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EOQ in a Just in Time (JIT) World: An Empirical Analysis of the Impact of EOQ Variables on Operating Profit: The Case of Nigerian Bottling Company Plc

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Abstract
With today's uncertain economy, companies are searching for alternative methods to keep ahead of their competitors by effectively driving sales and by cost reduction. Big manufacturing companies – as well as other companies, do not stand a chance in today's environment if they do not have an appropriate inventory control model intact. The Economic Order Quantity (EOQ) and Just in Time (JIT) have been used for many years, but yet some companies have not taken advantage of it. An Economic order quantity could assist in deciding what would be the best optimal order quantity at the company's lowest price. Similarly JIT focuses on providing customers with stocks at the right time and with the right quantity thereby reducing in process inventory and carrying costs and maximizing profits at the same time (Gonzalez and Gonzalez, 2010). All these in place in any organization are known as its inventory management system which invariable needs to be as efficient as possible in other to reduce costs and translate in profit maximization. In recent times there has been a clarion call to abandon EOQ model in place of JIT. Perhaps this is because of the perceived benefits of JIT which includes: time reduction as well as improved flow of goods from warehouse to shelves which in turn leads to regular replenishment of stock amongst others. However, one might be tempted to ask: is this call for abandonment justifiable? Using JIT does it actually reduce costs as well as lead to profit maximization in the organization?. This study looks at the relevance of EOQ Variables – Cost of goods purchased and overheads in impacting on the profitability of the firm. In doing this, the relationship of increase in cost of goods purchased against Operating profit as well as increase in Overhead against Operating profit of manufacturing companies in Nigeria were compared. Using Nigerian Bottling Company (**NBC**) Plc as a case study, Twenty – Nine (29) Years financial statements (1980-2009) were analyzed and the relationships between these variables were compared using regression analysis. It was found out that there is a relationship amongst these variables in NBC PLC. This paper thereafter, suggests that rather than abandon EOQ for JIT, they should complement each other for effective inventory management and ultimately lead to profit maximization.
Keywords: Economic Order Quantity (EOQ), EOQ Variables, Just In Time (JIT), Nigerian Bottling Company Plc and Regression Analysis.

CHAPTER ONE

1.1 INTRODUCTION

With today's uncertain economy, companies are searching for alternative methods to keep ahead of their competitors by effectively driving sales and by cost reduction. Big manufacturing companies – as well other companies, do not stand a chance in today's environment if they do not have an appropriate inventory control model intact. The Economic Order Quantity (EOQ) and Just in Time (JIT) have been used for many years, but yet some companies have not taken advantage of it. An Economic order quantity could assist in deciding what would be the best optimal order quantity at the company's lowest price. Similarly JIT focuses on providing customers with stocks at the right time and with the right quantity thereby reducing in process inventory and carrying costs and maximizing profits at the same time (Gonzalez and Gonzalez, 2010).

All these in place in any organization are known as its inventory management system which invariable needs to be as efficient as possible in other to reduce costs and translate in profit maximization.

Additionally, Inventory management of which Economic Order Quantity (EOQ), and Just in Time (JIT) are some of them, is pivotal in effective and efficient organization. It is also vital in the control of materials and goods that have to be held (or stored) for later use in the case of production or later exchange activities in the case of services. The principal goal of inventory management involves having to balance the conflicting economics of not wanting to hold too much stock. Thereby having to tie up capital so as to guide against the incurring of costs such as storage, spoilage, pilferage and obsolescence and, the desire to make items or goods available when and where required (quality and quantity wise) so as to avert the cost of not meeting such requirement. Inventory problems of too great or too small quantities on hand can cause business failures. If a manufacturer experiences stock-out of a critical inventory item, production halts could result. Moreover, a shopper expects the retailer to carry the item wanted. If an item is not stocked when the customer thinks it should

be, the retailer loses a customer not only on that item but also on many other items in the future. The conclusion one might draw is that effective inventory management can make a significant contribution to a company's profit as well as increase its return on total assets (Adeyemi and Salami, 2010). It is however, the management of this economics of stockholding, that is appropriately being refers to as inventory management. The reason for greater attention to inventory management is that this figure, for many firms, is the largest item appearing on the asset side of the balance sheet.

Consequently, inventory management, within the context of the foregoing features involves planning and control. The planning aspect involves looking ahead in terms of the determination in advance: (i) What quantity of items to order; and (ii) How often (periodicity) do we order for them to maintain the overall source-store sink coordination in an economically efficient way? (ii) How often (periodicity) do we order for them to maintain the overall stock coordination in an economically efficient way?

The control aspect on its own, which is often described as stock control involves following the procedure, set up at the planning stage to achieve the above objective. This may include monitoring stock levels periodically or continuously and deciding what to do on the basis of information that is gathered and adequately processed. Effort must be made by the management of any organization to strike an optimum investment in inventory since it costs much money to tie down capital in excess inventory. In recent time, attention was focused on the development of suitable mathematical tools and approaches designed to aid the decision-maker in setting optimum inventory levels. Economic order quantity model (EOQ) and later, Just In Time (JIT) Process have thus been developed to take care of the weaknesses emanating from the traditional methods of inventory control and valuation, which to some extent has proved useful in optimizing resources and thus, minimizing associated cost.

Financial analysts have sounded enough warning on the danger expose to the long run profitability as well as continuity of business concern when its inventories are left unmanaged. First, a company, which neglects it management of inventory, runs the risk of production bottlenecks and subsequently unable to maintain the minimum investment it requires to maximize profit. Second, inventories that are inefficiently managed may apart from affecting sales create an irreparable loss in market for companies operating in highly competitive industry. Invariably, a company must neither keep excess inventories to avoid an unnecessary tying down of funds as well as loss in fund due to pilferage, spoilage and obsolescence nor maintain too low inventories so as to meet production and sales demand as at when needed. (Adayemi and Salami, 2010).

Economic Order Quantity (EOQ) is the amount or size of inventory that is ordered at one time which minimizes the ordering and annual inventory costs. It aims at maintaining the amount of materials at a desired level at a minimum cost. The inventory level is closely monitored, and a fixed number of units are set so that each time that it reaches its reorder level, the exact quantity is ordered. It is applied especially if there is continuous demand for the product, and the new order is delivered in full.

