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# JUST-IN-TIME (JIT) PRODUCTION SYSTEM OPERATIONALIZATION AND RELIABILITY OF MANUFACTURING TECHNOLOGY IN NIGERIA

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***Abstract:*** **This paper examined Just-in-Time (JIT), operationalization and reliability of manufacturing technology amongst SMEs in selected rural community in South-South in Nigeria. The questionnaire was the major instrument for data collection. The data obtained from a sample of 525 respondents were subjected to both descriptive (mean and standard deviation) and inferential statistics (Ordinary Least Square). JIT was proxied by three dynamics such as actual production time, actual machine time and order accuracy. The results indicate that actual production time, actual machine time and order accuracy positively impact on operationalization and reliability of manufacturing technology and is statistically significant. From the findings, it was concluded that JIT system shapers reliability. On this note, it was recommended among others that manufacturing concerns should deploy JIT in their manufacturing processes, as it will ensure reliability of manufacturing technology.**

***Keywords:*** **Just-in-Time, Manufacturing, Discounted Cash Flow, International Accounting Standard, Statement of Accounting Standard.**

## 1. INTRODUCTION

In manufacturing concerns, the most fundamental objective is to produce goods and render services that are of high quality to consumers, notably at the right time and lowered possible costs by way of satisfying consumers' needs and actualizing economic benefit of the producing firm. Actualizing economic benefit of manufacturing concerns result to producing goods/services at the minimum cost in order to maximize shareholders wealth. There are different approaches to the measure or appraisal of the wealth of the stakeholders, and this includes traditional and modern (Discounted Cash flow) approaches. The means of arriving at the different components that will facilitate the determination of the stakeholders' wealth are enormous especially as it relates with preparation of the organisations income statement and statement of financial position. These statements will be obtained after thorough valuation of the firm's inventory conventionally and other means in accordance with Financial Reporting Standards (FRS) of Nigeria generally known as Statement of Accounting Standards (SAS) and International Accounting Standards (IAS). Traditionally, accounting profits are used to determine whether a particular investment is viable or not and on the other hand, the viability is determined by calculating the payback period without considering the time value of the cash flows. In this case, the returns from the investment are compared to the outlay and other running cost to determine the period the returns payback. With the modern approach, the time value is strictly considered by discounting the cash flows to determine the Net Present Value (which is the stakeholders' wealth). Shareholders wealth maximization is one of the fundamental measures of optimum performance; hence, management tries to maximize shareholders wealth of manufacturing concerns by engaging in effective inventory system.

The questions are, whether the companies' inventory is properly managed. If properly managed, what methods are applied? Is it the traditional management accounting techniques or the modern techniques? If the modern management accounting systems are applied, are they the advanced manufacturing technologies? If they are adopted, are they operational and reliable in the Nigerian context? These questions provide the focus for this inquiry.

Advance Manufacturing Technology (AMT) is revolutionising the manner products are manufactured especially in what are termed world class manufacturers (Adeniyi, 2015).AMT is a general term that comprises the automated production technology, computer assisted design and manufacturing, flexible manufacturing systems, robotics, total quality control, and advances in production management which include materials requirement and manufacturing resources planning systems, just-in-time (JIT) and etc. These technologies assist organisations compete effectively and efficiently in the very dynamic, sophisticated markets (Flynn, Sakakibara& Schroeder, 1995; Furlan, Dal-Pont &Vinelli, 2010).One of the means of effectively competing in the market is proper production and operations management (Narasimhan, Swink& Kim, 2006). More importantly, JIT system is one of such advancements. JIT system of production was first introduced in Japan by TaichiOhno in 1970 after the second world-war as a result of the devastating economy which affected their manufacturing industry. Enormous defects, like rising cost of production, production delays and cultural factors existed in their manufacturing sector (Koh, et.al, 2007; and Mackelprang& Nair, 2010).The Japanese wanted to gain the most cost effective and efficient use of their limited resources as well as meeting customers' requirements (Ohno 1997; Colin, 2008 in Emmanuel &Oyadonghan 2014; Mistry, 2005).

