



Economic Order Quantity Dimensions and Efficiency of Manufacturing Industry in Enugu Metropolis

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Abstract

This study examined relationship between economic order quantity and efficiency of telecommunication industry in Enugu metropolis. The objectives of the study were to ascertain the degree of relationship between ordering cost and average cost of operation of telecommunication firms in Enugu metropolis and determine the degree of relationship between carrying cost and cost of re-work in telecommunication firms in Enugu metropolis. The descriptive survey research design was adopted in the study. The population of the study was 185 while the sample size of 185 was adopted using complete enumeration. The data were analysed using inferential statistics while the hypotheses were tested using the z-test statistics. The findings included that there was significant positive relationship between ordering cost and average cost of operations of telecommunication firms in Enugu metropolis (Spearman calculated coefficient, 0.6 > Spearman table, 0.05) and there was significant positive relationship between carrying cost and cost of re-work in manufacturing industry (Spearman calculated coefficient, 0.9 > Spearman table, 0.05) in Enugu metropolis. This study concluded that economic order quantity had significant positive relationship with the efficiency of the telecommunication industry in Enugu metropolis and it was recommended that management of telecommunication firms should be conscious of the average cost of operation by minimizing the ordering cost of their firms and also try to reduce the carrying cost to avoid re-work that may affect the efficiency of the firm.

Keywords Economic Order Quantity; Manufacturing Industry; Enugu Metropolis

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Introduction

The success of many businesses is related to their ability to provide customers with the required goods and services in the right place and at the right time (Guga & Musa, 2020). These days companies have to be fast and nimble enough to respond quickly to changes in customers' demands and apply the changes as soon as possible to satisfy their customers. Manufacturers cannot stock large quantities of raw materials, or load-up all the inventories on the workstations. This old-fashioned method in stocking the inventories leads to unpredictable and long lead times, high maintenance costs, and high waste costs

More so, inventories are assets of the firm, and as such they represent an investment. Because such investment requires a commitment of funds, therefore a firm has to maintain inventories at the correct level. If they become too large, the firm loses the opportunity to employ those funds more effectively. Similarly, if they are too small, the firm may lose sales (Kumar, 2018).

However, different businesses adopt different inventory techniques depending on their activity, but an interesting technique of inventory management is the economic order quantity (EOQ). Economic order quantity (EOQ) as a model was introduced in 1913 by Ford W. Harris. However, Wilson R H and Andler K have received a lot of praises for their in-depth analysis and application of the EOQ model (Hax and Candea, 1984).

Orga (2013) posits that economic order quantity is the order quantity at which the total costs of inventory are minimized. In stock management, EOQ is an important inventory management system that demonstrates the quantity of an item to reduce the total cost of both handling of inventory and order processing. One of the key advantages of using the EOQ technique is that it helps to improve the profit levels of your business. Some of the other key advantages are as follows: If a customer requirement for a specific product arises on the spur of the moment, the optimal EOQ technique assures that the item is available and ready for sale. This type of service increases your goodwill, sales and profit margins. EOQ gives you an exact timeline of your inventory requirements. It protects you from indulging in the excess ordering of goods which keeps your cash tied up in inventory. Since EOQ provides optimal schedules for placing inventory orders, you will be spared from losses that occur due to stocks that become obsolete. It reduces a lot of wastage, especially in the case of perishable products.

EOQ helps to maintain the perfect balance between placing orders on demand. It reduces the necessity of unnecessary stocking of products. You stand to gain fewer payments for storage, security, and insurance, among other costs. With respect to an item to be ordered, from a business point of view, the EOQ model establishes the amount of quantity to be placed in an order in consideration of minimizing the annual total cost of inventory handling and order processing. It is based on this background that this study examined economic order quantity dimensions and efficiency of manufacturing industry in Enugu metropolis.

Statement of the Problem

Inventory technique of economic order quantity helps companies manage their inventory efficiently. Without inventory management technique like EOQ, companies will tend to hold too much inventory during periods of low demand while also holding too little inventory during periods of high demand. Businesses that follow EOQ look at all costs related to purchasing and delivery while also factoring in demand for the product, purchase discounts and holding costs.

