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Is it Feasible to Produce Iron Ore in Nigeria via Local Foundry for Spare Parts? A Cost-Benefit and Net Present Value Analysis

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Abstract

In the wake of Nigeria's desire to diversify and the move to revive iron ore deposit, various options are considered on how best to produce iron ore at the least cost possible. This study evaluates plausible source of spare parts for earth moving equipment and establishment of local foundry to forge spare parts utilized for iron ore production. The benefit-cost and net discounted present value analysis were employed and findings shows that both sources are not profitable to the entity's operation as it increases running expenses, amid a 16 percent inflation rate, an unfavorable global market exchange rate of $1 to N359.201 and a non-profitable global market price of $62.59 (N22, 482) within projection of 5 years which is very critical to the revival of the nation's iron ore deposit. The policy suggestion from the findings is that new price higher than the current global market price be set in order to absorb current cost accruable to the entity at 16 percent inflationary rate and a global market exchange rate.

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INTRODUCTION

One of the desire of Nigeria as a nation is to ensure a drastic reduction in iron importation through local production at affordable price. Towards this end, the Ajaokuta Steel Company Limited (ASCL) was established which has failed to performed towards expectation. Suggestions have however been put forward that one of the assured means of ensuring efficient performance of ASCL is to source spare parts for earth moving equipment and establish local foundry to forge spare parts utilized for iron ore production. Despite studies on the importance of steel industry on the economic growth of Nigeria, there is lack of evidence on the cost and benefit analysis such venture in the production of iron ore.

Reliance on importation has been the only source of earthmoving equipment and its spare parts for the production of mineral products. With reference to Engineering Export Info Bulletin (2015), Nigeria's major import partner for sourcing engineering products, spare 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 her oil and gas sector. India is also one of Nigeria's import partners for engineering equipment, although import

transactions with the India are not steady. Despite, Nigeria's reliance on USA, China, Italy, Germany, United Kingdom and India, for spare parts of earthmoving equipment and earthmoving equipment for mining and construction activities, owing to their technical prowess, damage still remains inevitable. This obviously constitutes increase in terms of cost accruable to the utilization of earthmoving equipment for mining and construction activities. As cited in Shakti (2015), there is 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 effect of these occurrence on productivity. Also, Daily Trust (2013), identifies 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. This obviously is a serious obstacle to the production of iron ore. In addition, the issue of finance has been a major challenge to iron ore production. NIOMCO was concession to Global Steel Holding Company Limited (GSHL) in 2004 on the basis that its performance is below expectation, in terms of revenue generation and production, after the earlier concession with SOLGAS of the Unites States failed. This deal was contracted to span for ten years. This overwhelming crave for steel and iron ore is an opportunity for local and international investors to get involved in the expansion of Africa's largest economy. This optimism is informed by the fact that current local producers meets up to twenty five percent of demand for steel, which is the proposed growth strategy to unlock the solid mineral sector towards full potential. The measure taken by the Federal government to sustain welfare, by giving attention to the development of the solid mineral sector, amid recession, inspired this study.

Often, some components 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. The vulnerability of these parts generates a huge cost burden on NIOMCO's mining operation. This is one amongst other factors militating against NIOMCO's functionality. 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. Today at NIOMCO the halt in mining activity remains a contributory factor to its currently declined state of economic existence. The National Bureau of Statistics (2016) notes that the contribution of mining and quarrying activity, excluding crude oil and natural gas to Nigeria's GDP from 1980-2012, peaked at 1.12%. Of all, mineral ore was the lowest contributor to output, maintaining a declining growth. In 2010, it stood at N3, 285.21million, approximately 4.50% of the total formal sector output, growing by N518.63million which is approximately, 15.79% in 2011, which was marginally lesser to the tune of 4.43% of the total formal sector. The year 2012 saw a slight slow in growth, to 7.47 percent, with the increase of N284.14million, generating a total of N4, 088.03 million of output from the mineral ore activity, which resulted to 3.96% of the total mining and quarrying in the formal sector. In addition, the mining and quarrying sector recorded a negative growth of 7.91 percent, in the first quarter of 2015 which indicated a -1.52 percentage points lower than -6.39 percent growth rates recorded in the first quarter of 2014 and 9.27 percentage points lower than growth rates estimates for quarter four of 2014. In real terms, the contribution of

