Journal of the Nigerian Association of Mathematical Physics
Volume 56(**March – May** *2020 Issue*), **pp111 – 116**

NON-FERROUS FOUNDRY SHOP: A PRE-INVESTMENT ANALYSIS

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Abstract

This research is carried out to facilitate the setting up of a non-ferrous foundry shop in Warri Delta state and its environs by evaluating strategic plans on the basis of some feasibility studies. These studies include commercial feasibility, technical feasibility, social economic feasibility as well as financial feasibility of the project. The appraisal conducted, revealed the value of the annual profit to be N2 828 770.00, return on investment as 2.4 and expected payback period of 1year 5 months. It is intended to assist any one operating a small scale foundry in the expansion of the industry, by reviewing the various available processes and to select the most appropriate for the circumstance.

***Keywords*:** Feasibility, non-ferrous, Internal rate of return (IRR), Net present value (NPV)

1.0 INTRODUCTION

Metal castings such aluminum, brass and other metals, constitute an essential part of most engineering products. These products are manufactured in the foundry which is considered as the mother of all industries, since the machineries which other industries employed in their factories have their origin in the foundries which are further classified according to types [1]. This has brought about a continuous shift towards capital intensive facilities; automatic plant, robots and sophisticated controls from design to finished casting and proper communication will ensure the most economic and technically sound use of foundry process [2] it follows that for a given capital budgeting project the cash flows to which the Payback Period rule is applied are different from the cash flows to which the NPV rule is applied [3]. This is in contrast to the way these two capital budgeting rules are customarily taught in the field of Finance. Both the internal rate of return (IRR) and the net present value(NPV) methods present well-known limitations. The drawbacks of the IRR include multiple rates, the assumption that cash flows are reinvested at the IRR, and the scale effect, whereas in the case of NPV the limitations relate to the choice of the measurement units as well as to the project's scale. In many cases, applying these two methods produces conflicting rankings for alternative investment projects. Two alternative models were developed to overcome these pitfalls: the modified internal rate of return method (MIRR), which overcomes the IRR's limitations, and the profitability index (PI), which resolves the limitations of NPV [4]. The purpose is to show that there are no inconsistencies between the PI and MIRR, and that it is preferable to use a modified rate, the MPI, which is obtained by subtracting the cost of capital from the standard PI. Further, three main techniques were considered and used to tackle these obstacles facing the consistent project appraisal of capital investments: Discounted Cash Flow (DCF), Cost-Benefit Analysis (CBA) and Multi-Criteria Analysis (MCA) [5]. Also used is a conceptual analysis theories on payback period in which secondary data from past research in African, European and American companies were analyzed to determine the importance of the payback method in capital budgeting [6]. The analysis show that the payback method is preferred in appraising capital budget decisions in various organizations because of its simplicity, liquidity and risk assessment among many other advantages. Conversely findings research indicate that projects can show a negative NPV value and payback period. However, an interesting projection on the price reduction can give a positive NPV if the price system is reduced and subsidized by government and non-subsidized projects respectively [7]. Other areas of interest like cost estimation and economics of tooling were looked into [8]. The role of mathematics in modern financial analysis was used to analyze the basic connotation of financial mathematics, financial mathematics through research development, control theory, differential game theory and capital asset pricing model from stochastic optimal control theory [9]. Furthermore at analyzing the solidification time numerically with regard to the pouring temperature and mold pre heat temperature, the Finite Element Method was used to discretize and analyze the temperature distribution in the cast [10].This is to aid the rate of production.

2.0 Methodology

A four step approach was taken in the pre-investment analysis for the setting up of a non-ferrous foundry shop. This include commercial feasibility, technical feasibility, social economic feasibility as well as financial feasibility.

2.1 Commercial Feasibility

This study is aimed at determining the marketing aspect of the project. Area considered include the market survey, raw material, advertisement etc.

2.1.1 Market Survey

The survey reveals that there is high demand for non-ferrous castings in Warri and its environs. Fence protectors are casted and supplied to welders on their demand, ringing bells are casted and supplied to market women within Warri metropolis. Others include industrial parts which

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are manufactured and supplied to traders in Effurun and Warri, gas cooker and stove hubs for market women. However, the large number of buyers outnumbered the number of foundries existing, leading to inadequate supply and low level of competition.

