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Assessing Plausible Options For Sourcing Spare Parts Of Earthmoving Equipment On The Profitability Of Nigeria's Iron Ore Company

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ABSTRACT

As Nigeria takes a bold step to revive her iron ore company, it is pertinent she takes adequate account of her economic and technological limitations, in order to achieve a return on this venture. To this end, the Net Discounted Present Value approach to investment appraisal in mine economics, was employed to evaluate two feasible investment options (spare part importation and conventional sand casting) for sourcing parts of earthmoving equipment on the profitability of Nigeria's iron ore mining company (NIOMCO),over a period of five years. Findings revealed that, both options are not profitable to the federal entity, owing to the high rate of Nigeria's inflation (15.98%) and unfavorable market exchange rate of $1 to 359.201. However, it recommends that the entity be privatized to financially buoyant investors, able to withstand the cost of operating the company. Also, a new price has to be set, using the absorption pricing technique, in order to absorb running costs, through the projected period of five years. In addition, no additional unit of labour, be employed, due to its evident burden on running expenses, over the projected period of five years. Unfortunately, selling iron ore concentrate at the prevailing market price ($62.59) was found not to be profitable to the entity. To this effect, the design of modalities aimed at penetrating and coping in the domestic market is a necessity, to enhance the entity's sustainability, in the short-run. This is subject to further research.

Keywords: Iron ore, Spare parts, Earthmoving, Equipment, Profitability

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1.0 INTRODUCTION

Presently in Nigeria, the Federal entity vested with the responsibility of exploiting, exploring and processing of iron ore is NIOMCO (National Iron Ore Mining Company), located in the North-Central region of Nigeria, precisely Kogi State. With reference to Osemenam (2017), this entity has not been producing iron ore for decades, which is due to bureaucratic factors. Interestingly, the Federal government plans to revive, the company's production, as a strategy to diversifying the economy.

Diversifying the Nigerian economy stands to be one of the strategic priorities, of the present day administration, to stabilize the economy, by giving attention to the solid mineral sector. According to Olamide (2016), Nigeria having the 12th largest iron ore deposits in the world and 2nd largest in Africa, with over two billion metric tons, yet about 70% of Nigeria's mineral deposit are not proven. These figures represent a gross under-utilization of our iron ore resources, and are vastly inadequate to sustain the country's industrial ambitions.

Despite efforts in place to diversify the economy, by giving attention to the productivity of the solid mineral sector, of which NIOMCO's productivity, plays a vital role in enhancing the productivity of Nigeria's solid mineral sector, the issue of inadequacy of spare parts for earthmoving equipment amongst other factors remains an issue of concern, if it must begin production of iron ore again.

Worthy of note is, reliance on importation has been the major source of earthmoving equipment and facilities utilized in mineral production. With reference to Engineering Export Info Bulletin (2015), submits that Nigeria's major import partner for sourcing engineering products, spares parts and other commodities are Italy, China, Germany, United Kingdom and USA. The United Kingdom and USA accounts for over 26% of Nigeria's net import for engineering wares. Although USA possesses the greatest share of Nigeria's import in terms items used in her oil and gas sector. India, also ranks one of Nigeria's import partner for engineering equipment, although import transactions with the India is not steady. NIOMCO is a party to this, as all of its earthmoving equipment, spare parts and other ancillary facilities were provided through importation before the halt in production.

In addition, Baligidad, Krishnamurthy, Narendra & Srinivasan (2014), identified sand casting to be a source through which spare parts of earthmoving equipment can be sourced or fabricated, which identified as one of the oldest metal manufacturing technique. It employs wooden pattern to develop mold cavity by ramming the molding sand around the pattern. The molten metal is poured into the mold cavity and allowed for solidification. After the molten metal gets solidified, the mold is broken and the solid casting is removed. Sand casting is often utilized in industry (automotive, aerospace, etc.) to fabricate or make parts that are comprised of iron, bronze, brass and sometimes aluminum. Sand casting is usually use because it is inexpensive relative to other forms of casting, but still has its limitation. In addition, Ammen (1979), identifies this method as is the most versatile of various methods and techniques of forming metals which include forging, punching, rolling, stamping, extrusion and many others. Sand casting affords the designer the greatest freedom and latitude of any forming methods, with an unlimited choice of metals and alloys that can be readily sand cast, singly or by the millions. While this method is worth exploring, it isn't without limitation, as identified in Sanjiv, Ritesh & Sharad (2016). However, the product quality of conventional sand casting method can be improved (Taguchi, 1993). To this end, this study seeks to evaluate the profitability, of feasible options (importation of spare part and local sand casting) opened to Nigeria's mining company, to source spare parts, for iron ore production, for no venture can be sustained without a 'degree of profit', irrespective of its role in a society.

Despite, the qualities and existence of conventional sand casting method, for spare part fabrication, the issue of inadequacy of spare parts, for mining activities, at NIOMCO remains a crucial problem.

