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INFORMATION TECHNOLOGY ADOPTION AND INNOVATION IN MANUFACTURING COMPANIES IN RIVERS STATE

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A B S T R A C T

Notwithstanding the popularity of Information Technology (IT), there is scanty literature between Information Technology (IT) Adoption and innovation within the manufacturing sector. This study investigated information technology (IT) adoption and innovation of manufacturing firms in Nigeria. Data was collected from 121 employees from seven manufacturing firms. Descriptive statistics (frequencies, percentages and charts), were generated with the aid of IBM SPSS version 27. Three hypotheses were tested using the Partial Least Squares-Structural Equation Modelling, with the aid of SmartPLS 3.2.6, while ordinal regression was used to ascertain the combined effect of the independent variables on the dependent variable. Results suggest that information technology infrastructure and technology alignment moderately amplify innovation, while employee learning had a weak impact. The study recommends that manufacturing firms should have a huge budget for purchasing information technology hardware/software, and also embrace modern IT applications, and should have technology or applications that supports improved products designed in compliance with certified manufacturing standard. Also, employees should quickly learn and adopt modern IT applications for their work. They should not see adopting to new IT applications as a challenge.

K E Y W O R D S

Employee Learning, Information Technology Adoption, Information Technology,Infrastructure, Innovation, Technology Alignment

1.0 Introduction

Innovation is perhaps one of the most important variables in manufacturing activities (Barney, 1991). Innovation is the application of new or upgraded goods, service, and process by organisations (Mothe & Nguyen-Van, 2015). Innovation gives firms competitive advantage (Afuah, 1998), and aids them to stay afloat in the marketplace (Hult, Harley & Knight, 2004), thereby improving their profitability (Amabile, Barsade, & Mueller, 2005). According to Tohidi and Jabbari (2012), it helps new products, processes and services to be lucrative in the market. Furthermore, innovation endows organisations with outstanding fortunes (Corbett-Etchevers & Mounoud, 2011), and is a vehicle for economic growth (Abdu & Jibir, 2017).

Information Technology Adoption (IT adoption) has been an anchor for industrial activities and is right at the centre of innovation (Dahlman & Nelson, 1995). The adoption of information technology by manufacturing firms gave rise to the present scientific and industrial revolutions (Weill, Subramani & Broadbent, 2002). Olusola and Oluwaseun (2013) posit that in developing economies, adopting information technology is significant to increase in innovation. Other benefits of adopting information technology include (i) increase in the firm's efficiency, (ii) increase in quality of goods and services, (iii) increase in consumer demand, and (iv) reduction of production costs (Hall, 2011). Furthermore, organisations strive to infuse information technology into their production mechanism, and this can be achieved by internally developing (through research and development) or adopting modern technologies from developed countries (Olusola & Oluwaseun, 2013).

Accordingly, IT adoption has become pivotal and recognized by organisations because of its potentially significant impact on economic growth (Lee, 2008). For this study, IT adoption, is decomposed into: Information Technology Infrastructure (Bharadwaj, 2000), Technology Alignment (Venkatraman, 1989; Palmer & Markus, 2000), and Employee Learning (Chonko, Dubinsky, Jones & Roberts, 2003).

Information Technology Infrastructure (ITI) helps to keep companies abreast with modern technologies and their applications (Bharadwaj, 2000). It is also significant to firms by supplying the required infrastructure, which is necessary for providing appropriate types of information at the right time (Sircar, Turnbow & Bordoloi, 2000).

Technological alignment (TA) (also known as strategic alignment in IT adoption) is the link between information technology, the adopted technology and corporate strategy (Palmer & Markus, 2000). It supports technologies/strategies that empowers customer service, and to improve product/service. It is also a booster to the overall management process of the organization (Palmer & Markus, 2000).

Employee learning (EL) creates a formidable platform for technological training and the application of new information technology. Its importance to organisations and employees include: (i) fast learning of new information technology applications, (ii) quick adoption of new information technology applications for work, and (iii) innovation of new ideas, views and approaches. (Chonko, Dubinsky, Jones & Roberts, 2003).

