EFFECTS OF RETAINING COSTS ON TRANSITION FROM AGING SERVER HARDWARE TO CURRENT SERVER HARDWARE

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CERTIFICATION

This is to certify that the thesis "**Effects of Retaining Cost on Transition from Aging Server Hardware to Current Server Hardware**" was carried out by **Okafor Ifeanyi, Anayo** with registration number 20095720329 of the department of Information Management Technology, School of Management Technology, Federal University of Technology, Owerri under the supervision of Dr. B. C. Asiegbu and is hereby admitted as partially satisfied the requirements for the award of the degree of Master of Technology in Information Management Technology.

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DEDICATION

This thesis is dedicated to OKAFORs. Thank you for all the support.

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ABSTRACT

This research is geared toward assessing the extent cost of retaining an aging server hardware has affected the transition to current server hardware in a developing country like Nigeria. Primary data were the major source of data for the study. The collected data were subjected to multiple regression analysis. The study found that software update, Random Access Memory (RAM) maintenance, hard disk maintenance and power/ cooling costs have significant cost impact on aging server hardware. Based on these finding, we recommend that Information Technology (IT) Managers should carry out yearly retaining cost analysis of aging IT server infrastructure. Yearly retaining cost analysis will aid IT Managers forecast the most appropriate time to upgrade to newer server models.

Keywords: Impact, Transition, Server, IT infrastructure, Cost, Hardware

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Today, we live in a world that is governed by absolute technological changes. The benefit of information technology and the internet as a strategic tool is so phenomenal that it has been a major catalyst to boost the assessment of cost of retailing Information Technology (IT) in the 1990s.

With the ever-increasing reliance of businesses upon the IT systems and electronically stored business data, this becomes an equivalent increase in management's duty to ensure due diligence and fiduciary responsibility with respect to protecting them against all causes of loss or damage. The potential costs of failing to do so can be enormous.

The information revolution is sweeping through our economy. No organization can escape its effects. Dramatic reductions in the cost of obtaining, processing, and transmitting information are changing the way we do business. Information technology is changing the way companies operate. It is affecting the entire process by which companies create their products. Furthermore, it is reshaping the product itself: the entire package of physical goods, services that information companies provide to create value for their buyers.

Hitherto, the populace and most organizations know that the revolution is underway, and few dispute its importance. However, more and more of their time and investment capital is absorbed in information technology and its effects, executives have the awareness that the information technology have been growing tremendously. As they see their rivals use information for competitive advantage, these executives recognize the need to become directly involved in the management of the new technology.

Notwithstanding, in the face of rapid change, this project aims to help managers and the general public respond to the challenges of the information revolution. How will advances in information technology affect competition and the sources of competitive advantage? What strategies should be pursued to exploit the technology? What are the implications of actions that competitors may already have taken? Of the many opportunities for investment in information technology, which are the most urgent?

To answer these questions, managers must first understand that information technology is more than just computers. Today, information technology must be conceived of broadly to encompass the information that businesses create and use as well as a wide spectrum of increasingly convergent and linked technologies that process the information. In addition to computers, then, data recognition equipment, communications technologies, factory automation, and other hardware and services are involved.

The information revolution is affecting competition in three vital ways:

- It changes industry structure and, in so doing, alters the rules of competition.
- It creates competitive advantage by giving companies new ways to outperform their rivals.
- It spawns whole new businesses, often from within a company's existing operations.

In assessing the effect of retaining costs on transition to current server hardware, we shall go further, to know the reasons why information technology has acquired strategic significance and how it is affecting all businesses. We can then ascertain how the new technology changes the nature of competition and how astute organizations have exploited this. Finally, we will determine a procedure that can be used to assess the role of information technology in their business and to help define investment priorities to turn the technology to their competitive advantage.

As any city depends on a functioning infrastructure, companies operating in a digital world are relying on a comprehensive information technology infrastructure to support their business processes and competitive strategy. With ever-increasing speed, transactions are conducted; likewise, with ever-increasing amounts of data to be captured, analyzed, and stored, companies have to thoroughly plan and manage their infrastructure needs in order to gain the greatest returns on their information technology investments. When planning and managing their information technology architectures, organizations must answer many important and difficult questions.

Clearly, the effective managing of an organization's information technology infrastructure is complex but today's digital world has made it necessary. Any area where people live or work needs a supporting infrastructure, which entails the interconnection of all basic facilities and services enabling the area to function properly.

This research focuses on the effect of retaining cost on transition to current server hardware.

1.2 Statement of the Problem

The problem of this study is related to the fact that most Information Technology (IT) managers avoid making further changes, resulting in a delay in updating the systems or providing a technology refresh. Often, they do not replace the equipment before its normal depreciation cycle runs its course, as long as the system is performing adequately and meeting availability requirements. This approach to server replacement/renewal cycles relies on the calendar to determine when the server should be replaced or refreshed with new technology.

During this time, system administrators may work to repeatedly upgrade and reconfigure servers in support of workloads rather than to consider a fully burdened cost assessment highlighting the cost reductions that could be gained by replacing the servers sooner. Some studies report that a cycle of repeated upgrades, security patches, and rising maintenance and management costs can accelerate, over time, if the life cycle of the server is extended to four years or more. The drive to reduce capital expenditures is strong and understandably so given the current economic climate. However, IT managers also know that the need to address operational expenditure within the datacenter is equally important.

In view of the above stated situation, this work is geared toward assessing the extent costs of retaining an aging server hardware have affected the transition to current server hardware in a developing country like Nigeria.

1.3 Research Objectives

The broad objective is to assess the extent costs of retaining of an aging server hardware have affected the transition to a current one. The specific objectives include:

i. To identify aspects of costs of retaining an aging server hardware.
ii. To assess the extent each aspect of costs of retaining aging server hardware has affected transition to current one.
iii. To assess the extent the collective aspects of costs of retaining aging server hardware has affected transition to current one.
iv. To rank the effect of each aspect of the costs on transition to current server hardware.

1.4 Research Questions

The following research questions have been posed to guide the study in relation to the specific objectives:

I. What are the aspects of costs of retaining aging server hardware?
II. To what extent has each aspect of the cost affected transition to current server hardware?
III. To what extent have the collective aspects of the costs affected transition to current server hardware?
IV. What are the ranks of these aspects of costs in relation to their effect on transition to current server hardware?

1.5 Research Hypothesis

- H_{01}: There is no significant effect of the collective aspects of the costs on transition to current server hardware

- H_{A1}: There is significant effect of the collective aspects of the costs on transition to current server hardware
- H_{02}: There is no significant effect of each aspect of the costs on transition to current server hardware.
- H_{A2}: There is significant effect of each aspect of the costs on transition to current server hardware.