2.1.2Supply of Raw Materials

Metal scraps can be obtain in Warri and at different prices i.e. Aluminum (1kg) cost N150 (naira), Zinc (1kg) cost N 150 (naira), Copper (1kg) cost N200 (naira) etc. In addition, scraps can be obtain through trade directories obtained through embassies and trade offices. Consultant can be contacted through information services to assist in the buying by recommending one or more suppliers since many scraps are subjected to wide price fluctuation and thus, required informed and skill buying.

2.1.3Advertisement and Publicity

This will be carried out by a reputable radio station such as Jeremi F.M located at Otu-Jeremi Community in Ughelli South Local Government Area. The cost of advertising for a minute is N3, 600.00 (naira) in the evening. Thus, to minimize cost, it is expected that this is done in the morning alone and thrice a month. This require the sum of N 10,800 per month and thus, N129, 000 per annum.

2.2 Technical Feasibility

The technology for metal casting is a process flow type, consisting of pattern making, core making, mould casting etc. The furnace to be employed for melting operation is the crucible type which is most suitable for the melting of non- ferrous metal. The various processes involved are discussed thus:

2.2.1 Production Processes

The first stage in the production process is the preparation of pattern for creating the cavity needed for receiving the molten metal. This is done by working from a scale drawing of the casting to be produced i.e. calculating the dimensions in order to provide sufficient moulding allowance as well as allow for the contraction of metal, based on the metal to be casted. The pattern is tapered towards the joint of the mould to allow it leaves the sand cleanly in forming the mould. The next stage involves mould casting. This is done by ramming sand (clay-bonded sand with natural or synthetic clay) around the pattern in the moulding box which consists of two parts; the top half (cope) and the bottom half (drag). Thus, the mould is made in two parts so that the pattern can be withdrawn.

Next is the melting of the metal. The crucible is placed in the furnace and then the metal to be melted is estimated and charged into the crucible. As crucible is heated, the metal melts. When the metal gets to the correct pouring temperature, the crucible is removed with special tongs and then to a carrier from which the crucible is used as a ladle to pour the metal directly to the mould.

The next stage is the running of the molten metal into the mould, from the Laddle, through the runner system. This consists of a basin formed on top of the mould to receive the molten metal. From here a vertical channel leads to the mould joint level, where horizontal channels lead to the cavity of the casting. The metal flows into the cavity from the runner bars through ingates. During pouring, the temperature of the metal is controlled i.e. bronze is poured at between 950^0c and 1000^0c while aluminum is poured at about 700%. The metal solidifies as it cools. Cooling duration is between 20 minutes and 25hour. The casting is broken out from the sand using a vibrating steel grid which shakes the sand out into a conveyer for collection and re-uses leaving the casting and the box. Finishing is carried out using the band saw (which is more suitable for non-ferrous metal). Machining is carried out by grinding to remove joint flashes and the stubs of ingates and other unwanted projections, using the grinding machine.

2.2.2 Expected Production Capacity

An annual production capacity of 18, 200kg is required with a melting furnace capacity of 100kg. To ensure this is achieved, the workshop will operate in a 5-day schedule and the total working days per annum will be 250 days.

2.2.3 Location of the Foundry

The foundry will be located at Refinery RoadEkpan, in Effurun Delta state due to its commercial nature, presence of electricity, good road network and enormous potential for buyers.

2.2.4 The Foundry Layout

The proposed foundry layout is shown in figure 3.2. The size of the land will be 50 x 50. The layout is such as to facilitate approach from the main high way, taking maximum advantage of natural light and to be fairly close, to provide cost effective internal communication and service facilities. The various section that will make up the workshop include the pattern making section, the mould section, the core production section, the melting section, the fettling section, quality control section, machining section and the finishing section.

2.3 Social Economic Feasibility

The project is expected to impact positively on the social and economic system of the country in general and the locality in particular.

2.3.1 Social Impact

The project is expected to develop the social life of the inhabitants in the area by promoting skills development (particularly metal casting) as well as improve the standard of living of the people by engaging the unemployed and providing marketing opportunity to market women.