It is utilized under the following assumptions:

1.That the demand for the products and ordering costs are constant.,

2. and that the inventory is exhausted at a fixed rate and a fixed number of units must replenish it to its starting level. Because stocks are replenished immediately, there are no shortages and no extra costs. It minimizes the holding costs and the order costs.

JIT on its own is a Japanese management philosophy which focuses on providing customers with stocks at the right time and with the right stock quality and quantity. It aims at reducing in-process inventory and carrying costs and maximizing profits at the same time.

It was created by Taiichi Ohno, a Toyota executive, who is the father of JIT or Lean Manufacturing. It was developed as a way for the company to meet its customers' demands on time and with minimum time, resource, and material wastes.

JIT offers the following benefits: Reduced setup time. Improved the flow of goods from warehouse to shelves. Efficient use of the employees' skills. Synchronization of production schedules and work hours. Strengthens relationship with suppliers. Regular replenishment of supplies. It is most effective when the following Japanese work ethics are applied: high motivation and striving to attain the highest standard possible, sharing of skills, ideas, and talents to accomplish a collective goal, putting work over leisure, and loyalty to the company, (http://www.differencebetween.net/business/difference-between-eoq-and-jit/#ixzz2W6Yb7NBn) Assessed on 13/06/2013).

In recent times there has been a clarion call to abandon EOQ model in place of JIT. Perhaps this is because of the perceived benefits of JIT as stated above which includes time reduction as well as improved flow of goods from warehouse to shelves which in turn leads to regular replenishment of stock amongst others. However, one might be tempted to ask: is this call for abandonment justifiable? Using JIT does it actually reduce costs as well as lead to profit maximization in the organization?

Apart from the fact that an ineffective inventory management affects virtually the organizational objectives but also the need to actually show the relevance of EOQ variables in cost reduction that ultimately

lead to profit maximization for organization, before making a decision to axe EOQ for JIT necessitates this type of research work.

The researchers have taken Nigeria Bottling Company as a case study so as to clearly see if their resounding success that showed in terms of its continues profitability can be attributed to the kind of inventory system the company embarks on. In the words of the Chairman of NBC plc as stated in their 2009 annual report (see appendix)

" as at 2009, our supply chain continued in its effort to further upgrade our production facilities and improve on our production and package quality. The juice packaging was changed from brick to prisma which in turn boosted our sales volume in this segment of the market and positively affected our market share. Supply chain also played an important role in rebuilding our Benin plant and facilitated the installation or a new ultra glass line at our Ikeja plant. A new juice line which is under construction at our Ikeja plant will further boost our market share and profit at completion"

This indicates that they have high regard for high inventory management. Furthermore, Since their production process requires a lot of raw materials and despite the economic condition of the country at any given time, production has never ceased and their products have never been scarce. In addition, the company has always – year upon year posted a positive financial position since its incorporation in Nigeria.

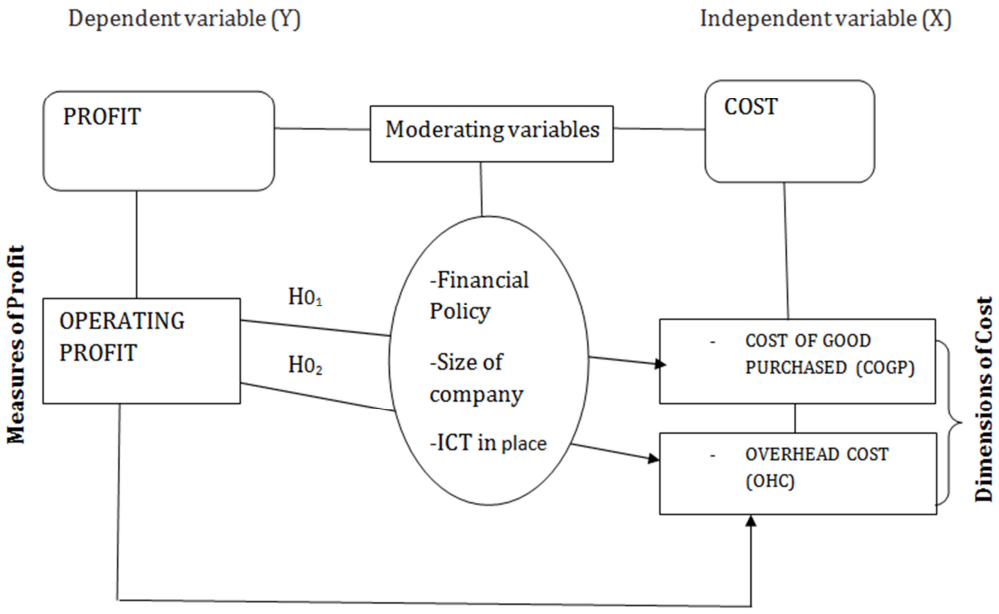
1.2 STATEMENT OF THE PROBLEM

This is a simple declarative sentence that gives a brief of the major aspect of the problem stated in the background of the study. The problem that necessitated this research is therefore, the issue of abandonment of EOQ model in place of JIT perhaps because of the perceived benefits of JIT as analyst claim that it is a far much better inventory management tool than EOQ. Not many researchers have actually considered finding out empirically whether or not this call for abandonment is justifiable. Again, considering the variables that make up EOQ models which includes various kinds of costs (as we will see later in this work) as vital tools that have the tendency to affect the profitability of any company, none has dared to test the relevance of these in affecting profitability before calling for axing of EOQ inventory management tool.

1.3 CONCEPTUAL FRAMEWORK

In this framework, the dependent variables as well as independent variables are identified and conceptualized. In addition, the moderating variables are also highlighted as all these help in directing the course of the research. For this study, the dependent variable is adopted as the Profit, whilst Costs are the independent variables. Furthermore, a measure of profit – Operating Profit is adopted as the dependent variable of testing and analysis while the Cost of Goods purchased as well as Overhead costs are the dimensions of Cost for test and analysis. The costs was adopted because EOQ model consists of variables such as holding costs, ordering costs, cost of production etc all these if adequately managed leads to lower annual inventory cost and this can in turn translate to increased profit as a result of cost minimization, all things being equal.

Diagrammatically, the conceptualization of this study is represented below.



1.4 PURPOSE OF THE STUDY

The major purpose of the study is to study how Cost of goods purchased and Overhead costs (Variables of EOQ model) affect the Operating Profit of Nigerian Bottling Company Plc .The specific purpose of the study however, are:

1. To what extent does cost of Goods purchased by NBC Plc affects its Operating profit?
2. To what extent does Overheads of NBC plc affect its operating profit?