1.6 Scope of the study

The scope of the research is restricted to only Information Technology organizations that make use of Server for their daily transactions .The researcher selected specific organization as case studies namely: Integrate Computer Limited 89, Choba Road Port Harcourt, Centre for Information Technology, Research and Educational Services (CITRES), 87 Airport Road, Calabar, Cross River and Institute for Management Studies (IMS), 90 Mary Slessor Avenue, Calabar Cross River State. The researcher in view of this scope issued questionnaires to the staff of these organizations and the data collected were used for analysis purposes.

Limitation of the study

This research is however limited due to the following factors:

- The cost of running wide research is high. Consequently, the researcher limited hisworks to the three organizations to enable him carry out a comprehensive research work.
- Some organizations were concerned about information security, general security and safety. These organizations did not grant access to carry on the research.

1.7 Significance of the Study

The significance of any research is pegged to finding a solution to an impending problem that faces these entities, mankind, the environment and the society.

The study creates awareness for Chief Executive Officers' who make use of server in their daily running of businesses to make informed decisions on the most appropriate time to replace aging servers taking into cognizance organizational efficiency and cost.

CHAPTER TWO

LITERATURE REVIEW

2.1 IT Infrastructure Investment

Many organizations, when faced with budget challenges, put off capital expenditures (capex) and seek alternatives to acquiring new hardware platforms, such as lengthening server life cycles and extending software licenses. This pattern of stretching the useful life cycle of servers has a number of near term benefits for customers in terms of depreciating assets over a long period of time or prolonging an existing lease. But if a transition to new technologies has been deferred too long, then the time comes when the system has fallen far behind the performance and cost efficiency levels being offered by multiple vendors in the marketplace today. This has been especially true in recent years, as the performance of processors has more than doubled each year, based on the emergence of multi-core, multiprocessor system designs with improved system speeds. Source: IDC White Paper, the cost of retaining aging it infrastructure (Jed Scaramella et al, 2014)

The assessable effect of information technology investment on performance of firms remains a subject of debate among managers and researchers. Although developed organizations persist to invest heavily in highly developed communications and computing technologies, researches demonstrate opposing findings on effects of these investments on organizational performance. This effect “has also produced what may be labeled the paradox of IT productivity” (Santos &Sussman, 2000).

Numerous papers and researches can be found concerning this topic and area. Anchored in prior observed researches, there is insignificant connection between investment in information technology (IT) and cost assessment. It may give rise to numerous companies to implement IT schemes inefficiently and exclusive of profound consideration of redesigning and reengineering the processes and building the appropriate stage for implementation of IT (Stratopoulos&Dehning, 2000).

During the past decades, we have observed a growing convergent set of Information and computing technologies that are being identified as facilitators of essential business alters. Taking into account dominant variables such as total quality management, reengineering of processes and organizational infrastructures is a suggested approach to explicate productivity paradox (Albadvi et al, 2007).

We can consider dominant variables to recognize the meandering affiliation between IT and organizational performance, which directs us to better illumination of impact of IT. A number of investigators have stated these superseding variables as complementary of information technology, which can reinforce IT efficacy (Keramati&Albadvi, 2006).

In view of information technology usages, information technologies applications plus IT tools are applied by organizations to smooth the advancement of the business processes for example in ground of administration and accounting, production and operation, human resource management and management control (Keramati&Albadvi, 2006).

Investments in information technology (IT) have grown continuously over the years to a point that IT has become the largest item of capital expenditure in most organizations. For example, Avram outlined in 2001 that global ICT expenditure was growing at a rate faster than worldwide GDP. Gwillim et al (2005) suggested that global lCT spending exceeds $1 trillion per annum. According to Agarwal and Lucas (2005), ICT is one of the most important business driving forces of the 21st century. While organizations have invested in IT as a means to improve organizational performance, many previous researchers have failed to show any evidence of the IT impact on organizational productivity. This 'IT productivity paradox' has been a debated issue since the mid-1980s.While recent firm level studies have claimed that the IT productivity paradox no longer existsSawyar (2005).

A competitive business environment brings fourth new technologies to be employed for improving organizational performance level of organizations resources; this leads to improved customer service hence customer satisfaction. Although ICT investment is a catalyst in competitive advantage realization, it is also high-risk. Risk is a function of project size and complexity, newness of technology, project structure, hidden costs, and human, political and cultural factors (Willcocks& Lester, 1999). Some authors, for example Tingling & Parent (2004), suggested that ICT investment is fundamentally different from other investment types. This is due to problems associated with identifying and quantifying costs and benefits including intangibles. However, the difficulty with this view is that ICT may not be subjected to the rigorous evaluations or appraisals associated with other capital investments, and as a result the IT's impact may remain unknown and its potential unrealized.

Organizational performance is one of the important factors to evaluate the economic growth both at the industry and firm level. Its growth directs companies to increase their market share (Wong, 2009). At the most basic level, organizational performance cannot be observed without defining organizational productivity. Organizational productivity is based on the economics of the firms. It is measured as the ratio of output to input. Historically, organizational productivity is often defined as the ratio of output to the most limited or critical input, with all the other input held constant. Investigation of the organizational productivity achieves the following results: The resources efficient will be judged and Evaluation of resources management will be facilitated (Gholani, 2005).

There is no doubt that the use of ICT is perceived as a catalyst for economic growth for any organization and any country that embraces ICT to drive business. By its very definition as a set of activities that facilitate by electronic means the processing, transmission and display of information (Estavillo, 2004); it is important to know how the effectiveness of such a process has an impact on an organizations performance. Typical ICT components include hardware, software and telecommunication equipment (Kaiser, 2004).

IT infrastructure provides the foundation for serving customers, working with vendors, and managing business processes. It defines the capabilities of the firm today and in the near term.Figure 2.1 is IT Infrastructure and Business capabilities. Source: Brien & Neo, 1996

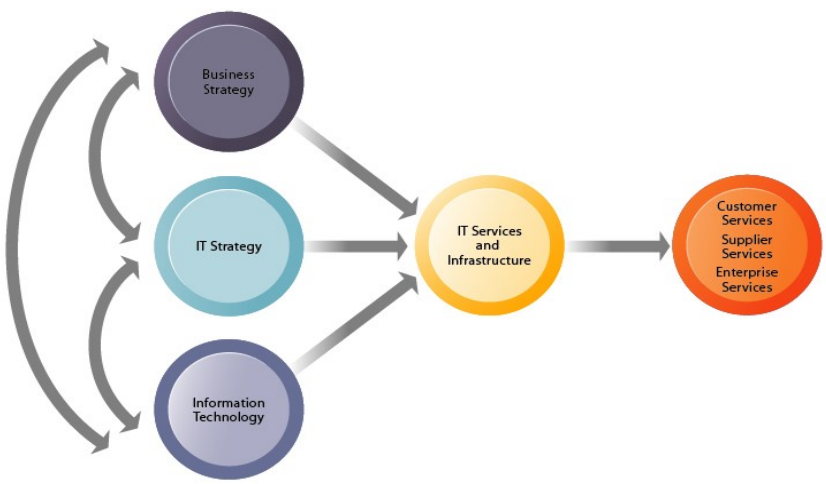

Figure 2.1

The services a firm is capable of providing to its customers, suppliers, and employees are a direct function of its IT infrastructure. Ideally, this infrastructure should support the firm's business and information systems strategy. New information technologies have a powerful impact on business and IT strategies, as well as the services that can be provided to customers.

