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## **Technological Innovation Capability and Firm's Performance in New Product Development**

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### **ABSTRACT**

*Technological innovation is one of the driving and fundamental instruments of growth strategies. The main objective of this study is to provide the understanding the way in which technological innovation capabilities affect the efficiency and potential of firm performance. The study attempted to draw on the theoretical literature and empirical studies on innovation, management and capabilities of technology in an effort to explore the role of technological innovation on new product development. The study posits the importance of technological innovation as an essential ingredient of competitive advantage for new product development. The study is different from previous research and focuses on an integrated framework of potential influence on innovation incorporating other variables. Adopting the Principal Component Analysis (PCA) approach, we were able to reduce the larger set of variables into a more manageable set of scales. A PCA with varimax rotation was conducted to find out the underlying dimensions of innovations and firm performance. We used the SPSS for window 12.0 software pack as our statistical analysis tool for all the data, and Pearson's analysis to verify the relationship between technological innovation and new product development, and t-test to verify the hypotheses. In this study, the researcher constructed research variables for measurement ( $\alpha$ ) was used to measure the internal consistent of the study. For Cooper and Emory (1995) if Cronbach's alpha ( $\alpha$ ) is between 0.70-0.98, then the reliability is higher but if it is lower than 0.35, then the results are not reliable and should be refused. For this study, Cronbach's  $\alpha$  was above 0.80, indicating that the results of the survey were all well within the parameters of reliability. The survey findings verify the existence of correlation between technological innovation and firm performance on new product development. Based on the findings, recommendations were proffered which have crucial role for innovative capabilities.*

**Keywords:** Technological innovation capabilities, firm performance, new product development

### **INTRODUCTION**

A critical issue for industrialization and governments everywhere is the need to encourage innovation and change among industry members in order to increase productivity and enhance the industry's competitive position. In order to achieve this objective, it is important that all those involved in making decisions that affect productivity improvement and industry development understand the complex processes and dynamics that are at work within and between organizations and individuals that are also involved in the context of the innovation system. It has been argued that the success of today's businesses increasingly, depends on their intellectual assets as opposed to their tangible resources (Stewart, 1997). Among other things, these assets

include attitude, knowledge and skills of the workforce. According to American Society for Training and Development (ASTD), these assets are known as competences. It is a general belief that managing individual competencies is one important element in the management of strategic competitive advantage, and technological innovation has become an important competence of individuals. The purpose of technology innovation is to create business value, the value, that can take many different forms such as incremental improvements to products, the creation of entirely new products and services and reducing costs. Drucker (2001) emphasizes that every organization needs one core competence innovation, and further stresses that every organization needs a way to record and appraise its innovative performance: Mohanty (2006) outlined that for an economy or a nation to achieve preeminent position and superior status, it has to pioneer the culture of innovation. In the history of business, it is clear that the effective innovators have a better chance of surviving and non-innovators tend not to survive at all. The method of innovation is to develop ideas, refine them into a useful form and bring them to fruition. Amabile (1996) define technological innovation as the successful implementation of creative ideas within an organization while Tidd, Bessant, and Pavitt (2001) says that technological innovation is the process of turning opportunities into new ideas and of putting them into widely used practice. Freeman and Carloza (1988) sees this as a process that includes the technical, design, manufacturing, management and commercial activities involved in the marketing of a new or improved product. Afuah (1998) suggests that innovations do not have to be breakthrough or paradigm shifting. Roberts (1988) suggests that the overall management of technological innovation includes the organization and direction of human and capital resources towards effectively creating new knowledge, generating ideas aimed at new and enhanced products, manufacturing processes and services, developing those ideas into working proto types and finally transferring them into manufacturing, distribution and use. The conclusion is that innovation is concerned with the process of commercializing or extracting value from ideas. From this perspective, innovation would be expected to be closely linked to firm performance.

### **Objectives**

In this study, we aim to explore innovations and their effects on firm performance on new product development by examining product, process and marketing, as well as by focusing on various aspects of firm performance such as innovation performance, production performance, marketing and financial performance respectively. In essence, the widespread application of technology has become an important factor in structuring an industry, with technological innovation providing a competitive advantage for a company. This study conducted a questionnaire survey on the plastic manufacturing industry in Nigeria to collect empirical data, in order to discuss issues such as the relationship between a company's technological innovation, new product development and firm's performance.

### **Scope and Target Issues**

The scope and target issues for this include the following:

- The relationship between a company's technological innovations and its performance in new product development.

- Whether different patterns of technological innovation can have a significant impact on a company's performance.
- To discuss which aspects of a company's technological innovation might influence new product development.

