

# LOW CAPACITY UTILIZATION AND ITS EFFECTS ON THE PERFORMANCE INDICATORS OF NIGERIAN MINES

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## ABSTRACT

This paper examines the causes and effects of low capacity utilization in Nigerian mines. In particular, the effects of low capacity utilization on such performance indicators as overhead costs and unit production costs are illustrated with a hypothetical mining establishment operating at increasing capacity utilization. Analysis shows that at 10% capacity utilization, the unit production cost may increase by 225% when compared with its value at optimum production, while overhead cost can contribute to as much as 77% of this unit production cost.

**Keywords:** Capacity utilization, Overhead costs, Unit cost at optimum production.

## INTRODUCTION

Research carried out by Nwosu and Ugwu (2009) shows that utilization of installed production capacity of Nigerian mines, especially in government owned mines varies from 5% - 15% for metal open-pit mines and increases to 20% for mines exploiting industrial minerals. This no doubt has economic implications for the sector. Indeed the profitability of any mining venture depends to a large extent on the utilization of the potential production rate (capacity) of the mine and on the full utilization of its installed capacity. High production capacity means low unit cost of production and huge profits. Low capacity utilization on the other hand spells high overhead and unit cost. Therefore, capacity utilization must be given priority attention in any mining business.

*Low capacity utilization in Nigerian mines occur in two forms:*

- i) When the production rate of a deposit is under-estimated. This may occur due to failure to carry out detailed geological exploration of the deposit, thus leading to unreliable geological data. Hence, the mine planner is compelled to estimate the production capacity with great caution and conservatism. It may also occur due to inadequate funds for procurement of mine equipment. The production rate in this case may be determined not by a consideration of available ore reserves, minimum costs and maximum profits but by the amount of funds available to Management.
- ii) When the estimated production rate is not utilized. In the second form of low capacity utilization, the production rate of the mine is optimally estimated and installed but not utilized. Based on the optimally estimated production rate of the mine, equipment are procured; plants, ancillary facilities and infrastructure are installed; labour and Management size and structure are established, but owing to lack of

funds for daily operation of the mine and other factors which are enumerated below, the installed capacity of the mine cannot be achieved. In such cases, overhead and unit costs of mining are usually very high.

## CAUSES OF LOW CAPACITY UTILIZATION IN NIGERIAN MINES

*The major causes of low capacity utilization are as follows:*

- i. **Under-funding:** As mentioned above, poor funding deprives mining establishments of the necessary capital to procure mining equipment to carry out detailed exploration of the deposit, thus compelling the mine planner to give a conservative estimate of ore reserve and production capacity of the mine. Also, the installed capacity of mines are often not utilized because of lack of funds to procure spare parts and other consumables. Sometimes workers go on strike owing to non-payment of salaries. All these affect capacity utilization of Nigerian Mining Establishments.
- ii. **Job planning:** Absence of proper harmonization of production operations scheduling and development work scheduling may result to idleness of production equipment (Arsentiev 1982). In multiple bench mining applied in open-pit operations, development work at lower benches must be carried out in parallel with production activities in upper benches. The practice whereby the reserve in upper benches are allowed to exhaust before development work are started at lower benches will only lead to idleness of production equipment until when new production benches are created. In many mining establishments in

our country, there are not enough equipment to carry out production and development work simultaneously.

Although such logistics problems like fuel and vehicles to convey workers to mine site may look very unimportant to mine property owners or Management, productivity analysis shows that they contribute in most cases to low capacity utilization in mining establishment all over the country.

iii. **Absence of Research & Development:** Absence of research and development is perhaps one of the major causes of capacity utilization in Nigerian mines. Virtually all mines in the world over, except perhaps in few African countries, research and development form a strong department studies and monitors the activities and decisions taken by all other department with a view to understanding the effects of such activities or decisions on the efficiency of the mining establishment as a whole. It is also responsible for developing new technologies and improving the existing ones. The activities of this department, even though seemingly unimportant to many mining establishments in the country, actually determine the profitability of many mining ventures in the advanced world. Research and Development can uncover the reasons for frequent equipment failures or bad fragmentation during blasting operations. This will not only save the cost of secondary blasting, but will go a long way to minimize idleness and lack of productivity (Nwosu et'al 2020).

iv. **Expatriate Consultants:** While it may be believed that expatriate consultants are more exposed to technical decisions than the local ones, it is also true that local consultants are more familiar with local peculiarities than foreign consultants. Improper investment appraisal by expatriate consultants contribute in no small measure to the economic

jeopardy of low capacity utilization in Nigeria. Mine design and production scheduling must be tailored to suit not only the technical requirements of the deposit but also the psychological, social and other conditions of Nigeria. Unfortunately all these are not taken into consideration by foreign consultants who design the mines in Nigeria. Experience over the years has shown that Nigerian mines are financed at not more than 10% of the optimum requirement; yet this is not taken into consideration by foreign consultants who recommend very big and costly equipment, labour, ancillary facilities, plants and infrastructure as if the mines were located in Europe. All these oversized labour strength with associated infrastructure, oversized crushers that can never be fully utilized, very big and costly loading and haulage equipment that are incomparable with the level of productivity result to low capacity utilization with the attendant high unit cost of production. Hence, right from the onset, expatriate consultants install a production capacity, which we cannot utilize by reason of our poor financial capability.

