The impact of Lean Inventory Management Practices on Firm Performance: A Study of Selected Oil and Gas Companies in Rivers State, Nigeria

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***Abstract*: This study examined the effect of lean inventory strategies on firm performance in the oil and gas industry in Nigeria using a regression approach. Lean inventory was measured using two dimensions; namely, just in time and total quality management, while firm performance was measured in terms of productivity and delivery performance. The study further examined the moderating effect of organizational support on lean inventory practices and firm performance. The sample comprises 96 senior employees from 10 selected oil and gas companies in Rivers State, with a 79% response rate. The employees were purposely selected from three functional departments: production, human resource and marketing. All variables were measured on an interval scale using Likert type questions with five ordered options. The study found that that both just in time and total quality management have positive and highly significant effect on both productivity and delivery performance. Both lean inventory strategies significantly account for approximately 72% and 67% of the variance of firm productivity and delivery performance, respectively. However, for each performance measure, the magnitude of the effect of just in time is much higher than that of total quality management. The study established the fact that organizational support has a positive moderating influence on the relationship between inventory leanness and firm performance. Based on these findings, the study recommends that oil and gas companies should support the use of an integrated lean inventory approach that combines both just in time and total quality management as a way of improving productivity and meeting corporate delivery targets. However, more emphasis should be placed on just in time strategy.**

***Keywords*: Inventory leanness, Just in Time, Total Quality Management, Firm Performance, organizational support**

I INTRODUCTION

With the fierce competition that characterizes today's business environment, there has been increasing reliance on lean inventory strategies as a veritable tool for improving performance, especially in the manufacturing industry. Inventory leanness is defined as a strategy that allows firms to improve performance through simplifying inventory within corporate supply chain. According to Wallin, Johnny Rungtusanatham and Rabinovich (2006), the right inventory management approach must address both the problem of cash tied up and the high costs of planning, storingand handling associated with inventory holding. According to Bendig, Strese and Brettel (2017), higher inventory leanness increases the cash available to settle maturing debts. This leads to higher operating performance. Lean inventory practices, which focuses on waste elimination and continuous improvement, is now a common inventory management practice for achieving superior performance.

One facet of lean inventory practices that has attracted considerable academic attention is the Just in Time(JIT) practices (Shah & Ward, 2003). JIT has been defined as a waste reduction strategy that focuses on continuous improvement and is associated with throughput time reduction, improved internal and external quality, improved labour productivity, improved employee behaviour, reduced inventory levels and decreased unit cost (Chong, White & Prybutok, 2001). Thus, JIT is a lean inventory strategy that focuses on improving firm productivity and delivery performance.

Another dimension of lean inventory practices that has also attracted considerable scholarly attention is Total Quality Management (TQM). TQM has since become part of strategic business thinking and is defined in Powell (1995) as an integrated management strategy that focuses on amongst others, continuous improvement in inventory management, meeting customer requirements, reducing rework, increased employee involvement and teamwork, and competitive benchmarking. According to Shah and Ward (2003), TQM and JIT are the two dimensions of lean inventory practices that have attracted considerable scholarly attention.

It is well established in the theoretical literature that lean inventory practices can enhance productivity and lead to higher firm performance. Several empirical studies (such as Elking, Paraskevas, Grimm, Corsi and Steven (2017), Eroglu and Hofer (2011), Papadoupoulou and Özbayrak (2006), Shah and Ward (2003), Womack and Jones (1994)) have also considered the relationship between lean inventory management practices and corporate performance. These empirical studies, however, focused mainly on the developed countries, hence, the evidence thatlean inventory practices lead to higher firm performance has not been fully established as developing countries were largely ignored by previous researchers.

This study contributes to the growing empirical literature by considering the effect of lean inventory practices on firm

performance in the context of Nigeria oil and gas industry. This study is significant in two distinct ways. First, the study uses both productivity and delivery performance as dimensions of firm performance. Although, some authors (for example, Lawrence and Hottenstein, (1995)used productivity as a dimension of firm performance, no previous study (to the best of our knowledge) in this line of research considers delivery performance. Therefore, the questions that are begging for answers are: Is it that inventory leanness is not among the important determinants of firm delivery performance. Or is it that delivery performance is not a good dimension of firm performance?

Second, the current study considers the moderating role of organizational support in the relationship between lean inventory practices and firm performance. A closely related study in this regard is Chong, White and Prybutok (2001). However, while Chong, White and Prybutok (2001) considered the link among organizational support, JIT and firm performance, this study considered the relationships among organizational support JIT, TQMand firm performance. Therefore, the inclusion of TQM is a contribution of this study to the literature.

1.1 Hypotheses of the Study

H_{01}: Just in Time practices has no significant effect on firm productivity in the oil and gas industry in Nigeria.

H_{02}: Total quality management has no significant effect on firm productivity in the oil and gas industry in Nigeria.

H_{03}: Just in Time practices has no significant effect on delivery performance in the oil and gas industry in Nigeria.

H_{04}: Total quality management has no significant effect on firm productivity in the oil and gas industry in Nigeria.