Several scholars have written on the innovation construct at the organisational and industry levels (e.g. Rogers, 1983; Damanpour, 1991; Srivardhini & Krishnan, 2013; Alsabbagh, & Al Khalil, 2017). Others investigated it under survival (Alderman, 1996), knowledge transfer (Corso & Paolucci, 2001), organisational dynamic capability (Liao, Kickul & Ma, 2009), and organisational performance (Suhag, Solangi, Larik, Lakh & Tagar, 2017) Past research involving IT adoption in the area of manufacturing sector has been scanty (Chen & Tsou, 2007; Ghobakhloo, Hong, Sabouri, & Zulkifli, 2012). However, it appears there are not enough empirical studies on this construct in the manufacturing sector and in Nigerian context compared to other sectors such as Small and Medium Enterprises (e.g. Hassan & Ogundipe, 2017; Agwu, 2018). From the foregoing, it could be speculated that IT adoption may have a relationship with innovation in manufacturing firms. Therefore, this study seeks to investigate the nexus between information technology adoption and innovation in manufacturing firms.

Low level of innovation and over dependence on developed countries for technical and technological support are problems which affect manufacturing firms (Ojo & Ololade, 2013). Other problems identified in literature include inability to create, establish and rebrand existing product line, lack of creativity and poor approach to work (Wang & Ahmed, 2004), "high production costs, poor

infrastructure and poor financing" (Sylva, Ofoegbu & Akpan, 2016, p. 78). These problems impede the innovation of this sector and have resulted in the extinction of several manufacturing firms. Thus, manufacturing firms that fail to continually invest in innovation is at greater risk of having their products marginalized (Dibrell, Davis & Craig, 2008).

Venkatraman (1989) found that technological alignment as a facet of IT adoption accelerates innovation. According to him, whenever manufacturing firms fail to adequately deploy modern IT applications, their innovative capacity will nosedive. Additionally, poor innovation might be the consequence of poor employee learning (Zahra & George, 2002).

It is noteworthy that the manufacturing sector in Nigeria is experiencing continuous drop in profitability. The contribution of manufacturing sector to real Gross Domestic Product (GDP) is consistently reducing overtime as against the current global trend (Ekpo, 2018). The contribution of manufacturing to real GDP was around 4% between year 2009 and 2019 without any major improvement in the sector. Despite the current rebase of the economy, the manufacturing sector's contribution to real GDP is between 7% and 10% between year 2014 and 2019 (Central Bank of Nigeria (CBN), 2019).

Zalk (2014) argued that in order for manufacturing firms to remain in business, innovation is paramount. This view is based on the innovation report of World Bank and Commission on Growth and Development (2018) that showed evidence of persistent growth of some economies since after the second world war which includes: Brazil, China, Japan, Malaysia, Singapore, Thailand. Nigerian manufacturing sector lacks the requisite infrastructure to be industrialized, because of poor innovation by manufacturing firms. Thus, it has become imperative that firms should improve on innovation which has a multiplier effect capable of harnessing their resources.

In sum, it seems manufacturing firms in Rivers State do not possess the capacity that will enable them engage in IT adoption in order to increase innovation. Thus, series of problems have required that a prompt investigation should be carried out to examine the relationship between IT adoption and innovation in manufacturing firms in Rivers State in order to provide solution to these problems.

Conceptual framework of the study

Based on the foregoing, a conceptual framework is developed as shown below

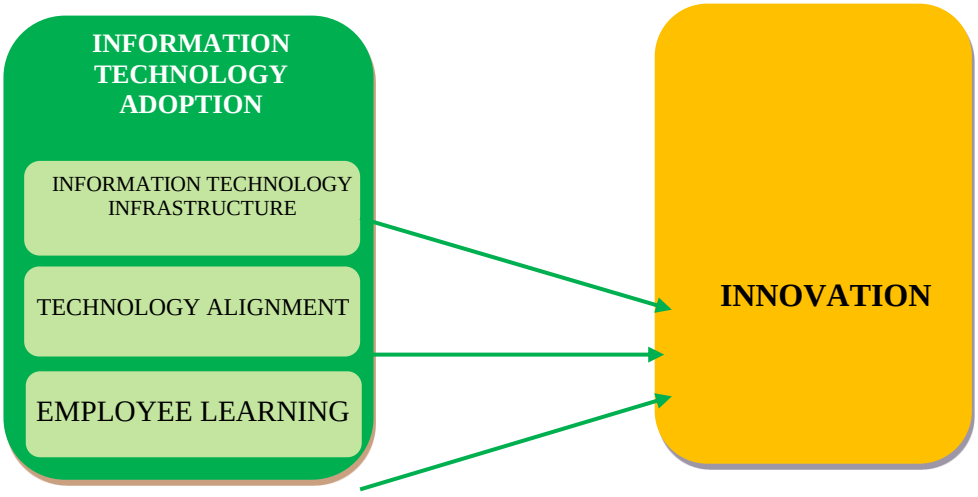

Figure 1.1: Conceptual Framework of the study.

