

# The Role of Foundries in Spare Parts Production and Economics Development of Nigeria using Ajaokuta Steel Company as a Case Study

Ocheri C

*Department of Metallurgical and Materials Engineering, University of Nigeria, Nsukka*

*Email: cyril.ocheri@unn.edu.ng , +2348051793922*

**Abstract:** Foundry practice has become one of the highly specialised branches of engineering that embrace many skills including those of the pattern maker, the moulder, the core maker, the smelters and casters, the foundry men, the Metallurgists and Metallurgical Engineers. It is one of the intermediary basic industries complementing forging and machining processes through which metallic raw materials like Pig iron, Crop ends (steel scrap), Ferro-alloys could be processed, refined and shaped into new products in the form of machine components and spares. Achieving specific mechanical properties of these components and spare parts on an industrial scale, required an in-depth understanding and application of service conditions envisages for the components which in turn underlines the need for appropriate casting, design, flawless pattern making, stringent selection of mould and charge calculations (Materials), appropriate melting, refining and casting technique and rigorous working and supervisory regimes. The focus of this paper is to underscore the role of foundry in National Economic empowerment and development, which will assist the Nation in developing and manufacturing her machine tools and related machinery, equipment and other accessories. It only when these machines are developed in our country, that the maintenance problem will definitely reduce; the probability of importing an expert for maintenance purpose will become something of the past and it is then and only then that the country will enjoy the real benefit of industrialization.

**Keywords:** Foundries spare parts, Economic, Development, Ajaokuta

## 1.0 INTRODUCTION

The basic requirements of man can be classified as Food, Housing, Health Care, Clothing and Transport Hence the industrial activities initiated by foreign investors in the country had started on such products. These activities have failed because the planners failed to recognise the principle of self-reliance, which involves the use of indigenous raw materials, indigenous labour and management, local markets to develop our technology and inputs into such industries. The modalities for creation of basic core industries such as Metallurgical, Mechanical, Electrical and Electronic industries have never been worked out. The development of the metallurgical industry, particularly the foundry in a sine qua is for the industrialization of

Nigeria. This is because it provides an effective linkage and is essential to the production of basic equipment and machine tools. It is apparent therefore that the manufacture and development of final consumer goods and equipment in the country require the simultaneous growth of the intermediate core industries, which provide inputs to the basic needed industries.

## 2.0 NIGERIAN FOUNDRIES

Foundry is a process through which intricate mechanical spare parts are produced. Large tonnages of Iron and steel foundry products of finished and unfinished were imported some times ago.

The reason then was that very many foundries could not cope with the demand. Most of these have facilities, which are very small, dilapidated and old fashioned. In some cases, these small foundries were integral part of a production unit. Some of these foundries cast unfinished parts and employ the services of an external machine Shop to make these unfinished parts to finished parts by machining them.

There are some existing foundries in Nigeria, but few of these are mentioned;

(a) Ajaokuta steel Company Limited (Foundry), which in presently operating its Electric Arc Furnace of (two) 6Tonnes capacity and 1-ton induction Furnace. Both furnaces are used to melt Cast iron and steel products.

The foundry shop of the Ajaokuta Steel Company can also handle Non –ferrous casting (using 50 kg crucible for melting).

(b) Nigerian foundries, located at Ilupeju (Lagos) that can handle simple iron castings.

(c) Railway foundry which is old fashioned that use to provide iron parts to the railway sector as become history.

(d) The Delta Steel Company – foundry, which has modern equipment but with low capacity has since stopped producing. Most of her spare parts requirements are handled by Foundry in Ajaokuta Steel Company.

Although in the past Delta Steel Company use to produce both alloyed steel and iron parts

There were very other foundries with low capacities in Nigeria and to produce Ferrous and Non – ferrous castings.