1.5 RESEARCH QUESTIONS

Although most of the data gathered for this study were from secondary sources as stated in chapter three of the report, however, results from interview had with one of the managers at the Nigerian Stock Exchange, Port Harcourt branch, provided useful information that helped to corroborate the reliability of the data used. The questions asked during the interview include:

1. How often and timely do NBC forward their financial statements to NSE?
2. Has NBC Plc stopped operation at any point in time?
3. Has NBC posted a loss position or not on their financial statements submitted to your office?

1.6 THE HYPOTHESES TO BE TESTED

A hypothesis is a declarative statement about the relationship between two or more variables which can be stated in a null (negative) or alternate (Positive) form. For this study however, the following hypothesis are stated below and are tested:

$H0_1$: There is no significant relationship between operating profit and cost of goods purchased in NBC Plc.
$H0_2$: There is no significant relationship between Operating profit and overhead costs of NBC Plc.

1.7 THE SIGNIFICANCE OF THE STUDY

The study will benefit organization, financial analysts, the academia as well as organizational stakeholders whilst contributing to the body of knowledge and literature regarding the thorny issue of EOQ abandonment.

1.8 THE SCOPE OF THE STUDY

This study focused on the relationship of costs against operating profit. Specifically, it looks at the operating profit measure of profit as well as cost of goods purchased and overheads dimensions of Cost in organizations with NBC plc as a case study.

1.9 LIMITATION OF THE STUDY

The study is limited to manufacturing companies and a case of NBC and as such results can differ from companies in other sectors of the economy. Population sample considered that was adequate was not easily available, however that which was available and easily retrievable from the Nigerian Stock Exchange, Port Harcourt branch within the time frame of study was used.

1.10 DEFINITION OF TERMS

1.10.1 COST OF GOODS PURCHASED (COGP). This is the price of product or service available for suppliers or consumers. Calculated as Invoiced cost plus shipments and other add on costs (ehow.com). Whilst cost of Sales according to investorwords.com is the cost of purchasing raw materials and manufacturing finished products. Equal to the beginning inventory plus the cost of goods purchased during some period minus the ending inventory. Also called **Cost Of Goods Sold (COGS).** For the purpose of this study, COS is considered the Cost of Goods purchased – both raw materials and other supplies by NBC Plc for production purposes**.**

1.10.2 ECONOMIC ORDER QUANTITY (EOQ): Undoubtedly, one of the best-known and most fundamental inventory decision models is the Economic Order Quantity Model. Its origin dated back to the early 1900s. The EOQ has been previously defined by Dervitsiotis (1981), Monks (1996), Lucey (1992), and Schroeder (2000) as "the ordering quantity which minimizes the balance of cost between inventory holding costs and re-order costs". Lucey (1992) stressed further that to be able to calculate a basic EOQ, certain assumptions are necessary:

(i) That there is a known, constant, stock holding costs; (ii) That there is a known, constant ordering costs; (iii) That the rates of demand are known (iv) That there is a known constant price per unit (v) That replenishment is made instantaneously, that is the whole batch is delivered at once. (vi) No stock-outs are allowed.

It would be apparent that the above assumptions are somewhat sweeping and that they are a good reason for treating an EOQ calculation with caution. Also, the rationale of EOQ ignores buffer stocks, which are maintained to cater for variations in lead-time and demand. The above assumptions are wide ranging and it is unlikely that all could be observed in practice. Nevertheless, the EOQ calculation is a useful starting point in establishing an appropriate reorder quantity.

The EOQ formula is given below; it's derivation and graphical presentation.

EOQ = $\frac{2CoD}{Cc}$ …….. (1)

Where Co, Cc and D denote the ordering costs, carrying cost and annual demand respectively. Note also that Annual stock = Q/2, Total annual carrying cost = CcQ/2, Number of orders per annum = D/Q, Annual ordering costs = CoD/ Q and

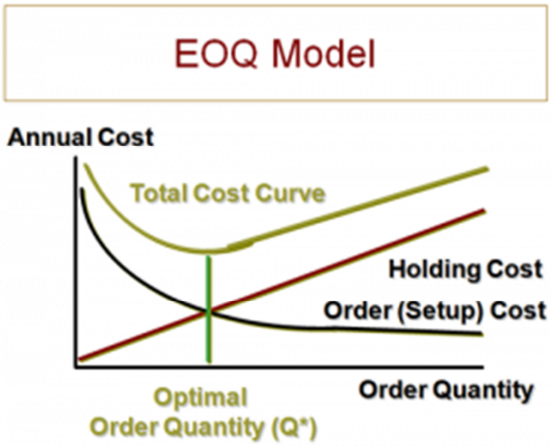
Total cost = CcQ/2 + CoD/Q --------..(2)

In the above formula, Q is defined as the result of the calculated EOQ.

The order quantity, which makes the total cost (TC) at a minimum, is obtained by differentiating with respect to Q and equating the derivative to zero the above total cost equation 2.

Thus, dTc/dQ = Cc/2 – CoD/Q2 and when dTc/dQ = 0 cost is at minimum. DCo/Q2 = Cc/2 Q2 = 2DCo / Cc and Q which represent the EOQ formula would now be **EOQ = $\frac{2CoD}{Cc}$**

Graphically, it is represented as thus:



(Source: http:supplychainalmanac.com/wp-content/uploads/2012/06/EOQ.pnc)

1.10.3 EOQ VARIABLES: a variable is an element, feature or factor that is liable to vary or change (freedictionary.com). Variables are the components that make up a model. They could be dependent and as well as independent variables. For EOQ model, there are certain variables that make up the model. Hadly and Whitin (1963) identified four variables that make up the EOQ model viz:

1) The Demand in quantity per time,
2) The order quantity,
3) The order cost, and
4) The holding cost per unit time.

Again, for this purpose of this study, we concentrate on the variables of Ordering cost and Holding costs. Furthermore, we have also grouped these two costs as part of Cost of goods purchased as well as part of Overhead costs, hence the variables of study to show their relationships with operating profit.

1.10.3 JUST IN TIME (JIT): is a method of close coordination with suppliers maximizing the relationship between production and sales levels with inventory, reducing carrying costs. Often JIT is linked with a computerized point - of - sale system and inventory levels are maintained through an automated reordering system connected to suppliers, so that stock outs are minimized (Businessdictionary.com). Like EOQ model, JIT is also a type of inventory management tool that ensures that "what stock is needed arrives just in the time it is needed and no room for storage".