In the light of the above, this study investigates whether JIT production system is operational and reliable in the Nigerian context. Specifically the study addressed whether dimensions like order accuracy, actual production, and actual machine time availability hinder the operationalization and reliability of the technology among small and medium scale enterprises in Bayelsa State. This paper is sectioned as follows: literature review, materials and methods, results, conclusion and policy implication.

## 2. LITERATURE REVIEW

### *2.1 Just-in-Time (JIT)*

In a manufacturing setting, the systems of planning and control is an information system running throughout the manufacturing process, given the fact that the manufacturing environment can be changedto make planning and control systems simpler and much more effective. Organizations are therefore seeking for measures or control techniques via which it can improve the manufacturing environment, hence the concept of Just-in-Time (JIT). According to Vijay and Keah (2005), JIT is a method of production system geared towards reducing waste of inventory, labour cost, space, work-in-progress, time (cycle, setup, lead, throughput, standard hours), increasing production and number of shipments, and improving quality including feedback from suppliers and to customers when goods are needed.

In the views of Shah and Ward (2007), JIT is a method that aims ateradicating waste by plummeting supplier, internal and customer variability via anintegrated socio-technical system that contains the simultaneous use of many practices.JIT may be referred to as lean manufacturing or Toyota production system, which provides useful control measures for manufacturing concerns. The features of a JIT control technique according to Holl, Pardo and Rama (2010) encompassuniform loading, pull system, repetitive process, synchronized production and using production cards. In addition, JIT tries to smooth the flow of materials from suppliers to customers, thus enhancing the rapidity of the manufacturing process. The objectives of JIT among others include enhanced product quality, product cost, flexibility of manufacturing process, responsiveness to customers as well as improved communication among departments and suppliers.

### *2.2 Theoretical Foundation*

The Just-in-Time (JIT) model or system of production is of the view that customers' needs are supplied only when they are demanded with high quality and almost zero closing inventory. This means that the firm's supply is always equal to the demand. That is, in JIT production system, customers' needs breakeven the supply. Some of the advantages of the technology are; carrying cost is completely eliminated, waste is minimized, there will be optimum performance.

### *2.3 Empirical Studies*

There is avalanche of empirical studies on just-in-time while there is dearth of empirical studies on just-in-time, operationalization and reliability of technology in Nigeria. Empirical studies as regards the spatial implications of JIT are however, inconclusive. For instance, Vijay and Keah (2005) empirically assessed the extent to which JIT, supply-chain management, and quality managementare associated, and how they influence business performances. The results clearly demonstrate that at both strategic and operational levels, connections exist between how JIT, TQM, and supply-chain management are viewed by manufacturing concerns as part of their operations strategy. Also, it was found that a commitment to qualityand an understanding of supply-chaindynamics have the greatest effect on business performance.

Holl, Pardo and Rama (2010)studied the spatial extent of subcontracting connections of medium and large-sized manufacturing firms operating in the automotive and electronics industries in Spain. Specifically, the study analysed how JIT organizations of production is linked to the spatial pattern of sourcing nexus when contractors' structural/ organizational features are taken into cognizance. The study finds that firms which implement new technologies and manufacturing systems at the plant level tend to prefer regional to extra-regional outsourcing. The results support the view that JITincreases the importance of proximity.

Gunawardana (2014) analysed the role of advanced manufacturing technology (AMT) in enhancing business performance and the problems encountered with adopting AMT. The study suggests that proper understanding of AMT encourages more firms to invest in AMT and realize the benefits to make more contributions to society by improving world standard quality of product.Santhirasegaran, Sitraselvi and Adam (2014) investigated the pitfalls in JIT practices affecting supply chain in Japan. The study found that the pitfalls surrounding the weakness particularly on small order retrieval, sudden jerk on demand, vendor capacity, inefficient flow of information between vendor-buyer, sudden change in new materials supply and constant revision of scheduling further dampened the lean system.

