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Implication of Poor Energy Supply on the Productivity of Nigerian Manufacturing Industry
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---ABSTRACT---

A comprehensive evaluation of the effectiveness and delay contribution due to power outages and fluctuations is presented. The purpose of this study is to reveal the implications of poor energy supply on the effective utilization of the input resources in a typical Nigerian Manufacturing Industry. Delta steel company .Delata state Nigeria was used as a casestudy. Data on power outages were collected from the energy distribution unit, steel melting shop and the rolling mill. Additionally, the total delays, standard or planned production and actual production were determined from the records, from which the power delay contributions and effectiveness were evaluated. Results from this study revealed that power delay contributed more than 6% and the monthly effectiveness was more than unity throughout year 2010. Analysis of data collected for 2010 production period showed that the energy distribution unit experienced 54 outages with a total duration of 11472 mins, while a total of 44947 mins was lost in the steel melting shops due to power outages and under-voltage. More so, 25 billets worth 44tonnes were scrapped and 20811 mins were lost as a result of power failure and fluctuations. The implications clearly showed that poor power supply lowers the productivity of the company.

KEYWORDS: *Energy, Manufacturing, Productivity.*

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I. MANUFACTURING SECTOR AND ENERGY SECTOR

Every manufacturing industry requires energy to power their machines, computers, lighting and establishment for various purposes. However, in Nigeria, power requirement of the manufacturing sector far outweighs the available power being generated, transmitted and distributed by power holding company of Nigeria (PHCN) to both manufacturing and non manufacturing sectors. This energy deficiency has resulted in the emigration of some companies to other companies as exemplified by Mitchelin, which relocated their production capacity to ghana , some industries lying moribund as experienced by most textile industries in Nothern Nigeria and some industries resorting to diesel engines as prime movers of industrial alternators, which supplied inadequate power and cannot run continously for many days. Also, the running cost of these diesel engines are on the high sides , thereby increasing the cost of production and in many cases, lowers productivity.

FUNDAMENTAL CONCEPTS

Pertinent to this study is the understanding of the keywords: “Manufacturing” and “Productivity”.

MEANING OF MANUFACTURING

The word manufacturing is derived from the latin word manus and factus meaning hand and made respectively. That is the literal meaning is “made by hand”. However, in the modern sense, manufacturing means making of goods or articles from raw materials by hand and/or machinery by following a well defined plan for each activity required.

DEFINITION OF PRODUCTIVITY

Productivity has become an everyday watch word that is crucial to the welfare of the industries as well as the economic progress of the country. Productivity is the measure of how well the resources are brought together in an organization and utilized for accomplishing a set of objectives (Telsang 2008).

Productivity is the ratio of outputs of goods or services from the conversion process to input consumed in the generation of these outputs (Arthur, 1978). Productivity is a summary measure of the quantity and quality of work performance with resource utilization considered (Schermerhorn, 1986) Productivity can be defined as the optimum utilization of all the resoures of organization: Men, material, money and machinery, energy, space, technology, etc (Sharma, 2006).

II. MEASUREMENT OF PRODUCTIVITY

Productivity is the arithmetic ratio of amount produced (output) to the amount of resources(input). Mathematically: Productivity= Output/Input Productivity refers to the efficiency of the production. (Telsang, 2008). The basic component of productivity measurement is a means of comprising output forecasts with actual output at selected intervals. In general system theory, effectiveness is defined as the degree to which the actual output of the system corresponds to its desired or planned outputs. Productivity is a function of effectiveness and efficiency (www.authorsden.com).

Effectiveness= Actual Outputs/Desired Outputs

Productivity = Actual Production/ Standard Production

III. DELTA STEEL COMPANY AS AN INTEGRATED STEEL PLANT

Delta Steel Company(DSC) is an integrated steel plant with iron making, steel making and rolling mill facilities. These three important plant consume a lot of power during production and adversely lower the productivity of the company when there is power fluctuations or failure. However, the steel melting shop and rolling mill were functional during the period under study.

IV. DATA COLLECTED AND PRESENTED PROCEDURE

Power outages in DSC were collected for one year (January-December 2010) from the energy distribution unit. The record which show the specific date , timeout, timein, duration and feeders has been summarized as shown in table 1. The delay due to power outages, insufficient power to run the furnaces and preheat ladies, power fluctuation and power failure that resulted in the abortion of heats were determined from one year record and percentage contribution of the power failure to total delay was determined and compared to the productivity of the steel melting shop. See table 4.2. Moreso, delay due to power outages, cobbles due to power outages, percentages contribution of power failure compared to the total delay was determined and compared to the productivity of rolling mill (see table 4.3)

V. POWER UTILIZATION IN THE STEEL MELTING SHOP

Melting in the plant is achieved with Electric Arc Furnaces (EAF), which cannot do without electric Arc Furnaces (EAF), which cannot do without electricity. The melting point of steel is about 1539c, its superheat temperature before tapping into the preheated ladle is 1700c and the casting temperature in the continuous casting platform is 1600c. when there is power failure and the temperatture of the liquid steel is below 1600c, the usual option is to abort the heat by quickly tapping into the ladies and pouring the liquid steel on the ground floor before it solidifies. More so, when the Power failure is experienced at a temperature of about 1200c, the metal is left in the furnace, while heating and melting continue when the power is re-instated.