As cited in Daily Trust (2013), inadequacy and low availability of mining equipment, support facilities, spare parts and consumables such as explosives and non- completion of the 4th beneficiation line that is designed to provide super concentrates to Delta Steel Company (DSL), as factors hindering the full operation of NIOMCO's plant. These obviously are serious impediments to the production of iron ore. However, Shakti (2015), on his treatment of the performance of heavy earthmoving machines in open cast mining, identified time loss in mining operation due to idleness and breakdown of earthmoving equipment as occurrence common to earthmoving equipment during opencast mining, thereby stressing on the negative effects of these occurrence on productivity.

Therefore, as the nation strives to revive her solid mineral sector, taking into cognizance NIOMCO's productivity, it is imperative to explore feasible means by which the issue of inadequacy of spare parts can be resolved, taking into cognizance, its implication on the firm's profitability, in a bid to sustain the entity over time.

1.1 STATEMENT OF PROBLEM

Often, some components (parts) such as gears, bearings, crawlers, track chains and sprocket of earthmoving equipment utilized for iron ore mining operations at NIOMCO are vulnerable to frequent or constant damage, owing to frequent friction, tension and compression, resulting from the frequent contact of earthmoving equipment with the earth crust. This makes wearing frequent. In other words, the continuous usage of earthmoving equipment regardless of the condition of worn parts has a negatively huge effect on the company's productivity. Besides failing to extract sufficient amount of ore, breakdown becomes regular resulting to a costly downtime.

In exposing the intensity of NIOMCO's declined economic status, Daily Trust (2013), stated, that, the National Iron Ore Company (NIOMCO) located in Kogi State is capable of generating approximately N72.9 billion annually as revenue and provide employment for over three thousand persons, excluding the thousands of employment opportunities it can create. Unfortunately at the moment, the revenue generating capacity company (NIOMCO), alongside with its multiplier effect on the economy, such as employment creation, igniting innovation in the manufacturing sector with the availability of iron ore concentrate is currently on hold, in response to numerous constraints militating against the company's operation.

1.2 OBJECTIVES OF THE STUDY

The objectives of this study are;

I. To assess the profitability of utilizing the option of spare parts importation on NIOMCO's production.

II. To evaluate the profitability of utilizing the alternative of conventional or local sand casting in sourcing (fabricating) spare parts of earthmoving equipment on NIOMCO's production.

1.3 HYPOTHESES OF THE STUDY

HO_1. The importation of spare parts for earthmoving equipment is not profitable to NIOMCO's production.

HO_2. Adopting local or conventional sand casting in sourcing (fabricating) spare parts of earthmoving equipment is not profitable to NIOMCO's production.

1.4 DELIMITATION OF STUDY

The study projects the profitability accruable to two feasible investments alternatives opened to the Federal entity (NIOMCO) for sourcing some spare parts of earthmoving equipment which are exposed to frequent damage in response to reoccurring tensions and frictions, during mining operations, through a period of five years. This projection is made subject to the current inflation rate of 15.98% and global market exchange rate of $1 to N359.201. In addition, 15% interest rate

on Federal government of Nigeria (FGN), bonds, is adopted as cost of capital, owing to the fact, the Federal government bond is one amongst other sources, from which it generates revenue. Also, the global market price per ton of iron ore at $62.59 (N22, 482), is adopted as NIOMCO's selling price, since it sold at the global market, before the halt in production. Included in the computation is the purchase of new earthmoving, due to the exposure of existing ones to long period of rain fall.

Worthy of note is, the salvage value will not be accounted for as a cash inflow in the fifth year (end period of projection). According to Adebimpe & Akande (2011), the iron ore deposit has an estimated reserve of 200million ton, with an estimated life span of 27 years. Unfortunately, the entity has not functioned for over ten years consecutively. As the federal plans to revive it, the probability of selling its equipment after a five year period is very slim.

1.5 SIGNIFICANCE OF THE STUDY

Generally, iron ore mining has been identified in various theoretical literatures as a potential opened to countries for sustaining welfare over time. However, in Nigeria's case, this assertion needs to be investigated to identify its sustenance over time, owing to current economic realities, such as the level of existing technology, inflation, exchange rate, availability of adequate facilities and materials to foster the growth of iron ore production. Therefore this study, acts as a guide to Nigerian policy makers, prospective investors in iron ore mining and mine economists, regarding the profitability, on average, accruable to two feasible alternatives for sourcing some spare parts of earthmoving equipment (which is, utilization of importation and adoption of conventional sand casting) opened to the entity (National Iron Ore Mining Company), if it must produce and sustain the production of iron ore concentrate.