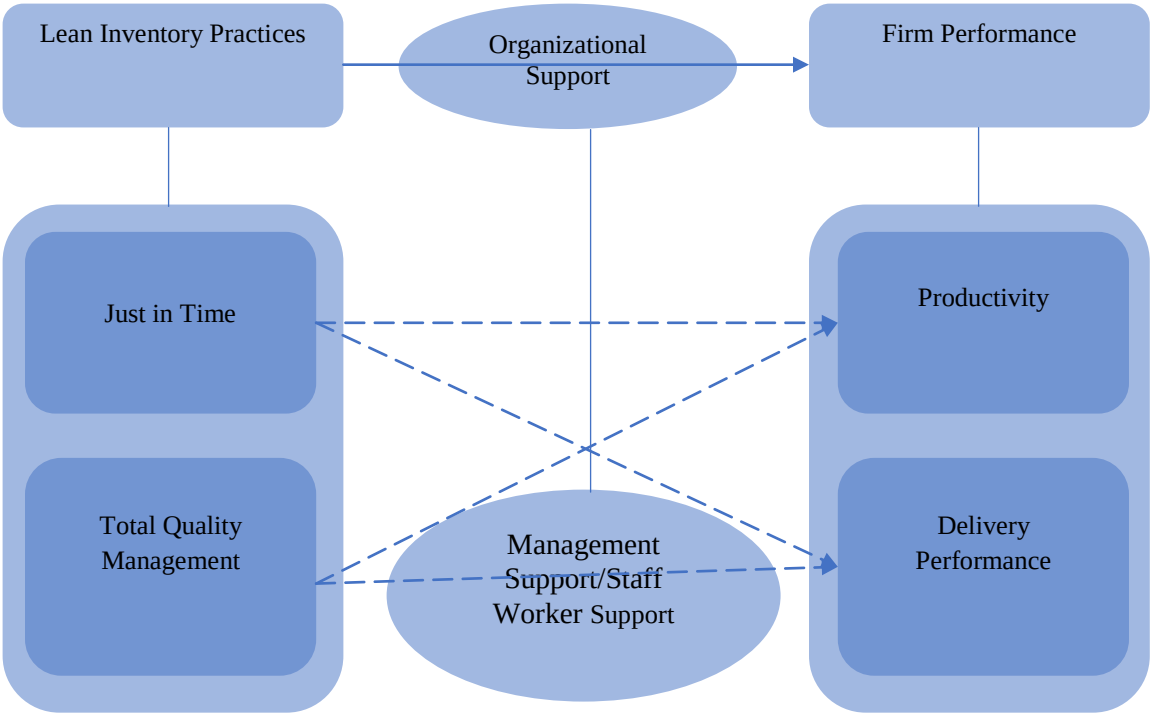
H_{04}: Organizational support has no significant influence on the relationship between lean inventory management and firm productivity and delivery performance.

II. LITERATURE REVIEW

2.1 Conceptual Framework

The conceptual framework for the relationship between lean inventory practices and firm performance is given in Figure 1.

Figure 1: Conceptual Framework



Source: Researcher

2.2 Lean Inventory Practices

The philosophy of lean inventory management can be traced to the automobile industry in the early and mid-1900s and focuses on waste reduction in supply chain through reducing excess inventory (Shah & Ward, 2007). Inventory leanness has been defined and measured in different ways. Bayou and Korvin (2018) define leanness as a strategy that focuses on using lesser resources to achieve higher operating performance. Ismail, Razak and Lazim (2015), citing namely,

Liker (1996), Papadoupoulou and Özbayrak (2006) and Womack and Jones (1994, p. 2), define lean as a strategy that systematically eliminates waste, involving "all members of the organization from all areas of the value system while".Ismail, Razak and Lazim (2015) contend that lean strategy focuses on the need for continuous improvement in inventory management practices that would lead to higher performance. Elking, Paraskevas, Grimm, Corsi and Steven (2017) define inventory leanness as a strategy that allows firms to simplify inventory within their supply chain.

Elking, Paraskevas, Grimm, Corsi and Steven (2017) measure inventory leanness in terms of the ratio of sales to inventory, which represents the number of times a company sells and replenishes its inventory in a given year. Eroglu and Hofer (2011) proposed a theory-based measure of inventory leanness, referred to as Empirical Leanness Indicator (ELI). ELI incorporates the effect of both firm size and economies of scales inventory management to measure inventory leanness. Eroglu and Hofer (2011) argued that these important effects were ignored in other measures of inventory leanness. According to Hofer, Eroglu and Hofer (2012), lean production and inventory leanness are two different but related concepts. Hofer, Eroglu and Hofer (2012) contend that lean production implementation not only has direct financial benefits, but also leads to higher inventory leanness, which in turn, leads to improved financial performance. According to Stevenson (2007), trust plays a significant role in lean inventory effectiveness as organizations depend on each other for a continuous and uninterrupted flow of goods for successful operations.

Among the dimensions of lean inventory practices that have emerged from the literature are just in time (JIT), total quality management (TQM), total preventive maintenance (TPM) and human resource management (HRM). However, according to Shaw and Ward (2003), most of the previous studies have focused only on two dimensions; namely, JIT and TQMwith empirical results suggesting that improved performance associated with JIT strategy outweighs the performance effects associated with TQM.

