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Abstract

The aim of every business organization is to survive amid the competition and the turbulent nature of business environment. The purpose of this study was to examine the relationship between information system development approaches and organizational competitive advantage of business organizations in Port Harcourt, Rivers State, Nigeria. The study adopted the explanatory and quantitative method, hence correlational research design is employed to investigate the correlation between the study variables with target population of 45 respondents as the study population. Krejcie and Morgan determination table was used to derived the study sample size of (40) participants. The closed ended structured 4 points Likert scale Questionnaire was constructed for use in data gathering. Collected data were coded into a format and analysed with the aid of Pearson Product Moment Correlation Coefficient Statistics and presented using Statistical Package for Social Sciences (SPSS) software package for ease of interpretations. The findings showed low and moderate significant relationship between the first dimension of information system development approaches -Waterfall approach and the two measures of organizational competitive advantage – customers' requirement and business performance. The second dimension of information system development approaches – Agile Management Approach significantly correlates with the two measures of organizational competitive advantage – customers' requirements and business performance. Therefore, we recommended that, when developing information system for business organizations, the aims and objectives should determine the recommended approach to be used by system developers.

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Keywords: *Information System Development Approaches, Waterfall Approach, Agile Management Approach, Organizational Competitive Advantage*

1.0 Introduction

In the contemporary business environment with the increasing numbers of competitors, organizational leaders are awakening the consciousness of the utilization of the advancement of information communication technology as a tool to address business problem across all structure of the organization for competitive advantage. Information system development is now deployed across all types of business organization that take part in the social economic advancement of the nation, be it large corporations or small/medium enterprises are considering how they can utilized the technology for organizational competitive advantage. Turban, Sharda and Denlen (2011) asserts that companies that are not able to keep up with the pace of the latest information communication technology (ICT) developments may lose their competitive advantage and the ability to compete under the same conditions as their competitors, leading to shrinking market share and profitability. The goal and aim of every business organization is to compete favourably well in the midst of competitors. In business organization perspective, competitive advantage is the attribute that allows an organization to outperform its competitors. And competitive advantage is achieved when the visions and goals of the organization are achieved ahead of competitors. Also, the favourable position organization seeks in order to be more profitable than its rival.

To achieve competitive advantage, organization must adapt to the challenging environmental factors and develop plan strategy that will enable the organization to leverage on information technology as a strategic tool for competitive advantage. Filipova (2004) state that, an expression of an enterprise's competitiveness is its adaptability, expressing the adequacy of its responses to the impact of the environment and complying the amendments to the dynamics of the environment. Dimitrova (2014) points out those competitive advantages are central to the process of shaping and developing the competitiveness of the enterprise. She also noted that the emergence of the modern concept of competitive advantages is predicated on the development of scientific and technical progress, globalization and the internationalization of competitive relations.

To this effect, it is everyday discussion as leaders of organization continue to adopt the scientific and technical approach through the development of information system that can facilitate the progress of their operations. The development of information system is not done using single pattern but different approaches are deployed by system developers to achieved information system. Furthermore, information system is used by organizations, institutions, businesses and many industries. The information system development approach is the technique and procedure that is used in the design stages of information system development by developers in the process of building a system. New technologies bring new opportunities to enhance business operations and interactions. Information systems developments (ISD) are implemented with the sole aim of improving the usefulness and efficiency of business operations and interactions. The capabilities of the information system and characteristics of such business, its employees and the systematic development and implementation of the information system determine the degrees to which that aim are accomplished. The unanswered question remains if development of information systems is the solution to business competitive advantage? And if the approaches of information system development influences organizational competitive advantage? We addressed the concern using the conceptual framework below as the study tends to use quantitative approach.