### 3.0 PROBLEMS ASSOCIATED WITH LOCAL INDUSTRIES

There are some problems associated with local industries, since the transfer of the demand for spare and original parts from imports to the domestic production is a very difficult task and sometimes costly processed. However, to depend solely on imported parts and machineries is even more costly which if proper measures are not put in place may will continue to drain the economy of the country to bankruptcy.

In the present time in Nigeria, the reduced demand for goods for exports and the resulting huge foreign exchange reserve that we have, Government still have to tighten up her belts on policy as regards import licenses and custom duties. This process has aggravated the operational problems of local industries by further delaying the acquisition of parts and materials necessary for the operation, raise finance, and inventory cost

The only and feasible solution is for industries to turn to local manufacturers for essential parts and materials whenever possible.

Since Nigeria is developing technologically, we need to known that 'Technology is the continuing response to the changing need of man'

For Nigerian to meet up with the requirements theses local manufacturers must sustain their existing industries and improve on them.

Even new industries could be built by private investors through local markets so as to meet their needs at all times, then the metal industries will be able to contribute and play prominent role for the growth of the economy of Nigeria.

This will in turn make Nigeria to be one of the developed Nation by the year 2020 , we need to ask ourselves this important question, how far is the country responding to the changing needs of man? Particularly in this 21<sup>st</sup> century.

#### 3.1 Problem of Spare Parts

In Nigeria today, most of the steel industries are not operating their industries to full capacity, The foundry shop of the Ajaokuta Steel company Limited is operating one of its 6 tons Electrical Arc Furnace, One Ton induction Furnace and the crucible furnace, and at about 40% utilization.

The foundry shop in Delta Steel Company Limited is not in operation, while the three Inland Rolling Mills are faced with one problem or the other; this has also made these industries to stop production long ago.

It is an unfortunate situation in the country as these gigantic set-ups have been the shadow of itself and has been the cynosure of eyes and much were expected

from these industries as steel forms the basis of any technological take off.

It may be necessary to use this forum to unveil a major underlying problem, which has been plaguing Nigeria steel sector – the problem of spare parts and operating consumables.

The problem is not peculiar to the steel sector .It is starring at the faces of almost all Nigeria manufacturing and production industries. Agricultural Engineers and other stakeholders are not finding things easy, as they are complaining of spare parts for their machinery. The cement manufacturers too are facing similar challenges of spare parts availability. These problems are threatening these industries; the automobile industries are crying foul of the same spare parts problem and even the oil industry, which, is a special child to Government (Known as The Golden Boy), is also pinched.

Why do we have a serious problem of spare part?

#### 4.0 MAINTENANCE

Maintenance is becoming of the most important industrial activities both in developing nations as well as developed ones. In both cases, more machines with complicated designs and electronic control systems are added to already existing equipment stock. As a national result, the ration of maintenance to production cost is continuously increasing. Thus if the machines are not maintained properly and handled in a good way to give designed capacities, the result can be a catastrophe.

This issue is even critical in a country just developing like Nigeria.

What plans are therefore necessary to ensure that there are availability of spare parts – Electrical, Electronic, & Mechanical before setting up a new or big industry in the country? Do we have such facilities? The answer is NONE.

The foundation for good production is not laid. The tendency is to neglect the maintenance, as this will hamper on production.

It is better to ensure that at least 60 –80 % of needed spare parts can be manufactured locally to give a support to the existing industries where more than 95% of the needed spares are to be imported this as good as not operating at all. One therefore should expect low production output.

#### 5.0 MARKET DEMAND PATTERN FOR FOUNDRY PRODUCTS

In developing country, the size of the domestic markets are always a major constraint in establishing an economic viable industry. Although, Nigeria is one of the developing countries today, the market size for the foundry and other core industry products is enormous.