IT infrastructure can be seen as technology or as service clusters. The service-based definition focuses on the services provided by the hardware and software, such as computing platforms, telecommunications, physical facilities management, application software, data management, IT management, IT standards, IT educations and IT research and development. The service platform perspective highlights the business value provided by IT infrastructure. Five stages in the evolution of IT infrastructure can be identified. Figure 2.2 shows the stages in IT infrastructure evolution. Source: Falk & Miller, 1992.

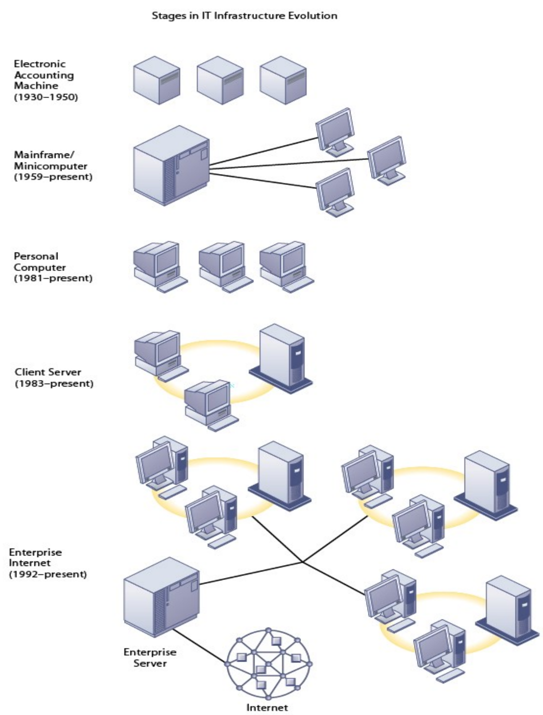

Figure 2.2

Five eras of IT infrastructure evolution.

- **Electronic Accounting Machine Era (1930-1950):** The use of large cumbersome machines with hardwired software for sorting, adding and reporting data (Falk & Miller, 1992).
- **General-Purpose Mainframe & Minicomputer Era (1959-present):** The introduction and continued use of mainframes were the first powerful computers that could provide time sharing, multi-tasking and virtual memory; and have become powerful enough to support thousands of remote terminals. The mainframe era was a period of highly centralized computing controlled by programmers and system operators. Minicomputers, powerful yet less expensive computers, began to change pattern, allowing decentralized computing customizable to individual departments or business units (Falk & Miller, 1992).
- **Personal Computer Era (1981-present):** The appearance of the IBM PC in 1981 is usually considered the beginning of the PC era because this machine was the first to be widely adopted by American businesses. 95 percent of today's 1 billion computers are Wintel PCs, using Windows software and Intel microprocessors. PCs were standalone systems until PC operating system software in the 1990s made it possible to link them into networks (Falk & Miller, 1992).
- **Client Server Era (1983-present):** In client/server computing, desktop or laptop computers called clients are networked to server computers that

provide the clients with services and capabilities. Computer processing work is split between these two types of machines. The client is the user point of entry, whereas the server typically processes and stores shared data, serves up Web pages, or manages network activities. The term server refers to both the software application and the physical computer on which the network software runs. The server could be a mainframe, but today server computers typically are more powerful versions of personal computers.

In two-tiered client/server architecture, a client computer is networked to a server with processing split between the two. In multi-tiered (N-tier) client/server architecture, the work of the entire network is balanced over several different levels of servers. Distributing work across a number of smaller inexpensive machines cost much less than minicomputers or mainframes (Falk & Miller, 1992). Figure 2.3 is a multi tiered client/ server network. Source: Earl, 1989

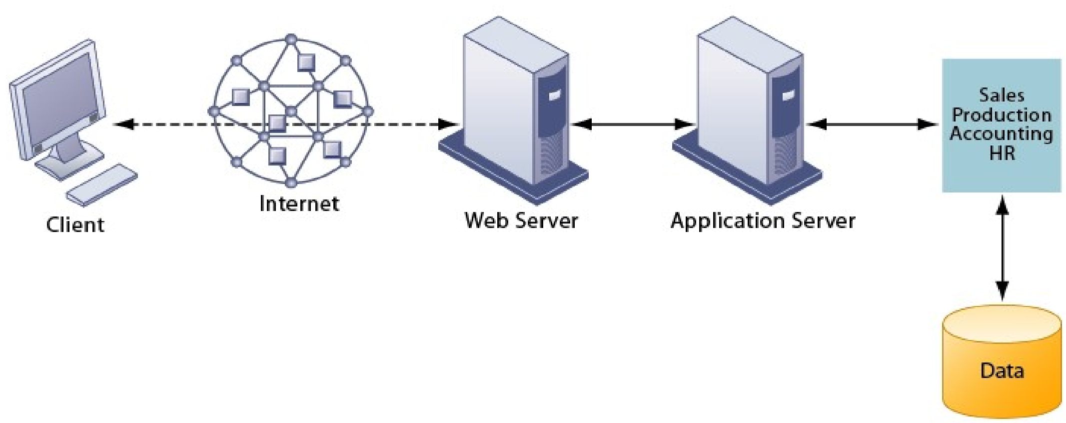

Figure 2.3

In a multi-tiered client/server network, client requests for service are handled by different levels of servers.

Enterprise Internet (1992-present): The Internet networking technology Transmission Control Protocol/Internet Protocol (TCP/IP) suite enables enterprises to link disparate devices and local area networks (LANs) into single enterprise-wide networks. Integrated computing environments allows for much faster and seamless gathering and distribution of data.

There are five important features or characteristics of information technology today that act as drivers toward the expansion and further development of technology. Moore's Law and Micro processing Power:Moore's law stated in 1965 that micro processing power doubles every two years. Variations of this law assert that Micro processing power doubles every 18 months Computer power doubles every 18 months the price of computing every 18 months.

2.2 Theoretical and Conceptual Framework of the Study

We develop our theoretical framework by first reviewing definitions of IT infrastructure and its components. We then define the concept of IT infrastructure flexibility and its relationship to strategic IT-business alignment and to applications implementation in the organization.