2.0 DATA COLLECTION AND ECONOMIC SOFTWARE

Data on labour and departmental expenses associated with NIOMCO's production, is sourced from the Office of the Federation (Ministry of Budget and National Planning) on 2017 budget proposal. Also, mining equipment expenses is sourced from CAT (Caterpillar) catalogue and Machinery trader information Bank. Data from CAT is employed because, majority of earthmoving equipment utilized at NIOMCO are procured from CAT (Oladipo, 2017, personal communication; Assistant General Manager, NIOMCO, construction dept.).However, expenses associated with the construction of conventional or local sand foundry for the fabrication of some parts of earthmoving equipment utilized for mining operations is sourced primarily from Mgbuka, a renowned local foundry in Onitsha, Anambra State, Nigeria. The economic software employed for analysis is Microsoft EXCEL, version 14.0

2.1 REVIEW OF EMPIRICAL LITERATURES

Adebimpe & Akande (2011) investigates the engineering economy of iron ore production in Nigeria, with reference to the iron ore mining company at Itakpe in Kogi State. The study identified the discounted cash flow to be a technique utilized in mining economics over the last three decades, in a bid to access the profitability of a mineral deposit. On aggregate, the wages and salaries for staffs amount to the sum of $1.641m, for the first year. The investigation also showed that, processing cost accruable the processing of iron ore is given at $7.821m. The iron ore investment was found to be positive. The project's IRR (Internal Rate of Return) was also found to be positive to the tune of 444.36%, which is greater than the discount rate 9.4%. In sum, the study reveals that, the iron ore production is a profitable venture in Nigeria.

Nwosu & Nwankwoala (2012) investigated the influence of some economic parameters on itakpe's iron ore deposit and its cut-off grade. In evaluating the impact of some economic parameters such as price and production expenditure variations on ore grade and ore

tonnage, the mathematical formula for cut-off grade estimation was adopted. Findings showed that, the cut-off grade lowers with increasing price of ore concentrates. Also it was discovered, with price constant and total cost of production increases, the cut-off grade also increases. Worthy of note is, a price per ton of concentrate was assumed, to show the effect of price on the cut-off grade. Interestingly, the cut-off grade was found to remain the same with varying prices and costs that generated the same price-cost ratio. Hence, it recommends that, the National Iron Ore Mining Company needs to adjust its cut-off grade and mineable ore reserve with changing prices of iron ore concentrates and cost of production, for it to operate at optimum.

Saadat (2016) in evaluating the influence of mineral resources on economic growth of Pakistan, emphasizes on the importance of natural resource endowment as a source capable of sustaining a country's welfare. He evaluates the correlation between, fuel productions, mineral resources and Pakistan's GDP (Gross Domestic Product).Ninety-five developing countries were investigated, utilizing data on the annual growth rate of countries under study from 1970 - 1990. For analysis, the study utilized GLS (Generalized Least Square) estimation technique. The study reveals a negative relationship between export of primary resource commodities and growth, despite its control for a number of variables. In addition, it was discovered that mineral resource production is negatively correlated to economic growth. Human capital indicator expenditure was also found to be insignificant. Expenditure on education was found to be positive but insignificant in the model. Synonymously, the estimate of the proxy (human capital) indicates, inadequate attention is devoted to the health care and educational sectors in Pakistan. Further, the study submits that, inadequate investment in human capital is a contributory factor for the decline of Pakistan's economic growth. Most importantly, it raised the need for the development of the mineral sector, as it has the potential of generating huge revenue for the country (Pakistan).

2.2 THEORETICAL FRAMEWORK

The framework employed as a structure to capture the objectives of this study is Keynes Theory of Investment. The theory indicates three major determinants surrounding every investment decision, they are; expenses, expectations and profits. According to the theory, decisions are made by comparing the marginal efficiency of capital (MEC) also known as the net rate of return or yield with the real rate of interest (r). As the MEC remains higher or greater than the interest rate (r), investment in new equipment, machinery and plant is feasible. Moreover the additional utilization of capital in production results in the diminishing marginal product of capital. A point where, the MEC (marginal efficiency of capital) equates the interest rate, this signifies no further investment will made in any new revenue producing asset.

As cited in Jinghan (2004), the marginal efficiency of capital is the highest rate of return anticipated from, additional unit of a capital stock or asset over its expenses or costs. Nevertheless, the European Commission identifies the term, 'marginal efficiency of capital' to mean a change in Gross Domestic Product at constant market prices of year (T) per unit of gross fixed capital formation at constant prices. Alternatively, the marginal efficiency of capital is that rate of discount which equates the cost of a fixed capital asset with its present discounted value of anticipated income (PV). Simply, the marginal efficiency of capital is the rate of return at which a project or investment is anticipated to breakeven, subject to the level of revenue expected from operating the project and the extent to which profits (gains) are anticipated to fall, owing to feasible reduction in prices of output, increase in real wages, increase in fueling and raw material expenses.

In sum, an investment is deemed profitable when its NPV (Net- Present Value) equal zero or is positive. Also, Ahuja (2008) on investment

decisions submits that, projects yields returns or profit in the form of a stream of dated incomes and expenses to be incurred at present. Profits from a project or investment are obtained as cash flows of income or output in future years. In addition, he presented the net- present value criterion to be a vital decision rule for accepting or rejecting investment (s). A support for this rule is that the worth of a commodity next year is less than the worth of the unit of commodity next year.