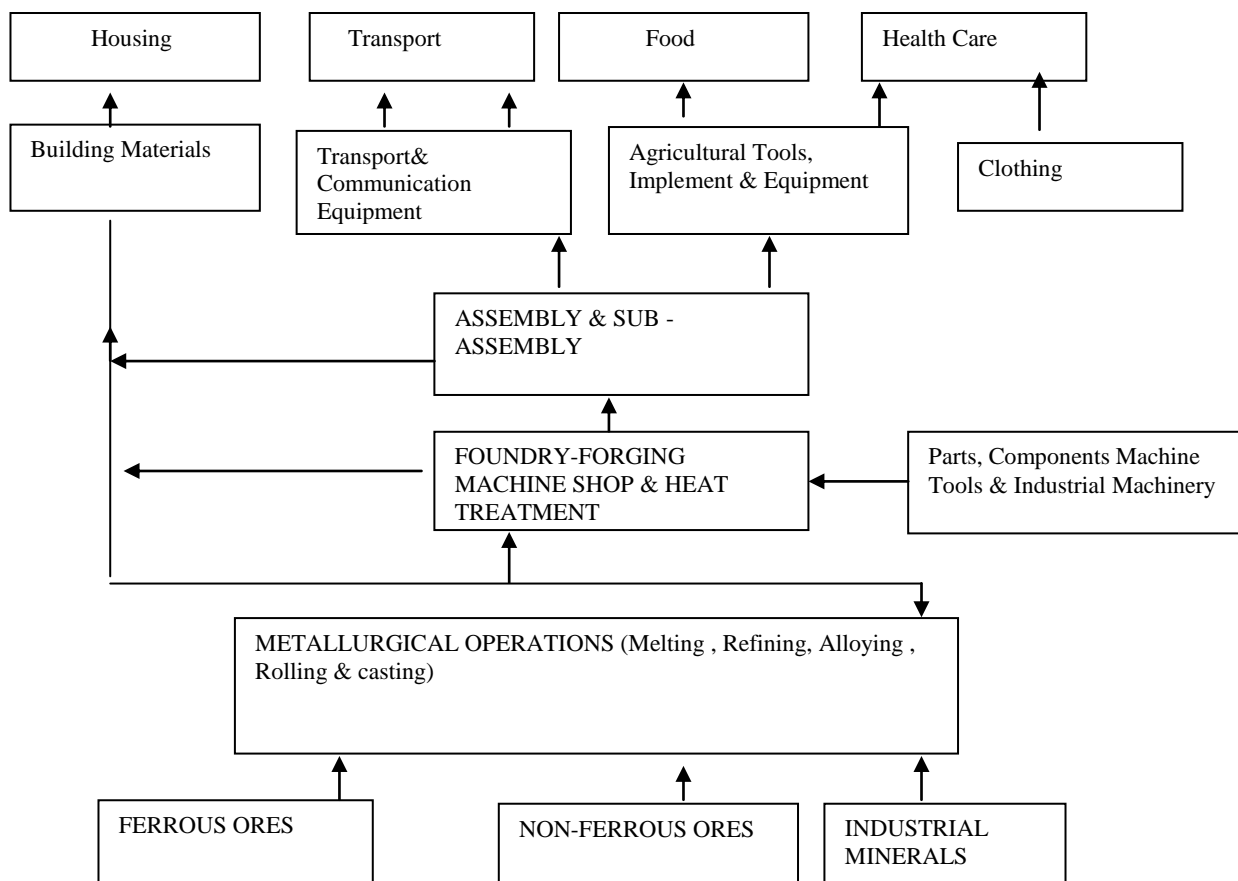


FIG. 1. SHOWS THE INTER LINKAGE BETWEEN BASIC METALS / ENGINEERING INDUSTRIES AND BASIC NEEDS

### 5.1 ASCL'S EXPERIENCE

The ASCL foundry shop was designed as jobbing foundry. The main objective was for it to produce Ferrous casting – 6810T and Non-ferrous casting – 190T on the basis of two shift arrangement and more so the capacity could be raised to ferrous castings – 11560T and Non-ferrous – 840T on three shift – 4 brigade arrangement. The shop has a very big Pattern Making Shop, Planning & Design and Quality Control & Materials Analysis, Sand Preparation & Moulding, Melting & Casting, Fettleing & heat treatment and Electrical & Mechanical Maintenance Units.