## 3. MATERIALS AND METHODS

In this paper, the survey design was employed. The population of the study comprised of both small and medium scale enterprises (SMEs) in selected rural communities. The respondents entail owner/employer, management staff and other categories of employees of SMEs. Given the enormous nature of the study population, the convenience sampling technique was employed in arriving at the study sample, resulting to525 participants within the SMEs subsector in South-South geopolitical region. Questionnaire formed the instrument of data collection and reliability test was conducted in order to ascertain the internal consistency of the research instrument which yieldedCronbach alpha values of 0.89 and 0.84 for the constructd investigated. The statistical analysis conducted comprised of both descriptive (i.e. percentage, frequency counts, mean andstandard deviation) and inferential (simple regression) statistics. The regression model is given as:

$$OPRE = F(ARAC, ACPT, ACMT) \quad - \quad eq.\ 1$$

Equation 1 above can be translated into a regression model and decomposed as follows:

$$OPRE = a_0 + ß_1 ARAC_i + \mu_t \quad - \quad eq.\ 2a$$

$$OPRE = a_0 + ß_1 ACPT_i + \mu_t \quad - \quad eq.\ 2b$$

$$OPRE = a_0 + ß_1 ACMT_i + \mu_t \quad - \quad eq.\ 2c$$

On the basis of equations 2a-2c, OPRE represents operationalization and reliability of technology, ACMT = actual machine time availability, ACPT=actual production time availability, ARAC=order accuracy, $a_0$,ß= regression coefficients; and $\mu_t$=error term. The statistical package - STATA 13.0 was used to perform data analysis.

## 4. RESULTS

**Table 1: Bio-Data of Respondents**

| S/N | Responses | Number of Respondents | Percentage |
|---|---|---|---|
| 1. | **Gender** | | |
| | Male | 378 | 72.0% |
| | Female | 147 | 28.0% |
| | **Total** | **525** | **100.0%** |
| 2. | **Marital Status** | | |
| | Single | 132 | 25.14% |
| | Married | 373 | 71.05% |
| | Separated | 3 | 0.57% |
| | Widowed | 17 | 3.24% |
| | **Total** | **525** | **100.0%** |
| 3. | **Qualification(s)** | | |
| | PhD | 12 | 2.29% |
| | M.Sc./MBA | 72 | 13.71% |
| | B.Sc./HND | 131 | 24.95% |
| | NCE/OND | 120 | 22.86% |

| | | | |
|---|---|---|---|
| | Others | 190 | 36.19% |
| | **Total** | **525** | **100.0%** |
| 4. | **Business Size** | | |
| | Small | 387 | 73.71% |
| | Medium | 138 | 26.29% |
| | **Total** | **525** | **100.0%** |
| 5. | **Position** | | |
| | Owner/Employer | 399 | 76.0% |
| | Management Staff | 36 | 6.86% |
| | Others | 90 | 17.14% |
| | **Total** | **525** | **100.0%** |

Source: Field Survey, 2018

Table 1 shows that 378(72.0%) of the respondents were male while 147(28.0%) were female. On marital status, it was shown that 373(71.05%) and 132(25.14%) of the respondents were married and single respectively while 3(0.57%) and 17(3.24%) were separated and widowed. The academic qualification of respondents revealed that 131(24.95%) and 120(22.86%) of the respondents hold B.Sc./HND and NCE/OND degrees respectively.72(13.71%) and 12(2.29%) of the respondents hold M.Sc./MBA and PhD degrees respectively, while 190(36.19%) of the sample represent owners and employees with SSCE, FSLCE and those without any academic qualification. Also, it was found that 387(73.71%) and 138(26.29%) of the respondents are small and medium scale enterprises respectively, with a large proportion of them representing 399(76.0%) who are owners/employers.