mining and quarrying to Real GDP in the first quarter of 2015 stands at 10.61 percent, showing a decline in the sector by -1.37 percent with respect to its addition to GDP, relative to 11.98 percent recorded in the corresponding quarter of 2014, but higher than 9.12 percent, estimated in the fourth quarter of 2014. In the first quarter of 2016, the Mining and Quarrying sector contributed 10.34 percent to Real GDP, which is marginally lower relative to the corresponding quarter of 2015, yet higher from the previous quarter by 2.13 percent. In sum the contribution of Mining and Quarrying to Real GDP, diminished progressively over the periods of evaluation. This beyond all reasonable doubt X-rays the deplorable state of the Mining sector, as witnessed in today's Nigeria.

This present study is confined to comparing plausible options for sourcing spare parts of earthmoving equipment, with the interest of accessing its cost implication on iron ore production. Precisely, it concentrates on exploring two feasible options opened for sourcing spares parts of earthmoving equipment for iron ore production, taking into cognizance the vulnerability of some parts of earthmoving equipment during mining.The projection would be carried over a period of five years, with a 15.98% inflation rate (CBN, Statistical Bulletin, 2010).In addition, 15% risk free rate on Federal government bonds would be used as the minimum attractive rate of return (discount rate) of investment (CBN, Statistical Bulletin, 2010). In the treatment of contingent liabilities (contingent cost) the IAS (International Accounting Standard) will be employed. According to NIOMCO, the economic useful life of earth moving equipment with respect to machine hours utilized, on average is 9years. On the other hand, its laboratory equipment has an economic useful life of 10 years. .In this study, $1 to N359.201 exchange rate is used for the valuation of all costs items. The study also incorporates the procurement of new earth moving equipment in its analysis, on the basis, majority of the earth moving equipment utilized at NIOMCO's have been exposed to long period of rain fall throughout, the period of non-operation.

METHOD

Investment decisions are made by comparing the marginal efficiency of capital (MEC) with the real rate of interest (r). So long as the MEC is higher or greater than the rate of interest (r), investment in new plant, equipment and machinery is permitted. Moreover the additional utilization of capital in production results in the diminishing marginal product of capital. Once the MEC equates the rate of interest, this point signifies no further investment will be made in any new revenue producing asset (s). In accepting investment (s), attention is given to the MEC, otherwise referred to as the expected return or profits which could be gained by an addition in the amount invested in a project. In this regard, project (s) whose MEC are higher than the interest rate (r) are accepted while project (s) whose MEC are lower than its rate of interest (r) are rejected. It is worthy to note that the marginal product of capital should not be substituted to imply the marginal efficiency of capital for they are not synonymous. As identified earlier, the level of investment rests not only on its expected returns but also on its costs incurred to finance the business or investment. A project is identified profitable at a point where the MEC equal the capital cost. In other words a project is deemed profitable when its NPV (Net- Present Value) equal zero or is positive. In sum MEC of capital is the rate of discount which equates the cost of a fixed capital asset with its present discounted value of expected income. The MEC is calculated as:

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

PV is the resent value of expected return or gain from a project or investment, R_1, R_2, and R_n is expected cash flows from the investment on a machine or asset for the first year, second year and subsequent period the machine or asset is to be utilized, (r) is the Market rate of interest rate which equates the cost of a fixed capital or asset with the present value.C_1, C_2, and C_n = Non- recoverable expenditures or costs made on the investment of an asset in the first year, second year and subsequent periods the machine or asset is to be utilized. This study takes into cognizance costs (fixed and variable costs) accruable on the average, emanating from the investment in two alternatives of sourcing parts for its mining operation. These alternatives are investment on importation of spare parts and investment on conventional sand casting.