The foundry produces Steel and cast iron (Ferrous and Non-Ferrous castings).

It can handle jobbing repetitions and gravity die cast work. It is equipped with two electric Arc furnaces for melting as well as other supporting equipment for Casting, Moulding, Melting & Casting / Pouring, Fettleing and Heat Treatment. The melting capacity alone is about 36,000T of ferrous and 3,000T of Non-ferrous metal per annum.

The shop produces 7,000 tones of castings annually for the steel plant, this comprises -

The 3,500 tonnes of iron castings with a maximum weight of 10 tonnes 3,260 tonnes of steel castings with a maximum weight of 800kg. The major equipment and their capacities include.

#### (a) Moulding Equipment

- ✓ Pneumatic shaking moulding machine sizes: 1600 x 1200 x 1600mm x 800x 100-x450mm -Stationary moulding sand slingers capacity 12m<sup>3</sup>/hr.
- ✓ Continuous Action Mixer of cold – hardening mixture capacity, 1t /hr
- ✓ Crusher capacity, 40-m<sup>3</sup>/hr

#### (b) Casting Equipment

- ✓ Electric Arc Steel melting furnace 2 Nos (6T each)
- ✓ Crucible induction mixer furnace 1No capacity
- ✓ Induction – type Electric furnace for melting Non-ferrous metal / 2No 1 Ton each.
- ✓ Crucible Hearth for non-ferrous metal 1 No capacity 100kg

- ✓ Car – hearth heat treatment furnace 1 No. Hearth Area 18m<sup>2</sup>
- ✓ Calcining furnace for Ferro –alloys 1No Hearth Area 36 m<sup>2</sup>
- ✓ Hot metal and steel ladles of various capacities

**(c) SPECTRO- Analytical Instrument;** Used for the determination of the chemical compositions of rolled and cast products (Ferrous Metals) as being produced in Foundry shops and other related industries.

Since commissioning in 1990, the shop has produced more than 1000 finished assorted Iron and Steel parts for some industries **as shown on Table 1.**

It has earned some revenue for the company and as well as saving some of these industries from being shut down.

The continued interest shown by other companies and industries in the potential of ASCL Foundry to meet their needed spare parts cannot be to over-emphasized.

Consequently, it has become very essential for ASCL management to consider the available facilities in the shop Visa- a –visa the product demand from them. Theses demand can be categorized into these groups.

**Table 2:** shows Demand of products from these industries

S/no	Items	Orders Rec / Year
1	DSC [Grinding Media ( Ø 30MM,40MM &50MM )]	40,000 T
2	Automobile Parts	20,000T
3	Railway brake Pads	6,000T
4	Quarrying items	8000T
5	Cement Parts	10,000T
6	Agricultural Parts	5,000T
7	Dredging & Navigation	3,000T
8	Miscellaneous	15,000T
9	Total	107,000T

**Table 3 :** Foundry Production Plan –2019

PRODCUTION PLAN FOR 2007 IN ASCL FOUNDRY (TONS)														
S/N	DESCRIPTION	JAN	FEB	MAR	APR.	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	Grinding Media (Ø50mm) & Above	5	10	10	10	15	15	15	15	20	20	20	20	175
2	Crusher Plates	0	0	0	5	5	5	5	10	10	10	15	15	80
3	Rolls	0	0	0	0	5	5	10	10	10	10	10	10	70
4	Pallets	0	0	0	0	10	10	16	16	16	16	16	16	116
5	Grate Bars	0	0	0	0	0	4	0	0	0	0	0	0	4
6	Crane Wheel Bearing Block	2	0	2	0	0	0	0	0	0	0	0	0	4
7	Impact Hammers	0	1.5	0	0	0	0	0	1.5	0	0	0	0	3
8	Furnace Roof Hanger II	1	2	0	0	0	0	0	0	0	0	0	0	3
8	Furnace Roof Hanger III	0	0	1	2	0	0	0	0	0	0	0	0	3
9	Furnace Door Seal	0	0	0	2	0	0	0	0	0	0	0	0	2
														460