Today, it is still essential to consider traditional manufacturing processes and relationship with suppliers and customers, and to enhance them by using information technology (IT) to relieve collaboration with trading partners in real time. The online market place will assist both purchasers and suppliers by acting as a distinct point for their interaction, removing the limits intrinsic in bonding trading partners (Wu & Chen, 2006).

The transformation from the traditional to e-business in manufacturing requires large investments in IT (Wu & Chen, 2006).

Technology has been the engine of development for economy during previous decades and it is rational to suppose that suitable selection and management of technology within the company would keep on to be greatly important to its achievement even in future (Malhotra et al., 2001).

Communication technologies such as fax, email, Electronic Data Interchange (EDI); advanced manufacturing technologies (ATMs) such as Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Flexible Manufacturing System (FMS), Just In Time (JIT), Robotic, Manufacturing Requirement Planning (MRP), Enterprise Resource Planning (ERP) and computer application software such as word processor and spreadsheet are most common information technologies which can be employed by organizations" (Keramati&Albadvi, 2006).

2.3 Information Technology Infrastructure

The topic of IT infrastructure has been a key issue for both researchers and practicing managers for some time. The organization's IT infrastructure basically integrates technology components to support business needs but the IT infrastructure concept is more complicated. The definition of IT infrastructure encompasses a variety of components (Brancheau et al, 1996).

Based on previous studies, IT infrastructure includes a group of shared, tangible IT resources that provide a foundation to enable present and future business applications. These resources include:

- Computer hardware and software (e.g., operating systems);
- Network and telecommunications technologies;
- Key data;
- Core data-processing applications;
- Shared IT services.

IT infrastructure includes the alignment of IT plans to business objectives, the IT architecture and the skills of IT personnel (Duncan, 1995).

IT infrastructure capabilities enable the various types of IT applications required to support current and future business objectives, and enable the competitive positioning of business initiatives (Broadbent & Weill, 1997).

IT infrastructure as the enabling foundation of shared IT capabilities upon which the entire business depends. This foundation is standardized and shared by business functions within the organization, and typically used by different organizational applications (McKay & Brockway, 1989).

A thorough definition of IT infrastructure as: “the shared IT resources consisting of a technical physical base of hardware, software, communications technologies, data, and core applications and a human component of skills, expertise, competencies, commitments, values, norms, and knowledge that combine to create IT services that are typically unique to an organization. These IT services provide a foundation for communications interchange across the entire organization and for the development and implementation of present and future business applications (Byrd & Turner, 2000).

As can be seen from these definitions, the IT infrastructure is composed of two components: a technical IT infrastructure and a human IT infrastructure. The technical infrastructure consists of the applications, data and technology.The human IT infrastructure consists of the knowledge and capabilities required to manage organizational IT resources (Lee et al, 1995].

A robust IT infrastructure enables employees to be able to perform their respective jobs, both from having the available technology and the necessary technological skills (Davenport & Linder, 1994).

2.4 Information Technology Infrastructure Flexibility

Early work on IT infrastructure flexibility described the concept without actually defining it. IT infrastructure should be flexible to be able to handle increased customer demands without increased costs (Weill, 1993).

IT infrastructure flexibility should be viewed as a core competency of the organization and suggested that an effective IT infrastructure is flexible and robust (Davenport & Linder 1994).

One organization's IT infrastructure may enable strategic innovations in business processes, while another's IT infrastructure may limit such innovations. She referred to this characteristic as IT infrastructure flexibility and suggested that both business and IT application development capabilities reflect the flexibility of infrastructure components. She suggested that infrastructure flexibility improves systems developers' ability to design and build systems to meet organizational business objectives.

She described IT infrastructure flexibility through the characteristics of connectivity, compatibility, and modularity. She maintained that an organization with high modularity, compatibility and connectivity would have high technical IT infrastructure flexibility. Connectivity is the ability of any technology component to communicate with any of the other components inside and outside of the organizational environment. Modularity is the ability to easily reconfigure (add, modify or remove) technology components. She stated that modularity is the standardization of business processes for shareability and reusability e.g structured programming and component-based software architectures (Duncan, 1995).

IT compatibility helps span organizational boundaries, empower employees and make data, information and knowledge readily available in the organization. IT connectivity enables seamless and transparent organizations that are independent of time and space (Tapscott&Caston, 1993).

According to Byrd and Turner , IT infrastructure flexibility as "…the ability to easily and readily diffuse or support a wide variety of hardware, software, communications technologies, data, core applications, skills and competencies, commitments, and values within the technical physical base and the human component of the existing IT infrastructure." Historically, the flexibility of the IT infrastructure has been viewed as necessary to accommodate a rapidly changing business environment. This flexibility enables businesses to effectively use IT to prosper in dynamic environments (Byrd & Turner, 2001).

The literature review points out that strategic IT-business alignment and core business applications are embedded in the definitions of IT infrastructure and IT infrastructure flexibility. However, the actual relationships between IT infrastructure flexibility and strategic IT-business alignment and between IT infrastructure flexibility and business applications have not been empirically tested. We test these relationships through our conceptual model.

2.4.1 IT Infrastructure Flexibility and Strategic IT-Business Alignment

Strategic IT-business alignment refers to the extent to which the IT mission, objectives and plans support are supported by the organization's mission, objectives and plans (Hirscheim&Sabherwal, 2000) .

This alignment creates an integrated organization in which every function, unit, and person are focused on the organization's competitiveness. However, IT management is a problem of aligning the relationship between the business and the IT infrastructure to take advantage of IT opportunities and capabilities (Sambamurthy&Zmud, 1992).

The alignment of IT plans to business objectives of IT infrastructure. She continued by noting that an organization's IT infrastructure could be considered flexible if it enabled strategic innovations in business processes (Duncan, 1995). The IT infrastructure capabilities provide the foundation for "…competitive positioning of business initiatives" (Broadbent & Weill, 1997)."

2.4.2 IT Infrastructure Flexibility and Applications Implementation

Today, IT applications not only process data and provide management information reports but:

- Corporations now use IT applications to gain competitive advantage (Earl, 1989; Powell, 1992; Saunders & Jones, 1992; Porter & Miller, 1985; Smith &McKeen, 1993).

- To create new business opportunities (Earl, 1989; Rockart& Scott-Morton, 1984; Smith &McKeen, 1993).

Several studies have included business applications as part of IT infrastructure (Broadbent & Weill, 1997; Byrd & Turner, 2000; Duncan, 1995). However,

- Duncan further addressed business applications when she asserted that IT infrastructure flexibility enabled organizations to build applications that more closely satisfy business objectives (Duncan, 1995).

- Broadbent & Weill (1997) stated that IT infrastructure capabilities are the "base for computer applications."

- Byrd & Turner (2000) noted that IT infrastructure flexibility enabled organizations to "…easily diffuse and support…core applications."