Information Technology Adoption adapted from Bharadwaj (2000), Venkatraman (1989), and Chonko, Dubinsky, Jones and Roberts (2003). Innovation adapted from Wang and Ahmed (2004).
The following hypotheses are formulated for this study.

H_{O1}: There is no significant relationship between information technology infrastructure and innovation.
H_{O2}: There is no significant relationship between technology alignment and innovation.
H_{O3}: There is no significant relationship between employee learning and innovation.

2.0 Literature Review

2.1. Baseline Theories

2.1.1 Technological Acceptance Model (TAM)

The Technology Acceptance Model (TAM) proposed by Davis (1985) is the most widely used and recognized model for Information Technology (IT) (Awa, Ukoha, & Emecheta, 2012). The model points out that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are critical to the use of IT adoption (Davis, 1989). Davis, defined Perceived usefulness as "the degree to which an individual's perception for particular system enhances job performance" (p. 34), and Perceived Ease of Use "as the degree to which an individual's intuition determines the use of a particular system" (p. 34). TAM has helped scholars understand the acknowledgement of various types of information systems, and also used to evaluate the acceptance of eLearning (Taylor & Todd, 1995). The goal of this model is to predict, explain, analyze and explore factors influencing the adoption of information technology (Liao, Hong, Wen, Pan & Wu, 2018).

2.1.2 Dynamic Capabilities Theory

The dynamic capabilities theory introduced by Teece & Pisano (1994) emphasized that the dynamic capabilities theory emphasized that in order for organisations to achieve their overall goals, they have to be part of the internal and external systems to deal with the competitive environment (Teece, Pisano & Shuen, 1997). According to Zahra, Sapienza, and Davidsson (2006), dynamic capability is the ability of a firm's principal decision-makers to change or reconfigure existing substantive capabilities, routines, and resources in a manner that meets the demands of a dynamic business environment.
Dynamic capability is designed to create wealth for the firms operating under environments of rapid technological change with the objective of sustaining competitive advantage by changing the resource base. Examples of dynamic capability are "the acknowledgement of technological innovations, changes in consumers' tastes/preferences and in government policy (Sylva, 2018, p. 38), and tactical moves of competitors to satisfy demand conditions" (Sylva & Ojiabo, 2018, p.53). Consequently, applying the dynamic capabilities approach on manufacturing firms in Nigeria, where the business environments are uneven and unsafe, is vital for a wider context.

2.2 Information Technology Adoption

Information technology is defined as "capabilities offered to organisations by computers, software applications, and telecommunications to deliver data, information, and knowledge to individuals and processes" (Attaran, 2003, p. 54). Lohr, (2007) submits that Information technology adoption (IT adoption) has globally transformed management practices and work processes. To succeed in the

global village, organisations must be proficient in the adoption of information technology in order to reduce expenses and time spent on repetitive tasks (Chinomona, 2013). Thus, IT adoption has transformed tasks of firms that aim to achieve the five R's which are: producing the right product, with the right quality, in the right quantity, at the right price, and at the right time (Rana, 2013).

Thong and Yap (1995) postulated that IT adoption is the application of computer hardware and software solutions that aids operations, management, and decision-making in organisations. Similarly, Yan, Yingwu, and Changfeng (2007) opine that IT adoption is the application of information, computing and communication tools such as computer hardware, software, and networks as a prerequisite for connecting to the global world. IT adoption improves efficiency and increase productivity in different ways leading to lower transaction cost, better resource allocation and technical improvements (Olusola & Oluwaseun, 2013). Furthermore, IT adoption aids globalization, thus, bringing the world closer and reducing the barriers to geographical distance (Idiegbeyan-Ose, Ifijeh, Adebayo & Segun-Adeniran, 2016).

