologist	2	2
1	X-ray technologist	2	2
12	Total	15	28

Training of the technicians should start during the manufacture of the machinery so that they are able to return to participate in the assembly of the plant.

This group of trained staff will train other technicians, skilled and semi-skilled workers, at the plant after their return.

During the initial phase of production, foreign experts in pipe manufacture will be employed who will, among other duties, train existing staff at the factory.

12-CONCLUSIONS

12. CONCLUSION

The steel pipes complex will be an industrial beacon in Kano State. Establishing such a plant in Kano will have the following advantages:

12.1. The project will use imported steel coils until Nigerian steel mills start production, but it is easier and cheaper to import the coils than the finished pipes.

12.2. The project will supply the northern states' steel pipes requirements. Surplus can be distributed to other areas of the country.

12.3. The project will provide work for 328 people in the factory, and indirectly for at least another 1,000 people.

12.4. The project will save millions of Naira in foreign exchange currently spent on importing this important commodity.

12.5. The project will provide all industries, including the construction and oil industries, with their steel pipe requirements.

12.6. Steel pipes are much superior to PVC and asbestos pipes in durability, ability to withstand high pressure, for the transport of petroleum products, and in price.

12.7. The project will be an industrial training centre for workers. Their experience could be used for many other industries in Kano State.

12.8. The complex will produce pipes which are 30% cheaper than the present market price, thus reducing inflation in related industries.

12.9. This will be the first plant in the country producing pipes which have been tested in accordance with recognized international standards. This should force other local pipe manufactures to improve the quality of their products.

12.10. Financially, the project is viable and a highly profitable investment.

13 -

RECOMMENDATIONS

13. RECOMMENDATIONS

The study has identified the importance of establishing a steel pipe complex in Kano as specified above. It is therefore strongly recommended that this industry is established as soon as possible, by taking the necessary steps to develop the project and implement it.

Planning for the expansion of the plant in order to produce pipes of up to one metre diameter is also recommended.

It is certain that Nigeria requires more than one steel pipe complex to provide for its current needs and future development.

14 -

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