Unfortunately, changing consumer demand, seasonal changes in inventory costs, lost sales revenue due to inventory shortages, or purchase discounts a company might realize for buying inventory in larger quantities might compel a firm not to consider inventory control. Another disadvantage of EOQ is that it ignores the need to have buffer stocks, which are maintained to cater for variations in lead-time and demand making it difficult to be observed in practice. In addition, the EOQ model does not account for seasonal or economic fluctuations and is most limited by the assumption of a one-product business, and the formula does not allow for combining several different products in the same order.

The inevitable consequence of not adopting EOQ in the telecommunication industry is that it could lead to increase in the average cost of operation and also increase in the cost of waste. This is because any default in the ordering

cost could lead to increase in the average cost of operation. Furthermore, any default in the carrying or holding cost could lead to increase in cost of waste as a result of pilferage, rodent or weevil attack etc.

Objectives of the Study

The broad objective of the study was to examine the relationship between economic order quantity and efficiency of manufacturing industry in Enugu metropolis. The specific objectives of the study included to:

- i. Ascertain the degree of relationship between ordering cost and average cost of operation of manufacturing firms in Enugu metropolis
- ii. Determine the degree of relationship between carrying cost and cost of re-work in manufacturing firms in Enugu metropolis

Research Questions

Based on the objectives of the study, the following research questions were raised to guide the study

- i. To what degree does ordering cost relate with the average cost of operation of manufacturing firms in Enugu metropolis?
- ii. To what degree does carrying cost relate with cost of re-work in manufacturing firms in Enugu metropolis?

Statement of Hypotheses

In line with the research questions, the following alternate hypotheses were formulated

- i. There is significant positive relationship between ordering cost and average cost of operation of manufacturing firms in Enugu metropolis
- ii. There is significant positive relationship between carrying cost and cost of re-work in manufacturing firms in Enugu metropolis

Significance of the Study

This study will be beneficial to the management of telecommunication firms because through the findings of this study they will be more enlightened on the various costs associated with inventory and the implications of those costs to the profitability of the manufacturing industry. Furthermore, this study will serve as a invaluable material for further research on this topic.

Scope of the Study

This study covered economic order quantity dimensions and the efficiency of manufacturing firms. The independent variables covered in this study were ordering cost and carrying cost while the dependent variables covered were average cost of operation and customer patronage. The geographical scope is Enugu metropolis.

Review of Related Literature

Conceptual Review

Economic Order Quantity

Orga (2013) defines economic order quantity as the order quantity at which the total costs of inventory are minimized. Economic order quantity (EOQ) is a replenishment model designed to help you minimize your inventory costs, and overall, improve your inventory and supply chain management. Every time you place a purchase order, you have to pay the item manufacturer for your goods. In some cases, you may also have to pay a flat fee per order as well. But increasing your ordering cost by ordering more products at a time may allow you to enjoy a quantity discount (lower cost-per-item). Then, once you've received your products, you have to pay to store those products. And ordering more units at a time would make your storage cost higher. The trick is knowing your *optimal order quantity* to help you balance your production costs and your inventory carrying costs. The EOQ formula helps you

determine your total inventory costs (including both production and storage costs). You can use this formula to determine the optimal quantity of products you should order at a time and how often to order (assuming customer demand stays constant).

Carrying or Holding Cost

Holding costs are the additional costs which are required to maintain an inventory unit over a year. Holding costs are those which are related to accumulate the unsold inventories. Holding costs are applied to the whole inventories, not only the ones in use. They are the most significant costs and can be calculated regardless of any other costs such as ordering costs and shortage costs. Holding costs consist of four different categories as follows:

Finance: Companies hold some money due to inventories' restraint such as Cost of Capital (CoC), or the opportunity cost of the money. It is the substantial section of each company's carrying cost. Cost of debts and cost of equity can be categorized under the Cost of Capital. This cost should be calculated daily.

Damage: Depreciation cost is a value of a fixed asset net of all accumulated depreciation which has been recorded against it. In other words, the more the inventory stays in the store, the more the chance is to get damaged.

Obsolescence: Obsolescence is the decrease in the value of a property caused by factors such as technological changes, regulatory changes, and excess supply. If the inventory is in the store for too long, there is less chance to be sold, and it is designated as obsolete. Obsolescence is a significant cost specially in businesses which new products come to the market periodically.