### **Research Hypotheses**

In order to discuss the relationship between technological innovation on firm's performance and new product development, we propose the following hypotheses for verification:

- H1. Technological innovation has a positive and significant correlation with new product development.
- H2. Technological innovation, firm's performance and new product development are significantly related
- H3. Technological innovation and firm's performance have a positive and significant a correlation with new product development.

### **RELATED RESEARCHES**

Technological Innovation is a concept developed within the scientific field of innovation studies, which serves to explain the nature and rate of technological change. The concept of technological innovation was introduced as part of a wider theoretical school called the Innovation System Approach (ISA). The central idea behind this approach is that determinants of technological change are not to be found in individual firms or in research institutions, but also in a broad societal structure in which firms as well as knowledge institutes are embedded (Freeman, 1995). Since the 1980s, innovation system studies have pointed out the influence of societal studies on technological change and indirectly on long-term economic growth within nations, sectors or technological fields. The technological innovation concept emphasizes that stimulating knowledge flows is not sufficient to induce technological change and economic performance. Hence, there is a need to exploit this knowledge opportunities. This stresses the importance of individuals as sources of innovation. Suurs (2009) emphasizes that technological innovation approach focuses on system dynamics. The focus on entrepreneurial action has encouraged scholars to consider technological innovation as sometime to be built up over-time. Carlsson and Stankiewicz (1991) pointed that:

Technological Innovation Systems are defined in terms of knowledge/competence flows rather than flows of ordinary goods and services. They consist of dynamic knowledge and competence networks. In the presence of an entrepreneur and sufficient critical mass, such networks can be transferred into development blocks . . . within industry or group of industries.

Technological innovation is broadly seen as an essential component of competitiveness, embedded in the organizational structures, processes, products and services within a firm. Innovativeness is one of the fundamental instruments of growth strategies to enter new markets, to increase the existing market share and to provide the company with a competitive edge.

Schumpeter (1934) described different types of innovation as new product, new methods of production, new sources of supply, the exploitation of new markets and new ways to organize business. Drucker (1985) defined innovation as the process of equipping in new improved capabilities or increased utility. Metcalfe (1998) stated that when the flow of newness and innovation desiccate firms' economic structure settles down in an inactive state with little growth. Therefore, innovation plays a significant role in creating the differences of performance and competition among firms. McAdam and Keogh (2004) investigated the relationship between Firms' performance and its familiarity with innovation and research. They found that the firms' inclination to innovations was of vital importance in the competitive environments in order to obtain higher competitive advantage. Miller (2001) stated that most firms seek technological innovation to gain competitive advantage in their market.

As described by Patel and Pavitt (1997), technology is one of the main sources of competitive advantage for a company. Within the same industry, companies with a technological edge tend to have better profitability as well as being faster in developing new product lines or other technological innovation.

According to numerous studies related to resource-based theory, such as Andersson (2003) and Gallon, Stillman and Coates (1995), technological innovation is at the core of the company's competitive capability. Gallon et al (1995) suggests it is the most important core asset. Hafeez, Zhang, and Malak (2002) attest that a company should develop its competitive edge in order to acquire long lasting competitive advantages. Companies need to be constantly aware of the changing environment while keeping and developing new technological capabilities in order to survive.

A study by Walsh and Linton (2002) technological innovation is a unique technique or manufacturing process owned by a company, which allows it to react quickly to an environmental shift. Burgelman, Christensen and Wheelwright (2004) posit that technological innovation designates the capability of an organization to choose, diffuse and then improve it technology. As such, it is a progressive process of experience accumulation including the use of technology, the improvement and application of existing technology. Yam, Guan, Pun and Tang (2004) emphasizes that technological innovation is the skill involved in realizing and supporting a company's technological innovation strategy. In their study, they also propose seven dimensions for measuring technological innovation which include: technology learning, R & D, Resource allocation, manufacturing ability, marketing skill, organizational skill/strategy and scale related ability, Archibugi and Coco (2005) point out that technological innovation is the ability to access and digest external knowledge into some unique skill or knowledge, then using it in a dynamic way to improve or develop a new product and Launch it successfully.

Guan, Yam, Mok and Ma (2006) also remark that technological innovation is the combination of knowledge techniques and management skills from different areas, that by strengthening these areas, the company can build its organizational competitiveness.

From the above studies, one can see that technological innovation is a multi-dimensional concept, which tackles the diffusion and application of technology in order to acquire

commercial benefits. In essence, technological innovation is the way in which an organization can efficiently select, implement and use a technology in comparison with a competitor.