Therefore the MEC (Marginal Efficiency of Capital) is given as;

$$PV = \frac{R_1}{(1+r)^1} + \frac{R_2}{(1+r)^2} + \ldots\ldots \frac{R_n}{(1+r)^n} - \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} \ldots\ldots \frac{C_n}{1+r^n} \ldots\ldots\ldots\ldots (1)$$

Where, PV = Present value of anticipated return, R_1, R_2 …..R_n = Anticipated cash flows from the investment on a plant, machine or equipment for the 1st, 2nd and subsequent periods a new plant, machine or equipment is to be utilized. C_1, C_2, and C_n = Non- recoverable expenses made on the investment of fixed capital (asset) in the 1st, 2nd and subsequent periods (years). (r) = interest rate which equates the cost of a capital (fixed) with the present value.

Hence, the model for this study takes into recognition costs (fixed and variable costs) or expenses accruable to NIOMCO's operation on the average, emanating from the investment in two alternatives for sourcing some spare parts of earthmoving equipment.

3.0 METHODOLOGY

In order to achieve the objectives of this study and validate, hypotheses stated above, the Net Discounted Present Value approach to investment appraisal is employed.

3.1 Table. 1: OPEN PIT PARAMETERS OF NIGERIA'S IRON ORE DEPOSIT

OPEN-PIT PARAMETER	VALUES
Daily waste production	122885.76
Daily ore production	30721.44
Life span	Estimated (27 years)
Annual ROM production	7.373 million tons
Waste-to-ore ratio	4:1
Iron ore reserve	200million tons

Source: Akande & Adebimpe (2011)

3.2 MODEL SPECIFICATION

Model 1: To assess the profitability of utilizing the option of spare parts importation on NIOMCO's production.

$$NDPV_{IS} = \frac{\beta_1}{(1+r)^1} + \frac{\beta_2}{(1+r)^2} + \frac{\beta_3}{(1+r)^3} + \frac{\beta_4}{(1+r)^4} + \frac{\beta_5}{(1+r)^5} - \frac{\varepsilon_1}{(1+r)^1} + \frac{\varepsilon_2}{(1+r)^2} + \frac{\varepsilon_3}{(1+r)^3} + \frac{\varepsilon_4}{(1+r)^4} + \frac{\varepsilon_5}{(1+r)^5} \ldots\ldots (2)$$

Where; NDPV = Net discounted present value or worth of NIOMCO's investment on importation of spare parts for earthmoving equipment.

ε_1,through ε_5 = Total expenses, on average accruable to NIOMCO's production subject to investing on importation of spare parts of earthmoving equipment over a period of five years. These include haulage, drilling, crushing, tailing, blasting, loading, grinding, administrative costs and salaries and wages.

β_1 through β_5 = returns accruable to NIOMCO on average from investing on importation of spare parts through a period of five years.

With the aid of the summation operator, equation (2) can be rewritten as;

$$NDPV_{IS} = \sum_{t=1}^{n} \frac{\beta_t}{(1+r)^n} - \sum_{t=0}^{n} \frac{\varepsilon_t}{(1+r)^n} = 0 \ldots\ldots\ldots (2a),$$

where t moves from year one through year five. Equation (2a) captures the first objective.

Model 2: To evaluate the profitability of utilizing the alternative of conventional or local sand casting in sourcing (fabricating) spare parts of earthmoving equipment on NIOMCO's production.

$$NDPV_{CS} = \frac{\alpha_1}{(1+r)^1} + \frac{\alpha_2}{(1+r)^2} + \frac{\alpha_3}{(1+r)^3} + \frac{\alpha_4}{(1+r)^4} + \frac{\alpha_5}{(1+r)^5} - \frac{\pi_1}{(1+r)^1} + \frac{\pi_2}{(1+r)^2} + \frac{\pi_3}{1+r^3} + \frac{\pi_4}{(1+r)^4} + \frac{\pi_5}{(1+r)^5} \ldots\ldots\ldots\ldots (3)$$

Where; $NDPV_{CS}$ = Net discounted present value or net worth of NIOMCO's investment on conventional sand casting for fabricating spare parts of earthmoving equipment.

α_1 **through** α_5 = Total revenue, on average accruable to NIOMCO from utilizing the investment option of conventional sand casting in sourcing (fabricating) parts of earthmoving equipment through a period of five years.

π_1,**through** π_5 = Total costs, on average to be incurred by NIOMCO from investing on conventional sand casting in sourcing (fabricating) spare parts of earthmoving equipment. These include fabricating costs, administrative, labour, crushing, grinding, tailing, blasting, loading, drilling, haulage and administrative costs.

Applying the summation operator to equation (3) yields;

$$NDPV_{CS} = \sum_{t=1}^{n} \frac{\alpha_t}{(1+r)^n} - \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^n} = 0 \ldots\ldots\ldots \quad (3a)$$

. Therefore, equation (3a) captures objective (2) of this study.

3.3 PRESENTATION AND DISCUSSION OF RESULTS

3.4 PRESENTATION OF RESULTS

Table 2: Net-Discounted Present Value of spare part importation for NIOMCO's production in US' ($) in five years.