**Table 4:** Foundry Revenue Plan -2019

S/No	Job Description	Prod. Cost/ Ton of Casting	Revenue/Ton Of Finish Casting	Profit /Ton	Annual Tonnage	Total Revenue (Naira)	Total Profit (Naira)
1	Grinding Media (Ø50mm & Above (DSCL)	150,000	200,000	50,000	100	20,000,000	5,000,000
2	Grinding Media (Ø50mm &Above (External)	150,000	300,000	150,000	75	22,500,000	11,250,000
3	Crusher Plates(External)	175,000	321,000	146,000	80	25,680,000	11,680,000
4	Rolls			100,000	70		7,000,000
5	Pallets	225,000	450,000	225,000	116	52,200,000	26,100,000

6	GrateBars	293,000	2,250,000	1,957,000	4	9,000,000	<b>7,828,000</b>
7	Miscellaneous	127,500	150,000	22,500	15	2,250,000	<b>337,500</b>
					Naira	131,630,000	<b>69,195,500</b>
					USD	1,012,538	<b>532,273</b>

**6.0 ANALYSIS**

It should be noted that the above tables on market demand pattern represent the tonnages of finished foundry products demand in the country. No matter where the products are cast, unless there are good foundries, machine shop, and forge shop established as it is the case of ASCL foundry, where it is located near the Machine & Tools Shop and Forge & Fabrication Shops at Engineering Services of the Company.

Depending on importation of all the needed spare parts will slow down the pace for development in our country – Nigeria, particularly in technology (especially in our Research & Development activities). This indicates that there will be no development of indigenous entrepreneurship and capabilities; it means no increase in employment and empowerment opportunities not only within the sub- sectors but also in other economic sectors for Nigerians and Nigeria to meet the challenge of development.

The availability of these products will assist in providing the needed strategies for the development of the economic sectors, therefore reducing the philosophy of mass retrenchment, downsizing, rightsizing, disengagement and other ill practices, that will continue to hamper on production activities.

It means lack of utilization of highly qualified and skill labour which ought to be absorbed in all industrial activities; it means putting a final blow to the self – reliance and self –sustaining economic development for this country, and it means that the only way to survive is to drain our dwindling economy until there is nothing to drain.

However, it should be noted that development and establishment of gigantic iron and steel foundry complexes of high capacities of 50,000 to 80,000 tonnes are not what the country wants now. It is preferred that rather than embarking on such ambition highly capital intensive projects, medium, small scale foundries of 2,000, 3,000, & 4,000 (t) per annum be established.

They should be built in various industrial locations to meet the needs of the local basic needs industries.

**7.0 FAVOURABLE CONDITIONS**

**(a)MARKETS** .The market demand pattern and the ASCL’s experience are enough evidence to show that any foundry established in this decade will be very viable. Many factories are down, they need to be reactivated, many machines and tools need to be built and the answer is setting up of foundries, also the competitions are still not strong.

**(b)MATERIALS:** the bulk of materials to be used with exception of the Ferro-alloys and refractoriness are found locally. Already serious work is going on some refractory works, and there is hope that in no distant time many of the required refractoriness will be obtained locally.

**(c) PERSONNEL:** There are so many metallurgical, mechanical and production Engineers in this country who are roaming the street in search of jobs that do not even exist. Hence, there will be no problem of skilled labour if such groups of people are engaged. Six months training will be enough time to ginger up any interested engineer with foundry technology. The same goes for semi- skilled labour.