2.2 Dimensions of Information Technology Adoption

2.2.1 Information Technology Infrastructure

A large chunk of the information technology budget of an organisation is expended on information technology infrastructure (Weill & Broadbent 1998), Information technology infrastructure consists of computing (management and provision), research and development, electronic data interchange and shared databases, and networks (Davenport, Hammer & Metsisto, 1989). Furthermore, it helps organisations to adequately share information among various units (Weill, Subramani & Broadbent, 2002), and enable flexibility in adapting to changes in the business environment (Joglekar & Yassine, 2002). It is also a key to investment and management of IT infrastructures of the organisation (Tanriverdi, 2005).

2.2.2 Technology Alignment

Technology alignment is the connectivity between information technology, the adopted technology and corporate strategy (Chan, Huff, Barclay & Copeland, 1997; Palmer & Markus, 2000). In order to achieve success, organisations can link information technology and business strategies by complementing its business and information purview, as well as the business environment (internal and external) (Henderson & Venkatraman, 1993). According to Chan et al., (1997), and Sabherwal and Kirs (1994), linking information technology and business strategies is vital for information technology adoption and positively related to organisational performance. Technology alignment is used as a tool to strengthen customer service and improve process management, as well as improvement of products/services (Palmer & Markus, 2000). Furthermore, Sylva (2018) submits that it is used as the "sophistication of processes, vis-à-vis: performance standardization, maintenance, emergency planning, backup recovery, and systems control" (p. 50).

2.2.3 Employee Learning

The entire workforce in an organisation is critical in the adoption of information technology (Van Riel, Lemmink & Ouwersloot, 2004). Employee learning is the acquisition of new information technology-related skills and knowledge by individuals in an organisation. It gives the organisation an edge of information technology in the market (Scott Morton, 1995; Grover, Fiedler & Teng, 1999). The

significance of employee learning include: (i) fast learning of new information technology applications, (ii) quick adoption of new information technology applications for work, (iii) innovation of new ideas, views and approaches, and (iv) adoption of new information technology applications to aid work effectiveness (Chonko, Dubinsky, Jones & Roberts, 2003).

2.2.4 Innovation

Innovation is vital to organisational development as well as affirm their existence (Porter, 1980; Drucker, 1985). Several scholars averred that innovation is the application of modern products, process, service, and organisation routine in order to gain competitive advantage (Makanyeza & Dzvuke, 2015). Similarly, Atuahene-Gima (2012) postulated within the African context to include adoption of modern products, processes and technologies developed or built beyond its shores and possible adjustments made on existing products (Egbetokun, Richmond, Oluseye & Edward, 2016). Hence innovation aids economic growth and a major determinant for the development of countries globally (Mowery & Oxley, 1995). According to Wang and Ahmed (2004), innovation breeds, creates and establish new ideas, approaches and product to work. In the view of Esteve-Perez and Manez-Castillejo (2008), organisations that "acquire innovation are consistent with the responsibility of being new and develop the competence to stay afloat" (p. 234). Furthermore, Crespi and Zuniga (2011) submitted that innovation promotes competitiveness among organisations in both developing and developed countries.

2.2.5 Empirical Review

Chen and Tsou (2007) studied how information technology is adopted and managed to enhance service innovation practices and competitive advantage in a survey of 558 financial firms in Taiwan. Using partial least square for analysis, 124 valid observations was collected and analyzed. The result revealed that all five hypotheses were positively significant with T-values and P values as: IT adoption and service innovation in process ($t=9.28$, $p < .01$), IT adoption and services innovation in product ($t=7.56$, $p < .01$), service innovation in process and external competitive advantage ($t=3.57$, $p < .01$) service innovation in product and external competitive advantage ($t=4.80$, $p < .01$) service innovation in process and internal competitive advantage ($t=4.06$, $p < .01$). The authors concluded that adopting information technology has positive and significant impact on service innovation practices, which in turn gives rise to increase in competitive advantage of firms.

Ghobakhloo, Benitez-Amado and Arias-Aranda (2011) investigates why small and medium enterprises (SMEs) adopt information technology (IT), as well as its relationship with IT sophistication. Using logistic regression from a survey sample data of 121 Iranian manufacturing SMEs. The result shows that with a $R^2 = 0.757$, $F = 71.373$, $F = 0.000$, all hypotheses are supported. The finding revealed that external pressure, information processing needs, IT-enabled innovativeness, performance and competitive pressure are the key drivers of IT sophistication within SMEs.