1.10.4 NIGERIAN BOTTLING COMPANY PLC - A BRIEF PROFILE OF NBC PLC: Nigerian Bottling Company came into existence on 8th may 1886. Late A. G. Leventis founded the company and was the first in this country to be offered franchise by an international "soft drink firm". The first plant, which was sited in Lagos, went into operation in March 1953. Coke was the first soft drink to have its own designed shaped bottles, which was different from the common trade bottles. In 1972, the company went public by the issue of 372,580 ordinary shares of 50 kobo each. This was in compliance with the Nigerian Enterprise Promotion Decree of 1972. Furthermore, the range of soft drinks bottled by Nigerian Bottling Company, includes: Fanta, Coke, diet coke, Sprite, , Bitter Lemon, and Eva water as well as Five alive Juices. In terms of sales, the company enjoys a wide acceptance of its products. Its performance is highly appreciated. In fact, the company enjoys a robust and consistent high sales and turnover. According to Nigerian Stock Exchange (Port Harcourt branch), since its

inception (the inception of Port Harcourt branch of NSE in 1980), NBC plc has always presented a positive financial position until the time of its delisting in 2009.

1.10.5 OPERATING PROFIT (OP): This is the profit NBC earned from its core business operations. This does not take into account earnings from other aspects of its business as well as taxes and interest. Operating profit however, takes into account the two aspects of cost chosen for this study – COGP and OHC. This is also known as Earnings Before Interest and Tax (EBIT).

1.10.6 OVERHEAD COST (OHC) is "an accounting term that refers to all costs not including or related to direct labour, materials, or administration costs. This is a very ambiguous term unless a modifier is added. A commonly used expression is manufacturing overhead. In other words, OHC can be referred to the ongoing administrative expenses of a business which cannot be attributed to any specific business activity, but are still necessary for the business to function. Examples include rent, utilities, and insurance (investorwords.com). In the case of NBC Plc, the overhead cost, though not explicitly stated in its financial statements, is determined in the course of this research, by adding up the administration expenses and distribution expenses as the case may be. Hence total overhead costs for each financial year (as shown in the table 1 below).

Table 1: Computed values of Operating Profit, COGP and OHC NBC PLC

S/No	Year	OP. Profit (Y)	Cost of Sales (X)	Overheads (X)
		N'M	N'M	N'M
1	1980	19	43.4	27
2	1981	20	63	42
3	1982	31	82	55
4	1983	41	102	68
5	1984	52	129	86
6	1985	42	98	65
7	1986	57	152	101
8	1988	63	278	186
9	1989	78	409	273
10	1990	108	644	430
11	1991	271	954	287
12	1992	372	1,459	521
13	1993	686	2,705	783
14	1994	1,192	4,172	1,533
15	1995	1,447	6,580	2,560
16	1996	2,209	10,016	4,411
17	1997	1,967	12,202	4,379
18	1998	2,302	1,277	5,796
19	1999	68	14,560	5,752
20	2000	1,327	13,626	7,692
21	2001	4,165	21,472	9,411
22	2002	5,637	24,787	11,232
23	2003	5,964	26,385	12,020
24	2004	3,411	30,641	13,653
25	2005	3,418	36,464	15,613
26	2006	2,411	41,964	15,335
27	2007	4,606	47,314	16,683
28	2008	2,457	50,303	19,379
29	2009	4,694	64,143	20,407
Total		**49,114**	**413,023**	**168,778**

Source: Annual Financial Statements of NBC PLC (See Appendix 2).

1.10.7 REGRESSION: Regression is "*a technique used to discover a mathematical relationship between two variables using a set of individual data points.* Regression analysis on its own is "*A statistical technique used to find relationships between variables for the purpose of predicting future value* (www.investorwords.com). Regression equation, which represents the function is *"a statistical technique used to explain or predict the behaviour of a dependent variable".* Generally, a regression equation takes the form of **Y=a+bx+c,** where Y is the dependent variable that the equation tries to predict, X is the independent variable that is being used to predict Y, a is the Y-intercept of the line, and c is a value called the regression residual.

The values of a and b are selected so that the square of the regression residuals is minimized. In other words, a

and b serve as the Y – intercept and slope respectively, of the line of which all the profit means are assumed to lie. (Nwachukwu, 2008).

1.11 OUTLINE OF THE RESEARCH

The remaining of the study is divided into four chapters: Chapters two to five. Chapter two reviews related literature as well as theoretical underpinnings; Chapter three looks as the methodology adopted for this study whilst chapter four presents and analyses the data. Chapter five is the concluding comments and summary. Finally, after the concluding comment come the references as well as appendix.

CHAPTER TWO

2.1 THEORETICAL UNDERPINNING.

There are several models of inventory management. These ranges from the traditional ones to the more recent and computerized models of inventory management. Apart from the EOQ and JIT models of inventory management that have been briefly discussed in the previous chapter of this research, there is the Material Requirement Planning (MRP) as well as the Enterprise Resources Planning (ERP) models.

(MRP) is a computer-based inventory management system designed to assist production managers in scheduling and placing orders for dependent demand items. Dependent demand items are components of finished goods—such as raw materials, component parts, and subassemblies—for which the amount of inventory needed depends on the level of production of the final product.

The first MRP systems of inventory management evolved in the 1940s and 1950s. They used mainframe computers to explode information from a bill of materials for a certain finished product into a production and purchasing plan for components. Before long, MRP was expanded to include information feedback loops so that production personnel could change and update the inputs into the system as needed. The next generation of MRP, known as manufacturing resources planning or MRP II, also incorporated marketing, finance, accounting, engineering, and human resources aspects into the planning process. "Thus, MRP is designed to answer three questions: what is needed? how much is needed? and when is it needed?" and this it does by breaking down inventory requirements into planning periods so that production can be completed in a timely manner while inventory levels—and related carrying costs—are kept to a minimum (Stevenson, 1996).

In line with this concept of computerized inventory management is the ERP. This is a related concept that expands on MRP. (ERP) on its own uses computer technology to link the various functional areas across an entire business enterprise. All these are models for inventory/ supply chain management for effective business or production operation that leads to overall company profitability. However, this paper concentrates on the models of EOQ and JIT as these though may be traditional, have its relevance anywhere, time and regardless of technological inclinations.