Following Akande & Adebimpe (2011), to obtain the profitability index accruable to NIOMCO's operation the net present value model is adopted and the model is specified as;

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

$NDPV_{IS}$= Net discounted present value or worth of investing in importation of spare parts for iron ore production, β_1 - β_5 = average total returns obtainable from utilizing the investment option of importation of spare parts for a period of five years, ε_1-ε_5 = average the total costs accruable to iron ore production from investing on importation of spare parts of earthmoving equipment utilized in iron ore production over a period of five years (which include haulage, drilling, crushing, tailing, blasting, loading, grinding, administrative costs and salaries and wages).. Applying the summation notation, equation can be rewritten as;

$$NDPV_{IS}=\sum_{t=1}^{n} \frac{\beta_t}{(1+r)^n} -\sum_{t=0}^{n} \frac{\varepsilon_t}{(1+r)^n} = 0 \ldots\ldots\ldots\ldots\ldots (3)$$

To evaluate the profitability of utilizing the option of conventional sand casting in sourcing (fabricating) spare parts for NIOMCO's mining operation, the model is specified as;

$$NDPV_{CS} = \sum_{t=1}^{n} \frac{\alpha_t}{(1+r)^n} - \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^n} = 0 \ldots\ldots\ldots\ldots\ldots (4)$$

π_1,throughπ_5= on average the total costs incurred from investing on conventional sand casting in sourcing (fabricating) spare parts of earthmoving equipment for NIOMCO's mining operation. Similarly, to assess on average the amount of benefit to cost of adopting local or conventional sand casting in sourcing (fabricating) spare parts for iron ore operation, the equation is specified as;

$$BCR_{CS}= \sum_{t=1}^{n} \frac{\alpha_t}{(1+r)^n} / \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^n} = 0 \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The cost component of iron ore production normal mining equipment, mine main equipment, field maintenance equipment, ancillary facilities, administrative costs, large equipment capacity cost and local foundry cost. Ancillary facilities, comprises of laboratory equipment, mine workshop equipment, ammonium nitrate storage and storage yard expansion. The dump trucks, gyratory crusher, primary crushing plant and excavators are equipment which make up large capacity equipment.

Normal mining, main mine, field maintenance and large capacity equipment can be collectively referred to as mining equipment utilized for iron ore production. Administrative costs entails, expenses such as maintenance, utilities, personnel, repairs and other services accruable to the running of NIOMCO. The production costs identifies, cost associated with the transformation of iron ore in its natural state into its finished state, such as crushing, grinding, processing, haulage, blasting, tailing, drilling and loading expenses. Worthy of note is, the administrative also takes into account, costs accruable to the Mines, Beneficiation, Commerce, Finance and Estate departments, in terms salaries and running of these departments. Foundry cost include expenses accruable to the installation and establishment of local foundry, otherwise known as conventional sand casting. These includes diesel, foundry layout and civil work, 450 KVA generators, crucible pot, EOT cranes, molding boxes, furnace, fettling tools, machining tools, pattern shops, heat treatment facilities, shaking out machines, core making machines, core making facilities and air compressors. Data on labour costs associated with iron ore production would be sourced from the NIOMCO's finance department. Mining equipment costs was sourced from CAT (Caterpillar) catalogue and Machinery trader information Bank.

RESULTS AND DISCUSSION

Table 1. Profitability analysis of iron ore production (spare part importation) for 5 years in US' ($)

Years	Start of 2017	2017	2018	2019	2020	2021
Initial capital	(15,929,274)					
Net cash-inflows	-	537,717	623,644	723,303	838,887	972,941
Net cash-outflows	-	(226,765)	(262,829,)	(304,657)	(353,169)	(409,434)
Discount Rate @15%	1	0.8696	0.7561	0.6575	0.5718	0.4972
Net cash flow	-	-226,227	-262,206	-303,934	-352,331	-408,461
Present value	(15,929,274)	-196,727	-198,254	-199,837	-201,462	-203,086
Net present value	-$1,015,297					
Naira equivalent (NPV)	-N364,695					