Al-Nashmi and Amer (2014) studied the significance of information technology adoption factors to determine the levels of employee productivity experienced among staff working in non-governmental organisations in Yemen. With a cross-sectional sample data of 138 employees, using regression analysis. The results indicate that staff in non-governmental organisations showed high employee productivity through three variables. IT infrastructure ($r = 0.526$, $p < 0.01$), innovation ($r = 0.485$, $p < 0.01$), and IT knowledge management related to IT adoption ($r = 0.543$, $p < 0.01$). The study

recommends that decision-makers in non-governmental organisations should know more about IT adoption and ensure an efficient use of IT for the purpose of improving employee productivity and consequently, enhance the outcomes of the organisation.

Jabbouriab, Sirona, Zaharic and Khalida (2016) investigated the impact of information technology (IT) Infrastructure on innovation performance in Iraqi private Universities. 75 academics were chosen, using several regression techniques and results were extracted from SPSS. The result revealed that there is a positive and significant relationship between IT infrastructure and innovation performance (R^2=0.68, α=7.996, f=6.44). The authors recommended that private universities in Iraq use IT infrastructure as a strategic tool to enhance innovation performance.

3.0 Methodology

3.1. Population and Sampling Method

The population of the study comprises of all manufacturing firms in Rivers State. Records from the Manufacturing Association of Nigeria (MAN)-Rivers/Bayelsa branch reveals that 547 firms are operational. However, only seven firms were chosen as the sample frame because of proximity and accessibility. This amounted to a sample size of one hundred and twenty-one (121) employees. The names of the seven manufacturing firms and the number of employees used for the study are: Air Liquide Nigeria Plc (16), Bua Sugar Refinery Ltd (30), Demcok Paints (13), Eastern Enamelware Factory Ltd (10), International Breweries Plc (Formerly Pabod Breweries) (25), New Rivoc Nigeria Ltd (19), and Regal Cosmetics Ltd (8).

3.2. Data collection, Questionnaire Design and Operational Measures

The primary and secondary methods of data were used to collection of data. The secondary data were retrieved from journal articles and association records, while primary data were retrieved from responses of the questionnaire administered on the respondents. One hundred and twenty-one (121) copies of the questionnaire were administered, 26 were rejected due to conflicting and incomplete information. The remaining 95 (78.5%) copies were used for analyses to determine the impact of information technology adoption on innovation.

The questionnaire consists of three sections. Section A has seven items describing the demographical details of the respondents, section B contains eleven statement items detailing information technology adoption in their firms, while, section C contains four items on innovation. Information technology adoption was dimensionalized using information technology infrastructure, technology alignment and employee learning. The dimensions were measured using eleven indicators adopted and modified from the work of Bharadwaj (2000), Venkatraman (1989), and Chonko, Dubinsky, Jones and Roberts (2003). Information Technology Infrastructure has three items (e.g., “Has adopted modern internet applications”). Also, four statement items were used to describe Technology Alignment (e.g., “Design products in compliance with manufacturing standards”). Finally, Employee Learning was observed through four statement items (e.g., “Adopt new information technology applications for their work”). Four statement items adopted from the work of Wang and Ahmed (2004) were used to describe innovation, with such items as “creating and establishing new product lines”, “repackaging existing products in the past three years”. Apart from the demographic variables, all other items in the survey instrument were placed on a five-point Likert scale of 1=Strongly Disagree to 5=Strongly Agree.

3.3 Data analysis Techniques

The Partial Least Square (PLS) - Structural Equation Modeling (SEM) was used to evaluate the research hypotheses, with the aid of SmartPLS 3.2.6 (Ringle, Wende & Becker, 2015). Moreover, PLS-SEM is distribution free (accommodates both normal and non-normal data) (Fornell & Bookstein, 1982). In addition, ordinal regression was used to ascertain the combined effect of the independent variable on the dependent variable. This tool is appropriate because the model satisfies the following conditions: (i) The dependent variable is measured on an ordinal level, (ii) One or more or all of the independent variables are continuous, categorical or ordinal. Moreover, multi-colinearity was tested before final the analysis (McCullagh, 1980). Descriptive statistics (frequencies and percentages) was reported on respondents' demographics with the aid of the IBM SPSS Statistics version 27.