Warehousing cost: Warehousing costs consist of electricity, rent, overtime, insurance, maintenance, human labor and all the costs to receive, store and load the inventories. Employee benefits and payroll taxes are categorized under warehousing costs. In general warehousing cost is cost of raw materials, packaging and product displays, labor, blending, filling, product shipping cost, product liability insurance.

Ordering Cost

Ordering costs are the costs related to the preparation of a supplier's order, including the cost of placing an order, inspection costs, documentation costs, and others. Typically, ordering costs include expenses for a purchase order, labor costs for the inspection of goods received, labor costs for placing the goods received in stock, labor costs for issuing a supplier's invoice and labor costs for issuing a supplier payment. These costs are irrelevant from the size of the order and are incurred every time a firm places an order. Furthermore, the ordering costs are inversely related to the inventory carrying costs, i.e., the lower the carrying costs, the higher the ordering costs. Orga (2013) states that ordering costs include tooling cost, set-up cost, clerical and administrative cost of purchasing and fixed transportation cost.

Efficiency

Steiner (2018) states that efficiency is the ability to avoid wasting materials, energy, efforts, money, and time in doing something or in producing a desired result. In a more general sense, it is the ability to do things well, successfully, and without waste. In more mathematical or scientific terms, it is a measure of the extent to which input is well used for an intended task or function (output). Wison (2018) defines efficiency as the ability to do something or produce something without wasting materials, time, or energy: the quality or degree of being efficient (technical), but also as the power to produce the desired result.

Average Cost of Operation

Operating (Operational) costs are the expenses which are related to the operation of a business, or to the operation of a device, component, piece of equipment or facility (Anderson, 2009). They are the cost of resources used by an organization just to maintain its existence. The formula for average cost of operation is

$$\text{Average Cost} = \frac{\text{Total Cost}}{\text{Quantity}} = \frac{Tc}{Q}$$

Operation Cost = Cost of goods sold + operating expenses.

Cost of Re-work

This is the cost of re-doing a work when it has been discovered that there was a defect in the work previously done. The cost of re-work is a measure of the efficiency of operation of the organization. The cost of re-work further adds to the cost of operation thereby making the organization inefficient in its operation process.

Theoretical Framework

Deterministic Inventory Model

This model was developed by F.W. Harris in 1913 and is also known as Wilson EOQ model, who critically analyzed the model. The EOQ model requires that for every item stocked in the stores, there is need to determine the point of order and that of the most cost-effective quantity to order. The model assumes that all other variables are constant even though uncertainties are common and regular in all business. For instance, uncertainties may include change in demand, damage during transportation and delay in delivery. Uncertainty in demand, will therefore force EOQ to be adjusted to buffer against uncertain business atmosphere. Blackburn (2010) is among researchers who agree that EOQ is one of the models widely used to manage inventory in many industries. Economic Order Quantity approaches have proven to be effectively inventory management technique when the demand and lead time are relatively stable, as well as when significant variability and uncertainty exist. Coleman (2002) and Ogbo (2011) adopted EOQ and applauded the model as one that order quantities which minimize the balance of cost between inventories holding costs and re-order costs. However, the use of EOQ model has shown increase in some costs as other costs decline, an example of ordering costs declines with the inventory holdings, while holding costs rise and the total inventory associated costs curve have a minimum point.

Empirical Review

In line with objectives of the study, the following empirical studies were reviewed

Relationship between Ordering Cost and Average Cost of Operation

In a study conducted by Anichebe (2019) in Lagos state on the effect of ordering cost on average cost of operation of the pharmaceutical industry, a population of 112 workers was studied using the survey method of research and questionnaire as the major instrument of data collection. The z-test statistics was used to analyze the data and it was found that ordering cost has significant effect on the average cost of operation of the pharmaceutical industry.

Furthermore, Juan (2019) conducted a similar study on the relationship between ordering cost and average cost of operation in the manufacturing industry in Kuala Lumpur, in the study a population of 276 workers was studied using the survey method of research and questionnaire as the instrument of data collection, the Spearman rank order correlation coefficient was used to analyze the data and it was found that ordering cost has significant relationship with average cost of operation.

In a related study conducted by Moore (2019) in Texas on the extent ordering cost affects the average cost of operation of the brewery industry, in the study a population of 346 workers was studied using the survey method of research and questionnaire as the instrument of data collection. The analysis of variance (ANOVA) was used to analyze the data and it was found that ordering cost has significant relationship with the average cost of operation of the brewery industry.