2.2.1Just in Time and Firm Performance:

According to Chong, White and Prybutok(2001),there is a growing consensus in the literature that the implementation of JIT is associated with reduced throughput time, improved internal quality, improved external quality, improved labour productivity, improved employee behaviour, reduced inventory levels and decreased unit cost. Similarly, Gupta (2012) observed that most researchers have agreed that JIT is a strategy of continuous improvement that focuses on cost reduction, product quality improvement, manufacturing flexibility, workforce innovation and improved delivery performance. The key components of JIT are waste reduction and continuous improvement in firm productivity. According to Fullerton and McWatters (2001), some of the benefits of JIT strategy include lower inventory levels, higher quality production, improved throughput times and reduced customer response times.

2.2.2 Total Quality Management and Firm Performance:

Total Quality Management (TQM) is a concept popularized in the late 1950s (Sallis, 2014) and has since become part of strategic business thinking (Powell, 1995). According to Powell (1995), TQMis an integrated management strategy that allows firms to achieve higher performance through amongst others, meeting customer requirements, reducing rework, increased employee involvement and teamwork, and competitive benchmarking. According to Shah and Ward (2003), TQM and JIT are the two dimensions of lean inventory practices that have attracted considerable scholarly attention. Choi and Eboch (1998) and Samson and Terziovski (1999)found that TQM has a significant direct impact on operational performance.

2.2.3 Organizational Support:

Research (Chong, White & Prybutok, 2001; Flynn, Sakakibara & Schroeder, 1995) suggests that organizational support is a necessary ingredient for successful lean inventory practices. Chong, White and Prybutok (2001) found that management support/commitment, which includes management participation, employee participation, continuous interaction between management and employees etc. is a key factor for successful implementation of JIT strategies. Flynn, Sakakibara and Schroeder (1995) found that management support is positively related to shorter cycle times and improved quality. Hallihan, Sackett and Williams (1997) contend that support levers (management actions) are required to provide the inspiration for successful implementation of the waste elimination practices associated with JIT. Thus, organizational support is a key factor for successful lean inventory management practices.

2.3 Empirical Review

Adam Jr (1994) examined the relationship between alternative quality improvement approaches and both operating and financial performance using a sample of 187 US firms. In order to define better the relationship between quality and productivity, the study also examined the link between productivity improvement approaches and performance. The results indicate that quality improvement approaches and performance quality are strongly related. The results, however, indicate that either financial or operating performance has a weaker but significant relationship with a quality improvement approach.

Chong, White and Prybutok (2001) examine the relationship between organizational support, JIT implementation and performance of US manufacturing firms using path analysis and structural equation modeling. The study examined ten JIT practices including quality circles, group technology, reduced set-up times, total preventive maintenance, Kanban, uniform workload, total quality control, JIT purchasing, multifunction employees and focused factory. The study found that

organizational support is a good predictor of JIT implementation and that both organizational support and JIT implementation collectively improve performance.

Shah and Ward (2003) empirically validated four dimensions of lean inventory practices; namely, Just in Time, Total Quality Management, Human Resource Management and Total Preventive Maintenance, and examined their effects on firm operational performance. The study sample consisted of 1757 managers of manufacturing firms in US, while the empirical analysis was based on a hierarchical regression. The results show that lean inventory bundles had significant effects on operating performance of plants and explained approximately 23% of the variance of operational performance, holding the influence of both industry and contextual factors constant.

Chavez, Yu, Jacobs, Fynes, Wiengarten and Lecuna (2015) examinedthe effect of internal lean practices on both operational and organizational performance using the OLS technique and structural equation modeling. The study defined internal lean practices as practices that focus on reduction of waste and elimination of non-value-added activities. The sample comprised 228 manufacturing companies in the Republic of Ireland. The study found that internal lean practices have positive effect on both operational and organizational performance, and that established relationships were negatively moderated by technological turbulence.

III METHODOLOGY

3.1 Sample and Sampling

The study sample comprises ten selected oil and gas companies in Rivers State. The sample was selected using non-probability method. Specifically, convenience sampling technique based on proximity was used. The number of employees in the selected firms is shown in Table 1. A total of 96 employees participated in the study. These participants were purposely selected from three relevant departments of the selected companies; namely, production, human resource and marketing departments. The sample size was determined using Yamane's (1967) formula as follows:

$$n = \frac{N}{1 + Ne^2} = \frac{2735}{1 + 2735 \times 0.1^2} = 96.47$$

Where

n = sample size

N = population size

e = sampling error

The sample for each firm was determined as follows:

$$Firm_i = \frac{No\ of\ Employee\ in\ Firm\ A}{Total\ number\ of\ employees} \times 96$$

Both the distribution and retrieval of copies of the questionnaire were aided by some paid assistance who worked as data analysts in a reputable research firm in Port Harcourt. However, there was 79% response rate as not all the participants completed and returned their questionnaire.