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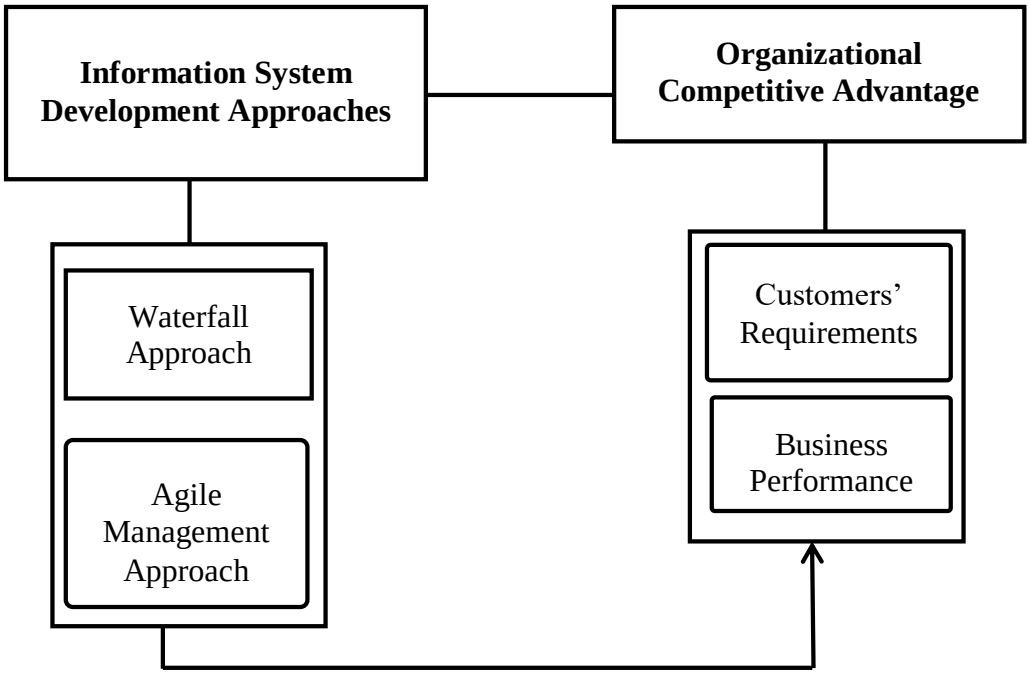

Researcher's conceptualization, 2022

1.1 Purpose of study

i. To determine how waterfall approach of information system development influence organizational competitive advantage in business organizations in Port Harcourt, Rivers State.
ii. To examine how Agile management approach of information system development influence organizational competitive advantage of business organizations in Port Harcourt, Rivers State.

1.2 Research Questions

i. How does waterfall approach as an information system development influence organizational competitive advantage of business organizations in Port Harcourt, Rivers State?
ii. How does Agile Management Approach as an information system development approach influence organizational competitive advantage of business organizations in Port Harcourt, Rivers State?

1.3 Research Hypotheses

$H_{0:1}$ There is no significance relationship between waterfall approach as an information system development and customers requirement of business organizations in Port Harcourt, Rivers State.

H_{02} There is no significance relationship between waterfall approach as an information system development and business performance of business organizations in Port Harcourt, Rivers State.

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H_{03} There is no significance relationship between Agile Management Approach as an information system development and customers requirement of business organizations in Port Harcourt, Rivers State.

$H_{0:4}$ There is no significance relationship between Agile Management approach as an information system development and business performance of business organizations in Port Harcourt, Rivers State.

2.0 Review of Literature

Information System Development Approach

Every information system are developed using different approaches depending on the developers and the requirements of the users. The goal of every information system development is to integrate physical work processes into computer software as to enhance the performance of such activities using technology. Coy (2004) explain that information system (IS) enhance the coordination of hardware and software to collect, filter, process, create and distribute data within a confine network to achieve business excellence. It aims at supporting business operations and managerial decision making in achieving business productivity and excellence. It deals not only with infrastructure but also the manner at which users interact with the system in support of business processes to achieve this excellence.

Kroenke (2008) defined information system (IS) as an interaction formed by users and information technology (such as process, data, models, applications, machines and others) to achieve some organizational functions and purposes. This interaction can occur within or across organizational boundaries. An information system is the technology an organization uses and also the way in which the organizations interact with the technology and the way in which the technology works with the organization's business processes. This takes cognizance of human computer interaction. Hence, information system (IS) is the interconnection and operation of information technologies and human managerial skills to achieve business productivity and excellence. Korpela, Mursu and Soriyan (2002) posits that information systems development (ISD) can be seen as the process of interaction by which some collective work activity is facilitated by new information-technological means through analysis, design, implementation, introduction and sustained support, as well as process management to achieved business excellence. It is the developmental change in process that is aimed at achieving certain business objectives or purposes by using information systems.

This change is targeted towards business operational excellence and productivity. Mingers (2003) identified Waterfall, Prototyping, Incremental, Spiral, Rapid application development (RAD) and Extreme Programming approaches as commonly used in information system (IS) project and system development. However, these approaches have been found not to be sufficient to achieve inclusive business excellence that is been anticipated by developers and information system users. For inclusive business excellence and comprehensive solution to complex system development, a multi-methodological approach is considered the most effective strategy (Iden, Tessen & Paivarinta, 2012; Higgins, Taylor & Francis, 2012). Generally, information system development approach or method is the collection of procedures, techniques, tools and documentation aids which help the system developers in their efforts to implement a new information system. And a system comprises of different components join together to perform a generic task. For the purpose of this study, we focused basically on two approaches, and they are waterfall and Agile Management Approaches.