Source: Author's computation

The net discounted present value cash flow of iron ore production through a 5-year projection period presented in Table 1 shows that investing the sum of $15,929,274 at the start of 2017 on importation of spare part yields a negative net cash flow of -$226,227 -$262,206, -$303,934, -$353,331, -$408,461 respectively. In addition, the present value of -$226,227, -$262,206, -$303,934, -$353,331, -$408,461 as at end of the projection respectively is worth -$196,727, -$198,254, -$199,837, -$201,462, -$203,086 at present. The summation of all negative present value at 15% interest rate summed up to - $1,015,297 with a Naira equivalent of -N364, 695. This indicates that the net cash inflows generated before tax from the sales of iron ore throughout the 5- year projection period fell below the anticipated expenses.. In effect, investing on spare part importation will not be profitable, as it will yield a net loss in the short-run, considering the gap between, anticipated revenues and anticipated expenses accruable to spare part importation.

Table 2: Profitability of iron ore production (conventional sand casting) for 5 years in US ($)

Year	Start of 2017	2017	2018	2019	2020
Initial capital	(13,772,333)	-	-	-	-
Net cash inflows	-	537,717	623,644	723,303	838,887
Net cash outflows	-	(226,765,)	(262,830)	(304,658)	(353,170)
Discount Rate@15%	1	0.8696	0.7561	0.6575	0.5718
Net cash flow	-	-226,227	-262,206	-303,935	-352,331
Present value	(13,772)	-196,727	-198,254	-199,837	-201,463
Net present value	-$1,013,142				
Naira equivalent (NPV)	-N363,921				

Source: Author's computation

Table 2 presents the net discounted present value of iron ore production obtainable from the investment or utilization of conventional sand casting, for a 5-year projection period. The result reveals that investing $13,772,333 in 2017, on local sand casting yields negative net cash flows of -$226,227, -$262,206, -$303,935, -$352,331, -$408,462 in 2017 through 2021. The negative present values implies that, the net cash flows, -$226,227 -$262,206, -$303,935, -$352,331, -$408,462 obtainable from the utilization of conventional sand casting in sourcing spare parts of earth moving equipment as at the end of 5-year projection period respectively were worth -$196,727, -$198,254, -$199,837, -$201,463, -$203,087 at present. On the aggregate, negative present values at a 15% interest rate, results in a negative net present value of -$1,013,142. This signifies, the estimated or projected revenues generated before tax at the end of 2017 through 2021, from the sale of iron ore, stood below the anticipated expenses to be incurred, from investing in conventional or local sand casting. Therefore, investing in conventional sand casting as a means to source, spare parts of earth moving equipment through five years, will yield a net loss in the short-run.

Table 3: Benefit-cost ratio of iron ore production (spare part importation) for five years in US' ($)

Year	Start of 2017	2017	2018	2019	2020	2021
Initial capital	(13,772)	-	-	-	-	-
Cash inflows		537,717	623,644	723,303	838,887	972,941
Cash inflows@15% DR	1	0.8696	0.7561	0.6575	0.5718	0.4972
PV cash inflows	-	467,599	471,537	475,571	479,675	483,746
Cash outflows	-	(226,765)	(262,829)	(304,658)	(353,170)	(409,435)
Cash outflows@15% DR	1	0.8696	0.7561	0.6575	0.5718	0.4972
PV cash outflows	(13,772	197,195	198,726	200,312	201,942	203,571
BCR@15% DR	0.0024					

Source: Author's computation

Table 3 displays the benefit and cost accruable in money terms at a 15% interest rate, to the utilization of conventional sand casting iron ore production, for 5 years and evidence indicates that investing $13,772 in the conventional sand casting will yield anticipated cash inflows of $467,599, $471,537, $475,571, 479,675, $483,746 respectively which is less than anticipated expenses of $197,195, $198,726, $200,312, $201,942 respectively for a 5-year period. The ratio of anticipated cash outflows over anticipated cash inflows, at a 15% interest rate results to 0.0024, which is less than 1. In effect, the estimated cash inflows generated, before tax from the sales of iron ore will be insufficient to cover anticipated expenses from the utilization of conventional sand casting, for the projected period.