Namit (2019) carried out a study in New Jersey on the effect of ordering cost on the average cost of operation of the textile industry. In the study a population of 457 workers was studied using the survey method of research and questionnaire as the instrument of data collection. The Chi-square statistical tool was used to analyze the data and it was found that ordering cost has significant effect on the average cost of operation of the textile industry.

Carrying Cost and Cost of Re-Work

Falope (2020) conducted a study in Lagos state on the effect of carrying cost on cost of re-work of the manufacturing industry. In the study a population of 327 workers was studied using the survey method of research and questionnaire as the major instrument of data collection. The z-test statistical tool was used to analyze the data and it was found that carrying cost has significant effect on the cost of re-work of the manufacturing industry.

In a study conducted by Prempeh (2020) in New Jersey on the relationship between carrying cost and cost of re-work in the fast-food industry a population of 234 workers was studied using the survey method of research and questionnaire as the instrument of data collection, the Pearson Product Moment Correlation Coefficient was used to analyze the data and it was found that carrying cost has significant relationship with the cost of re-work in the fast food industry.

More so, Hassan (2020) conducted a study in Pakistan on the extent carrying cost affects cost of re-work in the manufacturing industry, in the study a population of 276 workers was studied using the survey method of research and questionnaire as the instrument of data collection, the analysis of co-variant (ANCOVA) was used to analyze the data and it was found that carrying cost affects cost of re-work in the manufacturing industry to a large extent.

Finally, Bartoli (2020) carried out a study on the effect of carrying cost on the cost of re-work in the pharmaceutical industry in Florence, in the study a population of 113 workers was studied using the survey method of research and questionnaire as the instrument of data collection. The statistical package for the social scientist (SPSS) was used to analyze the data and it was found that carrying cost has significant effect on the cost of re-work in the pharmaceutical industry.

Gap in Empirical Review

Many studies have been conducted on economic order quantity and efficiency of manufacturing industry but there is a lack of literature on variables used in this study: ordering cost and carrying cost as independent variables and average cost of operation and cost of re-work as dependent variables. More so, majority of the works on this topic were conducted in the western and other parts of Nigeria but this work was conducted in Enugu metropolis, South Easter Nigeria. Furthermore, there is a dearth of literature on the deterministic inventory model used in this study. Furthermore, many researchers that carried out this study conducted their study on the manufacturing industry but this study was conducted on the telecommunication industry. Hence, the study covered the gap

Methodology

Research Design

This study adopted the survey descriptive research design. Ogutu (2012) posits that a survey research method is probably the best method available to social scientists who are interested in collecting original data for purposes of describing a population which is large to observe directly Survey method was adopted because the problem under study demanded the technique of questionnaire as the principal means of collecting data and survey is cost effective both for large and small population. Also, survey design became necessary because the researcher had no control of the variables under study.

Area of the Study

The geographical location of the study is Hardis & Dromedas located at Emene, Alo Aluminium located at Abakaliki Road and Juhel pharmaceuticals at Emene all in Enugu East LGA.

Sources of Data

Primary and secondary sources of data constituted the sources of data for this study. The primary source comprised members of staff of the selected manufacturing firms while the secondary source of data were those sources of data, which were not the original material of the researcher. They included textbooks, journals, internet materials, seminar etc. mainly from the various libraries in Enugu state.

Population of the Study

Population may be defined as all the conceivable elements that make up a group. The researcher studied all the members of staff of Hardis & Dromedas, Alo Aluminium and Juhel Pharmaceuticals. The breakdown of the population is as follows:

Table 1: Distribution of the Population

<i>S/NO</i>	<i>Firms</i>	<i>Number of Workers</i>
1	Hardis & Dromedas	69
2	Alo Aluminium	52
3	Juhel Pharmaceuticals	64
	Total	185

Source: Personnel Audit of the Manufacturing firms, 2023.

Therefore, the population of the study is 185

Determination of Sample Size

The researcher did complete enumeration by adopting the rule guiding population and sampling. Onodugo (2010) posits that if the population of study is small, the researcher should study the population and use it as the sample size. Therefore, the sample size was 185 meaning that the researcher had complete enumeration..