2.2 LITERATURE REVIEW

This work fits well with the works of Adayemi and Salami (2010), Gonzalez and Gonzalez (2010) and Rayman (2003).

Adeyemi and Salami (2010) studied Inventory Management: A Tool of Optimizing Resources in a Manufacturing Industry In Nigeria and they found out that Inventory constitutes the most significant part of current assets of larger majority of Nigerian manufacturing industries. Further, because of the relative largeness of inventories maintained by most firms, a considerable sum of an organization's fund is being committed to them. It thus becomes absolutely imperative to manage inventories efficiently so as to avoid the costs of changing production rates, overtime, sub-contracting, unnecessary Using Coca Cola Bottling plant Ilorin branch as a case study - to determine whether or not inventories in the Nigeria Bottling Company, Ilorin Plant can be evaluated and understood using the various existing tools of optimization in inventory management. The study employed the variance analysis, Economic Order Quantity (EOQ) Model and the Chi-square method to study data for five years period. It was consequently found that for at least three years out of the five years studied, the expected value was greater than the observed value for each product. This implies that the Nigeria Bottling Company, Ilorin Plant has excess investment in inventory. They also observed that there is a positive correlation between sales and inventory usages. And thus, concluded that inventory usage depends on sales that means as sales increases, inventory usages should also be on the increase. Therefore, inventory management is a must for the continuity and survival of any goal focused manufacturing organization (Adeyemi and Salami, 2010).

Gonzalez and Gonzalez (2010) on their work analyzed a US retail company's current forecasting model and recommending an inventory control model to help them solve their current issue. In doing this they adopted, in addition to EOQ model, the method of demand forecasting which included seasonal and annual trends. These techniques they used to calculate the annual trends involved moving averages and exponential smoothing. Furthermore, the annual trend was used in the EOQ model as the annual demand in order to manipulate the fix order cost or the holding cost of each product. As a result, an Economic Order Quantity (EOQ)

and a Reorder Point was recommended along with two forecasting techniques to help them reduce their product stock outs.

In addition, a cost estimate was done to compare both their current and the recommended models. As a result, Company would be able to reduce their overall total cost from $13,654 to $5,366. This was a cost reduction of approximately 61%, which summed to a total saving of about $8,300 per quarter. (Gonzalez and Gonzalez, 2010).

Rayman (2003) in his work considered supply chain model for an assembly system with a preprocessing of raw materials. An assembly line that procures raw materials from outside suppliers and processes the materials into finished products was considered. An ordering policy is proposed for raw materials to meet the requirement of a production facility, which, in turn, must deliver finish products in a fixed quantity at a fixed time interval to the outside buyers. Two different types of raw materials, 'unfinished' and 'ready-to-use', are procured for the manufacturing system. The 'unfinished raw materials' are turned into 'processed raw materials' after preprocessing. In the assembly line, the 'processed raw materials' and the 'ready raw materials' are assembled to convert into the final products. A cost model was developed to aggregate the total costs of raw materials, Work-in-process, and finished goods inventory. Based on the product design and manufacturing requirement a relationship is established between the raw materials and the finished products at different stages of production. A non-linear integer-programming model was developed to determine the optimal ordering policies for procurement of raw materials, and shipment of assembly product, which ultimately minimize the total costs of the model. Numerical examples are presented to demonstrate the solution technique. Sensitivity analysis is performed to show the effects of the parameters on the total cost model. They concluded that Solving the original problem with relaxed integer constraints, a set of closed-form optimal solutions is obtained. The branch and bound algorithm is used to find the integer values of the variables. It was observed that the total cost found by B&B algorithm is within 99% of the optimal total cost. The sensitivity analysis has been focused on the dynamic nature of the system parameters and their influences on model costs. From the sensitivity investigation, it is observed that batch size, shipment order size and delivery rate have significant effect on total cost and are interactive in many cases. The sensitivity of procurement of raw materials is greater at lower rate (>3) and level at (3-5) and again increases slowly at the higher rate (<5). The production rate at processing stage and finished product transportation cost reveal significant effects on total cost. The analysis also identified the incremental total cost due change of holding costs and the interactive nature between raw materials order cost and production setup costs. Possible areas of modification are also suggested during the sensitivity analysis for effective improvement of the model. This research reveals the insights into the order policies and inventory sequence of an assembly type problem when two components are required to produce the finished product. Using a rigorous mathematical approach, the optimal solution of the problem is accomplished. In the practical situation, the proposed model can be implicated in industries producing regularly consumable product where product supply is in the JIT environment and their demand pattern is approximately constant (Rayman, 2003).

All these works and others not mentioned here one way or the other point out the importance and indispensability of an inventory management system in an organization. In other words, they have also stressed the indispensible nature of EOQ model in particular in this present dispensation. They further concluded that it is highly recommended that Companies implement the inventory control models such as EOQ and others in order to reduce stock out and back orders. So that associated costs can be reduced and enable the companies to remain competitive and profitable in their industry.

Similarly, there are various works by several scholars on the impact of Cost of Sale and Overheads on a company's bottom line. For example, Udu and Okafor (2012:149) stressed that the operating profit is not the actual profit of a business because the operating expenses of the business has not been taken care of. However, to ascertain this, the profit and loss statement is prepared to know the net profit of the business. The net profit is determined through subtracting the operating expenses from the operating income (Udu and Okafor, 2012).

According to Luke Arthur of ehow.com, "Increasing the profit of a business is one of the most important objectives of any company, as this tells how much money the company makes after expenses are deducted. Depending on the structure of the business, several factors could affect the net profit and the ultimate success of the business. And these factors include: overhead, cost of sales, selling price as well as governmental factors. This speaks volumes of the relationship of profit and expenditures. Even government factors, as Luke noted is also expenditure in nature. Taxes and levies fall under this category. The net profit is easily affected by expenses.