Table. 4: Benefit-cost ratio of iron ore production (spare part importation) for 5 years in US' ($)

Years	Start of 2017	2017	2018	2019	2020	2021
Initial capital	(15,929)	-	-	-	-	-
Cash inflows	-	537,717	623,644	723,303	838,887	972,941
Cash inflows @ 15%DR	1	0.8696	0.7561	0.6575	0.5718	0.4972
PV cash inflows	-	467,599	471,537	475,571	479,675	483,746
Cash Outflow		226,765	262,829	304,658	353,170	409,435
Cash outflows@ 15% DR	1	0.8696	0.7561	0.6575	0.5718	0.4972
PV cash outflow	15,929	197,195	198,725	200,221	201,942	203,570
BCR@15 % DR	0.0024					

Source: Author's computation

Table.4 exposes the benefits and cost at a 15% interest rate accruable to investing on spare part importation for iron ore production. Investing $ 15,929 at a 15% over a period of 5 years will yield anticipated cash inflows of $197,195, $198,725, $200,221, $201,942, $203,570, respectively, which is below cash outflow of $226,765, $262,829, $304,658, $353,170 and $409,435. In effect, the estimated cash inflows generated from the sales of iron ore over a period of five years will be insufficient to cover anticipated expenses incurred from the utilization of imported spare parts of earth moving equipment for the projected period of five years. It should be noted that the residual value was not accounted for in deducing the net discounted present value computations. In other words the residual value is zero. This is because NIOMCO being a Federal government entity has not extracted up to half of its iron ore reserve. Thus, the likelihood of equipment disposal, after 5 years is minimal. Also, contingent liabilities were not accounted for, as a cash outflow, throughout the projection period. This is in line with IAS (International accounting standard) 37. Hence, possible known-unknowns in NIOMCO's case are unexpected damage of earth moving equipment, legal services, inadequate explosives resulting from blasting tougher rocks and likely erosion control.

CONCLUSION

Considering the projected revenue generated before tax, with respect to the current global price of iron ore, inflation rate and global market exchange rate, the importation of spare parts and utilization of conventional sand casting in sourcing

spare parts of earth moving equipment is not profitable to NIOMCO due to accumulated expenses accruable to both investments within a 5-year projection period. However, it is important to set a new price to reflect current expenses at a 15.98% inflation rate and market exchange rate of ($1 to N359.201) if, it must continue to produce and sell iron ore. Despite the loss emanating from both investment options, finding shows that importation of spare parts is relatively cheaper, in sourcing spare parts of earth moving equipment, though the difference between the investment options, in terms of cost is relatively low. This is an indication that, the iron ore investment is extremely capital intensive irrespective of the options employed to source spare parts for earthmoving equipment. On the aggregate, it is more expensive to invest in conventional sand casting, for sourcing spare parts relative to investing in importation of spare parts with respect to NIOMCO's operation. This is evidenced from the disparity in the net discounted present value and cost to benefit computations which portends that costs returns accruable from both investments, will be inadequate to offset expenditures. In effect, the entity is most likely not to make profits through a span of 5 years, due to the burden of costs. In this regard Global Steel Holding Limited (GSH) has to continue with production since they have shown the financial capacity to withstand current cost because chances of generating foreign revenue will be very minimal. Investing on the importation of spare parts should not be made by the federal government, considering the fact that it is not profitable, at current global price of iron ore, which is $62.59 (N22, 482) and the current exchange rate ($1 to N359.201) since revenues will not be to cover expenses, at a 15.98% inflation rate. A new price should be calculated by absorbing cost or expenses, on average emanating from the running of each department, of which each department running cost on average is summed up to obtain a new price.

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