2.3.2 Economic Impact

The project is expected to contribute to the Gross National Product (G.N.P)

2.4 Financial Feasibility

The capital required and the project finance are considered. This is necessary for the successful take off of the project.

2.4.1 Capital Requirement

A conservative sum of fix capital of N 15 467 500.00 (naira) (fifteen million four hundred and sixty seven thousand and five hundred naira only) is required for the fixed capital which will embrace the cost of plant and machineries, transport and office equipment, land, building, infrastructural facilities, preliminary and pre-operative expenses. An annual operating cost the sum of N 8 248 600.00 (naira) (eight million two hundred and forty-eight thousand six hundred naira only) is required for the annual operating expenses on full production. This will embrace man power costs, raw material costs, lubricants, electrical power etc. Thus, the total capital requirement is N 23 716 100.00(twenty three million seven hundred and sixteen thousand one hundred naira only).

2.4.2 Project Finance

The total capital required for the successful take – off of the project shall be obtained through;

(A) **Equity**

Contribution from personal savings is estimated at 40% of the total project cost

$$\frac{40 \times 23716100\ .00}{100} = N\,9486440\ .00$$

(B) **Short term loan**

This is estimated at 60% of the total project cost i.e.

$$\frac{60 \times 23716200 \quad .00}{100} = N14229600 \quad .00$$

Table 1: Sources of Capital

S/N	Source	% of Total Investment	Value (N)
1	Equity	40	9,486,440.00
2	Short term loan	60	14,229,600.00
	Total	100	23,716,100.00

Furthermore tables 2-7 give a detailed list of the fixed and working capital required for the successful takeoff of the project. The fixed capital and working capital, the total capital investment is estimated as follows:

Total capital investment = Fixed Capital + Working Capital

= 15,467,500 (Table 6) + 8,248,600 (Table 7)

= N 23,716,100.00

Table 2: Plant and Machineries

S/N	Description	Quantity	Unit Cost	Total Cost
1	Crucible pot with melting capacity of 100kg/hr	4	60,000.00	240,000.00
2	Vice	6	6000.00	36000.00
3	Sledge Hammer	2	2000.00	4000.00
4	Filter (Sieve)	4	600.00	2400.00
5	Trowel	3	400.00	1200.00
6	Filing Machine	2	25000.00	50000.00
7	Plier	3	300.00	900.00
8	Scale	2	1000.00	2000.00
9	Caliper	3	4000.00	12000.00
10	Blower(100lb/m^2)	2	50000.00	100000.00
11	Hand file	4	400.00	1600.00
12	Welding machine	2	50000.00	100000.00
13	Drilling machine	2	10000.00	20000.00
14	Hand saw	3	300.00	900.00
15	Laddle	4	2000.00	8000.00
16	Skin rod	4	300.00	1200.00
17	Hand gloves	4 pairs	500.00	2000.00
18	Runner	4	2000.00	8000.00
19	Milling machine, 1.5foot arbor, fairly used	1	500000.00	500000.00
20	Clamp	4	1000.00	4000.00
21	Standby generator, 100KVA, sun proof (Perkings)	1	4500000.00	4500000.00
22	Lathe machine (1.5 metre), fairly used	1	500000.00	500000.00
23	Diesel tank	1	30000.00	30000.00
24	Chisel	3	200.00	600.00
25	Punch	3	200.00	600.00
26	Wire Brush	2	250.00	500.00
27	Land (50 x50)		-	1000000.00
28	Building		-	7000000.00
29	Preliminary expenses		-	400000.00
		TOTAL		14547500.00

Table 3: Transport and Office Equipment

S/N	Description	Quantity	Unit Cost	Total Cost
1	Light truck, Toyota Dyna, small size , 4 wheel	1	800000.00	800000.00
2	Office equipment including telephone	-	-	75000.00
3	Miscellaneous office and transport equipment	-	-	45000.00
	TOTAL			920000.00

Table4: Manpower Requirement

S/N	Description	Quantity	Unit Cost	Total Cost
1	Plant attendant	1	108000.00	108000.00
2	Electrician	1	144000.00	144000.00
3	Welder	1	120000.00	120000.00
4	Truck driver	1	144000.00	144000.00
5	Security guards	2	96000.00	193000.00
6	Foundry assistants	3	108000.00	324000.00
7	Cleaners	2	96000.00	192000.00
8	Gardener	2	96000.00	192000.00
9	Machine tool operators	2	144000.00	288000.00
	TOTAL			170400.00