Waterfall Approach

The waterfall approach was established in 1970 by Winston W. Royce. Royce (1970) describes the fundamentals of software/system development. In an intermediate phase of his elaboration, Royce presents a sequence of phases which form a software development sequence, known as waterfall approach. Waterfall approach of the information system development is a software development approach that breakdown activities into linear sequential phase depends on the deliverables of the previous one and corresponds to a specialization of tasks. Unhelkar (2016) emphasizes the sequential dependability on the previous deliverable. A dependability which holds back system design when the analysis model is still to be signed off, and holds back coding if the design is still to be signed off. A next step in Royce's disquisition covered the iterative relationship between successive development phases. Royce (1970b) believes that as each development step progresses, and the design is further detailed, there is iteration with the preceding and succeeding steps, but rarely with the more remote steps.

Thus, at any point in the design process after the requirements analysis is completed there exists a firm and close up moving baseline to which to return in the event of unforeseen design difficulties. The model is considered to offer a well-defined set of criteria and requirement indications before actually starting the design phase and implementation of the project, thus, offering a basis plan of the project before starting and continuing in an orderly sequence of phases. The main issue with the Waterfall model is that it cannot ensure quickly changes of stakeholder's requirements until the project is finished or nearly finished, thus, being more appropriate for projects that are considered to have more stable or unchanged requirements at least for a longer period of time, (Vallabhaneni, 2018). Previously, Othman, Ismail and Wahab (2017) assert that, the waterfall model implies one phase has to be finished before the other one starts, the risk being high that errors from the previous phase can be transmitted to the next phase, as verification occurs at the end of the software development or close to the end phase. This type of model sustains a more traditional type of management organization, where requirements circulate from top management to basis management and further on to employees and minimal or no contact with customers or other stakeholders occurs with developers teams.

Waterfall Constraints

Ganis (2010) has the view that the Waterfall Model predominately emphasizes on the freezing of requirement specifications or the high-level design very early in the development life-cycle. So the Waterfall model is likely to be unsuitable if requirements are not well understood/defined or are likely to change in the course of the project. Petersen, Claes and Dejan (2009) associate the Waterfall Model with high costs and efforts. The number of documents to be approved in every phase, the difficulty to make changes, the difficulty iterations take to initiate achieve goals and problems that arise only in later phases confirms this belief. Consequences of these constraints have been that the customers' current needs are not captured/addressed, resulting in implemented but unused features.

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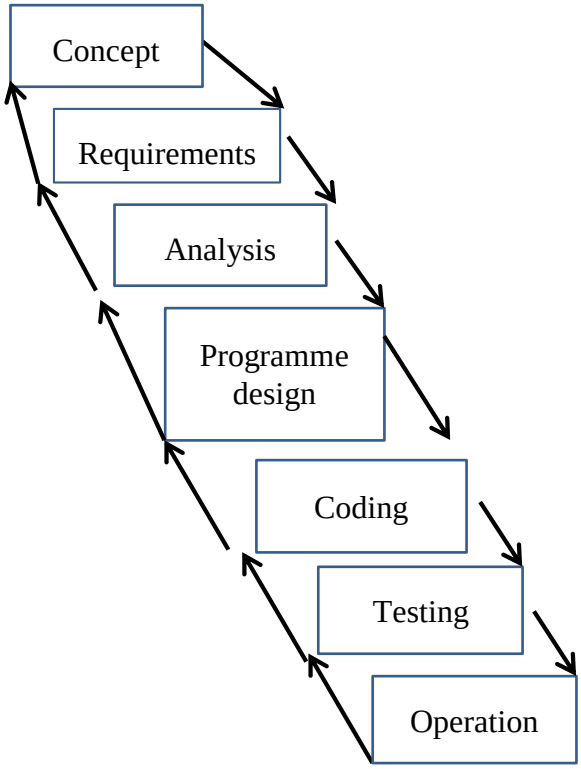
The waterfall approach follows the sequences in the phases below:



***Source**: Westfall, (2010)*

The Waterfall Model: iterative relationship between successive phases

Agile Management Approach

The Agile information system development approach is a system development approach which promotes adaptive planning, evolutionary development, early delivery, continuous improvement, and encourages rapid and flexible response to change. Sequent Inc, (2010) states that, this methodology is an iterative methodology which focuses on prototyping, constant communications with stakeholders and reviewing of requirements; as such the requirements and solution tends to evolve through the process. It is a flexible methodology which easily facilitates the changing of requirements even at very late stages during the development process. During the initial stage basic requirements are required from which a prototype is built. The process then moves to the next stage, iteration stage, where further requirements are gather in consultation.

