Exploring the Relationships Between Just-In-Time Technique and Manufacturing Performance: Empirical Evidence From Selected Nigerian Firms

~ *Ph. D.* **John Kolade Obamiro** *(College of Business and Social Sciences - Nigeria)*

Abstract: *This study explores the relationship between just-in-time technique and manufacturing performance of some selected Nigerian companies. Just-in time was considered to be an overall organisational phenomenon. Data were obtained through a structured questionnaire from a sample size of 300 knowledgeable employees to test the developed model and formulated hypotheses that cover both just-in-time and the supporting infrastructures. Bivariate correlation analysis was used to test the three hypotheses. The results showed that: (1) there was a significant relationship between total quality management (supporting infrastructure) and just-in-time practices; (2) Human resources management (supporting infrastructure) was positively related to just-in-time practices; (3) there was a positive significant relationship between Just-in-time practices and manufacturing performance. These results demonstrate that just-in-time practices can be successfully implemented if certain supporting infrastructures are provided, and also support the notion that just-in-time should be practiced at all levels and departments of the organisation, rather than viewing it strictly for shop floor workers.*

Key words: Just-in-time; total quality management; human resources management; just-in-time practice; manufacturing performance; competitive advantage; supporting infrastructure

Introduction

Numerous operations paradigms, initiatives, and practices have emerged in recent years in response to competitive pressures calling for improved product quality, increased responsiveness, and shorter lead times, but at lower cost (Kannan and Tan, 2005). One of the most pressing challenges facing firms in today's business environment is the transformation to these new paradigms for manufacturing (The Economist, 1987; Drucker, 1990). One of these battery of

innovations (paradigms) that have received particular attention in both academic and practitioner circles is Just-in Time (JIT), which is essentially a philosophy- a statement of objectives- that defines the manners in which a manufacturing system should be managed (O'Grady, 1988). The JIT philosophy advocates the elimination of waste by simplifying production processes. Reductions in setup times, controlling material flows, and emphasizing preventive maintenance are seen as ways by which excess inventories can be reduced or eliminated and resources utilised more efficiently (Kannan and Tan, 2005).

JIT manufacturing represents approach to improving the effectiveness and efficiency of an organisation's total operations functions by aiming at waste reduction, improvement of product quality and customer services. In the view of Linge (1991), JIT concepts have more pervasive implications than they are generally recognised, not only for firms and systems of firms engaged in manufacturing but also for the organisation and operation of a much wider range of private and public sector activities. Morgan (1988) asserts that under a JIT system, a manufacturing firm must see itself as part of a broad inter organisational network and realise that it is this wider network of relations that must be managed. It is thus not uncommon to find manufacturers taking some responsibility for the management of their suppliers and engaging in novel methods of collaboration. Suppliers, manufacturers and retailers increasingly have to develop new mindsets consistent with this network of their identities.

Research has showed that JIT manufacturing system is a relatively new concept in Nigeria (Adeyemi, 2000). Recently, some Nigerian manufacturing firms have gained a strong foothold in producing goods to selective markets once dominated by foreign companies (Obamiro, 2007). To achieve a strong economy and world class competitiveness, Nigerian firms have focused on Japanese techniques, and in particular, Just-in-Time (JIT) manufacturing systems. The adoption of JIT systems has helped the manufacturers to tackle the problems of customers concerning the dissatisfaction with the low quality of goods produced and the inability of firms to deliver the right quantity at the right time. It also finds solution to the inability of the firms to identify and eliminate all forms of waste and variance that led to the failure of some Nigerian manufacturing in 1990's.

The apparent linkages between JIT practices and organisational performance raised two questions that need to be answered, namely; what key JIT practices are consistent with each supporting JIT infrastructure that guarantee success, and how do they affect a manufacturing business performance. The purpose of this research is to provide answers to these questions. The structure of the paper is as follows: Section 2 presents a summary of literature on JIT, JIT conceptual framework and hypotheses. In section 3, we present the materials and methods. In section 4, we present the results of our analysis using Bivariate correlation, discussions of the results and conclusion.