Table 5: Estimation of Raw Material Cost Per Annum

S/N	Description	Quantity	Unit Cost	Total Cost
1	Aluminium	3000	150.00	450000.00
2	Zinc	3000	150.00	450000.00
3	Lead	3000	200.00	600000.00
4	Cast Iron	3000	30.00	90000.00
5	Brass	3000	400.00	1200000.00
6	Bronze	3000	500.00	1500000.00
7	Copper	3000	700.00	2100000.00
	TOTAL			6390000.00

Table 6: Estimation of Fixed Capital

S/N	Description	Value (N)	Data source
1	Plant and Machineries, land and building	14547500.00	Table 2
2	Transport and office equipment	920000.00	Table 3
	TOTAL	15467500.00	

Table 7: Estimation of Working Capital

S/N	Description	Value (N)	Data source
1	Cost of manpower	1704000.00	Table 4
2	Raw materials	6390000.00	Table 5
3	Taxes	25000.00	
4	Advertorial	129600.00	
	TOTAL	8248600.00	

3.0 PROJECT APPRAISAL

For final decision to be reached by rejecting or accepting the investment proposal, profitability assessment, return on investment and payback period techniques were employed.

3.1 Profitability Assessment

To determine the annual net profit, profitability analysis was done, and this was achieved by the annual production been scheduled, in order to obtain the annual turnover from which the total cost of production is to be deducted.

Table 8: Scheduled Production per Annum

S/N	Description	Amount per Annum (kg)	Unit Cost per Kg	Total Cost
1	Aluminium alloy	2900	600.00	1740000.00
2	Zinc alloy	"	500.00	1450000.00
3	Lead	"	500.00	1450000.00
4	Cast Iron	"	350.00	1015000.00
5	Brass	"	900.00	2610000.00
6	Bronze	"	1200.00	3480000.00
7	Copper	"	1600.00	4640000.00
	TOTAL	18200		16385000.00

From the table above, Expected Annual Production = 18,200kg

Annual turnover = N 16 385000.00

Depreciation on

a. Plant and machineries at 10% = $\frac{10 \times 6547500}{100} = N\,654750\ .00$

b. Building at 2.5% = $\frac{2.5 \times 6547500}{100} = N\,175000\ .00$

c. Land at 2.5%= $\frac{2.5 \times 1000000}{100} = N\,25000\ .00$

d. Truck at 20%= $\frac{20 \times 800000}{100} = N\,160000\ .00$

e. Office equipment at 20%= $\frac{20 \times 120000}{100} = N\,24000\ .00$

f. Interest on Capital investment at 30%= $\frac{30 \times 14229600}{100} = N\,4268880\ .00$

Total recurrent expenditure = $N\,8284600\ .00$

Therefore, Total cost of production equals:

Total Depreciation + Interest on Capital Investment + Total recurrent Expenditure.

Total depreciation =654750.00 + 175000.00 + 25000.00 + 160000.00 + 24000.00

= N1 038 750 .00

Total Cost of Production = 1038750.00 + 4 268 880.00 +8 248 600 .00

= N 13556230.00

But Annual Net Profit = Annual Turn Over – Total Cost Production

:. Annual Net Profit = 16 385 000.00 – 13 556 230.00

=N 2828770 .00

3.2 Return on Investment

In obtaining the return on investment the income before depreciation, income after depreciation, income after tax, and the book value of the investment was determined. To obtain the expected income before depreciation for successive years, the least square or strait line equation is employed.

$$Y = a + bx \quad (1)$$

Where Y = projected income for a particular year
b = slope of the line
a = intercept on Y
x = deviation for each period or year
Also,

$$\sum Y = Na + b\sum x \quad (2)$$

$$\sum xY = a\sum x + b\sum x^2 \quad (3)$$

Where N = number of periods or years.