Furthermore, this issue also fits well with what Dretler and Dennen (2012)[1] described as "Overhead consuming the greater pie of the universities". Dennen and Dretler[2] have, in their research indicated that a 20%

[1] Jeff Dennen and Tom Dretler: '' The financially sustainable university" (Bain Brief July 2012)

[2] *Jeff Denneen leads the Americas Higher Education practice for Bain & Company and is a partner in the Atlanta office. Tom Dretler is an executive in residence with Sterling Partners and is board chair and co-founder of the Alliance for*

increase in American Universities and Colleges' expenses leads to a 12% decrease in equity and that leads to a downward equity trend. They continued that the survival of American colleges and Universities depends on the check on their expenses. One way they have been doing that though is by the "Law of More". Explaining the law of more, they assert that "Much of the liquidity crisis facing higher education comes from having succumbed to the "Law of More." *Many institutions have operated on the assumption that the more they build, spend, diversify and expand, the more they will persist and prosper.* But instead, the opposite has happened: Institutions have become overleveraged. Their long-term debt is increasing at an average rate of approximately 12% per year, and their average annual interest expense is growing at almost twice the rate of their instruction-related expense. In addition to growing debt, administrative and student services costs are growing faster than instructional costs. And thus, fixed *costs and overhead consume a growing share of the pie*. However, they also argued that the law of more is not the best way to remain financially sustainable. The only way is to reverse the Law of More and create a more differentiated and financially sustainable institution, innovative college and university presidents are doing four things: 1)Developing a clear strategy, focused on the core. 2) Reducing support and administrative costs; 3) Freeing up capital in non-core assets; 4) strategically investing in innovative models.[1]

Bakar and Tahir (2009) in their paper used multiple linear regression technique and simulated neural network techniques for predicting bank performance. Return on Asset (ROA) was used as dependent variable of bank performance and seven variables including liquidity, credit risk, and cost to Income ratio, size and concentration ratio were used as independent variables. They concluded that neural network method outperforms the multiple linear regression method however it needs clarification on the factor used and they noted that multiple linear regressions, not withstanding its limitations, can be used as a simple tool to study the linear relationship between the dependent variable and independent variables.

All these writings suggests that the issue of Profit and Expenses (COS and OH) relationship is an issues that is receiving great attention both among scholars as well as industry practitioners. This explains the indispensability of the Operating Profit in business profitability and survival. This also shows that the Operating profit determination depends on the expenditure – overheads, Cost of sales etc in the business. However, to what extent these expenditures affects Operating profit has not been ascertained.

Finally, Broyles et al, in their writing "*Just-In-Time Inventory Management Strategy & Lean Manufacturing"* indicates that Just-in-time is a movement and idea that has gained wide acceptance in the business community over the past decade. As companies became more and more competitive and the pressures from Japans continuous improvement culture, other firms were forced to find innovative ways to cut costs and compete. The idea behind JIT, or lean manufacturing, is to have the supplies a firm needs at the exact moment that they are needed. In order to accomplish this goal a firm must constantly be seeking ways to reduce waste and enhance value. A recent survey of senior manufacturing executives showed that 71% used some form of JIT in their processes. This simple statistic illustrates that JIT is here to stay and also that firms must constantly be searching for ways to cut costs and achieve an advantage. JIT is one way to achieve that end result (Broyles et al, 2005). They further asserted that apart from the strengths of JIT which includes : JIT makes production operations more efficient, cost effective and customer responsive. JIT allows manufacturers to purchase and receive components just before they're needed on the assembly line, thus relieving manufacturers of the cost and burden of warehousing and managing idle parts. Just in time has also its weaknesses. The weaknesses include: In just-in-time, everything is very interdependent. Everyone relies on everybody else" (Greenberg, 2002). Because of this strong interdependence with JIT, a weakness in the supply chain caused by a JIT weakness can be very costly to all linked in the chain. JIT processes can be risky to certain businesses and vulnerable to the supply chain in situations such as labor strikes, interrupted supply lines, market demand fluctuations, stock outs, and lack of communication upstream and downstream in the supply chain and unforeseen production interruptions.

With all these thus said, one can conclude that Just in Time cannot be a viable alternative to EOQ model. Rather it will be better if they complement each other. It is by so doing that proper inventory management that will reduce cost and increase efficiency can be achieved.

Business Leadership. Their writings are found online at http://www.bain.com/publications/articles/financially-sustainable-university.aspx (accessed on 15/06/2013):

[1] http://www.bain.com/publications/articles/financially-sustainable-university.aspx (accessed on 05/06/2013)

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 RESEARCH DESIGN

The research design refers to the overall strategy that is chosen to integrate the different components of the study in a coherent and logical way, thereby, ensuring an effective addressing of the research problem; it constitutes the blueprint for the collection, measurement, and analysis of data[1]. In this study, a mix of Historical, Corelational and case study methods were used. Historical in the sense that Historical data – financial statements of over 29 year period were used. Case study – the case of NBC PLC whilst correlational method adopted, hence using regression analysis. Correlational method measures the relationship between two variables. Unlike in experimentation, the relationship is observed in a more natural environment.

3.2 POPULATION OF STUDY

A total population of 40 years financial statement was available for study going by the time the company was listed in the Nigerian Stock Exchange, (1972).

3.3 SAMPLE SIZE DETERMINATION

Using Taro Yemani method of sample determination, an optimum sample of study was arrived at as 36 years financial statement. However, this was not assessable as what was available from the Nigerian Stock Exchange; Port Harcourt branch was 29 years financial statement which was used. This is because the NSE Port Harcourt branch started operation in 1980 and had financial statements from 1981 until 2009 when NBC Plc was delisted from the Stock Exchange. This sample however is reliable as it represents over 80% of the optimum identified assessable population for study (36 years), and hence was used for the research.

3.4 METHOD OF DATA COLLECTION

The data collected were from secondary sources. This was collected from the annual financial statements of NBC Plc filed and retrieved at the Nigeria Stock Exchange, Port Harcourt branch. The reliability of this data was further corroborated by the results of the Interview had with one of the Managers of NSE, Port Harcourt which provided information on the reliability of NBC PLc financial positions from the books within their disposal.

CHAPTER FOUR

4.0 DATA ANALYSIS AND PRESENTATION

This chapter presents, analyzes, and interprets the data collected from the NBC Plc. First, the raw data (29 years financial statement) were extracted and prepared into an operating profit, Cost of goods purchased and Overhead costs table whilst identifying the variables used for regression analysis (See Table 1 above).

4.1 HYPOTHESIS TESTING

The two hypotheses stated earlier on which are:

$H0_1$: There is no significant relationship between operating profit and cost of goods purchased in NBC Plc.

$H0_2$: There is no significant relationship between operating profit and overhead costs of NBC Plc, were analyzed with multiple regression analysis. Multiple regression was used to test if a relationship exists between the two parameters – the independent and dependent variables. This is presented in the table below of which analysis was based on.