Technological innovation is an important source of growth and a key determination of competitive advantage for many organizations. Achieving innovation requires the coordinated efforts of many different actors and the integration of activities across specialists' functions, knowledge domains and contexts and application. The ability of an organization to innovate is a pre-condition for the successful utilization of innovative resources and new technologies. Accordingly, Lazonick's (2005) theory of the innovative enterprise is rooted in the Chandlerian Framework as it focuses on how strategy and structure determine the competitive advantage of the business enterprise. It also builds on Lawrence and Lorsch's (1967) conceptualization of organizational design problems as differentiation and integration. The theory distinguishes the optimizing firm from the innovative firm. Lazonick identifies three social conditions that support the development of the innovative firm. The first condition is strategic control, which refers to the set of relations that give key decision-makers the power, knowledge and incentives to allocate the firm's resources to confront market threats and opportunities. The second condition is organizational integration. That is, the horizontal and vertical integration of skills and knowledge to support cumulative learning over-time. The third condition is financial commitment to ensure that sufficient funds are allocated for competence development to sustain the cumulative innovative process. The essence of the innovative enterprise, according to Lazonick (2005), deals with the organizational integration of skill base that can engage in collective and cumulative learning. The theory of the innovative firm propounded by Lazonick, alongside other researchers in the field of strategy stresses the importance of organizational and management processes as core elements that underpin firms, innovative performance. Innovative performance is seen in the literature as one of the most important drivers of other aspects of firm performance. Hence, innovative performance exerts positive effects on firm's production, market and financial performances. Innovative performance, especially in the form of new product success, is linked in the literature to an increase in sales and market shares, since it contributes considerably to the satisfaction of existing customers and gaining of new customers.

## **RESEARCH METHODOLOGY**

Building upon the literature, the researcher used four data collection methods. These methods were designed to complement each other in terms of data collection, analysis and verification, case studies and a questionnaire was designed and a survey conducted. The initial survey draft was discussed with firm's executives and it was pre-tested with pilot interviews to ensure that the wording, format and sequencing of questions were appropriate. Firms to be contacted were selected randomly from the database from the Nigerian chamber of commerce. The sample consists of manufacturing firms drawn from six main manufacturing sectors in Lagos State, Nigeria. These industries set to be major plastic manufacturing firms in Lagos, Nigeria. Ten firms were selected randomly and questionnaire was applied simultaneously through surveys and randomly selected face-to-face interview were arranged concurrently. The questionnaire was pre-tested to make the research instrument more valid. The questionnaire provided data that would allow some understanding of the psychological variables that affect technological innovation and firm's performance. The questionnaire was based on the Technology, Acceptance model, which

suggests that the use of new technology depends on two key beliefs, perceived usefulness and perceived ease of use.

*Reliability Assessment.* Test reliability indicates the extent to which individual differences can be attributed to differences in the characteristics under consideration. We used Cronbach's  $\alpha$  to assess the reliability of performance management data. Alpha values for all the factors were found to be greater than 0.70.

*Measurement of Variables.* In many recent studies, different criteria of performance were used to measure firms' competitiveness, productivity and efficiency. In this study, we adapted financial, marketing, production and innovation performance constituted quantitative firm performance measure. Financial measures such as return on sales (RGS), return on investment (RGI) and return on assets (ROA) were favored for performance evaluation. In addition, we adapted Hagedoorn and Cloudt (2003) approach to evaluate the in-firm innovation environment and the innovation performance of companies. The respondents were requested to compare the perceived average performance of their firm in the last four years to the perceived average performance prior to this period. In addition to these perceptual measures, respondents were asked to provide objective data (sales exports, total sales, market share and innovation outlay) for the last four years. The base of items asked regarding innovation measures consists of production performance, market performance, financial, product and innovation performance. The respondents were asked to indicate on a five-point Likert scale to which extent the related applications and practices were implemented in their companies.

### **Data Analysis and Interpretation**

Descriptive statistics and correlation analysis were used to explore the relationships of the variables on firms' sales growth. The analysis stresses the fact that innovative firms tend to develop the most suitable fit between structure, operating contingencies and flexibility.