For this study, we use the extent to which organizations have implemented a variety of business applications to examine the concept of "applications implementation.” These eleven business applications in our study include transaction processing systems, management information systems, executive information systems, decision support systems, expert systems, data warehousing, data mining, inter organizational information systems (e.g., electronic data interchange), knowledge management, network management, and disaster recovery.

2.4.3 Conceptual Model

This study utilizes four previously identified measures of IT infrastructure flexibility: the technical components of modularity, compatibility, connectivity, and IT personnel skills [Duncan, 1995; Byrd et al, 2000]. The conceptual model representing the relationships addressed in this study is presented in Figure 2.4: Conceptual model representing IT relationships (Byrd et al,2000)

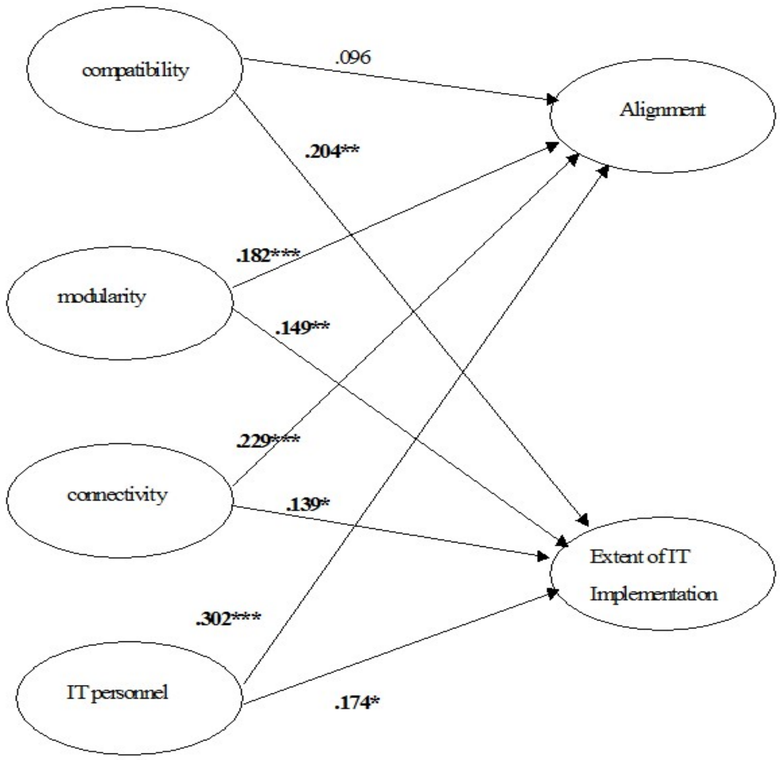

Figure 2.4

2.5 Empirical framework of the study and research gap

Assessing the payoff of IT investments has been a chief worry of Directors and Researchers for many years. Empirical studies before middle 1990s received zero or slightly negative relationship between IT investment and organizational performance, while earlier studies shows significantly positive coloration between these two factors. These conflicting outcomes led to various disputes regarding the IT productivity paradox (Yongmei et al., 2008).

Whereas the information technology (IT) studies is diverse concerning the straight advantages of e-Business technologies on performance, the influence of such technologies on supply chain actions stays mainly an unknown field of research (Devaraj et al., 2007).

In spite of the debates regarding the worth of IT investment at the industry stage, it is obvious that whereas some firms have been unsuccessful to acquire promised advantages from IT investment, further organizations have been victorious in IT applications (Lee, 2004).

IT infrastructure often does not provide direct business performance benefits. The benefits are derived from the business systems connected to and enable by the infrastructure. Traditional methods of capital expenditure justification, such as discounted cash flow are thus not well suited to IT infrastructure for three reasons.

- It is almost impossible to specify with confidence the future income stream from the investment.
- IT infrastructure investment occurs in the form of specific projects such as a new data base management system or a telecommunications upgrade. In contrast, business value is derived from the interaction of several independent IT infrastructure investments and business systems. This complex relationship confounds the justification process.
- Projects with long lives are often less attractive when using the discounted cash flow procedures. Firms often use artificially high hurdle rates for the judging the worth of an investment. In times of capital rationing this bias is

more often used as a screening process. The longer life projects, like IT infrastructure, are more severely penalized by the compounding effect of the higher hurdle rate (Kaplan 1986).

In 2006, Keramati&Albadvi conducted a review of more than 50 IT and Productivity journal articles from 1999 to 2003. They concentrated on firm level productivity and categorized researches based on productivity evaluations into three clusters: direct measures method intermediary measures method and complementary method. The 'Direct Measures' method mostly highlighted diverse direct measures of productivity; for instance, numerous partial productivity measures counting workforce and capital productivity and whole factor productivity in addition to profitability and cost reduction (Keramati&Albadvi, 2006).

Conflicting outcomes in researches based on this approach result in the so Called `Productivity Paradox'. They came to the notion that “the first two approaches focuses on the effects of IT investment on direct, intermediary, financial and non-financial measures of productivity”.

The third method, "complementary" method, focuses on IT accomplishment and effects considering the role of complementary investments that improve and balance the IT completion or complementary which can improve the influence of information technologies on firms’ performance (Keramati&Albadvi, 2006).

In addition, a vigilant study of the available work at firm level IT productivity discovered that researchers have expanded two diverse methods in evaluating the relationship between IT accomplishment and productivity. First method, direct approach, may optimistically verify either a direct relationship or need of such a correlation. The second method supposes the IT accomplishment but highlights the role of dominant investments that improve and balance the IT implementation (Albadvi et al., 2007).

In spite of the possible advantages of IT investment, conventional capital

Accounts' models fail to hold its real value owing to their failure to determine Indefinable strategic advantages or optimism in planning financial returns receiving no investment option (Lee, 2004).

"IT facilitates connections across disciplinary, institutional, geographical and Cultural boundaries. Taken together, the computational and communication Capabilities in IT offer great promise for supporting continual improvements in Academia (Ranjan, 2008).

Funding IT infrastructure is not a popular activity in this company" was a typical response from all the companies. Most of the organizations observed did not use formal discounted cash flow methods to justify IT infrastructure investments. The most common process was that the information systems department consulted with all the businesses (in one case over 40 different businesses) and tried to understand the future business needs. Via the information systems planning process these business needs were translated into a multi-year IT budget. The information systems department has the budget approved (or otherwise) by corporate. The information systems department is then often free to invest in IT infrastructure with no further external justification. This process is made more difficult by the often different lengths of time a typical business strategy and IT infrastructure investment are current or useful. Many IT infrastructure investments have 7-10 year lives while businesses strategies can change each year or two.