In recent time, the taste of customer's changes, the need for organization to upgrade their information system becomes necessary, hence the agile management approach. This model is suitable where competition in the product field is increased and new features have to be implemented quickly. The agile model is considered more appropriate due to its increased flexibility to customer requirements implementation and frequent product releases. According to Cohen, Mikael and Patricia (2003) posits that, all agile methodologies share common characteristics, a focus on interaction, communication, and the reduction of resource-intensive intermediate artefacts. Furthermore, agile approach combine short iterative cycles with feature planning and dynamic prioritization which give room to constants upgrade of the system. Highsmith and Cockburn (2001) asserts that, agility requires face-to-face communication,

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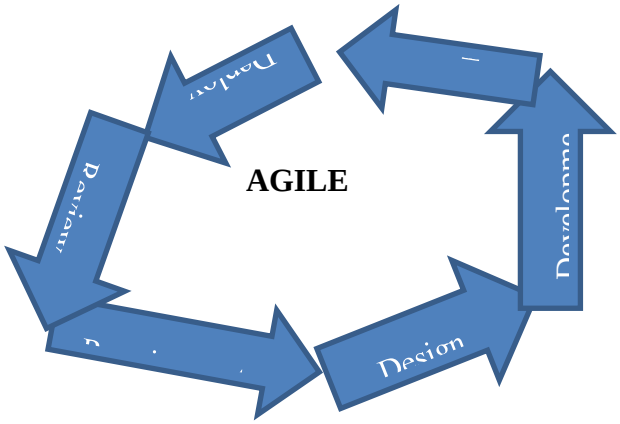
which in turn implies working in close location, facilitating teams to make decisions and act on them immediately rather than wait on correspondence. Later, Cohenm, Mikael and Patricia (2003) add that, agile development also requires close customer partnerships. The Agile model has itself two main versions of software development management, namely the ***Scrum method and the Test driven development***. The agile management model follows the sequences phases below:



Source: *Die, (2016)*

Scrum method

The Scrum method is a version of the agile model that supports also a quick implementation of new customer requirements. First a product backlog is created, namely, a list, where the customer requirements priorities are selected, while afterwards requirements are split into short term objectives, named Sprints (maximum three to four weeks), that are established by the project manager or scrum master, as they can be named (Linz, 2014). An essential part of a successful implementation of the Scrum method is the involvement of the development teams that have to meet daily to discuss software development progress and obstacles in order to quickly implement the requirements.

Test Driven Development

The Test Driven Development is another version of managing software development within the agile method. This method offers a new approach as test is written before the actual start of software development through coding, thus, it starts with establishing the requirements for the new product feature and with the testing of a first version of the product, being followed by the feature implementation through coding and testing (Paranj, 2017). If after coding the test is not successfully passed it implies the feature was not implemented, whereas when all tests are passed it means it was successfully implemented. This method is considered to reduce the amount of errors through the frequent testing.

Constraints associated with agile management approach

The architectural design, not a key value in agility, flaws or errors that seriously compromises the integrity of the design, though are more costly to correct when detected late in the development process. Tacit knowledge makes projects that use agile processes dependent on experts. Besides, the informal evaluation techniques of agile processes may not be sufficient for establishing the quality of safety-critical systems, (Dan, Robert & Bernhard, 2014).

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Organizational Competitive Advantage

The term organizational competitive advantage refers to a set of capabilities that permanently enable the business organization to demonstrate better performance than its competitors, (Bobillo Iturriaga, & Gaite, 2010). Porter's developed three ways to achieve competitive advantage of business organization; cost leadership, centralization and creating differentiation of product. He argued that businesses should think about how they enter a market and then create and keep a proper competitive position for themselves, (Porter, 1980). There are two general perspectives for elaboration on stable competitive position in an organization; the first perspective is developed on the industrial organization theory introduced by Michel Porter in the 1980s as a prevailing perspective, in which attaining competitive advantage is caused by environmental opportunities.