Variable	Mean	S.D.	Innovation			Performance		
<b>Innovation</b>								
Product	1.702	0.78	1	0.534**	0.562**	0.572**	0.583**	0.293**
Process	1.747	0.82		1	0.468**	0.263**	0.421**	0.184**
Marketing	2.121	1.06			1	0.473**	0.411**	0.376**
<b>Performance</b>								
Financial	3.529	2.48				1	0.425**	0.284**
Production	2.763	1.84					1	0.357*
Market	2.13	1.36						1

Source: Data Analysis \*\* = correlation significant  $P < 0.01$  level

**Table 1: Descriptive Statistics and Correlation Analysis.**

The coefficient analysis indicates a strong positive association between factors. All the hypotheses were supported regarding correlations. Therefore, we can, generally deduce that higher product process and marketing innovation capabilities were associated with increased innovation production and marketing performance. Correlation analysis presents not only significant relationships among almost all variables, but it also exhibits a complex web of associations. These findings infer the existence of mediating effects of some innovation types on

innovation performance relationships. The analysis proved that to achieve competitive advantage, the sampled firms showed that financial and marketing performance, as well as the rest elements of the innovation capabilities, were important factors in strengthening their innovative efforts.

### **Measurement of Variables**

S/N		Mean	STD
To what extent were the <b>Product Innovations</b> implemented in your organization in the last four years related to the kinds of activities?			
1.	Increasing manufacturing quality in components and materials of current products	4.28	2.65
2.	Decreasing manufacturing cost in components and materials of current products	3.64	1.86
3.	Developing new products with technical specifications and functionalities	3.86	1.97
To what extent were the following kinds of <b>Process Innovations</b> implemented in your companies in the last four years?			
1.	Increasing output quality in manufacturing process, techniques, machinery and software	3.75	1.67
2.	Determining and eliminating non-value adding activities in delivery related processes	2.68	1.47
3.	Increasing variable cost and increasing delivery speed in delivery related logistics	2.47	1.26
To what extent were the following kinds of <b>Marketing Innovations</b> implemented in your organizations in the last four years?			
1.	Renewing the design of the current and new products through changes such as appearance, packaging, shape	3.79	1.49
2.	Renewing the distribution channels without changing the logistics processes	3.57	1.36
3.	Renewing the product pricing techniques employed for the pricing of current and new product	3.36	1.24

**Table 2: Items Innovation Measures.**

S/N		Mean	STD
How would you rate the level of achievement of the following <b>Production Performance Items</b> in your organizations in the last four years?			
1.	Conformance quality	4.75	2.48
2.	Production cost	4.42	2.25
3.	Production flexibility	3.96	1.86
4.	Production and delivery speed	3.64	1.58
How would you rate the level of achievement of the following <b>Financial Performance Items</b> in your organization in the last four years compared to the previous years?			
1.	Return on sales (Profit/Total Sales)	3.85	1.79
2.	Return on Assets (Profit/Total Assets)	3.64	1.52
3.	Cash flow excluding investment	3.47	1.36
4.	General profitability of the firm	3.24	1.18
How would you rate the level of achievement of the following <b>Market Performance Items</b> in your organization in the last four years compared to the previous years?			
1.	Customer Satisfaction	4.83	2.47
2.	Total Sales	3.75	1.69
3.	Market share	3.49	1.48

**Table 3: Items Performance Measures.**



The questions above on Tables 2 and 3 about firm performance and innovation measures were asked to the respondents, employing 5-point Likert scale to what extent the related applications and practices were implemented in their organizations for the last four years.

In this section of data analysis, we apply the principal component Analysis (PCA) to reduce the larger set of variables into a more manageable set of scales. A PCA with varimax rotation was conducted to find out the underlying dimensions of innovations and firm performance in order to extract the dimensions of each construct. Factors with eigenvalues (the amount of variance accounted for by a factor) larger than 1 were carried for further analysis. This stage was concluded by exploring internal consistency and reliability (content validity) among the items of each construct via Cronbach's  $\alpha$  coefficient.

Tables 4 and 5 display the results of principal component analysis (PCA) for innovation and firm performance items respectively.

S/N	Factor	Factor Load	Eigenvalue	Cum. % (variance explained)	Cronbach's $\alpha$	AVE
<b>Factor 1—Process Innovation</b>			1.82	17.47	0.83	0.582
1.	Increasing output quality in manufacturing process, techniques machinery and software	0.582				
2.	Determining and eliminating non value added activities in delivery related process	0.583				
3.	Decreasing variable cost and increasing delivery speed in delivery logistics	0.627				
<b>Factor 2—Process Innovation</b>			1.64	34.49	0.78	0.57
1.	Increasing manufacturing quality in components and materials in current products	0.482				
2.	Decreasing manufacturing cost of components and materials of current product	0.536				
3.	Developing new products with technical specifications and functionalities	0.684				
<b>Factor 3—Marketing Innovation</b>						
1.	Renewing the design of the current and new products through changes such as appearance, packaging and shape	0.692	2.46	55.70	0.82	0.707
2.	Renewing the distribution channels without changing the logistics process	0.736				
3.	Renewing the product pricing techniques employed for the pricing for current and new products	0.693				