The justification rationales used included:

- Necessary to keep up with technology. A strong motivation amongst the technical IT managers was to keep the infrastructure current with new technology. Having new technology for its own sake was certainly part of the motivation. Also optimism often existed that a particular new technology would provide great value and thus a pilot project was initiated.
- Necessary to provide the agreed service levels to our internal customers.
- An essential part of the infrastructure that is required by the business as identified during strategy discussions with the businesses.
- Infrastructure that is expected by the information systems department to be important to the business. This type of infrastructure was not motivated by the expressed needs of the businesses. Instead the information systems group perceived these future needs inspired by a variety of sources including: observations of competitor's use of IT, trade and industry press and IT vendors. Most of firms identified some of this type of IT investment and

report some spectacular payoffs.

- The IT department identifies a basket of business process applications that will aggregate enough benefits to justify the infrastructure investment. The IT department acts as a broker to identify emerging business needs by a number of businesses and provide infrastructure to enable systems to meet this need.

2.6 Need for an IT Infrastructure

As people and companies rely on basic infrastructures to function, businesses also rely on an information technology infrastructure to support their decision making, business processes, and competitive strategy. Business processes are the activities that organizations perform in order to reach their business goals and consist of core processes and supporting processes. The core processes make up the primary activities in the value chain; these are all the processes that are needed to manufacture goods, sell the products, and provide service, and so on. The supportingprocesses are all the processes that are needed to perform the value chain's supporting activities, such as accounting, human resources management, and so on.

Almost all of an organization's business processes depend on the underlying information technology infrastructure, albeit to different degrees. For example, an organization's management needs an infrastructure to support a variety of activities, including reliable communication networks to support collaboration between suppliers and customers, accurate and timely data and knowledge to gain business intelligence, and information systems to aid decision making and support business processes. In sum, organizations rely on a complex, interrelated information technology infrastructure to effectively thrive in the ever-increasing, competitive digital world. Figure 2.5 is the Generic value chain showing an organization's core and supporting activities (Earl, 1989)

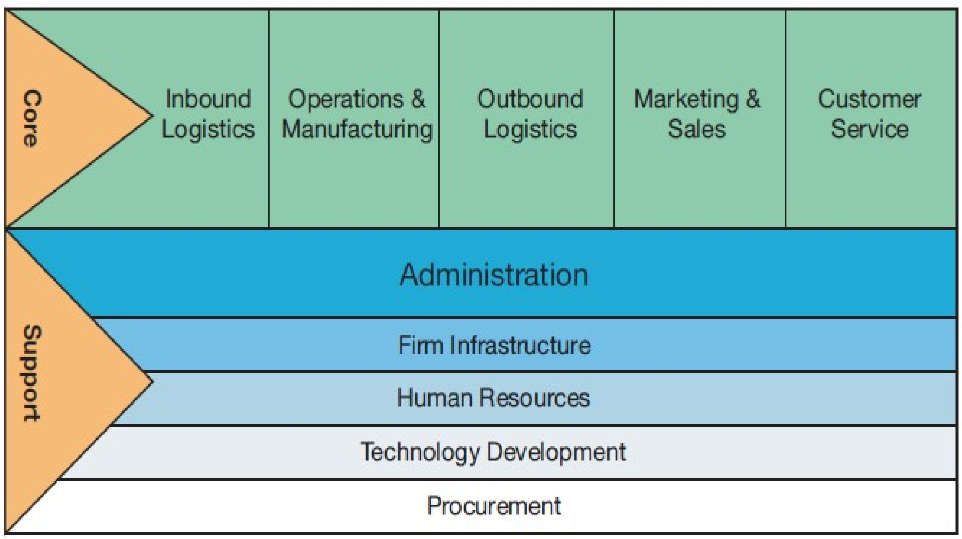

Figure 2.5

In order to make better decisions; managers at all levels of the organizations need to analyze information gathered from the different business processes. The process of gathering the information as well as the information is commonly referred to as business intelligence.Whereas some of these processes obtain the information from external sources such as marketing research or competitor analysis other processes gather business intelligence from internal sources, such as sales figures, customer demographics, or performance indicators.While there are a variety of different systems used for gaining business intelligence, all gather process, store, or analyze data in an effort to better manage the organization. In other words, modern organizations rely heavily on their information technology infrastructure (Earl, 1989).

Complementary method demonstrates that the strategic stress is altered from "IT to improve and support ongoing operations "to "IT as a capability builder" (Keramati&Albadvi, 2006).Figure 2.6 framework for impact of complementary on IT (Keramati&Albadvi, 2006)

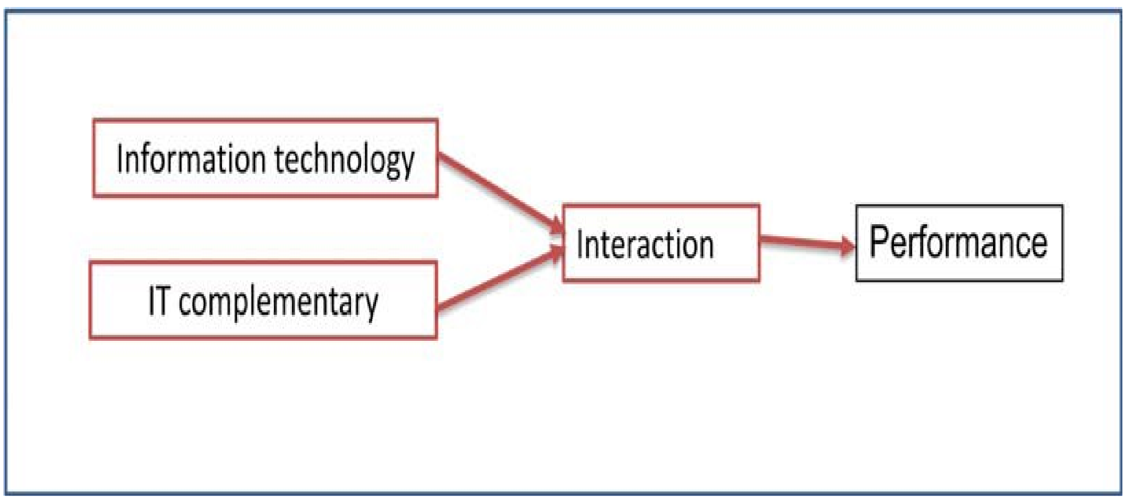

Figure 2.6**.**

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, discussions are made on how the data were generated and carefully applied in investigating the true nature of the relationship existing among variables. Here, a thorough examination of the sources of data, the method used in collecting the data and data analysis is carried out.