Years	Start of 2017	2017	2018	2019	2020	2021
Initial capital	(15,929,274,973.6034)					
Net cash-inflows	-	537,717,644.4	623,644,924	723,303,382.9	838,887,263.5	972,941,448.2
Net cash-outflows	-	(226,765,227,935.7)	(262,829,999,096.3)	(304,657,920,676.7)	(353,169,944,174.6)	(409,434,189,045.6)
Discount factor @15%	1	0.8696	0.7561	0.6575	0.5718	0.4972
Net cash flow	-	-226,227,510,291.3	-262,206,354,172.3	-303,934,617,293.8	-352,331,056,911.1	-408,461,247,597.4
Present value	(15,929,274,973.6034)	-196,727,442,900	-198,254,224,300	-199,837,010,800	-201,462,898,300	-203,086,932,300
Net present value	-$1,015,297,783,573.6					
Naira equivalent (NPV)	-N364,695,979,157,420.7					

Source: Author's Computation

Table 3: Net-Discounted Present Value of conventional sand casting for NIOMCO's production in US' ($) in five years

Year	Start of 2017	2017	2018	2019	2020	2021
Initial capital	(13,772,333,062.6277)	-	-	-	-	-
Net cash inflows	-	537,717,644.4	623,644,924	723,303,382.9	838,887,263.5	972,941,448.2

Net cash outflows	**-**	**(226,765,684,509.83)**	**(262,830,528,497.41)**	**(304,658,534,542.72)**	**(353,170,656,002.93)**	**(409,435,014,490.69)**
Discount factor@15%	**1**	**0.8696**	**0.7561**	**0.6575**	**0.5718**	**0.4972**
Net cash flow	**-**	**-226,227,966,865.4**	**-262,206,883,573.4**	**-303,935,231,159.8**	**-352,331,768,739.4**	**-408,462,073,042.5**
Present value	**(13,772,333,062.627)**	**-196,727,839,900**	**-198,254,624,600**	**-199,837,414,400**	**-201,463,305,300**	**-203,087,342,700**
Net present value	**-$1,013,142,859,962.63**					
Naira equivalent (NPV)	**-N363,921,928,441,436.7**					

Source: Author's computation

3.5 DISCUSSION OF RESULTS

Tables 1 and 2, shows the Net-Discounted Present Value of spare part importation and investing on conventional sand casting, with respect to NIOMCO's production, respectively. Interestingly, the initial capital outlay (all capital expenditures associated with NIOMCO's production) emanating from conventional sand casting stood at $13,772,333,062.6277billion, which was lower than the alternative investment (spare part importation). However, the present values of both investments yielded negative values, through the projection period of five years (2017 through 2021) as shown in Tables 1 and 2, respectively. This implies, the anticipated revenues (net cash inflows) generated before tax from the sales of iron ore, over a projected period of five years, fell below anticipated expenditures (net cash-outflows), to be incurred on both investments, subject to NIOMCO's operation (mining exploration costs, including labour employed at deposit). The summation of all present values accruable to both investments, i.e. spare part importation and conventional sand casting, yielded negative NPV's (-$1,015,297,783,573.6 and -$1,013,142,859,962.63) with Naira equivalents of (**-**N364,695,979,157,420.7 trillion and -N363,921,928,441,436.7trillion) respectively. By implication, investing in either investments will yield a net loss to the entity (NIOMCO), over a period of five years.

Hence, HO_1: The importation of spare parts for earthmoving equipment is not profitable to NIOMCO's production and HO_2: Adopting local or conventional sand casting in sourcing (fabricating) spare parts of earthmoving equipment is not profitable to NIOMCO's production are valid and accepted.

Worthy of note is, estimated cash outflows (expenditures) of spare part importation and investment on conventional sand casting subject to NIOMCO's activities are annexed in the appendix to this study, labelled Tables 3 and 4, accompanied with projected cash flow obtainable to both investments, labelled Tables 5 and 6.

3.6 RECOMMENDATION AND CONCLUSION

In consonance with the findings of this study, investing on the importation of spare part or conventional sand casting should not be made by the Federal government on the entity, due to the capital intensive nature of mining activities rather the firm should be privatized to foreign investors, with adequate financial capacity to cope with, the burden of costs accompanied by mining activities in the Nigerian society. Worthy

of note is, selling iron ore concentrate at the global market price, $62.59 (N22, 482.39) will not be profitable to the entity, over a period of five years, with 'all things being equal'. Therefore a new price must be set, using the absorption pricing technique, to absorb costs emanating from each departments in the entity, as modalities needs to be worked out to penetrate the local market. However, the entity should not increase labour, due to its burden on running cost, over the projected period of five years, if it must be sustained.

In conclusion, Nigeria's mining sector is one seeking attention, as majority of her mineral deposits remains unexplored. This calls for the need to explore, technicalities and coping strategies in order to harness her mineral deposits, as she struggles to sustain welfare.