2. Theoretical background

Just-in-Time (JIT) manufacturing, a set of reforms aimed at reducing waste and improving quality, has been receiving substantial attention in the literature, particularly in publications aimed toward practitioners (Drucker, 1981; Sur and De Treville, 1986;

Hannah, 1987 as cited in Brown and Mitchell, 1991). JIT has been defined by several authors in different ways which seems to differ slightly, but revolve around the general philosophy of reducing waste and improving product quality (Schonberger, 1982; Heiko, 1989; Payne 1993; William, 2005). Melnyk (1996) defines JIT as an organisation wide quest to produce output within the minimum possible lead time and at the lowest possible total cost by continually identifying and eliminating all forms of waste and variances. According to Horngren and Foster, (1987) JIT can be defined in four aspects namely; i) the elimination of all activities that do not add value to product or service, ii) a commitment to a high level of quality, iii) a commitment to continuous improvement in the efficiency of an activity and, iv) an emphasis on simplification and increased visibility to identify activities that do not add value.

Although JIT is a relatively new concept in Nigeria, it has been applied for quite a while in many developed countries like Japan, United Kingdom, USA, etc. Few among the numerous studies that examined issues relating to the implementation of the Just-in-Time production system, Mesimo (2007) studied the impact of Just-in-time (JIT) techniques on manufacturing performance; Kannan and Tan (2005) examined the linkages between Total Quality Management (TQM) and Supply Chain Management (SCM) and their impact on business performance; Linge (1991) evaluated the extent of the flexibility of JIT in relation to the management of work and the location of economic activities; Sakakibara, Flynn, Schroeder and Morris (1997) studied the impact of Just-in-Time manufacturing and its infrastructure on manufacturing performance and Obamiro (2007) did a survey research on the extent of the application and benefits derived from Just-in-Time manufacturing system.

The literatures reviewed helped us to identify a number of economic benefits of JIT such as lowering inventory investments (Sage, 1984; William, 2005,), ordering cost reduction (Hall, 1983), respect for people (Meybodi, 2004), product simplification, production flexibility and employee morale (William, 2005). Respect for people include elements such as employee training, employee participation, teamwork, fair compensation and a new attitude towards suppliers (Wantuck, 1983; Gunasekeren, 1999). The literature reviewed also led us to identify the following key JIT practices: short set-up time, reduction in machine downtime, production schedule, flexibility, JIT purchasing (supplier relationship). These are considered JIT practices in our model in this present study.

Supporting Infrastructure to the Success of JIT

An area often neglected in the literature is the linkage between JIT practices and other activities that provide support for the use of the JIT practices (Sakakibara, Flynn, Schroeder and Morris 1993). In this study, supporting infrastructure refers to those concepts that give synergy advantages to JIT practices in terms of improvement in waste reduction and manufacturing cycle time, reduction of inventory buffers, flexible problem system and workforce capable of solving problems as they arise. Few amongst the JIT supporting infrastructure that are considered in this day are;

Total Quality Management: A linkage between quality management activities and JIT facilitate the development of free flow goods through the process, and allows buffer