Source: Data Analysis

**Table 4: PCA for Innovations.**

S/N	Factor	Factor Load	Eigenvalue	Cum % variance (n) explained	Cronbach's $\alpha$	AVE
<b>Factor 1—Production Performance</b>			2.75	27.63	0.764	0.691
1	Production cost	0.648				
2	Conformance quality	0.682				
3	Production: flexibility	0.735				
4	Production and delivery speed	0.698				
<b>Factor 2—Financial Performance</b>		4.88	62.92	0.891	0.882	
1.	Return on sales	0.825				
2.	Return on assets	0.846				
3.	Cash flow excluding investment	0.931				
4.	General profitability of the firm	0.927				
<b>Factor 3—Marketing Performance</b>			1.741	84.23	0.735	0.714
1.	Customer satisfaction	0.647				
2.	Total sales	0.735				
3.	Market share	0.749				

Source: Data Analysis

**Table 5: PCA for Firm Performance.**

With the adoption of principal component analysis (OPCA), three factors were respectively labeled based on the items included in each factor. The total variance explained to innovation was found to be 55.70 percent, with Cronbach's  $\alpha$  coefficient ranging from 0.79 to 0.83, suggesting satisfactory levels of construct reliability, since for Cronbach's  $\alpha$  values greater than 0.70 is accepted as reliable (Nunnally, 1978; Streiner, 2003).

Similarly, PCA produced three factors extracted on firm performance with the total variance explained to be 84.33 percent. The Cronbach's  $\alpha$  values for the underlying factors range from 0.735 to 0.891, indicating satisfactory levels of construct reliability of factors.

This study suggests that building technology innovative capabilities entails not only matching structural forms with market opportunities, but with market opportunities, but also embedding the capacity for learning and knowledge creation within team processes and social relationship.

### **Future Research**

General implications for future research on technological innovation capability and firm performance on new product development have emerged. Our results support the claim that different types of Innovations are influenced differently by different contextual factors. For example, new product development is determined mainly by the dynamism of most of the factors mentioned in the study. We found from the study that the main contextual factors influencing innovation of new product in the production process originate from the rationality of the decision

making process and the organicity of structure. In drawing implications, this study established the importance of innovation in firm's performance on new product development. Our findings might encourage the continuation of theoretical and empirical research on technological innovation and its impact on firm performance. Such empirical research might include a different set of personality variables than those incorporated in the present effort. The findings may encourage future attempts to integrate the strategic choice perspectives as well as the need of supplementary use of economic, social and psychological theories in the attempt to explain innovation. By suggesting that the decision making process is shaped by both internal and external forces, our findings encourage future research on the role of Chief Executive officers on guiding the thinking of the staff of the adoption of contingency approach on strategic leadership and innovation.

## **CONCLUSION**

Technological innovation is an important source of growth and a key determinant of competitive advantage for many organizations. Achieving innovation requires the coordinated efforts of many different actors and the integration of activities across specialist functions. Innovation is a process of learning and learning is a collective process that occurs within an organized setting. From this study, we found that innovation is concerned with the process of commercializing or extracting values from ideas. From this perspective, innovation would be expected to be closely linked to firm performance. There is a widespread support for the assertion that firms should be innovative to survive and prosper in a competitive economy. These findings substantiate our conceptual framework and offer several managerial implications:

1. Managers should put additional emphasis on innovations, as they are important instruments for achieving sustainable competitive power.
2. Firms that are endowed with resources to improve their innovative capabilities could expect a more significant improvement on their production and market performance.

In addition, our findings support the fact that innovation strategy is an important major driver of firm performance and should be developed and executed as an integral part of the business strategy. Innovations provide firms with strategic orientation to overcome the problems they encounter while striving to achieve sustainable competitive advantage.

## **RECOMMENDATIONS**

Based upon the findings of this study, the following recommendations are proffered:

- Managers of the firms should invest more on innovative capabilities and support new attempts of introducing innovation on each type.
- Managers need to pay more attention to organizational innovations, which have a crucial role for innovative capabilities.
- Clear understanding of the exact nature of innovations will help firms to prioritize their market, production and technology strategies.

In essence, technological innovation is one of the driving and fundamental instruments of growth strategies to enter new markets, to increase the existing market share and to provide the company with a competitive edge.

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