Table 1: Selected Oil and Gas Companies in Rivers State

S/no	Company	No. of Empolyee[1]	Sample[2]	Returned
1	Shell Petroleum Development Coy ltd	400	14	12
2	Chevron Nig. Ltd	300	11	8
3	Nigerian Agip Oil Company Ltd	280	10	8
4	Slumberger Nig Ltd.	250	9	7
5	Solar Turbines Services Nigeria limited	220	8	6
6	Siemens Nigeria Ltd.	200	7	6
7	Baker Hughes Nigeria Ltd	210	8	7
8	Halliburton Energy Services Nigeria Limited	255	9	6
9	Cameron Offshore Systems Nigeria Limited	300	11	9
10	Pressure Control Systems Nig. Ltd.	250	9	7
Total		2735	96	76

Source[1]: Human Resource Department of the selected companies (2019)

Source[2]: Researcher (Distributed Questionnaire)

Table 2: Alpha Reliability Coefficients

S/n	Scale	Alpha Coefficient
1	Just in Time	0.838
2	Total Quality Management	0.856
3	Productivity	0.902
4	Delivery Performance	0.890
5	Organisational Support	0.832

Source: SPSS output

3.2 Method of Data Analysis

The study employed the cross-sectional regression analysis to examine the relationship between lean inventory practices and firm performance, in terms of productivity and delivery performance. The models are specified as follows:

Functional Models

Functionally, the relationship between inventory management practices and firm productivity and delivery performance is specified as follows:

$$PD = F(JIT, TQM) \quad (3.1)$$

$$DP = F(JIT, TQM) \quad (3.2)$$

$$PF = F(JIT, TQM, OS, OS * JIT, OS * TQM) \quad (3.3)$$

Where;

PD = Productivity

DP = Delivery Performance

JIT = Just in Time

TQM = Total Quality Management

OS = Organizational Support

PF = Firm Performance (A composite of productivity and delivery performance)

LIVP = Lean Inventory Practices (The composite of JIT and TQM)

OS*LIVP = The interaction between organizational support and lean inventory services

Empirical Models

Given the functional models, the empirical model for the lean inventory-performance relationship is specified as follows:

$$OP_i = \beta_0 + \beta_1 JIT_i + \beta_2 TQM_i + \epsilon_i \quad (3.4)$$

$$DP_i = \phi_0 + \phi_1 JIT_i + \phi_2 TQM_i + u_i \quad (3.5)$$

$$PF_i = \lambda_0 + \lambda_1 LIVP_i + \lambda_2 OS_i + \lambda_3 OS * LIVP_i + e_i \quad (3.6)$$

Where $\beta_0, \phi_0$and $\lambda_0$are the regression intercepts; β_1 and ϕ_1 are slope coefficients that capture the effect of just in time on productivity and delivery performance respectively; β_2 and ϕ_2 are slope coefficients that capture the effect of total quality management on productivity and delivery performance respectively; $\epsilon_i, u_i$and $e_i$are classical error terms. In model (3.6), the focus is on λ_2 and λ_3 which respectively capture the direct effect of organizational support on firm performance as well as interaction with lean inventory practices. Therefore, the significance of λ_3 would indicate evidence of moderating role of organizational support.

3.3 Measurement, Validity and Reliability

The instrument of data collection is structured questionnaire. All variables were measured on an interval scale using the five scale model. The ordinal responses were converted into interval scale through the SPSS variable conversion window. Both validity and reliability of the instrument were established. Specifically, the instrument was validated by two teaching professionals in the Department of Marketing at Michael Okpara University of Agriculture, Umudike. The determination of the reliability of the research instrument was based on the popular Cronbach Alpha method as shown in Table 2. The Cronbach Alpha model rate was 70% or 0.7.

IV DATA ANALYSIS AND RESULTS

4.1 Descriptive (Univariate) Analysis

The decision criterion for the descriptive analysis is presented in Table 3 thus:

Table 3: Decision Criteria for Univariate Analysis

Original Rating	Mean Range	Decision	
1	1.00 – 1.49	Very Low	Strongly Disagree
2	1.50 – 2.49	Low	Disagree
3	2.50 – 3.49	Moderate	Neither Agree nor Disagree
4	3.50 – 4.49	Great	Agree
5	4.50 – 5.00	Very Great	Strongly Agree

Source: Decision Criteria for Likert Scale(Nnaji, 2018)

4.1.1 Independent Variables

Table 4 shows the descriptive analysis for just in time and total quality management.

Table 4: Inventory Management Practices

Item	Description	$\bar{x}$	σ	Decision
Just in Time Scale (Alpha = 0.838)				
JIT1	Lot size reductions	4.18	0.725	Great Extent
JIT2	JIT/continuous-flow production	4.12	0.673	Great Extent
JIT3	Pull Systems	4.07	0.618	Great Extent
JIT4	Cycle-time reductions	4.16	0.654	Great Extent
Total Quality Management Scale (Alpha = 0.856)				
TQM1	Competitive Benchmarking	4.08	0.744	Great Extent
TQM2	Quality management programs	4.01	0.683	Great Extent
TQM3	Process capability measurements	4.11	0.685	Great Extent
TQM4	Formal continuous improvement	4.04	0.684	Great Extent

Source: SPSS output based on survey data (July 2019)

4.1.2 Dependent Variable

Table 5 shows the descriptive analysis for Productivity and Delivery Performances

Table 5: Firm Performance

Item	Description	$\bar{x}$	σ	Decision
Productivity (Alpha = 0.902)				
PD1	The implementation of JIT Strategy has improved our productivity and output.	3.83	0.773	Agree
PD3	The implementation of Total Quality Management has improved our productivity and output	3.78	0.685	Agree
Delivery Performance (Alpha = 0.890)				
DP1	The implementation of JIT Strategy has enhanced our on-time delivery	4.11	0.741	Agree
DP2	The implementation of Total Quality Management has a way of enhancing delivery of goods to customers.	4.05	0.728	Agree

Source: SPSS output based on survey data (July 2019)

4.1.3 Contextual Variable

Table 6 presents the descriptive analysis for organizational support.