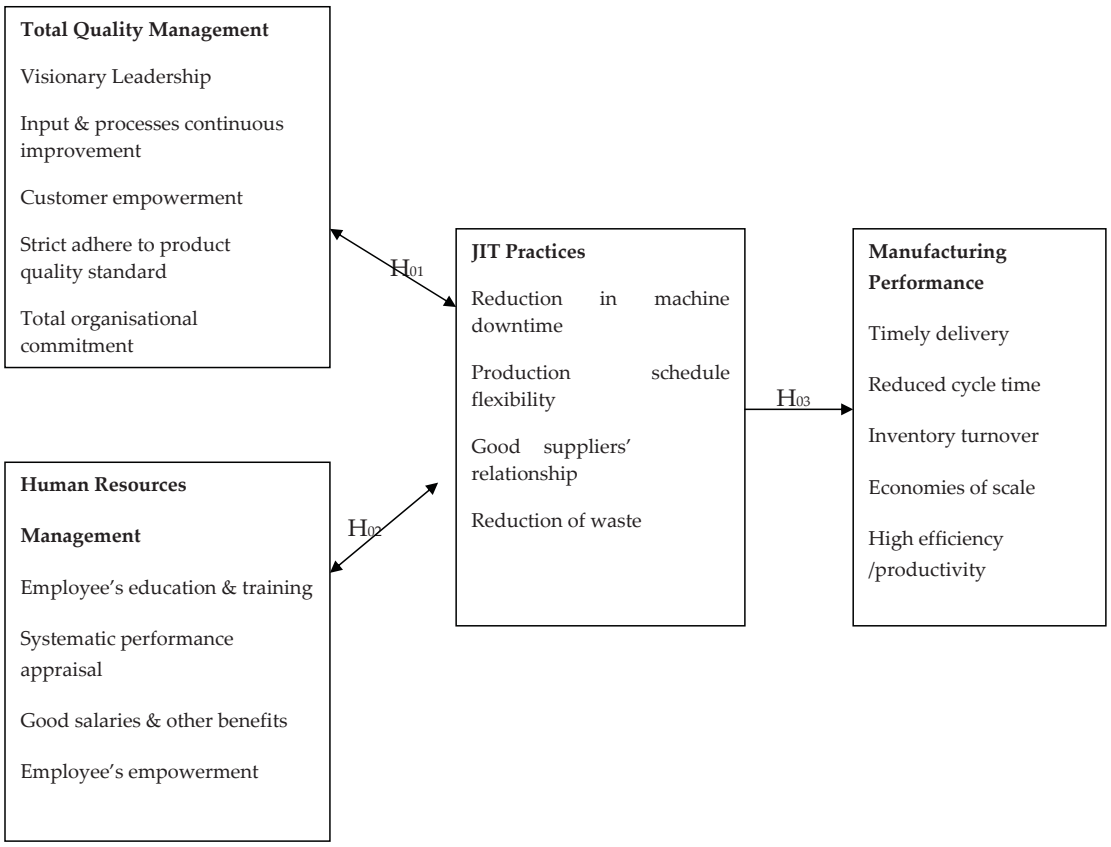
inventory reduction (Takeuchi and Guelchi, 1981, Schonberger, 1982). This also helps the production workers to produce defect-free products because they act on timely feedback about the manufacturing process.

Human resources management: Personnel activity that supports JIT includes the hiring of qualified workforce with good remuneration that promotes teamwork. Timely and effective training programmes are necessary in building flexible workforce that is capable and willing to shift to the place in the process where they are most required to facilitate a smooth production flow.

Conceptual Framework for assessing the relationship between JIT and Manufacturing Performance

The model to guide the research is an outcome of our discussion in key JIT practices, supporting infrastructure practices and manufacturing performance. Sakakibara et al (1997) assert that literature suggests that a wide variety of practices have an effect in manufacturing performance. The study separates them into those that are unique to JIT and those that support JIT as shown below;

Figure 1: *Conceptual Framework for assessing the relationship between JIT and Manufacturing Performance.*



Hypotheses of the study

1) H_0: There is no significant relationship between Total Quality Management and JIT practices.
2) H_0: There is no significant relationship between Human Resource Management and JIT practices.
3) H_0: There is no significant relationship between JIT practices and manufacturing performances.

Hypothesis 1 tests whether there is a direct significant relationship between practicing Total Quality Management and JIT practices. Rejection of the negative hypothesis would indicate that total quality management enhances or promotes the JIT practices.

Hypothesis 2 examines the relationship between effective personnel management and JIT practices. Rejection of null hypothesis would indicate that a well managed workforce enhances the adoption of JIT practices.

Hypothesis 3: The purpose of this final hypothesis is to evaluate the direct relationship between JIT practices and manufacturing performance. If the result shows that there is a relationship between the two variables, the null hypothesis will be rejected.