4.0 Results and Discussion

Table 4.1: Test of Validity, Reliability and Multicolinearity

	AVE	ITI	TA	IL	IN	Cronbach Alpha > 0.70	Composite Reliability 0.70-0.90	VIF
ITI	0.594	**0.753**				0.753	0.713	4.531
TA	0.623	0.431	**0.761**			0.921	0.811	3.508
EL	0.581	0.343	0.203	**0.765**		0.843	0.736	4.527
IN	0.572	0.264	0.124	0.103	**0.772**	0.912	0.824	

Source: SmartPLS 3.2.6 output on research data, 2022

Note: AVE = Average Variance Extracted. ITI = Information Technology Infrastructure, TA = Technology Alignment, EL = Employee Learning, IN = Innovation. The off-diagonal values are the correlations between latent variables, while **the diagonal values in (bold) denote square roots of AVEs.**

It can be observed in table 4.2 that the Cronbach's alpha values are not below 0.7 or above 0.9 (Hair Jr., Babin & Krey, 2017). Furthermore, all the latent variables reported values for Composite reliability satisfied the 0.7 criterion (Hair et al., 2017). Thus, the instrument is reliable. It can also be deduced from the table that there is no multi-colinearity, since all the Variance Inflation Factors (VIF) (ITI = 4.531, TA = 3.508, and EL = 4.527) for the dimensions are not highly correlated with each other.

Furthermore, convergent validity of the model is confirmed through the values of the Average Variance Extracted (AVE), which is above the recommended 0.50 threshold (Fornell & Larcker, 1981). The table also reported satisfactory that the model demonstrates discriminant validity since the square roots of the AVEs (diagonal values in bold) are higher than 0.70, and are far greater than the correlations between the constructs (the off-diagonal figures). This confirms that each construct is sufficiently distinct from any other one (Fornell & Larcker, 1981).

Table 4.2: Ordinal Regression Test

−2 Logistic Likelihood = 99.495 Intercept Only = 51.541 Final score = 99.495		
Chi-Square = 52.046, p = 0.02 (< 0.05)		
Nagelkerke Pseudo R^2 = 0.446		
Test of parallel lines Significance p > 0.05 p = 0.994		
Goodness-of-Fit, p > 0.05 Pearson = 0.748 Deviance = 1.000		
Dimension factor	**Wald Statistic**	**Sig.**
Information Technology Infrastructure	10.165	0.001
Technology Alignment	9.884	0.002
Individual Learning	8.070	0.000

Source: Research Data (SPSS Output), 2022

Table 4.3 shows that the Logistic Likelihood for Intercept Only (51.541), Final score (99.495), Chi-Square (52.046), and p-value of 0.02 reports a fit model between the dimensions of IT Adoption and Innovation. Furthermore, the Goodness-of-Fit indices: Pearson (p = 0.748) and Deviance (p = 1.000) indicate that there is a fit between the proposed model and the data, since the p-values are greater than 0.05. The table also shows that 44.6% (R^2 = 0.446) variance was explained by Nagelkerke Pseudo R^2 to ascertain the extent to which all the dimensions of IT adoption jointly explain the variability in innovation.

Furthermore, the parameter estimates for the dimensions of IT adoption as reported by Wald statistic showed that each dimension significantly affects innovation since the p-values are all less than 0.05 (ITI < 0.001, TA < 0.002, and EL<0.000). Finally, Test of Parallel Lines (p = 0.994) reveal that the slope coefficients in the model are the same across response categories since the p-value is greater than 0.05.

Next is the test of hypotheses using the path coefficient and t-statistic criterion. As a rule, path coefficients (β values) of .10 to 0.29, .30 to .49 and .50 to 1.0 are weak, moderate and strong correlations, respectively (Cohen, 1988). Also, for a two tailed test, t values greater than 1.96 are significant, while t values less than 1.96 are non-significant (Hair, Hult, Ringle & Sarstedt, 2014). Table 4.3 shows the results of test for hypotheses.

Table 4.3: Test of Hypotheses

Null Hypothesis	**Path (Relationship)**	**Path Coefficient (β)**	**Standard Error**	**t-Statistic**	**Decision**
H_{O1}:	ITI -> IN	0.421	0.065	2.131	Not supported
H_{O2}:	TA -> IN	0.457	0.071	2.150	Not supported
H_{O3}:	EL -> IN	0.206	0.052	1.970	Not supported

Source: SmartPLS 3.2.6 output on research data, 2022

Table 4.3 shows that there is a moderate, positive and significant relationship between information technology infrastructure and innovation (β=0.421, t=2.131); a moderate, positive and significant relationship between technology alignment and innovation (β=0.457, t=2.150); a weak, positive and significant relationship between employee learning and innovation (β=0.206, t=1.970). Therefore, H_{O1}, H_{O2} and H_{O3} were supported.