- v. **Technical know-how:** The need to use knowledgeable and experienced engineers in sensitive operations in mines cannot be overemphasized. In the East-pit of the National Iron Ore Mining Company Itakpe dump truck R35 was frequently out of order and some were cannibalized. When a study was carried out, it was discovered that the failure rate of this model of dump truck became frequent with arrival of D9N pay-loader in the mine field. The new pay-loader was too big a loading equipment for the truck that the dynamic loading during loading operations rendered the dump truck out of order virtually after every one or two weeks of operation (Nwosu 2003). In another operation, it was discovered that after each blasting operation, percentage boulder formation was frequently close 60%. When a study was carried out it

was also discovered that spacing, burden and bench height were much more than required (Nwosu Et'al 2020). The ultimate effects of equipment breakdown or frequent secondary blasting operation are obviously a fall in productivity. Such problems could be avoided by making use of knowledgeable and experienced engineers in such operations.

## EFFECTS OF LOW CAPACITY UTILISATION

The Russian Bureau of mines (Giproruda) developed a mathematical model (Arsentiev 1972) for assessing the effects of change of production rate on the unit costs mining in open-pit mines. Consequently, if a mining establishment is unable to utilize its full capacity, this model can be used to assess the effect of this under-utilization.

Here is the model:

$$C_x = C_0 \left( b_1 + b_2 \frac{A_0}{A_x} \right)$$

Where:

$C_x$  = Unit cost of mining if production rate is  $A_x$

$C_0$  = Unit cost of mining at optimum production rate  $A_0$

$b_1, b_2$  = The proportion of operating and overhead costs respectively

in the overall unit cost of production. If the production rate of an open-pit mine (total material) is less than 10 million tons per annum, then  $b_1=0.7$  and  $b_2=0.3$ . if the production rate is greater than 10 million tons per annum, then  $b_1=0.75$  and  $b_2=0.25$ .

Let us consider a hypothetical mining establishment with a production rate equal to 20 million tons of material per annum. Suppose this mine begins to operate at 10% of capacity and produces 2 million tons of material per annum, then;

$$C_x - C_0 \left( 0.75 + \frac{0.25 \times 20}{2} \right) = 3.25C_0$$

This means that the unit cost at 10% capacity utilization is 3.25 times its value at optimum production rate i.e (225% increment)

The expression  $(C_0 b_1)$  shows the amount contributed by operating costs in the overall unit cost of mining while the expression  $C_0 \left( b_2 \frac{A_0}{A_x} \right)$  shows

The amount contributed by the overhead cost in the overall unit cost. In our hypothetical mine, the amount contributed by overhead cost in the overall unit cost can be calculated as:

$$C_0 \left( \frac{0.25 \times 20}{2} \right) = 2.5C_0$$

Consequently, the percentage of overhead cost in the overall unit cost of mining can be calculated as:

$$\begin{aligned} \frac{2.5C_0}{3.25C_0} \times 100\% \\ = 76.9 \quad = 77\% \end{aligned}$$

At optimum production  $C_x = C_0$  since  $A_x = A_0$  Also overhead cost =  $0.25C_0$ .

Hence, percentage contribution of overhead costs in the overall unit cost = 25%.

The above calculation shows that for mines with 10% capacity utilization, overhead costs contribute 77% of the overall unit cost of mining, whereas in mines with optimum production, overhead costs contribute 25% of the overall unit cost of mining.

Percentage increase in unit cost of production at existing production rate when compared to its value at optimum production as well as the percentage contributed by overhead costs in the overall unit cost of mining for different values of capacity utilization are tabulated below:

Capacity utilization %	5	10	20	30	40	50	60	70	80	90	100
% increase in unit cost of production	475	225	100	58	37.5	25	17	11	6	2.8	0
% contributed by overhead cost in the overall cost of mining	87	77	62.5	52.6	45.5	40	36	32	29.4	27.3	25

## CONCLUSION

- i. Low capacity utilization is capable of rendering any mining establishment unprofitable no matter how economically viable the initial feasibility studies may show. For mines operating at 5 - 10% capacity, the unit cost of mining increases by 225 - 475% when compared to its value at optimum production, while the overhead costs contribute 77% - 87% of these costs. Most government owned mining companies in Nigeria fall within this category.



- ii. Elimination of low capacity utilization in Nigerian mines requires many approaches including: proper funding, proper job planning, research and development, proper investment analysis and technical know-how. Also labour size, ancillary facilities and infrastructure must reflect the production level in the mining outfit.

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