3. Materials and methods

A questionnaire survey was carried out at the three selected multinational manufacturing companies in Lagos metropolis. A sample size of 100 staff from each firm were selected which added up to hundred (300) from the entire employees of the chosen firms using stratified sampling. The stratified sampling technique was adopted to ensure representations of all the employees that are knowledgeable in providing the desired information from relevant departments of the companies. 300 questionnaires were administered but only 230 copies were adequately completed, resulting to a return rate of 76.7%. Responses to the questions were collected using a five-point Likert scales ranging from strongly agree (5) to strongly disagree (1). The questionnaire was sub-divided into four (4) sections. Sections A & B contain items that requested the respondents' evaluation of the contribution of some items to effective total quality management and human resource management. Section C required the respondents' to examine some aspects of just-in-time activities. Section D required respondents' information on the achievement of just-in-time techniques on business performance. The validity and reliability of the research instrument were considered. The questionnaire items were developed to correspond to the contents of the model proposed in this study. Also the set of questions posed to the respondents were worded with a view to achieving a high degree of content validity (i.e. covers what the study intends to measure) and to reducing the risk of common method bias. Also, the questions are akin to Adeyemi, (2000); Myebodi, (2004); Obamiro, 2007). The reliability of the questions and research instruments were tested using Cronbach Alpha Coefficient (1951) to ensure that items used in the model have internal consistency (Clark and Watson,1995) and measure effect of JIT on manufacturing performance. The results of these are shown in table 2.

4. Results and discussions

Respondent's Gender			**Working Experience**		
Sex	**Frequency**	**Percent**	**Year**	**Frequency**	**Percent**
Male	133	57.8	< 5 years	128	55.6
Female	97	42.2	5-10 years	60	26.1
Total	230	100	11-15 years	24	10.04
			16-20 years	12	5.22
			21 and above	6	2.6
			Total	230	10

Table 1: *Respondents' Socio-Demographic Characteristics*

Table 1 shows that 57.8% of the sample size is male while 41.3% represents female. This implies that the companies chosen are dominated by male workers, which is not surprising because manufacturing firms in Nigeria are mostly populated by men due to the nature of their operations. An analysis of the respondents' work experience revealed that more than half (55.6%) of the respondents have less than 5 years work experience while the rest 44% have a work experience ranging from 5 years and above.

A. Total Quality Management (TQMGT)	**Mean**	**STD Dev.**	**Scale Alpha**
1. Visionary leadership	4.10	1.06	.897
2. Inputs and processes Continuous Improvement	4.07	.93	.896
3. Customer Empowerment	3.75	1.11	.897
4. Strict adhere to product quality standard	3.92	0.98	.894
5. Total organisational commitment	3.75	1.03	.896

B. Human Resource Management (HRMGT)			
1. Employees Education and Training	3.89	1.17	.897
2. Systematic Performance appraisal	3.62	0.934	.934
3. Good salaries and other benefits	3.67	1.14	.895
4. Employees Empowerment	3.64	1.03	.892
C. JIT Practices (JITPRACTICES)			
1. Reduction in Machine Downtime	3.92	1.02	.895
2. Production Schedule Flexibility	3.48	1.12	.893
3. Good suppliers relationship	3.51	0.94	.897
4. Reduction in waste	3.59	0.97	.894
D. Manufacturing Performance (MANUPERF)			
1. On-time delivery	3.70	1.07	.896
2. Short lead time from order to delivery	3.57	1.01	.899
3. Reduced cycle time	3.56	1.01	.895
4. Economies of scale	3.77	1.10	.895
5. High efficiency/productivity	3.85	0.91	.897

Table 1: *Respondents' Socio-Demographic Characteristics*

Table 2 presents the means, standard deviations and coefficient alphas of the survey items. Considering the means of the survey items which are greater than 2.5 of the scale of 5, it implies that responses are positively skewed toward the application of JIT improving manufacturing performance. In testing reliability, the values of alphas (α) range

from 0 to 1, the nearer the values of α to 1, the more acceptable the reliability of the items. It is argued in literature that acceptable reliability should fall between 0.50 – 0.60, although 0.70 is desirable (Hair, Anderson, Tatham. and Black, 1998). The reliability of all the survey items used in this study fall above .80 as such were all accepted for further analysis. It means there is strong internal consistency and reliability.

Bivariate Correlation analysis was carried out to determine whether there is a relationship between TQM and JIT practices (table 3), HRM, and JIT practices (table 4), and JIT practices and manufacturing performance (table%).