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APPENDICIES

Table 4: Estimated cash outflow of NIOMCO's activities with respect to spare part importation for five years in US' ($)

Items	Start of 2017	2017	2018	2019	2020	2021
Initial capital	15,929,274,973.6034	-	-	-	-	-
Personnel cost	-	4,197,407.84	4,197,407.84	4,197,407.84	4,197,407.84	4,197,407.84
Miscellaneous. Expenses @ 15.98%	-	1,614.416432	1,872.400178	2,171.609726	2,518.63296	2,921.110507
Utilities	-	16,862.3862	16,862.3862	16,862.3862	16,862.3862	16,862.3862
Maintenance@15.98%	-	10,525.99519	12,208.04922	14,158.89549	16,421.48699	19,045.64061
Supplies@ 15.98%	-	2,195.60636	2,546.464256	2,953.389244	3,425.340845	3,972.710312
Repairs@ 15.98%	-	191,469.7514	222,066.6177	257,552.8632	298,709.8107	346,443.6384
Explosives@ 15.98	-	8,567.48904	9,947.011989	11,536.5445	13,380.08431	15,518.22178
Diesel@ 15.98%	-	6780.549052	7,864.080791	9,120.760901	10,578.25849	12,268.6642
Production cost@15.98%	-	225,686,684,700	261,751,416,900	303,579,293,300	352,091,264,400	408,355,448,500
Production electrical cost	-	1,074,074,074	1,074,074,074	1,074,074,074	1,074,074,074	1,074,074,074
Security services		9,743.8482	9,743.8482	9,743.8482	9,743.8482	9,743.8482
Cleaning & fumigation@ 15.98%	-	6,457.665764	7,487.600753	8,686.438953	10,074.5319	11,684.42952
Local training	-	1,391.978307	1,391.978307	1,391.978307	1,391.978307	1,391.978307
Transport& trips@15.98%	-	16,144.1644	18,724.00187	21,716.09737	25,186.32973	29,211.10522
TOTAL	15,929,274,973.6034	226,765,227,935.7	262,829,999,096.3	304,657,920,676.7	353,169,944,174.6	409,434,189,045.6

Source: Excel computation

Table 5: Estimated Cash outflow of NIOMCO's activities with respect to conventional sand casting for five years in US' ($)

Source: Excel Computation

Items	Start of 2017	2017	2018	2019	2020	2021
Initial capital	15,929,274,973.6034	-	-	-	-	-
Personnel cost	-	4,197,407.84	4,197,407.84	4,197,407.84	4,197,407.84	4,197,407.84
Miscellaneous. Expenses @ 15.98%	-	1,614.416432	1,872.400178	2,171.609726	2,518.63296	2,921.110507
Utilities	-	16,862.3862	16,862.3862	16,862.3862	16,862.3862	16,862.3862
Maintenance@15.98%	-	10,525.99519	12,208.04922	14,158.89549	16,421.48699	19,045.64061
Supplies@ 15.98%	-	2,195.60636	2,546.464256	2,953.389244	3,425.340845	3,972.710312
Repairs@ 15.98%	-	191,469.7514	222,066.6177	257,552.8632	298,709.8107	346,443.6384
Explosives@ 15.98	-	8,567.48904	9,947 Items.011989	11,536.5445	13,380.08431	15,518.22178
Diesel@ 15.98%	-	6780.549052	7,864.080791	9,120.760901	10,578.25849	12,268.6642
Production cost@15.98%	-	225,686,684,700	261,751,416,900	303,579,293,300	352,091,264,400	408,355,448,500
Production electrical cost	-	1,074,074,074	1,074,074,074	1,074,074,074	1,074,074,074	1,074,074,074
Security services		9,743.8482	9,743.8482	9,743.8482	9,743.8482	9,743.8482
Cleaning & fumigation@ 15.98%	-	6,457.665764	7,487.600753	8,686.438953	10,074.5319	11,684.42952
Local training	-	1,391.978307	1,391.978307	1,391.978307	1,391.978307	1,391.978307
Transport& trips@15.98%	-	16,144.1644	18,724.00187	21,716.09737	25,186.32973	29,211.10522
TOTAL	15,929,274,973.6034	226,765,227,935.7	262,829,999,096.3	304,657,920,676.7	353,169,944,174.6	409,434,189,045.6

Table 6: Estimated Cash flow of NIOMCO's activities with respect to spare part importation in US' ($)

Year (s)	201e	2018	2019	2020	2021

Revenues@15.98%	**537,717,644.4**	**623,644,924**	**723,303,382.9**	**838,887,263.5**	**972,941,448.2**
Cash outflows	**(226,765,227,935.7)**	**(262,829,999,096.3)**	**(304,657,920,676.7)**	**(353,169,944,174.6)**	**(409,434,189,045.6)**
Net cash flow	**- $226,227,510,291.3**	**- $262,206,354,172.3**	**- $303,934,617,293.8**	**- $352,331,056,911.1**	**- $408,461,247,597.4**

Source: Author's computation

Table 7: Estimated Cash flow of NIOMCO's activities with respect to conventional sand casting in US' ($)