Analytical tools used in this perspective include analysis of organization value chain, analysis of competitive forces, general strategies (cost leadership, differentiation, and centralization), competitiveness, clusters, competitive advantages of nations, and so on. The second perspective is the resource-based theory, in which it is argued that every business creates its own unique competencies that are difficult to imitates, and capabilities which result in competitive advantage. In fact, permanent competitive advantage and weakness and strength features of the business are mainly under consideration, (Moreno, Lorente, & Rio, 2012). The information technology in the prevailing situations is a resource base that organizational leaders must adhere to as to strengthening the performance of business organizations for competitive advantage. Lim, Stratopoulos, & Wirjanto, (2012) posits that the stronger the IT managers regarding the structural power in organizational hierarchy, the stronger the IT role in the organization and the more the competitive advantages for the organization. Hazen and Byrd (2012) state that, new information technologies such as electronic data interchange (EDI) and FRID technology have positive effect on attaining competitive advantages and expansion of innovation. They said that these technologies may bring differentiating features for the business performance.

Interestingly, today customers are always aware of the current products and services as soon as they entered the market, therefore, organizations that are not able to develop new product service strategy before others, faces the challenges of market competition. Bestman and Gonee, (2021) asserts that, the traditional knowledge management, knowledge creation can no longer cope with the high demand from customers, it is a routine activity, and its target is to increase profitability, while profitability is the final output of organizational performance through increase customers' patronage which the traditional method failed to considered; the IT era cope with the changes of customers demand which create avenue for organizational competitive advantage.

3.0 Methodology

This study adopted the explanatory and quantitative methods, drawn from their respective ontological, epistemological and human nature roots, carried out with a view to enhancing external validity. Being a cross sectional survey design study, it is correlational in nature because it investigated the relationship between Information system development approaches and organizational competitive advantage consequences. As a micro level study, both professional system developers and system users were studied. A two-stage sampling technique was adopted.

The first sampling technique involved the use of convenient sampling technique to collect business organizations that are conveniently accessible. The population of this study consists of forty-five (45) respondents. The second stage sampling involved the use of Krejcie and

Morgan determination table as a sampling technique to derive the sample size from the study population. Therefore forty (40) participants were derived to form the study sample size. The data collection for the study was done through the distribution of questionnaires. Both descriptive and inferential statistical tools were used to analyse the collected data retrieved from the respondents. The descriptive analytical tool such as frequency distribution tables was used for the analysis of respondent's demographics information and supported by chats due to the nominal scale type of the generated data set.

4.0 Data Analysis

At the secondary level the study adopted inferential statistical tool to test the relationships between the study variable dimensions and measures. This was done using the Pearson Product Moment Correlation Coefficient formula through the Statistical Package for Social Sciences (SPSS) to establish the relationship among the empirical referent of the predictor variable and the measure of the criterion variable. In testing hypotheses one to four, the following rules were upheld in accepting or rejecting our null hypotheses: All the coefficient values that indicate levels of significance (* or **) as calculated using SPSS were rejected and therefore, when no significance is indicated in the coefficient (r) value, we do not reject our null hypotheses. Our confidence interval was set at the 0.01 (two tailed) level of significance to test the statistical significance of the collected data in this study.

Table 1: Correlation Matrix for Waterfall Approach and Organizational Competitive Advantage

		Waterfall Approach	Customers' requirements	Business Performance
Waterfall Approach	Pearson Correlation	1	.451**	.576**
	Sig. (2-tailed)		.000	.000
	N	40	40	40
Customers requirement	Pearson Correlation	.451**	1	.539**
	Sig. (2-tailed)	.000		.000
	N	40	40	40
Business Performance	Pearson Correlation	.576**	.539**	1
	Sig. (2-tailed)	.000	.000	
	N	40	40	40

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

From the results in the table above, the correlation coefficient (r) shows that there is low significant and positive relationship of Waterfall Approach on customers' requirement'. The correlation coefficient .451** confirms the magnitude and low strength of this relationship and it is significant at p 0.000<0.01. The correlation coefficient represents low correlation indicative of a very weak relationship between the variables. Therefore, based on empirical findings our null hypothesis earlier stated is hereby rejected and the alternate upheld thus; there is a significant relationship between waterfall Approach and customers' requirement of selected business organization in Port Harcourt Rivers State. However, the low significant relationship is as a result of the lengthy period that takes in making changes of the customers' requirements. We also found that there is a moderate significant relationship between Waterfall

Approach and business performance (r = .576**, 0.000 <0.01). Going by this result, the hypothesis two was rejected and alternate upheld thus; there is a moderate significant relationship between Waterfall Approach and business performance. The moderate relationship occurs because the delay in the changes of the system will not close down the performance of the business completely.