Table 6: Organizational Support

Item	Description	$\bar{x}$	σ	Decision
Organisational Support (Alpha = 0.832)				
OS1	Top Management Support	3.53	0.773	Great Extent
OS3	Middle Management Support	3.85	0.685	Great Extent
OS3	Staff Worker Support	4.19	0.421	Great Extent

Source: SPSS output based on survey data (July 2019)

4.2 Empirical Analysis/Hypotheses Testing

4.2.1 Inventory Management and Productivity:

Table 7 presents the empirical results for the effect of the two dimensions of inventory management and firm productivity. Panel A presents the estimated model coefficients while Panel B shows the goodness of fit statistics.

Table 7: Inventory Management and Productivity

Panel A: Model estimates		
Variable	Coefficient	p-value
Constant(β_0)	-0.0322	0.9298
JIT (β_1)	0.9200	0.0000
TQM(β_2)	0.2165	0.0003
Panel B: Goodness of Fit statistics		
R-squared	0.7293	
Adjusted R-squared	0.7218	
F-statistic	98.337	
Prob(F-statistic)	0.0000	

Source: EViews output

From Panel A of Table 7, it can be seen that bothβ_1 (p-value = 0.0000) and β_2 (p-value = 0.0003) are positive and highly statistically significant. This suggests that the two inventory management strategies are significant factors for improving firm productivity. However, the size of the estimated betas shows that the magnitude of the effect on productivity of JIT (β_1 = 0.9200) is much higher than that of total quality management (β_2= 0.2165). This implies that JIT has more economic benefit and would lead to higher productivity than the TQM. Further, the intercept term ($\beta_0 = -0.0322, p$-value = 0.9298) is negative but statistically insignificant, indicating that there would be zero productivity if both JIT and total quality management are absent in the model. Thus, firms in the oil and gas industry in Rivers State would be less productive if both just in time and total quality management strategies are not implemented.

From Panel B, the Adjusted R-squared is 0.7218, indicating that the estimated model has a very good fit and accounts for approximately 72% of the variance of firm productivity. The F-statistic has a zero probability, indicating that the combined effect of JIT and total quality management strategies on firm productivity is highly statistically significant. Therefore, both JIT and total quality management strategies are good lean inventory strategies for enhancing firm's productivity in the oil and gas industry in Rivers State.

Testing of Hypotheses 1 and 2:

Hypotheses 1 and 2 are restated as follows:

H_{01}: JIT has no significant effect on firm's productivity in the Nigerian oil and gas industry.

H_{02}: Total quality management (TQM) has no significant effect on firm's productivity in the Nigerian oil and gas industry.

Hypotheses 1 and 2 were tested at 5% significance level based on the empirical results in Panel A of Table 7. Specifically, the p-values were used.

For H_{01}, the decision rule is to reject H_{01}if the p-value associated withJIT (β_1) is less than 0.05. If not, H_{01}would not be rejected. As Table 7 shows, JIT (β_1) is associated with a p-value of 0.0000, which is much below 0.05. Therefore, the study strongly rejectsH_{01} and concludes that just in time has a positive and highly significant effect on firm productivity in the oil and gas industry in Nigeria.

For H_{02}, the decision rule is to reject H_{02}if the p-value associated with TQM(β_2) is less than 0.05. If not, H_{02}would not be rejected. As Table 7 shows, TQM(β_2) is associated with a p-value of 0.0003, which is much below 0.05. Therefore, the study strongly rejectsH_{02} and concludes that total quality management has a positive and highly significant effect on firm productivity in the oil and gas industry in Nigeria.

4.2.2 Inventory Management and Delivery Performance:

Table 8 presents the empirical results for the effect of the two dimensions of inventory management and firm delivery performance. Panel A presents the estimated model coefficients while Panel B shows the goodness of fit statistics.

Table 8: Inventory Management and Delivery Performance

Panel A: Model estimates		
Variable	Coefficient	p-value
Constant(ϕ_0)	1.9826	0.0000
JIT (ϕ_1)	0.6954	0.0000
TQM(ϕ_2)	0.1672	0.0114
Panel B: Goodness of Fit statistics		
R-squared	0.6832	
Adjusted R-squared	0.6745	
F-statistic	78.736	
Prob(F-statistic)	0.0000	

Source: EViews output

From Panel A of Table 8, like the case of productivity, both ϕ_1(p-value = 0.0000) and ϕ_2(p-value = 0.0114) are positive and statistically significant, suggesting that the two inventory management strategies are significant factors for improving firm delivery performance. Also, like the case of productivity, the magnitude of the effect of JIT (ϕ_1= 0.6954) is much higher than that of total quality management (ϕ_2= 0.1672). This implies that JIT has more economic benefit and would

lead to higher delivery performance than TQM. However, unlike the case of productivity, the intercept term ($\phi_0 = 1.9826, p$-value = 0.0000) is positive and highly statistically significant, indicating that delivery performance of the sampled firms would record significant delivery performance in the absence of both JIT and TQM implementation. Thus, firms in the oil and gas industry would still meet their delivery targets even when both just in time and lean inventory strategies are not implemented.