**(d)TRAINING FACILITIES:** The Ajaokuta Steel Company Limited Training Centre & Facilities known as Metallurgical Training Institute (MTI) Ajaokuta. The facilities are enough to train up the entire semi – skilled labour are needed.

**(f)ECONOMIC SITUATION:** The country should not always depend on oil for her economy. Despite the fact that the prices of oil is rising internationally, the hardship been face by Nigeria is not abetting. Consequently, any operating foundry in the country should be made to be viable.

**8.0 MAJOR CONSTRAINTS**

(1)Lack of formulated and articulated plans on the part of the Government to encourage the setting up of foundries. Federal Ministry of Mine and Steel Development have to realise the importance and the role of foundry industries as very vital for the industrial take off any Nation. Consequently, the Ministry have to set up a National Committee on foundry with a view to formulating programs for the promotion of virile and widespread foundry industry in the country.

(2) Absence of policies and strategies to encourage setting up of such core industries and there must be political will to enforce and implement of what –ever polices and strategies formulated.

(3) Local entrepreneurs are not willing to invest on capital investment projects, which do not break even in six months.

(4) Inadequate indigenous capabilities for handling various aspects of projects, including planning, design, construction and implementation, as well as the procurement of finance and technology.

(5) Lack of research and development facilities and inability to source and develop locally based raw materials and other inputs for the industry.

Apart from the fundamental constraints of poor policy implementation by Government and the des-oriental pattern of most Nigerian entrepreneurs for importation of finished goods for quick returns on investments, rather than sourcing their requirements locally. A report made by Strategic Consultative Group on Foundries and Forges (SCG) identified the following as major constraints hampering the effective operation of the few existing Foundries in Nigeria.

(i) The Non -availability of the essential input materials - Pig iron, Furnace Crucibles, Refractory materials, Ferro-alloys etc.

(ii) Technical constraints - The utilization of obsolete equipment, lack of process Quality Control Equipment, lack of critical spare parts

(iii) Shortage of skilled man -power with only few educational institutions to train the middle work force. Most Nigerian Foundries lack skilled Foundry Engineers and Metallurgists.

(iv) Inadequate patronage of locally produced products by Government agencies and private operators.

(v) Poor Marking Strategies

(vi) Fluctuations in Foreign exchange.

(vii) Non-availability of low cost loans.

## 9. SUGGESTIONS & RECOMMENDATIONS

(i) The Ministry of Mine and Steel Development in conjunction with the Ministry of Industry should take a census of existing foundries in Nigeria; and find out how viable they are, and examine them by making **SWOT** analysis on them. **(STRENGTH, WEAKNESS, OPPORTUNITY AND THREAT)**. They should in turn determine the cost benefit and the possibilities of expanding or developing them.

(ii) The Government should encourage Research and Development of local substitute by providing funds for Research .All such research jobs should be co-ordinated by appropriate Government agency to avoid duplication.

(iii) The Government should continue to encourage private investors in participating in Foundry industries, by pledging incentive, which will not only prop up, but also will sustain the activities of the private sector.

(iv) The Nigeria economy could not be developed unless Government restructures the industrial base of the nation with particular attention towards enhancing capacity utilization of the manufacturing sector of the economy.

(v) Government should review the contract with PAN and VWON and other Auto manufacturers in the country with a view to increasing the local contents

input to at least 80% for the locally assembled automobiles. Compelling them to establish their own captive foundries in the country for precision could facilitate this and die casting of critically needed components.

(i) Government should allowed Private investors to participate in foundry engineering by creating an enabling environment and atmosphere for them.

(ii) Special import licence, low excise duty, better tax incentives and fiscal measure should be made deliberately to favour foundry industry.

(iii) Work force development scheme must be re-vitalised with the inclusion of Foundry technology and artisanship in Technical school

(iv) Improvement of quality control supervisions with the relevant equipment and making sure that existing Foundries commence gradual or sequential replacement of obsolete parts / components.