Table 2: Regression Analysis of EOQ Variables of NBC PLC

Model	R	R^2	Adjusted R^2	STD Err of Est.	R^2 Change	F Change	DF	Sign change	Durblin Waston
COGP, OP. Pr	.76396	.58363	.56821	12117.9266	.58363	37.84666	1	.0000	.67709
OHC, OP. Pr	.82024	.67279	.66067	3949.68200	.67279	55.51589	1	.0000	.78691

Source: SPSS output on Research data (see Appendix 1)

Comments: from the table below, it is observed that for cost of goods purchased (COGP), and Operating profit (OP), the result showed (R^2 = .58363, F = 37.8466, Sign F Change .0000), whilst for Overheads and operating profit (R^2 = .67279, F =55.51589, Signif F change =.0000). Therefore for $H0_1$, the regression results showed that the calculated F- value is greater than the tabulated value, hence the null hypothesis ($H0_1$) is rejected:

[1] http://www.cliffsnotes.com/study_guide/Research-Designs-and-Methods.topicArticleId-26831,articleId-26754.html. (Accessed 10/16/2013).

(Calculated F value = 37.8466, Tabulated value = ..76396, df = 1, level of significance = 0.05). Based on these results, we conclude that there is a significant relationship between operating profit and cost of goods purchased by NBC plc. This therefore implies that the level of increased operating profit that NBC plc is receiving could be as a result of the cost reduction techniques they have in place that has consequently reflected on the profitability of the company.

Similarly, for $H0_2$ which says that there is no significant relationship between operating profit and overhead cost of NBC Plc, the regression results showed as follows: (Cal. F- value = 55.51589, Tab. Value = .82024, df = 1 at 0.05 level of significance), since the calculated value is greater than the tabulated value, the null hypothesis is rejected. On these bases, it is concluded that there is a significant relationship between operating profits and overhead costs of NBC plc.

Furthermore, this result also shows that the strength of the relationships is stronger in Overheads compared to Cost of Goods purchased. This is reflected in their adjusted R^2 values: (Adjusted R^2 for Overheads = .66067; Adjusted R^2 for Cost of goods Purchased = .56821). In other words, this implies that the overhead costs when adequately reduced impacts more on the operating profit of NBC plc. In addition, for R squared of 0.58368 of COGP shows that 58% of the total variation of operating profit was due to the effect of Cost of Goods purchased by NBC PLC, whilst 0.56821 on adjusted bases, the operating profit was 57.21% relative to the COGP. The Durblin Watson (DW) is .67709 and it is less than 2. This shows that there is evidence of positive serial correlation between COGP and Operating Profit.

Finally, the analysis of the secondary data indicates that cost of goods purchased and overheads have a positive impact on operating profit. Further, the regression analysis carried out showed that the relationships between the independent and dependent variables were statistically significant; hence, the null hypotheses ($H0_1$ and $H0_2$) were not supported.

CHAPTER FIVE

5.1 CONCLUSION

In conclusion, as the call for EOQ Model abandonment continues, it has been shown that the call may not be justifiable given the variables that make up the model which play a significant role in overall company profitability. Several models – both traditional and modern, including the MRP, ERP, as well as JIT. Too, in reviewing vast amounts of literature by several writers all over the world, it has been ascertained that the relevance of EOQ variables in a company's profit maximization can be overemphasized. Furthermore, given the advent of JIT, it is also ascertained that JIT cannot function effectively in an organization if it operates in isolation. The study thus therefore suggests that rather than abandoning EOQ for JIT, they should complement each other. Each cannot effectively work in Isolation. This is because both have weakness and strengths which includes: strengths of JIT: JIT makes production operations more efficient, cost effective and customer responsive. JIT allows manufacturers to purchase and receive components just before they're needed on the assembly line, thus relieving manufacturers of the cost and burden of warehousing and managing idle parts. While JIT weaknesses include: In just-in-time, everything is very interdependent. Everyone relies on everybody else" (Greenberg, 2002). Furthermore, the functions of EOQ and JIT are summarized as:

1. Economic Order Quantity (EOQ) is a production method that aims at maintaining the amount of materials at a desired level at a minimum cost while Just-in-Time (JIT) is a Japanese management philosophy which aims at providing customers with the right kind and amount of stocks at the right time.
2. EOQ maintains a fixed amount of material in its inventory and has a reorder level wherein it must be replenished to avoid shortages and extra costs while JIT focuses on meeting customers' demands on time with the right quality and quantity with minimum resource, time, and material wastes.
3. Both are intended to reduce costs and increase the company's profitability. While EOQ is dependent on financial and marketing strategy, JIT is dependent on the work ethics and commitment of the entire workforce of the company.

With these in mind, both need to complement rather than stand alone for organizations to ensure proper inventory management. This perhaps is what is obtainable in NBC Plc, that have given them a high reputation for consistent and continues profitability in the manufacturing business.

5.2 AREAS OF FURTHER RESEARCH

1. The relationship of other variables of EOQ such as demand can be incorporated to look at how it impacts on the net profit of NBC PLC.
2. This same work can be replicated for other companies in different sectors such banking industry and other services sectors.
3. The impact of taxation and interest payment on the net profit of NBC plc can also be research.

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APPENDIX ONE

SPSS OUT PUT OF REGRESION ANALYSIS OF EOQ VARIABLES OF NBC PLC.

TRANSLATE FROM = 'OHC.WK1' /RANGE A1..C29.

Data written to the active file.
6 variables and 29 cases written.
6 of 603 storage units used.

Page 2 SPSS/PC+ 6/17/13

This procedure was completed at 15:32:14
TITLE = 'HYPOTHSIS ONE'.
VARIABLE LABELS A 'OP PROFIT' B 'COST OF SALE' C 'OVERHEADS'.
REGRESSION VARIABLES = A B
/STATISTICS = ALL
/DEPENDENT = B
/METHOD = ENTER
/RESIDUAL = DURBIN.