3.2 Re-Statement of Research Question/Hypothesis

On the basis of the statement of problem and objectives of the study discussed in Chapter One of this study, the following questions were raised by the researcher:

I. What are the aspects of costs of retaining aging server hardware?

II. To what extent has each aspect of the cost affected transition to current server hardware?

III. To what extent have the collective aspects of the costs affected transition to current server hardware?

IV. What are the ranks of these aspects of costs in relation to their effect on transition to current server hardware?

The following hypotheses were also formulated:-

- H_{01}: There is no significant effect of the collective aspects of the costs on transition to current server hardware

- H_{A1}: There is significant effect of the collective aspects of the costs on transition to current server hardware
- H_{02}: There is no significant effect of each aspect of the costs on transition to current server hardware.
- H_{A2}: There is significant effect of each aspect of the costs on transition to current server hardware.

3.3 Selection of the Study Population

A population is made up of all conceivable elements, subjects or observations relating to a particular phenomenon of interest to the researcher; it is the totality of elements under study (Nworuh, 2004). The total set of observations relevant to a study under investigation is referred to as universe of population. Here, it is extremely important to consider how the data is to be used prior to actual data collection. This helps to ensure the identification of the relevant universe or population.

In conducting this study, the researcher is concerned with estimating the elements comprising a particular population. The population of interest is carefully designed, and preliminary steps taken to ensure that the universe actually sampled is the one intended to be sampled.

The first step is to define the target population. A target population is defined as a finite population, with fixed boundaries, description by time, geography and the characteristics of individual members composing it, as well as the nature of the variables under study (Baridam, 1990). The target population is the universe that the analyst intends to sample and analyse. For the purpose of this study, the target population is IT organizations in Nigeria.

3.4 Sampling Techniques

A non-probability sampling method was used to select the sample for study. A sample is said to be a non-probability sample if the chance of including any elementary unit of the population in the sample is not known and cannot be determined (Nworuh, 2004). With non-probability sampling, all items in the population being studied do not have a chance of being selected (Nworuh, 2004).

For the purpose of this study, the type of non-probability sampling used is judgment sampling. According to Patton (2010), a judgment sample is a sample whose elementary units are chosen according to discretion of an expert, who is familiar with the relevant characteristics of the population. Judgment sampling is used whenever such limitation as extreme heterogeneity of the population, time and cost make it necessary to choose a very small sample.However, because the population is too large, and would be costly and time consuming, a sample is drawn from the population. A sample is a part of the population understudy selected so that information can be drawn from it about the population. The few IT organizations selected are situated in the Port Harcourt and Calabar.

The selected IT organizations include:

- Integrate Computer
- Centre for Information Technology, Research and Educational Services (CITRES),
- Institute for Management Studies (IMS)

3.5 Sources of Data

Data can be simply defined as a set of refined information. Data for research may be classified into two categories, namely: primary and secondary data. Both have been utilized in the course of this study. The primary source of data is collected from structured questionnaire; while the secondary sources of data are published books, journals, handbooks and records, cost and time in the execution of the sampled projects, etc.

3.6 Administration of Data Collection

One hundred and seventy five (175) copies of the questionnaire (attached in the Appendix A) for these studies were prepared for the selected IT organizations. The copies of questionnaire were delivered directly to respondents of these IT organizations respectively. Out of the questionnaires issued, only one hundred and fifty (150) questionnaires were completed and returned.

Table 3.1: Questionnaire distribution pattern

S/NO	FIRM	Frequency	Percentage (%)
1.	Integrated Computers Limited	75	42.85
2.	CITRES	45	25.71
3.	IMS	55	31.42
	TOTAL	**175**	**100%**

3.7 Method of Data Analysis

In the analysis of the data collected from the survey, simple percentage and regression analysis are used. In the analysis, cost on transition to current server was regressed against factors that retain costs for older server models identified as Server Software update, Power/ Cooling, Data transmission cable, RAM and Hard Disk Drive (HDD).

Thus, multiple regression analysis, analysis of variance (ANOVA) and Likert Five-point scale are the various tools used in this study.

3.8 Multiple Regression Analysis

Regression analysis is a statistical tool, which helps to predict one variable or variables, on the basis of assumed nature of the relationship between the variables (Patton, 2010). The variable being predicted is usually known as the dependent or unknown variable because its values are dependent on the values of the other variable or variables variously referred to as independent variables; explanatory variables or predictor variables.

In regression analysis, one attempts to determine how given changes in certain variables affect some other variable. A regression model may be simple or multiple, linear or non-linear. It is simple if there is one independent variable and multiple if there is more than one independent variable in the model. In multiple regression, the aim is to examine the nature of the relationship between a given dependent variable and two or more independent variables.

For this study, the relationship is formulated as follows:

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + e$............................ (3.1)

Where

n = the number of independent variables.

$\beta_0 =$ Constant

$\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 are parameters referred to as regression coefficient.

e = error term.

Y = Cost on transition to current server (dependent variable). (CURCOST)

The following are the independent variables:-

X_1= Server Software update cost (SOFCOST)

X_2= Power/ Cooling maintenance (PWRCOST)

X_3= Data transmission cable maintenance (CABCOST)

X_4= RAM maintenance (RAMCOST)

X_5= Hard Disk Drive (HDD) maintenance (HDDCOST)

3.9 Multiple Regression and Analysis of Variance

In multiple regression, as in simple regression, the total variation of each observation Y_i from the mean Y (Yi - Y) can be expressed as the sum of its explained and unexplained variations.

$\sum (Yi - Y)^2 = \sum (Y_i - Y)^2 + \sum (Y_i - Y)^2$.. (3.2)

SST = SSR + SSE

Where $(Y_i - Y)$ = Explained variables

$(Y_i - Y_i)$ = Unexplained variables

$SST = \sum Y_i^2 - \frac{(\sum Y_i)^2}{n}$ .... (3.3)

$SSR = \sum Yi - \frac{(\sum Yi)^2}{n}$ .... (3.4)

$SSE = \sum Yi^2 - \sum Yi^2 = SST - SSR$.. (3.5)

Where

SST = sum of square total

SSR = sum of square due to regression

SSE = sum of square due to error

The necessary sums of squares, degrees of freedom, mean squares and variance ratio for multiple regression are summarized in the ANOVA table.

Table 3.2: ANOVA TABLE FOR MULTIPLE REGRESSION

Source of Variation	Sum of Squares (SS)	Degree of Freedom	Mean Square	F-Ratio	Table value
Due to regression	$SSR = r^2\sum Y^2$	K	$MSR = \frac{SSR}{K}$		
Due to error	SSE = SST - SSR	N-k-1	$MSE = \frac{SSE}{N-K-1}$		
Total	$SST = \sum Y^2 - \frac{(\sum Y)^2}{n}$	n-1			

Source: Nworuh (2004)

3.10 Test for Significance in Multiple Regression

We are often interested in testing whether or not there is a significant relationship between the dependent variable Y and the independent variables X_1, X_2, X_3, X_4, and X_5. i.e. testing whether or not Y is dependent on X_1, X_2, X_3, X_4, and X_5, or the hypothesis.