(v) Corresponding expansion of existing machinery facilities and establishment of the few more to handle smaller and medium size jobs.

## 10 CONCLUSION

In order to save this Nation from total collapse, and to make meaningful contributions to National Economic Empowerment and Development efforts should be made to properly co-ordinate and to keeps the existing metal based industries alive and sustainable.

This is with a view of supplying basic needs necessities for living. Doing this will save the country a lot in terms of foreign revenue.

However, this can only be done by establishing foundry complex with machine shops and tool-making facilities that can sustain the production tempo. With these, it will even be possible to build some equipment and machine, which are badly needed in our major manufacturing industries for National empowerment. Consequently, our dependence on imported machinery and equipment will be reduced and the country will in no distant time join the link of industrialised world.

Government should try to empower the existing metal-based industries like the Ajaokuta Steel Company Limited, with particular reference to the foundry shop for better and optimal productivity. The management of Ajaokuta Steel Company Limited should pay more attention to foundry shop, provide the shop with all needed funds, materials, and encourage the staff.

Finally, the Ministry of Mine and Steel Development should make sure that the Ajaokuta steel Company limited and other related industries involved in the foundry activities be encouraged.

**Table: 5** Products from Foundry

SN/O	INDUSTRY	PRODUCTS
1	Cement	Grinder and crushers, crusher hammers clinker hammers, sprocket, impellers, diaphragms, rollers, shafts, bolt gears & cone crushers
2	Auto mobile	Brake disc, crank shafts, gears, pinions, rollers, steering knuckles, callipers rock arms brake drums, carburettors bodies, connecting rods, pistons, fuel pumps, intake manifolds master cylinder body, master cylinder pistons, Transmission housing, valve rocker arms, crank cases, engine block cylinder head etc.
3	Tool	Housing for power rills butting machines, power shears, hydro press for blocks, jigs and fixtures, machine and table vices etc.
4	Textile	Pulleys, gears, frames, spanning mules, spindle nails spinning drive cylinders, sewing machine parts tricot beams, etc.
5	Steel	Pallets, moulding machine parts, shafts, and wire block, covers wire block seals, roll bearings, fitting, wire block rocker long travel rolls and roller arms.
6	Mining & Quarry	These castings require alloying resulting in high chromium and nickel, chrome iron castings. Ball mill liners, crushers sleeves, dredger pumps liners, conveyor casting, grinding balls of various diameters, Jaw crushers (fixed and swing types), cone crushers
7	Paper	Pump casing, effluent clarifiers house, bronze, brass and blanks
8	Tobacco	Drum shafts, impellers frame, and blanks for gears, vacuum pump housing and sleeves, aluminium and cast iron blanks.
9	Ship Building	Pumps, housing gears valve bodies, propellers, cylinders, engine blocks, blower housing, water jackets, pistons, pulleys, sleeves, generator housing etc.
10	Furniture	Door locks, base for chairs etc
11	Building & Road Construction	Man hole covers, crate pipe fittings, valves, street lamp housing, door hangers etc.
12	Architectural Designers	Ornamental hard wares, Architectural fittings etc.
13	Ceramic& Refractory	Extrusion press, dies, impellers, ceramic press arm, stone polishing spirals. Die for tiles and bricks etc.
14	Agricultural & Agro allied Equipment	Parts for mowers, ploughs and cultivating equipment, corn mill parts and plates. Oil expellers parts, Walter pumps, hard pumps etc.
15	Railway Equipment	Brake shoes components, sprocket parts etc.
16	Electrical Equipment	Motor frames, heads, refrigerator compressor parts for power lines, cast resistor, Electric base, change over switch bodies, gear switch bodies gland (dating) etc.
17	Confectioneries & Beverages	Metal moulds, crusher roller housing mill pinions, round oven pipes, hammer mill oval oven pipes, motor frames, fan housing, dust collector, low & high pressure fan cylinders.

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