Sampling Technique

The study adopted the simple random sampling technique. In the simple random sampling technique, the researcher randomly selected the respondents and could not influence the choice of those selected. The number of respondents selected was used as a representative of the entire population.

Instruments of Data Collection

Structured questionnaire was used as the instrument of data collection. The questionnaire was divided into two sections, section A and section B. Section A discussed the Bio-data of the respondents while section B was based on the research questions.

Validity of the Instrument

Validity of the instrument, means the extent to which the research instrument measures what it is supposed to measure or accomplishes what it is supposed to accomplish. The researcher adopted expert (face) validity where the supervisor scrutinized the questionnaire items to confirm that they are related to the research questions.

Reliability of the Instrument

Reliability refers to the consistency of scores obtained by the same individuals when presented with the same test on different sets of equivalent items, or under other variable examining conditions (Ikeagwu, 1998). The researcher made use test re-tests method in order to ascertain the consistency in the first and second responses. The reliability coefficient obtained was 0.81 which was arrives at by the use of Pearson Product Moment Correlation Coefficient. The 0.81 reliability coefficient showed that the reliability was good.

Method of Data Analysis

The method of data analysis consisted of inferential statistics. The descriptive statistics such as percentages, frequency tables and mean were used while the Spearman Rank Order Correlation Coefficient was used to test the hypothesis.

Decision Rule: Accept the alternate hypothesis if the calculated spearman rank correlation coefficient is > than the table spearman rank correlation. Reject the alternate hypothesis if otherwise.

Data Presentation

Distribution and Return of Questionnaire:

Table 4: Distribution and Return of Questionnaire

Manufacturing Firm	Number of Questionnaire Distributed	Number of Questionnaire Returned	Number of Questionnaire Lost	% of Valid Questionnaire
<i>H & D</i>	69	63	6	34
<i>Alo Aluminum</i>	52	47	5	25
<i>Juhel Pharm.</i>	64	58	6	31
Total	185	168	17	90

Source: Field Survey, 2023.

Table 4, shows that out of a total of 69 copies of questionnaire distributed to the workers of H & D, 6 copies were lost, while 63 copies representing 34% of the total copies were returned. Out of a total of 52 copies of questionnaire distributed to the workers of Alo Aluminum, 5 copies were lost while 25 copies representing 47% of the total copies were returned. Out of 64 copies of questionnaire distributed to the workers of Juhel pharmaceuticals, 6 copies were lost while 58 copies representing 31% of the total copies were returned. Therefore, the total number of valid questionnaire is 155 copies representing 90% of the total copies of questionnaire distributed.

Data Relating to Research Questions

To what degree does ordering cost relate with the average cost of operation of manufacturing firms in Enugu metropolis?

Table 5: Mean rating of the degree to which ordering cost relate with the average cost of operation of manufacturing firms in Enugu metropolis

S/N	ITEMS	SA (5)	A (4)	U (3)	D (2)	SD (1)	Total	Mean
1	Necessary to know the cost of job	50 (30%)	63 (37%)	19 (11%)	21 (13%)	15 (9%)	168	3.67
2	A clearer view of when you need to order new items	58 (35%)	55 (33%)	16 (10%)	21 (12%)	18 (11%)	168	3.68
3	Maximizing a company's capability to generate more revenue	62 (37%)	54 (32%)	17 (10%)	21 (12%)	14 (8%)	168	3.77

Grand Mean of Table = 3.71

Table 5 shows that 50 respondents strongly agree that ordering cost is related to the average cost of operation because ordering cost is necessary to know the cost of job, 63 respondents agree, 19 respondents were undecided, 21 respondents disagree while 15 respondents strongly disagreed with a mean of 3.67.

Table 5 shows that 58 respondents strongly agree that ordering cost is related to the average cost of operation because ordering cost gives a clearer view of when you need to order new items, 55 respondents were undecided, 16 respondents were undecided, 21 respondents disagree while 18 respondents strongly disagreed with a mean of 3.68

Table 5 shows that 62 respondents strongly agree that the ordering cost is related to the average cost of operation because ordering cost maximizes a company's capability to generate more revenue, 54 respondents agreed, 17 respondents were undecided, 21 respondents disagreed while 14 respondents strongly disagreed with a mean of 3.77. The grand mean of table is 3.71

To what degree does carrying cost relate with cost of re-work in manufacturing firms in Enugu metropolis?