**Table 2: Descriptive Results on JIT operationalization (N=525)**

| S/N | Question Items | Mean | Std. | Min. | Max |
|---|---|---|---|---|---|
| 1 | Just-in-Time (JIT) production system is a well-known system of Inventory management, quality control, improved labour productivity, price reductions on purchased materials, reduction in lead time, scrap/ rework/warranty cost and the number of accounting transactions | 2.89 | 1.17 | 1 | 5 |
| 2 | It's very easy to search or find suppliers that are close by or can supply materials quickly with limited advance notice | 3.37 | 1.02 | 1 | 5 |
| 3 | Employees' works are dangerously insecure and unstable in a JIT system | 3.04 | 1.42 | 1 | 5 |
| 4 | Inventory Management cost is drastically reduced to the bearest minimum | 3.10 | 1.32 | 1 | 5 |
| 5 | Labour cost is reduced under JIT production system | 2.70 | 1.24 | 1 | 5 |
| 6 | There is reduction in space occupied by inventory | 2.95 | 1.14 | 1 | 5 |
| 7 | Work-in-progress stock is reduced under JIT | 2.96 | 1.14 | 1 | 5 |
| 8 | There will be reduction in standard hours of production and number of shipments | 3.25 | 1.20 | 1 | 5 |
| 9 | Quality of products will be improved in a JIT system of production | 3.04 | 1.05 | 1 | 5 |
| 10 | Defects elimination is a great concern | 3.22 | 1.19 | 1 | 5 |
| 11 | There is setup time reduction in adopting JIT system | 3.20 | 0.85 | 1 | 5 |
| 12 | Carrying or holding cost of inventory will be reduced | 3.20 | 1.24 | 1 | 5 |
| 13 | The design of a JIT production system constant improvement to meet customers prescription is a case | 2.77 | 1.31 | 1 | 5 |
| 14 | JIT supply chain system application is a critical or key issue in its operationalization | 3.29 | 0.96 | 1 | 5 |
| 15 | JIT is not appropriate in most of my business transactions or units or activities like stable non-perishable goods | 3.50 | 0.72 | 1 | 5 |
| 16 | Traditional economic order quantity approach is applied for perishable and exotic goods because suppliers are not reliable | 3.37 | 1.01 | 1 | 5 |

Source: Field Survey, 2018

Table 2 presents the mean and standard deviation responses of the field survey on Just-In-Time (JIT) production system, operationalization and reliability in Nigeria. It was found that all the questionnaire items recorded mean above 2.50, indicating that all the questionnaire items are good indicators for assessing JIT, operationalization and reliability in Nigeria. Besides, this was supported by the high standard deviation values which were above 0.5. On the basis of the descriptive results, it became vital to perform an inferential statistical analysis, hence the regression test to validate the nexus between JIT production system, operationalization and reliability.

**Table 3: Order Accuracy (ARAC) and Operationalization/Reliability (OPRE)**

| Source | SS | df | MS | Number of obs = | 525 |
|---|---|---|---|---|---|
| | | | | F( 1, 523) = | 39.96 |
| Model | 11.1698181 | 1 | 11.1698181 | Prob > F = | 0.0000 |
| Residual | 146.199219 | 523 | .279539615 | R-squared = | 0.0710 |
| | | | | Adj R-squared = | 0.0692 |
| Total | 157.369037 | 524 | .300322589 | Root MSE = | .52872 |

| opre | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| arac | .2046392 | .0323733 | 6.32 | 0.000 | .1410414 | .2682369 |
| _cons | 2.611798 | .1005917 | 25.96 | 0.000 | 2.414184 | 2.809411 |

Source: Field Survey, 2018

Presented in table 3 is the regression outcome of order accuracy (ARAC) and operationalization/reliability (OPRE) of the selected small and medium scale enterprises in Bayelsa State. The R-squared adjusted of 0.0692is an indication that 6.92% systematic variation in the dependent variable has been explained by the independent variable while the unsystematic variation is 93.08%. The F-ratio (39.96) with Prob. (0.0000) suggests that order accuracy has significant impact on operationalization and reliability of technology in Nigeria. More importantly, the t-value (6.32) is carrying the right sign (+), indicating the order accuracy positively affects operationalization and reliability of technology in Nigeria and is statistically significant given the p-value of 0.000.