Furthermore, the table reveals that technology alignment has the highest effect on innovation followed by information technology infrastructure, while employee learning is the least. This is evident in their respective β-values (TA=0.457, ITI=0.421 and EL=0.206).

The results above suggest that improvement in information technology infrastructure will moderately promote innovation of manufacturing firms in Rivers State. Thus, when manufacturing firms increase their technology for hardware and software, and have access to modern internet applications, it leads to the creation/establishment of new product lines; and modern ideas/approach to work. This finding is in consonance with Mithas, Ramasubbu and Sambamurthy (2011) who submitted that a cordial relationship between firms and clients not only promote the adoption of new technology, but also aids firms to innovate and improve their products. Similarly, Sylva (2018) concluded that one of the ways organisations can stay afloat is by having efficient information technology infrastructure. As such, an improved IT infrastructure is the bedrock of competitive advantage.

As stated in the results above, an improvement in technology alignment will moderately promote innovation of manufacturing firms in Rivers State. This means that as firms rebrand their products and approach to work, it will strengthen their customer service, improve process management and all these are executed in compliance with the certified manufacturing standards. This is in tandem with Venkatraman (1989) who concluded that technological alignment accelerates innovation. According to him, whenever manufacturing firms fail to adequately deploy modern IT applications, their innovative capacity will nosedive.

Furthermore, the results suggest that improvement in employee learning will strongly promote innovation of manufacturing firms in Rivers State. This means if employees are given sufficient training, it will aid the learning and adopting of modern technological applications and will lead to modern ideas and approaches to work. This finding aligns with the submission of Chen and Tsou (2007) that successful adoption of information technology requires that employees are provided with sufficient support and training to reap greater benefits beyond the change in technology.

5.0 Conclusion, Suggestions and Recommendations

The study empirically demonstrates that information technology adoption positively and significantly influences innovation. Based on the findings, the study concludes that higher levels of information technology adoption amplify innovation. Specifically, the study concludes that higher levels of information technology infrastructure and individual learning will give rise to higher level of innovation.

This study appears to be first to empirically investigate the relationship between Information Technology Adoption and Innovation in manufacturing firms in Nigeria. The study concludes that information technology infrastructure and technology alignment moderately amplify innovation of manufacturing firms in Rivers State, while employee learning has a weak effect.

This means that all the three variables are important. However, more attention ought to be given to employee learning. Thus, manufacturing firms should understand that products should be designed in

compliance with manufacturing standards, invest hugely on hardware and software technology, and adopt modern internet applications in order to improve their products or services.

Specifically, employees ought to quickly learn and adopt modern technology and applications through intensive training to have new ideas and approaches to work, in order to create and establish new products.

Based on the study, the following recommendations are made.

1) Manufacturing firms should have a huge budget for purchasing information technology hardware/software, and also embrace modern IT applications.

2) There should be technology or applications that supports improved products designed in compliance with certified manufacturing standard. Furthermore, organisations should have a mechanism that strengthens customer service and improve process management.

3) Employees should quickly learn and adopt modern IT applications for their work. They should not see adapting to new IT applications as a challenge. Furthermore, they should be given sufficient training while implementing new information technology systems and applications.

5.1 Limitations for Future Research Directions

Like previous studies, the findings of this study are prone to some limitations and thus, offer opportunities for further research

Firstly, future research should consider information technology adoption from a different perspective by using other factors such as perceived compatibility and technical know-how to investigate their study. Additionally, other factors such as a moderating variable which most likely affect IT adoption is not factored into the conceptual model. Thus, further studies can input competitive pressure as a moderating variable.

Secondly, there is a noticeable gap in the characteristics of the manufacturing industry and other sectors. The peculiarities in the population parameters of other sectors can account for different research results, findings and conclusions. Thus, future studies concerning the interactive nature of the variables should be conducted in sectors such as the banking, aviation and telecommunication.

Thirdly, future studies should investigate the predictive relevance of other variables on innovation. The predictive value of variables such as organisational learning, knowledge management, workers' competency management, and dynamic capabilities should be examined.

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