From Panel B, the Adjusted R-squared is 0.6745, indicating that the estimated model has a good fit and explains approximately 67% of the variance offirmdelivery performance. The F-statistic has a zero probability, indicating that the combined effect of JIT and total quality management strategies on firm delivery performance is highly statistically significant. Therefore, both JIT and total quality management strategies are good inventory management strategies for enhancing firm's delivery performance in the oil and gas industry, both individually and collectively.

Testing of Hypotheses 3 and 4

Hypotheses3 and 4 are restated as follows:

H_{03}:Just in time has no significant effect on firm delivery performance in the oil and gas industry in Nigeria.

H_{04}:Total quality management has no significant effect on firm delivery performance in the oil and gas industry in Nigeria.

Hypotheses 3 and 4 were tested at 5% significance level based on the empirical results in Panel A of Table 8. Specifically, the p-values were used.

For H_{03}, the decision rule is to reject H_{03}if the p-value associated with JIT (ϕ_1) is less than 0.05. If not, H_{03}would not be rejected. As Table 8 shows, JIT (ϕ_1) is associated with a p-value of 0.0000, which is much below 0.05. Therefore, the study strongly rejectsH_{03} and concludes that just in time has a positive and highly significant effect on firm delivery performance in the oil and gas industry in Nigeria.

For H_{04}, the decision rule is to reject H_{02}if the p-value associated with TQM (ϕ_2) is less than 0.05. If not, H_{04}would not be rejected. As Table 8 shows, TQM (ϕ_2) is associated with a p-value of 0.0114, which is below 0.05. Therefore, the study rejectsH_{04} and concludes that total quality management has a positive and significant effect on firm delivery performance in the oil and gas industry in Nigeria.

4.2.3 The Moderating Influence of Organizational Support

Table 9 presents the empirical results for the moderating influence of organizational support such as management support and staff worker support on the relationship between lean inventory management practices and firm performance. Panel A presents the estimated model coefficients while Panel B shows the goodness of fit statistics

Table 9: Organization Support, Lean Inventory Practices and Performance

Panel A: Model estimates		
Variable	Coefficient	p-value
Constant(λ_0)	1.5361	0.0002
LIVP (λ_1)	0.1673	0.0087
OS (λ_2)	0.6701	0.0000
OS*LIVP (λ_3)	0.1440	0.0125
Panel B: Goodness of Fit statistics		
R-squared	0.7097	
Adjusted R-squared	0.6976	
F-statistic	58.675	
Prob(F-statistic)	0.0000	

Source: E Views output

From Panel A of Table 9, it can be seen that LIVP($\lambda_1 = 0.1673, p$-value = 0.0087) enters the firm performance model positively and its influence is highly significant. Thus, consistent with the results in Tables 7 and 8, this evidence confirms the view that lean inventory management practices leads to superior performance through waste elimination and continuous improvement in both operating and delivery performance. Further, the coefficient on OS ($\lambda_2 = 0.6701, p$-value = 0.0000) is positive and highly significant, suggesting that organisational support has a direct positive influence on firm performance. Similarly, the coefficient on OS*LIVP ($\lambda_3 = 0.1440, p$-value = 0.0125) is positive and significant at 5% level, suggesting that management and staff worker support also affect firm's performance through its interaction with lean inventory practices. This is evidence that organisational support plays a positive moderating role in the relationship between lean inventory practices and firm's performance.

From Panel B, it can be seen that the estimated model is reasonably explained as adjusted R-squared indicates that almost 70% of the variation in firm performance is accounted for. The F-statistic also has a zero probability, indicating that the estimated performance model is highly significant. Therefore, organisational support strongly enhances the relationship between lean inventory management practices and firm performance.

Testing of Hypotheses 5

Hypothesis 5 is restated as follows:

H_{05}:Organizational support does not moderate the relationship between lean inventory practices and firm performance in the oil and gas industry in Nigeria.

The above hypothesis was tested at 5% significance level based on the empirical results in Panel A of Table 9. Specifically, the p-values was used. The decision rule is to reject H_{05}if the p-value associated with OS*LIVP(λ_3) is less than 0.05. If not, H_{03}would not be rejected. As Table 8 shows, OS*LIVP (λ_3)is associated with a p-value of 0.0125, which is much below 0.05. Therefore, the study rejectsH_{05}at 5% level

of significance and concludes that organizational support plays a positive moderating role in the relationship between lean inventory practices and firm performance.

4.3 Discussion of Findings

First, the study empirical analysis shows that JIT and total quality management both have positive and highly significant effects on firm productivity. Collectively, both strategies explain approximately 72% of the variance of firm productively. This implies that implementing the two inventory management strategies, either individually or collectively, would improve firm productivity. This is consistent with the popular view that lean inventory practices lead to superior firm performance through reduced throughput time, improved internal quality, improved external quality, improved labour productivity, improved employee behaviour, reduced inventory levels and decreased unit cost (Chong, White & Prybutok, 2001).This also agrees with the findings of Chong, White and Prybutok (2001) and many more others.