VI. POWER UTILIZATION IN THE STEEL ROLLING MILL

Both power fluctuation and failures are very dangerous and highly undesirable in the rolling mill. This is as a result of the formation of cobble which can occur when a billet undergoing deformation derails due to the stoppage or malfunctioning of the mall stands, shears, approach or roller table and loppers along the mill train. Power fluctuation or failure causes cobble formation in this mill, thereby grounding the rolling operation. Also, the temperature 1200c of the heated billets drops when there is power failure. When cobble forms, the mill is shut down, and cobble removal crew cut and remove the cobble, while the maintenance/production crew re-instates the plant before production continues.

VII. RESULTS AND IMPLICATIONS

The results from the data collected are summarized in tables 4.1, 4.2 and 4.3, while the implications of poor power supply are revealed in the tables 4.2 and 4. 3 and presented as shown below:

VIII. IMPLICATIONS OF POOR POWER SUPPLY IN THE STEEL MELTING SHOP

The implication of poor fluctuation and failure are listed as follows:

[1] Loss of consumables and ferroalloys are used in the treatment of aborted heat.
[2] Loss of money accruable from 110 tons (furnace capacity) of steel had it been successfully casted.
[3] Devaluation of already treated steel to scrap.
[4] Increased expenditure on the cutting of the aborted steel to sizeable form for easy loading into the EAF.
[5] Consumption of more energy in re-melting or continued melting because of temperature drop.
[6] Loss of money paid to PHCN for power expended on return or aborted heat.
[7] Increased idle times of workers because the entire plant get heated up and polluted when there is heat abortion.
[8] Loss of man hours especially when heat is aborted.
[9] Inability to make the planned or standard production
[10] Productivity ratio or effectiveness is always less than one with respect to the production quantity.

IMPLICATIONS OF POOR POWER SUPPLY IN THE STEEL ROLLING MILL

The Implications of power fluctuations and outages in the steel mill includes:

[1] Devaluation of the billet to scrap
[2] Loss of a would be income if the billet was successfully rolled
[3] Extra expense on the oxygen and acetylene used in cutting the cobbles
[4] Maintenance and repair of damage damage parts due to cobble
[5] Expenditure on the treatment of injured perssonnel or compensation on the family when a worker is entangled by cobble (death situation)
[6] Increased downtime
[7] Increased idle time of some workers
[8] Increased energy consumption when the furnace temperature drops
[9] Loss of man-hour and expenditure on power when cobble forms
[10] Productivity is always less than unity because actual production was always less than the planned production.
[11] Loss of machine hours as some machines take up to thirty minutes before assuming normal operating condition.

COMMENT ON THE RESULT

Table 4.1: The cause of the outages includes system collapse, system disturbance, high frequency, under voltage, over-voltage and poor generation. The number of power failure times was found to be 54 and the outage duration totaling 11472mins in 2010.
GIW – Ughelli Supply, S4W – Sapele Supply

Table 4.2: A total of 44937min delay due to power outages and inadequacy was recorded in 2010 and the steel melting shop which contributed 7. 37% to the total delay and resulted in the abortion or return of heat worth 1107tonnes of liquid steel. No monthly target was achieved throughout 2010, as revealed by the effectiveness.
EAF II and EAF IV delays due to power are presented in second column.

Table 4. 3: when the effectiveness is 0.82, the power delay contribution is 2.90% , while the effectiveness of 0.50 resulted when the power delay contribution is 17. 32%. These clearly show that power delay affect the productivity adversely. Also, the total number of billets devalued throughout 2010 was 25. Total delay due to power failure was calculated to be 20811mins with a contribution of 6.27% to the total delay. The effectiveness from January to December, 2010, was found to be less than unity.

IX. CONCLUSION

Obviously, poor energy supply lowers the productivity of manufacturing industries in Nigeria as shown by the two functional plants in Delta Steel Company. This is due to its associated unwanted events such as increased idle time, delivery time delay, Increased cycle time, reduced machine output, increased expenditure on material recovery and recycle, increased maintenance and repair expences , semi finished product devaluation, compensation to injured personnel or family of dead personnel, downtime, loss of consumables, alloys and extra expenses on raw materials or semi-finished product protection. All these implications arise due to power fluctuation and outages and in some cases the use of diesel engines as an alternative source of power supply.

Table 4.1: Power Outages for 2010. Source: Energy Distriburtion Unit

Month	Feeders	Distribuion	Number of power failures
August	GIW	2201	325
February	GIW, S4W	790	4
March	GIW, S4W	1319	5
April	GIW	68	4
May	GIW	520	6
June	GIW	238	3
July	GIW	642	10