Table 2: Correlation Matrix for Agile Management Approach and Organizational Competitive Advantage

		Agile Management Approach	Customers' requirement	Business performance
Agile Management Approach	Pearson Correlation	1	.968**	.988**
	Sig. (2-tailed)		.000	.000
	N	40	40	40
Customers' requirement	Pearson Correlation	.968**	1	.989**
	Sig. (2-tailed)	.000		.000
	N	40	40	40
Business performance	Pearson Correlation	.988**	.989**	1
	Sig. (2-tailed)	.000	.000	
	N	40	40	40

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

From the results in the table above, the correlation coefficient (r) shows that there is high significant positive relationship of Agile Management Approach on customers' requirement'. The correlation coefficient r = .968** confirms the magnitude and high strength of this relationship and it is significant at p 0.000<0.01. The correlation coefficient represents high correlation indicative of a very strong relationship between the variables. Therefore, based on empirical findings our null hypothesis earlier stated is hereby rejected and the alternate upheld thus; there is a significant relationship between Agile Management Approach and customers' requirement of selected business organization in Port Harcourt, Rivers State. The high significant relationship is as a result of the quick period in making changes of the customers' requirements. We also found that there is a high significant relationship between Agile Management Approach and business performance (r = .988**, p = 0.000 <0.01). Going by the result, the hypothesis four was rejected and alternate upheld thus; there is a strong significant relationship between Agile Management Approach and business performance. The strong relationship occurs because the quick changes made in the system will increase the performance of the business.

5.0 Findings

In the interpretation and discussion of the outcomes of our bivariate data analysis, we either accept or reject our Null hypotheses: All the coefficient values that indicate levels of significance (* or **) as calculated using SPSS were rejected and therefore, when no significance is indicated in the coefficient (r) value, we do not reject our null hypotheses. For hypothesis one to four, we applied guidelines to accept or reject our null hypotheses.

Consequently, our confidence interval was set at the 0.01 (2 tailed) level of significance to test the statistical significance of the data in the study.

Waterfall Approach and organizational competitive advantage

The result of the Pearson Product Moment Correlation Coefficient in table 1 showed presence of significant but low association between waterfall approach and customers' requirement. This result implies that, the low significant relationship is as a result of the lengthy period that takes in making changes made on customers' requirements. Furthermore, Waterfall approach also shows moderate significant relationship with business performance. This implies that the moderate relationship occurs because the delay in the changes made in the system will not close down the performance of the business completely but reduced its competitive advantage.

Agile Approach and organizational competitive advantage

The result of the Pearson Product Moment Correlation Coefficient in table 2 showed presence of high significant association between agile approach and customers' requirement. This result implies that, the high significant relationship is as a result of the lesser period that it takes in making changes made on customers' requirements. Furthermore, agile approach also showed high significant relationship with business performance. This implies that the high relationship occurs due to the quick changes made on the system and will increase the performance of the business to achieved competitive advantage.

6.0 Conclusion/Recommendations

The development of information system is now a usual practice in business organization both corporate and small/medium enterprises and these goes a long way in determining the organizational competitive advantage. The study validated the fact that waterfall approach of system development does not stand better chance for organizational competitive advantage as the difficulty in changing requirements of the customers' needs slow the performance of the business especially short period business objectives. And the agile management approach of system development stand better chance more than the Waterfall Approach in organizational competitive advantage as modification can be made at any given time. A survey seeking for the relationships was conducted on a sample size of 40 system developers in Port Harcourt. The survey results indicated low and moderate relationships with the hypotheses 1 and 2; hypotheses 3 and 4 showed strong significant relationships between the variables hypothesized. The strategy and methodology were designed in a way that addressed the achievement of the study objectives.

The study concludes that there is low and moderate significant relationship between waterfall approach and customers' requirement and business performance. Also agile management approach showed strong significant relationship between customers' requirement and business performance. The findings of this study therefore, implies that business organization when contracting the development of information system of the organization put into considerations the approaches to be used by developers having in mind taste of customers' changes per day as to create rooms for easy modifications of the system for competitive advantage.

Drawing from the implications of the outcome of our study, we therefore made the following recommendations:

i. Waterfall approach for information system development should be used for business organizations project with a long-term objectives that does not needs urgent modifications.

ii. Agile Approach for information system development should be used by business organization for the development of their information system as it is seen to be suitable for both long- and short-term business objectives and allow for easy and urgent modifications.

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