Second, the study results show that both JIT and total quality management exert positive effects on delivery performance. Both strategies also explain approximately 67% of the variation in delivery performance. Thus, like the case of productivity, implementing the two inventory management strategies, either individually or collectively, would improve delivery performance. This supports the view that JIT and other lean inventory practices represent strategy of continuous improvement that focuses on cost reduction, product quality improvement, manufacturing flexibility, workforce innovation and improved delivery performance (Gupta, 2012). This is also consistent with Shah and Ward's (2003) view that lean inventory bundles exert significant effect on operating performance of plants.

On the economic significance of the estimated coefficients, the results show that the effect of JIT is much higher than the effect of total quality management. For productivity model, JIT coefficient is 0.9200 while the TQM coefficient 0.2165. Similarly, JIT and total quality management coefficients in delivery performance model are 0.6954 and 0.1672respectively. This, therefore, implies that JIT has more economic benefit and would lead to higher firm performance than total quality management. This is consistent with Shah and Ward's (2003) finding that JIT practices lead to higher operational performance than total quality management.

Finally, the study results show that organisational support has, not only, a direct positive influence on firm performance, but also an interaction effect with lean inventory practices in the firm performance model. Thus, organizational support enhances the relationship between lean inventory practices and firm performance. This result is consistent with the findings of Chong, White and Prybutok (2001) that organizational support is a good predictor of JIT implementation and that both organizational support (management support and staff worker support) and JIT implementation collectively improve corporate performance.

Based on these results, our contribution to knowledge is represented in the heuristic framework as shown below:

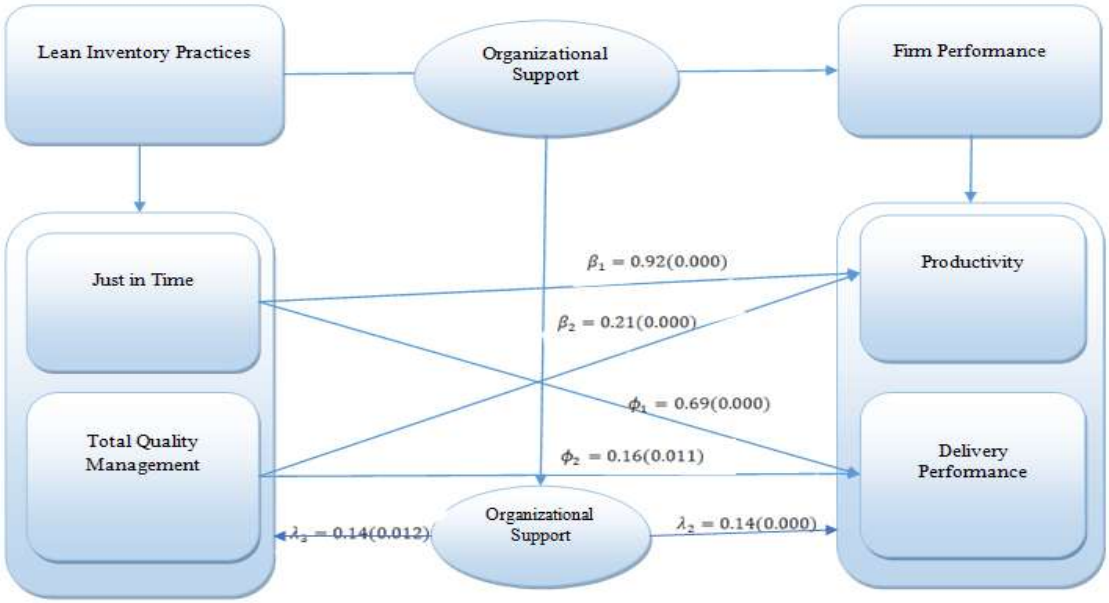


Figure 2: Lean Inventory Practicesand Firm Performance in Selected Oil and Gas Companies in Nigeria

Key

Significant Effect

No Significant Effect ( ) p-value

V. CONCLUSIONS

1. This study examined the effect of lean inventory strategies on firm performance in the oil and gas industry in Nigeria using a cross-sectional regression approach. The study also examined the effect of organizational support on the relationship between lean inventory practices and firm performance. The sample comprises 96 senior employees from 10 selected oil and gas companies in Rivers State, with a 79% response rate. The main findings are as follows:
2. There is evidence that both just in time and total quality management have positive and highly significant effect on both productivity and delivery performance. Both lean inventory strategies significantly account for approximately 72% and 67% of the variance of firm productivity and delivery performance respectively. However, for each performance measure, the magnitude of the effect of just in time is much higher than that of total quality management. Therefore, compared with total quality management, the explanatory power of just in time for changes in firm performance is much higher.
3. There is evidence that organizational support (top management support, middle management support and staff worker support) has a positive influence on firm performance both directly and through its interaction with both Just in Time and total quality management. Therefore, we conclude that organizational support enhances the relationship between inventory leanness and firm performance.
4. Based on these findings, the study recommends that oil and gas companies should support the useof an integrated lean inventory approach that combines both just in time and total quality management as a way of improving productivity and meeting their delivery targets towards customer satisfaction. However, more emphasis should be placed on just in time strategy

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APPENDICES

Appendix A: RESEARCH INSTRUMENT

QUESTIONNAIRE ON LEAN INVENTORY MANAGEMENT PRACTICES AND FIRM PERFORMANCE (LIMPFPQ)

COMPANY CODE ……

RESPONDENTS ID ……...