Year (s)	**2017**	**2018**	**2019**	**2020**	**2021**
Revenues @15.98%	**537,717,644.4**	**623,644,924**	**723,303,382.9**	**838,887,263.5**	**972,941,448.2**
Cash outflows	**(226,765,684,509.83)**	**(262,830,528,497.41)**	**(304,658,534,542.72)**	**(353,170,656,002.93)**	**(409,435,014,490.69)**
Net cash flow	**-226,227,966,865.4**	**-262,206,883,573.4**	**-303,935,231,159.8**	**-352,331,768,739.4**	**-408,462,073,042.5**

Source: Author's computation

OTHER INFORMATION

Table 8: Mine equipment utilized at NIOMCO

s/n	**Equipment Identification/ (Quantities)**	**Equipment capacity**	**Per unit price ($)**	**Total price ($)**	**Total price Naira Equivalent(N)**
1.	**Bulldozers (2)**	**400 HP**	**250,000**	**500,000**	**179,600,500**
2.	**Spare parts (15%)**	**-**	**-**	**75,000**	**26,940,075**
3.	**Bulldozers 300 HP (6)**	**300HP**	**300,000**	**1,800,000**	**646,561,800**
4.	**Spare parts (15%)**	**-**	**-**	**270,000**	**96,984,270**
5.	**Water sprinkler (Magnum) (2)**	**30m^3**	**29,180,300**	**58,360,600**	**20,963,185,880.6**
7.	**Spare parts (15%)**	**-**	**-**	**8,754,090**	**3,144,477,882**
8.	**Motor Grader 14G (1)**		**186,753,920**	**186,753,920**	**67,082,194,807.92**
9.	**Spare parts (15%)**	**-**	**-**	**268,013,088**	**10,062,329,222.688**
10.	**Explosives truck (1)**	**-**	**7,800**	**7,800**	**2,801,767.8**
11.	**Spare parts (15%)**	**-**	**-**	**1,170**	**420,265.17**
12.	**Explosives (2bags)**	**25kg**	**3,697.4**	**7,394.8**	**2,656,219.555**
13.	**ANFO loaders (1)**		**774.51**	**774.51**	**278,204.7665**
14.	**Spare parts (15%)**	**-**	**-**	**116.1765**	**41,730.71498**
15.	**Diesel tanker**	**12m^3**	**12,000**	**12,000**	**4,310,412**
16.	**Spare parts (15%)**	**-**	**-**	**1800**	**646,5618**
17.	**Soil compactor**	**-**	**39,685,208**	**39,685,208**	**14,254,966,398.808**
18.	**Diesel**	**12000litres**	**-**	**5,846.308891**	**2,100,000**

Table 9: Main mine equipment/Spare part specification

s/n	Equipment Identification/ (Quantities)	Equipment capacity	Per unit price ($)	Total cost($)	Total cost Naira equivalent (N)
1.	Hydraulic shovel (2)	-	700,327,200	1,400,654,400	503,116,461,134.4
2.	Spare parts (15%)	-	-	210,098,160	75,467,469,170.16
3.	Front end loaders-(3)	$9m^3$	586,761,389.6	1,760,284,169	632,295,833,788.969
4.	Spare parts (15%)	-	-	264,042,625.4	94,844,375,086.3054
5.	Rotary Drill rigs- (2)	120m (Lx4)	291,803	583,606	209,631,858.806
6.	Spare parts (15%)	-	-	131,311.35	47,167,168.23

Source: NIOMCO, Machinery Trader and Caterpillar (CAT) catalogue

Table 10: Field maintenance equipment

s/n	Equipment Identification/(Quantities)	Equipment capacity	Per unit price($)	Total cost ($)	Total cost Naira equivalent (N)
1.	Lubricating truck (2)	-	96,500	193,000	69,325,793
2.	Spare parts (15%)		-	28,950	10,398,868.95
3.	Washing station (1)		30,000	30,000	10,776,030
4.	Lubricating skid (1)	-	20,000	20,000	7,184,020
5.	Spare parts (15%)		-	3,000	1,077,603
6.	Mobile arc welding set (1)	-	219	219	78,665.019
7.	Spare part (15%)	-	-	32.85	11,799.75285
8.	Mobile flood light towers (12)	-	13,800	165,600	59,483,685.6
9.	Spare parts (15%)		-	24,840	8,922,552.84
10.	Breakdown vehicles (2)	-	1,670.373969	3,340.747938	1,200,000
11.	Spare parts (15%)			501.1121907	180,000
12.	Bucket truck (1)	-	120,900	120,900	43,427,400.9
13.	Spare parts (15%)	-	-	18,135	6,514,110.135

Source: NIOMCO, Machinery Trader and Caterpillar (CAT) catalogue

Table 11: Ancillary equipment

s/n	Equipment Identification	Per unit cost ($)	Unit cost Naira (N) equivalent
1.	Laboratory equipment	4,175.934922	1,500,000