**Table 4: Actual Production Time (ACPT) & Operationalization/Reliability (OPRE)**

| Source | SS | df | MS | Number of obs = | 525 |
|---|---|---|---|---|---|
| | | | | F( 1, 523) = | 83.43 |
| Model | 21.6502739 | 1 | 21.6502739 | Prob > F = | 0.0000 |
| Residual | 135.718763 | 523 | .259500503 | R-squared = | 0.1376 |
| | | | | Adj R-squared = | 0.1359 |
| Total | 157.369037 | 524 | .300322589 | Root MSE = | .50941 |

| opre | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| acpt | .2779254 | .0304275 | 9.13 | 0.000 | .2181504 | .3377005 |
| _cons | 2.372577 | .0965432 | 24.58 | 0.000 | 2.182917 | 2.562237 |

Source: Field Survey, 2018

Presented in table 4 is the regression outcome of actual production time (ACPT) and operationalization/reliability (OPRE) of the selected small and medium scale enterprises in Bayelsa State. The R-squared adjusted of 0.1359 is an indication that 13.59% systematic variation in the dependent variable has been explained by the independent variable while the unsystematic variation is 86.41%. The F-ratio (83.43) with Prob. (0.0000) suggests that actual production time has significant impact on operationalization and reliability of technology in Nigeria. In addition, the t-value (9.13) shows the right sign (+), indicating the actual production time positively affects operationalization and reliability of technology in Nigeria and is statistically significant given the p-value of 0.000.

**Table 5: Actual Machine Time (ACMT) and Operationalization/Reliability (OPRE)**

| Source | SS | df | MS | Number of obs = | 525 |
|---|---|---|---|---|---|
| | | | | F( 1, 523) = | 1140.48 |
| Model | 107.892125 | 1 | 107.892125 | Prob > F = | 0.0000 |
| Residual | 49.4769118 | 523 | .094602126 | R-squared = | 0.6856 |
| | | | | Adj R-squared = | 0.6850 |
| Total | 157.369037 | 524 | .300322589 | Root MSE = | .30757 |

| opre | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| acmt | .8166947 | .0241833 | 33.77 | 0.000 | .7691864 | .864203 |
| _cons | .6179041 | .078524 | 7.87 | 0.000 | .4636429 | .7721652 |

Source: Field Survey, 2018

Presented in table 5 is the regression outcome of actual machine time (ACMT) and operationalization/reliability (OPRE) of the selected small and medium scale enterprises in Bayelsa State. The R-squared adjusted of 0.6850is an indication that 68.50% systematic variation in the dependent variable has been explained by the independent variable while the unsystematic variation is just 31.50%. The F-ratio (1140.48) with Prob. (0.0000) suggests that actual machine time has significant impact on operationalization and reliability of technology in Nigeria. In addition, the t-value (33.77) shows the right sign (+), indicating the actual machine time positively affects operationalization and reliability of technology in Nigeria and is statistically significant given the p-value of 0.000.

## 5. CONCLUSION AND POLICY IMPLICATIONS

Manufacturing practices and processes have come under amplified pressure from global competition, given the demands for enhanced customer service, breadth of product line, quality, quick response and a much reduced time-to-market for new product which cannot be disregarded by firms. In the face of these intense pressures, Nigeria and other manufacturers around the globe are moving away from mass production manufacturing processes to a greater flexibility and speed in manufacturing practices. These practices have become the bedrock for 'best in class' manufacturers and processors and have given rise to the concept of advanced manufacturing technology - JIT.

Consequently, this paper examined JIT, operationalization and reliability of manufacturing technology in Nigeria. The paper finds that actual production time, actual machine time and order accuracy positively impact on operationalization and reliability of manufacturing technology and is statistically significant. On the basis of the findings of the study, it was recommended that manufacturing concerns should consider introducing JIT in their manufacturing processes, as it will lead to operationalization and reliability of manufacturing technology. By introducing JIT, it will lead to improved production quality and positive impact on delivery performance.

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