SECTION A: DEMOGRAPHIC INFORMATION

1. Please indicate your sex: Male ☐ Female ☐
2. Please indicate which age group you fall into

   Below 25 years ☐

   25– 34years ☐

   35– 44 years ☐

   45– 54years ☐

   55 years and above ☐
3. Please indicate your educational level

   Primary Education ☐

   Secondary Education ☐

   Tertiary Education ☐

4. How long have you worked with your current organization? ……
5. How long have you worked in your current position?.....
6. Has your firm formally implementedlean inventory strategy? Yes ☐ No ☐
7. Has your firm formally implemented just in time strategy as a way of improving inventory management?

Yes ☐ No ☐

8. Has your firm formally implemented total quality management strategy as a way of improving inventory management?

Yes ☐ No ☐

SECTION B: LEAN INVENTORY MANAGEMENT PRACTICES

Please kindly indicate the extent to which your company has implemented these strategies (1. Very Low Extent, 2. Low Extent, 3. Moderate, 4. Great Extent, 5. Very Great Extent)		*Scale*				
		1	*2*	*3*	*4*	*5*
JUST IN TIME						
9	Lot size reductions					
10	JIT/continuous-flow production					
11	Pull Systems					

12	Cycle-time reductions					
TOTAL QUALITY MANAGEMENT						
13	Competitive Benchmarking					
14	Quality management programs					
15	Process capability measurements					
16	Formal continuous improvement program					

SECTION C: FIRM PERFORMANCE

For each of these statement items, please kindly indicate your level of agreement (1. Strongly disagree, 2. Disagree, 3. Neither agree nor disagree, 4. Agree and 5 Strongly Agree)		*Scale*				
		1	*2*	*3*	*4*	*5*
PRODUCTIVITY						
17	The implementation of JIT Strategy has improved our productivity and output.					
18	The implementation of Total Quality Management has improved our productivity and output					
Delivery Performance						
19	The implementation of JIT Strategy has enhanced our on-time delivery					
20	The implementation of Total Quality Management has a way of enhancing delivery of goods to customers.					

SECTION D: ORGANIZATION SUPPORT

Please kindly indicate the extent to which your company provides support for lean inventory practices at the following levels (1. Very Low Extent, 2. Low Extent, 3. Moderate, 4. Great Extent, 5. Very Great Extent)		*Scale*				
		1	*2*	*3*	*4*	*5*
ORGANIZATIONAL SUPPORT						
21	Top Management Support					
22	Middle Management Support					
23	Staff Worker Support					

Appendix B: Regression Results

Dependent Variable: PD				
Method: Least Squares				
Date: 08/23/19 Time: 14:41				
Sample: 1 76				
Included observations: 76				
Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	-0.032266	0.364930	-0.088418	0.9298
JIT	0.920012	0.065733	13.99624	0.0000
TQM	0.216506	0.058069	3.728426	0.0003
R-squared	0.729303	Mean dependent var		4.039211
Adjusted R-squared	0.721887	S.D. dependent var		0.591912
S.E. of regression	0.312153	Akaike info criterion		0.548027
Sum squared resid	7.113087	Schwarz criterion		0.640030
Log likelihood	-17.82504	Hannan-Quinn criter.		0.584796
F-statistic	98.33720	Durbin-Watson stat		2.174704
Prob(F-statistic)	0.000000			

Dependent Variable: DP				
Method: Least Squares				
Date: 08/24/19 Time: 02:04				
Sample: 1 76				
Included observations: 76				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.982651	0.357446	5.546722	0.0000
JIT	0.695404	0.056878	12.22618	0.0000
TQM	0.167231	0.064385	2.597372	0.0114
R-squared	0.683259	Mean dependent var		4.118816
Adjusted R-squared	0.674581	S.D. dependent var		0.535978
S.E. of regression	0.305751	Akaike info criterion		0.506581
Sum squared resid	6.824304	Schwarz criterion		0.598584
Log likelihood	-16.25010	Hannan-Quinn criter.		0.543350
F-statistic	78.73620	Durbin-Watson stat		1.909379
Prob(F-statistic)	0.000000			

Dependent Variable: PF		
Method: Least Squares		

Date: 08/25/19 Time: 07:29				
Sample: 1 76				
Included observations: 76				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.536124	0.386157	3.977977	0.0002
LIVP	0.167341	0.062064	2.696249	0.0087
OS	0.670154	0.055708	12.02981	0.0000
OS*LIVP	0.144037	0.056236	2.561300	0.0125
R-squared	0.709709	Mean dependent var		4.118816
Adjusted R-squared	0.697614	S.D. dependent var		0.535978
S.E. of regression	0.294732	Akaike info criterion		0.445697
Sum squared resid	6.254433	Schwarz criterion		0.568368
Log likelihood	-12.93650	Hannan-Quinn criter.		0.494722
F-statistic	58.67566	Durbin-Watson stat		1.650490
Prob(F-statistic)	0.000000			