2.	**Main Mine Workshop Equipment** ▪ **Overhead travelling cranes** ▪ **Equipment & tools** ▪ **Spare parts (5%)**	 **200,000** **25,055.60953** **1,252.780477**	 **71,840,200** **9,000,000** **450,000**
3.	**Ammonium nitrate storage**	**50,000**	**17,960,050**
4.	**Spare parts (5%)**	**2500**	**898,002.5**
5.	**Diesel storage**	**12,000**	**4,310,412**
6.	**Expansion of storage yard**	**3,340.747938**	**1,200,000**

Source: NIOMCO, Machinery Trader and Caterpillar (CAT) catalogue

Table 12: Large capacity equipment

s/n	Equipment Identification/(Quantities)	Equipment Capacity	Per unit price($)	Total price ($)	Total price Naira (N) equivalent
1.	**Dump truck (20)**	**100/120tons**	**468,577,841**	**9,371,556,820**	**3,366,272,581,300.82**
2.	**Spare parts (15%)**	**-**	**-**	**1,405,733,523**	
3.	**Gyratory crusher(1)**	**300m**	**50,000**	**50,000**	**17,960,050**
4.	**Primary crushing plant (1)**	**-**	**30,000**	**30,000**	**10,776,030**
5.	**Excavators (3)**	**-**	**316,943,338.8**	**950,830,016.4**	**341,539,092,720.8964**

Source: NIOMCO, Machinery Trader and Caterpillar (CAT) catalogue

Table 13: Administrative expenses (NIOMCO)

s/n	Items	Cost ($)	Naira(N) cost equivalent
1.	**Procurement** ▪ **purchase of furniture &fittings** ▪ **purchase of security and operational cars**	 **5,567.91323** **126,517.8985**	 **2,000,000** **50,000,000**
2.	**Personnel**	**4,197,407.084**	**1,507,712,822**
5.	**Net Salaries**	**237,509.2989**	**85,313,577.67**
6.	**Miscellaneous expenses**	**1,391.978307**	**500,000**
7.	**Utilities** ▪ **Electricity charges** ▪ **Internet facilities charges**	 **14,635.22094871674** **2,227.165292**	 **5,256,986** **800,000**
10.	**Maintenance** ▪ **Residential/ building maintenance (camp 1&2)** ▪ **Office maintenance & IT equipment** ▪ **Generators/plants**	 **2,783.956615** **1,391.978307** **1,113.582646**	 **1,000,000** **500,000** **400,000**

	▪ **Transport/motor vehicle equipment** ▪ **Office furniture maintenance**	**3,062.352276** **723.8287199**	**1,100,000** **260,000**
11.	**Supplies** ▪ **Printing of non-classified documents** ▪ **Office stationaries /computer consumables**	 **501.1121907** **1,391.978307**	 **180,000** **500,000**
12.	**Repairs** ▪ **Office building repairs/rehabilitation** ▪ **Road repairs/rehabilitation**	 **33,407.47938** **131,681.11479**	 **12,000,000** **47,300,000**
12.	**Other services** ▪ **Transport & trips** ▪ **Cleaning & fumigation services** ▪ **Local training** ▪ **Security services**	 **13,919.78307** **5,567.91323** **1,391.978307** **25,303.5797**	 **2,000,000** **500,000** **10,000,000**

Source: NIOMCO Finance Department

Table 14: Local foundry expenses (NIOMCO's capacity)

Melting capacity:

- **100 – 200 tons ferrous casting per month.**
- **10 – 20 tons non – ferrous casting per month.**

s/n	Local foundry equipment/capacity	Cost ($)	Naira (N) cost equivalent
1.	**Rotary/cupola (2 tons melting capacity)**	**5,567.91323**	**2,000,000**
2.	**Crucible furnace (2x 250kg capacity)**	**6,959.891537**	**2,500,000**
3.	**Heat treatment facilities**	**4,175.934922**	**1,500,000**
4.	**Air compressor (300/400litres) 7bars**	**1,948.76963**	**700,000**
5.	**Core making facilities**	**1,391.978307**	**500,000**
6.	**Shaking out machine**	**1,391.978307**	**500,000**
7.	**Fettling machine**	**2,505.560953**	**900,000**
8.	**Hand molding tools**	**1,391.978307**	**500,000**
9.	**EOT cranes**	**835.1869844**	**300,000**
10.	**Pattern shop equipment**	**1,391.978307**	**500,000**
11.	**Molding boxes**	**139.1978307**	**50,000**

12.	**Machine tool for finishing**	**8,351.869844**	**3,000,000**
13.	**Power supply ((2) 450 KVA generators)**	**200,000**	**71,840,200**
14.	**Crucible pot (200kg)**	**2,644.758784**	**950,000**
15.	**Labour**	**835.1869844**	**300,000**
16.	**Foundry layout &civil work**	**19,487.6963**	**7,000,000**
17.	**Diesel (38,092litres/year)**	**18,558.13319**	**6,666,100**

Source: Mgbuka (Nick Foundry), Onitsha, Anambra State.