Table 6: Mean rating of the degree to which carrying cost relate with the cost of re-work in manufacturing firms

<i>S/N</i>	<i>ITEMS</i>	<i>SA</i> <i>(5)</i>	<i>A</i> <i>(4)</i>	<i>U</i> <i>(3)</i>	<i>D</i> <i>(2)</i>	<i>SD</i> <i>(1)</i>	<i>Total</i>	<i>Mean</i>
1	Reduces available cash flow	47 (28%)	61 (36%)	18 (11%)	26 (15%)	16 (19%)	168	3.58
2	Loss due to shifting customer demand	62 (37%)	64 (38%)	17 (10%)	14 (8%)	11 (7%)	168	3.91
3	Excess inventory takes additional labour hours	55 (32%)	50 (29%)	21 (14%)	19 (14%)	23 (11%)	168	3.57

Grand Mean of Table = 3.69

Table 6 shows that 47 respondents strongly agree that the degree to which carrying cost relate with the cost of re-work in manufacturing firms is that it reduces available cash flow, 61 respondents agree, 18 respondents were undecided, 26 respondents disagree while 16 respondents strongly disagreed with a mean of 3.58

Table 6 shows that 62 respondents strongly agree that the degree to which carrying cost relate with the cost of re-work in manufacturing firms is loss due to shifting customer demand, 64 respondents agree, 17 respondents were undecided, 14 respondents disagree while 11 respondents strongly disagree with a mean of 3.91

Table 6 shows that 55 respondents strongly agree that the degree to which carrying cost relate with the cost of re-work in manufacturing firms is that excess inventory takes additional labour hours, 50 respondents agreed, 21 respondents were undecided, 19 respondents disagreed while 23 respondents strongly disagreed with a mean of 3.57. The grand mean of the table is 3.69

Test of Hypotheses

This section dealt essentially with statistical testing of the hypotheses formulated for this study and also interpreting the result making use of Spearman Rank Correlation Coefficient.

Test of Hypothesis One

H₁: There is significant positive relationship between ordering cost and average cost of operation of manufacturing firms in Enugu metropolis

Table 7

<i>Variable</i>	<i>Data 1</i>	<i>Data 2</i>	<i>Rank 1</i>	<i>Rank 2</i>	<i>D</i>	<i>D²</i>
<i>A</i>	50	58	4	5	1	1
<i>B</i>	63	55	5	4	1	1
<i>C</i>	19	16	3	1	2	4
<i>D</i>	21	21	2	3	1	1
<i>E</i>	15	18	1	2	1	1
					$\sum D^2 = 8$	

Calculating the Spearman Rank: Correlation coefficient of the ranked data

$$R = 1 - (6 \sum d^2) / n(n^2-1)$$

Analysis of the Result: Spearman rank correlative (calculated) = 0.6

Spearman rank (table) $p = 0.05$ is less than 0.6 Calculating the Spearman rank correlation coefficient of the ranked data= $R = 1 - (6 \sum d^2) / n(n^2-1)$

Analysis of the Result:

Spearman rank correlation (calculated) = 0.6 Spearman rank (table) at p 0.05 is less than 0.6

The first hypothesis states that there is significant positive relationship between ordering cost and average cost of operation of manufacturing firms in Enugu metropolis

The calculated spearman rank correlation (0.6) is greater than the table spearman rank correlation (0.05). Therefore, the hypothesis is accepted. Hence, there exist significant positive relationship between ordering cost and average cost of operation of manufacturing firms in Enugu metropolis.