Table 3: *Correlation Analysis: Total Quality Management (TQM) and JIT practices*

JIT practices TQM	**Reduction in machine downtime**	**Reduction Schedule flexibility**	**Good Suppliers Relationship**	**Reduction of waste**
Visionary leadership	.378**	.450**	.321*	.286*
Inputs and processes continuous improvement	.554**	.446**	.389** .	.494**
Strict adhere product quality standard	.488**	.506**	.430**	.386**
Customer empowerment	.404**	.621**	.391	.485**
Total Organisational Commitment	.385**	.574**	.230	.490**

** *Correlation is significant at the 0.01 level (2-tailed).*

* *Correlation is significant at the 0.05 level (2-tailed).*

Table 3, Shows the result of the first null hypothesis that is the relationship between TQM and JIT practices. To do this, we correlate the set of five TQM variables with the set of four JIT practices variables. All TQM variables correlate significantly with JIT practices variables (i.e. p< 0.05) except total organisational commitment and good supplier relationship are not significantly correlated because p>0.05. Also, the correlation coefficients were generally positive indicating that the more organisation and its employers are concerned about quality, the better the application of JIT. Therefore, the null hypothesis H0 should be rejected indicating that there is relationship between TQM and JIT practices.

Table 4: *Correlation Analysis: Human Resource Management and JIT practices*

JIT Practices **HRM**	**Reduction in machine downtime**	**Reduction Schedule flexibility**	**Good Suppliers Relationship**	**Reduction of waste**
Employee Education and training	.337**	.345**	.315**	.397** .
Systematise performance appraisal	.450**	.541**	.445**	.489**
Good salaries and other benefits	.461**	.546**	.368**	.496**
Employee Empowerment	.621**	.653**	.462**	.581**

** *Correlation is significant at the 0.01 level (2-tailed)*

In the analysis of the second null hypothesis, the variables representing human resource management variables were tested against the variables of JIT practices to establish whether a relationship exists. Table 4 shows the values of correlation of each individual HRM variable against JIT practices variables. All four human resources management are positively significantly related to the variables representing JIT practices. These results are indications of the importance of the effective management/contribution of human resource to successful JIT practices. The result also suggests that while human resource management has impact on performance of any individual variable of JIT practices, managing the human resources is the main driver of performance.

Table 5: Correlation Analysis; JIT practices and manufacturing performance

JIT Practices HRM	Reduction in machine downtime	Reduction Schedule flexibility	Good Suppliers Relationship	Reduction of waste
On-time delivery	.399*	.446**	.388**	.571**
Short lead time from order to delivery	.509**	.297**	.380**	.721**
Reduced cycle time	.566**	.412**	.430**	.578**
Economies of scale	.251*	.461**	.294*	.487**
High efficiency and productivity	.467**	.593**	.294**	.458**

** *Correlation is significant at the 0.01 level (2-tailed).*

* *Correlation is significant at the 0.05 level (2-tailed).*

In table 5, of the manufacturing performance measures, on-time delivery, short-lead time from order to delivery and reduced cycle time were mostly related to reduction of waste. Beside this, all other variables of JIT practices are significantly related to manufacturing performance. This implies that the null hypothesis should be rejected and accepts the fact that there is a strong relationship between JIT practices and manufacturing performance. This provides evidence that there is a relationship between TQM, HRM and JIT practices in achieving manufacturing productivity.

Table 6: Inter-correlation Analysis

	TQMGT	HRMGT	JITPRACTICES	MANUPERF
TQMGT	-	.836*	.746**	.740**
HRMGT		-	.751**	. 788**
JITPRACTICES			-	.788**

The analysis of interconnectivity relationships among different management techniques was presented in table 6. Total quality management and human resource management (both are supporting infrastructure) are strongly positively correlated, which are also significantly correlated with JIT Practices and manufacturing performance. The indication of this is that firms who have strength in total organisational quality and effective human resource management may likely have a good JIT practices, hence, achieve higher performance which invariably gives competitive advantage.

Conclusion

The results indicate that the success of manufacturing companies who adopted JIT techniques in their entire operations is largely determined by the explicit and effective coordinating of JIT supporting infrastructures and JIT practices into operations strategy which gives better position to organisation in responding to competitive pressures. The results of the study are consistent with similar previous studies in other countries (Kannan and Tan, 2005; Sakakibara et al, 1997; Karen and Terence, 1991).

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