Page 3 = 'HYPOTHSIS ONE' 6/17/13

* * * * M U L T I P L E R E G R E S S I O N * * * *

Listwise Deletion of Missing Data

Equation Number 1 Dependent Variable.. B COST OF SALE

Block Number 1. Method: Enter

Variable(s) Entered on Step Number 1.. A OP PROFIT

Multiple R .76396 Analysis of Variance
R Square .58363 R Square Change .58363 DF Sum of Squares Mean Square
Adjusted R Square .56821 F Change 37.84666 Regression 1 5557557410.73048 5557557410.73048
Standard Error 12117.92266 Signif F Change .0000 Residual 27 3964789341.61710 146844049.68952

F = 37.84666 Signif F = .0000

Page 4 = 'HYPOTHSIS ONE' 6/17/13
AIC 547.26926
PC .47805
CP 2.00000
SBC 550.00385

Var-Covar Matrix of Regression Coefficients (B)
Below Diagonal: Covariance Above: Correlation

A

A 1.46885

Page 5 = 'HYPOTHSIS ONE' 6/17/13

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. B COST OF SALE

XTX Matrix

	A	B
A	1.00000	-.76396
B	.76396	.41637

Page 6 = 'HYPOTHSIS ONE' 6/17/13

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. B COST OF SALE

---------- Variables in the Equation ----------

Variable	B	SE B	95% Confdnce Intrvl B		Beta	SE Beta	Correl	Part Cor	Partial	Tolerance	VIF
A	7.455954	1.211963	4.969211	9.942697	.763959	.124181	.763959	.763959	.763959	1.000000	1.000
(Constant)	1614.827339	3045.757928	-4634.551761	7864.206440							

---------- in ----------

Variable	T	Sig T
A	6.152	.0000
(Constant)	.530	.6003

Page 7 = 'HYPOTHSIS ONE' 6/17/13

Collinearity Diagnostics

Number	Eigenval	Cond	Variance Proportions	
		Index	Constant	A
1	1.67391	1.000	.16304	.16304
2	.32609	2.266	.83696	.83696

End Block Number 1 All requested variables entered.

Page 8 = 'HYPOTHSIS ONE' 6/17/13

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. B COST OF SALE

Summary table

Step	MultR	Rsq	AdjRsq	F(Eqn)	SigF	RsqCh	FCh	SigCh	Variable	BetaIn	Correl
1	.7640	.5836	.5682	37.847	.000	.5836	37.847	.000	In: A	.7640	.7640

OP PROFIT

Page 9 = 'HYPOTHSIS ONE' 6/17/13

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. B COST OF SALE

Residuals Statistics:

	Min	Max	Mean	Std Dev	N
*PRED	1754.9993	46082.1367	14242.1793	14088.4418	29
*RESID	-19697.1367	30368.8945	.0000	11899.5638	29
*ZPRED	-.8863	2.2600	.0000	1.0000	29
*ZRESID	-1.6255	2.5061	.0000	.9820	29

Total Cases = 29

Durbin-Watson Test = .67709

Page 10 = 'HYPOTHSIS ONE' 6/17/13

This procedure was completed at 15:32:14

TRANSLATE FROM = 'OHC.WK1' /RANGE A1..C29.

Data written to the active file.
6 variables and 29 cases written.
6 of 603 storage units used.

Page 11 = 'HYPOTHSIS ONE' 6/17/13

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REGRESSION VARIABLES = A C
/STATISTICS = ALL
/DEPENDENT = C
/METHOD = ENTER
/RESIDUAL = DURBIN.

Page 12 = 'HYPOTHESIS TWO 6/17/13

* * * * M U L T I P L E R E G R E S S I O N * * * *

Listwise Deletion of Missing Data

Equation Number 1 Dependent Variable.. C OVERHEADS

Block Number 1. Method: Enter

Variable(s) Entered on Step Number 1.. A OP PROFIT

Multiple R	.82024			Analysis of Variance			
R Square	.67279	R Square Change	.67279		DF	Sum of Squares	Mean Square
Adjusted R Square	.66067	F Change	55.51589	Regression	1	866047148.96300	866047148.96300
Standard Error	3949.68200	Signif F Change	.0000	Residual	27	421199674.33493	15599987.93833

F = 55.51589 Signif F = .0000

Page 13 = 'HYPOTHESIS TWO 6/17/13

AIC 482.24833
PC .37569
CP 2.00000
SBC 484.98292

Var-Covar Matrix of Regression Coefficients (B)
Below Diagonal: Covariance Above: Correlation

A

A .15604

Page 14 = 'HYPOTHESIS TWO 6/17/13

**** M U L T I P L E R E G R E S S I O N ****

Equation Number 1 Dependent Variable.. C OVERHEADS

XTX Matrix

A ³ C
³

A 1.00000 ³ -.82024
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄ
C .82024 ³ .32721

Page 15 = 'HYPOTHESIS TWO 6/17/13

**** M U L T I P L E R E G R E S S I O N ****

Equation Number 1 Dependent Variable.. C OVERHEADS

---------- Variables in the Equation ----------

Variable B SE B 95% Confdnce Intrvl B Beta SE Beta Correl Part Cor Partial Tolerance VIF

A 2.943283 .395024 2.132761 3.753805 .820238 .110086 .820238 .820238 .820238 1.000000 1.000
(Constant) 835.204062 992.725867 -1201.701178 2872.109302

---------- in ----------

Variable T Sig T

A 7.451 .0000
(Constant) .841 .4076

Page 16 = 'HYPOTHESIS TWO 6/17/13

Collinearity Diagnostics

Number Eigenval Cond Variance Proportions
Index Constant A
1 1.67391 1.000 .16304 .16304
2 .32609 2.266 .83696 .83696

End Block Number 1 All requested variables entered.

Page 17 = 'HYPOTHESIS TWO 6/17/13

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. C OVERHEADS

Summary table

Step MultR Rsq AdjRsq F(Eqn) SigF RsqCh FCh SigCh Variable BetaIn Correl
1 .8202 .6728 .6607 55.516 .000 .6728 55.516 .000 In: A .8202 .8202 OP PROFIT

Page 18 = 'HYPOTHESIS TWO 6/17/13

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. C OVERHEADS

Residuals Statistics:

	Min	Max	Mean	Std Dev	N
*PRED	890.5378	18388.9434	5819.9276	5561.4976	29
*RESID	-6368.9429	11312.1504	.0000	3878.5107	29
*ZPRED	-.8863	2.2600	.0000	1.0000	29
*ZRESID	-1.6125	2.8641	.0000	.9820	29

Total Cases = 29

Durbin-Watson Test = .78691

Page 19 = 'HYPOTHESIS TWO 6/17/13

This procedure was completed at 15:32:14

APPENDIX TWO

ANNUAL FINANCIAL STATEMENTS OF NBC PLC.

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