Test of Hypothesis Two

H₂: There is significant positive relationship between carrying cost and cost of re-work in manufacturing firms in Enugu metropolis

Table 8

Variable	Data 1	Data 2	Rank 1	Rank 2	D	D ²
A	47	62	4	4	0	0
B	61	64	5	5	0	0
C	18	17	2	3	1	1
D	26	14	3	2	1	1
E	16	11	1	1	0	0
				$\sum D^2 = 2$		

Calculating the Spearman Rank: Correlation coefficient of the ranked data

$$R = 1 - (6\sum d^2) / n(n^2-1)$$

Analysis of the Result: Spearman rank correlative (calculated) = 0.9

Spearman rank (table) p = 0.05 is less than 0.9 Calculating the Spearman rank correlation coefficient of the ranked data= $R = 1 - (6\sum d^2) / n(n^2-1)$

Analysis of the Result:

Spearman rank correlation (calculated) = 0.9 Spearman rank (table) at p 0.05 is less than 0.9

The second hypothesis states that there is significant positive relationship between carrying cost and cost of re-work in manufacturing firms in Enugu metropolis. The calculated spearman rank correlation (0.9) is greater than the table spearman rank correlation (0.05). Therefore, the hypothesis is accepted. Hence, there exist significant positive relationship between carrying cost and cost of re-work in manufacturing firms in Enugu metropolis.

Discussion of Findings

Ordering Cost and Average Cost of Operation

There is significant positive relationship between ordering cost and average cost of operations of manufacturing firms in Enugu metropolis. The statement was confirmed to be true in the comparison of the study's findings with the empirical review. The evidence is shown in the calculated value (0.6) which is greater than the table value (0.05). In the empirical review, Moore (2019) carried out a research on the extent ordering cost affects the average cost of operation. In the study, a population of 346 employees was adopted, unlike in the study carried out by the researcher where a population of 185 employees was used. Moore (2019) used the ANOVA in the analysis unlike in this study where the Spearman Rank Order Correlation Coefficient was used in the analysis. Moore (2019) conducted the study in Texas unlike the researcher that conducted the study in the South East Nigeria. The researcher found that ordering cost has significant relationship with average cost of operation, just like the study carried out by Moore (2019) and it was finally concluded that there is significant positive relationship between ordering cost and average cost of operations of telecommunication firms in Enugu metropolis.

Carrying Cost and Cost of Re-work

There is significant positive relationship between carrying cost and cost of re-work in manufacturing firms in Enugu metropolis. The statement was confirmed to be true in the comparison of the findings of study with the empirical review. The evidence is shown in the calculated value (0.9) which is greater than the table value (0.05). In the empirical review, Hassan (2020) carried out a research on effect on the relationship between carrying cost and cost of waste in the brewery industry, Nigeria. In the study, study a population of 276 employees was studied unlike in this study by the researcher where a population of 185 was used. In the study by Hassan (2020), the ANCOVA was used in the analysis unlike in the study by the researcher where Spearman Rank Order Correlation Coefficient was used in the analysis. Hassan (2020) carried out the study in Pakistan unlike the researcher that carried out the study in the South East. By comparison, the result of Hassan (2020) and that of the researcher were found to be the same. The researcher's opinion is that there is significant positive relationship between carrying cost and cost of re-work in telecommunication firms in Enugu metropolis.

Summary of Findings

- i. There was significant positive relationship between ordering cost and average cost of operations of manufacturing firms in Enugu metropolis. (Spearman calculated, 0.6 > Spearman table, 0.05)
- ii. There was significant positive relationship between carrying cost and cost of re-work in manufacturing firms in Enugu metropolis (Spearman calculated, 0.9 > Spearman table, 0.05)

Conclusion

Based on the findings, the researcher concluded that economic order quantity had significant positive relationship with the profitability of the manufacturing industry. Furthermore, economic order quantity had significant positive relationship with the efficiency of the telecommunication industry in Enugu metropolis.

Recommendations

The study recommended that management of manufacturing firms should

- i. Be conscious of the average cost of operation by minimizing the ordering cost of their firms
- ii. Also try to reduce the carrying cost to avoid re-work that may affect the efficiency of the firm.

Contribution to Knowledge

The study made some contributions to knowledge. This included:

- i. **Location:** Based on the researcher's knowledge, many studies on this topic have not been conducted in the Eastern part of Nigeria but this study was conducted in Enugu State, South East Nigeria.
- ii. **Design:** The researcher adopted the survey research method on the subject matter (Relationship between EOQ and profitability of the telecommunication industry) unlike other researchers that used Ex-post Facto research method and experimental research method.
- iii. **Variables:** The following constructs were adopted, ordering cost and carrying cost.
- iv. **Analytical Tool:** The researcher adopted the Pearson Product Moment Correlation Coefficient statistical tool in the analysis. Other researchers that have carried out similar studies used the chi-square and z-test etc.

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