Table 9:Sales Forecast

Year	Income (Y)	Deviation (x)	X^2	xY
2012	0	-0.5 (constant)	0.25	0
2013	16 385 000.00	0.5 (constant)	0.25	8 192 500.00
N=2	$\sum Y = 16385000.00$	$\sum x = 0$	$\sum x^2 = 0.5$	$\sum xY = 8192500.00$

Substituting these values into eqns (2) and (3) we have

$a = 8192500.00$

$b = 16385000.00$

Substituting the values of a and b into eqn (i), we have

$$Y = 8192500 + 16385000\ x$$

Table 10: Income before Depreciation

Year	Y(N)
2014	16385000.00
2015	32770000.00
2016	49155000.00
2017	65540000.00
2018	81925000.00
2019	98310000.00

Income after Depreciation = Income before Depreciation – Total Depreciation.

Table 11: Income after Depreciation

Year	Y(N)
2014	15346250.00
2015	31731250.00
2016	48116250.00
2017	64501250.00
2018	80886250.00
2019	97271250.00

The deduction of tax from the income after depreciation

Table 12: Income after Tax

Year	Y(N)
2014	15321250.00
2015	31706250.00
2016	48091250.00
2017	64476250.00
2018	80861250.00
2019	97246250.00

For the first year (2014), income after interest on capital investment equals:
Income after Tax – Interest on Capital Investment (i.e. N4 268 880.00).
For the proceeding years, the values remain the same since the interest was paid during the first year alone.
Book Value of Investment (beginning): = Initial Capital Investment – n x Depreciation
Where n = 0, 1, 2, 3, 4, 5 . . . , depending on the period or year

Table 13: Book Value of Investment (beginning)

Year	Y(N)
2014	23716100.00
2015	22677350.00
2016	21638600.00
2017	20599850.00
2018	19561100.00
2019	18522350.00

Book Value of Investment (ending):
= Book Value of Investment (beginning) – n x Depreciation

Where n = 1, 2, 3, 4, 5. . . depending on the period or year

Table 14: Book Value of Investment (Ending)

Year	Y(N)
2014	22677350.00
2015	20599850.00
2016	18522360.00
2017	16444350.00
2018	14367350.00
2019	13348600.00

From the foregoing:
Average Income = N 47 237 474.00
Average Investment = N 20 080 376.00
But Return on Investment= $\frac{Average\ ,\ Income}{Average\ ,\ Investment} = \frac{47237474\ .00}{20080376\ .00} = 2.4$

3.3 Payback Period

To determine the length of time at which the original cost of investment will be recouped the payback period was estimated with the initial capital investment at hand to be 2 years while the expected payback period is computed thus:
Total Capital Investment = N 23 716 100.00
Cash Inflow at the end of the first year
= N 11 052 370 .00
Net Cash Flow at the end of the first year
= Total Capital Investment – Cash Inflow at the end of the first year
= 23 716100.00 – 11052 370.00
= N 12 663730.00
Cash Inflow at the end of 2nd year = N 31706 250.00
Period of the second year at which the outstanding N 12,663,730 will be recovered to offset the cost of investment
= Outstanding cash to be recovered
Cash inflow at the end of second year

$= \frac{12663730}{31706250} = 0.399\ years$

But 1 year = 12 months
:. 0.399year $= \frac{12 \times 0.399}{1} = 5$ months
:. Expected Payback Period = 1year 5months

4.0 Conclusion

With the initial capital investment at hand, it was expected that the return on investment will be two years. Also, the expected payback period is 1year 5monthsas evident by the enormous buyers in Warri, Effurun and their environs, the availability and affordability of raw materials and the readiness with which operation is expected to be carried out. The analysis indicates that the return on investment is greater than the expected return on investment. It also indicates that the payback period is greater than the expected payback period. Thus, it is concluded that the investment proposal will be profitable and thus, acceptable. Since the analysis indicates the types of raw materials (and their actual prices), types and prices of plants and machineries required, and other requirements for setting up a non-ferrous foundry in Effurun, and since it considered the various available process involved in the setting up, adequate and appropriate training of personnel to be involved in the operation. This can be achieved by visitation to other foundries locally or abroad or by seeking the services of an experienced foundry man as a manager, at least for the initial months of the operation. Such personnel's should be subjected to the appropriate training time between 6-12 months for pattern designer, 3-6 months for pattern maker, 1-6 weeks for metal pourer, 1-2 months for crucible furnace operator. It is thus, recommended for anyone about to start or expand his or her foundry.

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