H_0: $B_1 = B_2 ....B_k = 0$ .... (3.6)

H_A: not all are B_k are equal to zero

F = MSR/MSE .... (3.7)

Under the null hypothesis, H_0 has an F-distribution with k an n - k – 1 degrees of freedom. H_0 is accepted at the α significance level if:

$F^* < F_i - \alpha; k, n - k - 1$ .... (3.8)

Otherwise, H_0 is rejected in favour of HA (Alternative hypothesis) $F_i - \alpha; k, n - k - 1$ is the usual critical value obtained from an F-distribution table at the α significant level and k and n - k – 1 degrees of freedom.

From $F^* < F_i - \alpha; k, n - k - 1$, we make our decision.

3.11 The T-Test For Multiple Regression Co-Efficient

From the F-test, if it is observed that there is a significant relationship between the dependent and independent variable, we proceed to examine the regression coefficients further and to test more hypotheses about them. Thus, if the null hypothesis, H_0 is rejected, we may examine the individual coefficients further to find out which ones contribute to the significance by testing the null hypothesis. Here, the test statistics:

$t = \frac{\beta_i - \beta_{i0}}{S_{bj}}$ is used

B = specified value which could be zero

S_{bj} = is the standard error for B_i, and is calculated thus:

$S_{bj} = \sqrt{MSEe_{jj}}$

Where e_{jj} is a constant called Gauss multiplier

The null hypothesis H_0 is accepted at the α significant level if $/t/ < {}^{\alpha}/_{2,}$ n - k – 1. Otherwise H_0 is rejected in favour of $H_{A.}$

3.12 Coefficient of Multiple Determination R^2

The coefficient of multiple determination measures the proportion of the total variation in the dependent variable Y that is attributable to the dependence of Y on all the independence variables X_1, X_2, X_3, X_4, and X_5 included in the regression.

R^2 assumes the value of 0 when all $B_i = 0$ (j = 1, 2 ...., k) and assumes the value 1 when all observations fall in the fitted egression line that is when Y_i = Yi for all î

R^2 is defined thus,

$$R^2 = \frac{SSR}{SST} = \frac{SST - SSE}{SST} = 1 - \frac{SSE}{SST} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.9)}$$

3.13 The Likert Scale

For the purpose of this study, the questionnaire is based on a five-point scale. The Likert Five-point scale involves a list of statements related to the attitude in question and which respondents are required to indicate the degree of agreement or disagreement with each of the statements.

The respondents is required to indicate whether he or she "strongly agree", "agrees", is "neutral", "disagree", or "strongly disagree", with each of the statements contained in the questionnaire. Each category is assigned a numerical value of 5, 4, 3, 2, 1 point respectively to the points. (The questionnaire is attached in the appendix).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The data collected from the field by means of the questionnaire administered are being presented in this chapter, and the required analysis is carried out on the data.

The emphasis being to evaluate the significant effect of the collective aspects of the costs on transition to current server hardwareas well as the statistical significant effect of each aspect of the costs on transition to current server hardware.

4.2 Results Presentations and Description

The data as presented on Tables 4.1 were collected from field survey. The columns of the Table 4.1 are described as follows.

Y = cost on transition to current server (dependent variable). (CURCOST)

The following are the independent variables:-

X_1= Server Software update (SOFCOST)

X_2= Power/ Cooling maintenance cost (PWRCOST)

X_3= Data transmission cable maintenance cost (CABCOST)

X_4= RAM maintenance cost (RAMCOST)

X_5= Hard Disk Drive (HDD) maintenance cost (HDDCOST)

4.3 Model Estimation, Hypothesis Testing and Interpretation

In estimating the model of relationship, the data were subjected to multiple regression analysis using SPSS version 19.0. The result obtained from the multiple regression analysis is as shown in

Table 4.2:-

$R^2 = 0.868$

Adj. $R^2 = 0.863$

Durbin-Watson = 1.723

Table 4.1: Model summary for the constructs.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.931	.868	.863	.639	1.723

a. Predictors: (Constant), SOFCOST, PWRCOST, CABCOST, RAMCOST & HDDCOST

b. Dependent Variable: CURCOST

Table 4.2: Coefficients of the constructs

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	6.104	2.771		2.202	.029			
	SOFCOST	.894	.038	.777	23.373	.000	.884	.890	.709
	PWRCOST	-.231	.047	-.190	-4.921	.000	-.538	-.379	-.149
	CABCOST	.070	.047	.057	1.473	.143	.348	.122	.045
	RAMCOST	-.165	.046	-.130	-3.621	.000	-.336	-.289	-.110
	HDDCOST	.092	.043	.071	2.139	.034	.210	.175	.065

a. Dependent variable CURCOST

Using the regression output on Table 4.2, we estimated the following equation:

$Y= 6.104 + 0.894(X_1) - 0.231(X_2) + 0.070(X_3) – 0.165(X_4) + 0.092(X_5)$ .. (4.1)

Where Y = cost on transition to current server (dependent variable). (CURCOST)

The following are the independent variables:-

X_1= Server Software update (SOFCOST)

X_2= Power/ Cooling maintenance cost (PWRCOST)

X_3= Data transmission cable maintenance cost (CABCOST)

X_4= RAM maintenance cost (RAMCOST)

X_5= Hard Disk Drive (HDD) maintenance cost (HDDCOST)

Table 4.3:ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	385.249	5	77.050	188.660	.000[a]
	Residual	58.811	144	.408		
	Total	444.060	149			

a. Predictors:(Constant), SOFCOST, PWRCOST, CABCOST, RAMCOST & HDDCOST

b. Dependent Variable: CURCOST

The interpretation of the relationship model is based on the output of multiple regression analysis (as shown in Tables 4.1, 4.2 and 4.3) is as follows:-

1. Equation 4.1 shows the relationship existing between cost on transition to current server (Y) and the five explanatory variables (X_1, X_2, X_3, X_4 and X_5) is strong. The R= 0.868 indicates that 86.8% correlation exists between the

dependent variablecost on transition to current server and the five independent variables-factors that retains costs for older server models.

2. Table 4.1 shows that 86.8% of the variation in cost on transition to current server (Y) is explained by the cumulative variations in the five independent variables (X_1, X_2, X_3, X_4 and X_5) when all possible error in the estimation is taken into consideration.

3. The standardized error in the estimation of cost on transition to current server (Y) using the five variables (X_1, X_2, X_3, X_4 and X_5) is 0.639.

4.4 Hypothesis Testing

- H_{01}: There is no significant effect of the collective aspects of the costs on transition to current server hardware
- H_{A1}: There is significant effect of the collective aspects of the costs on transition to current server hardware

Calculation of tabulated f-value

The degrees of freedom = N-K-1, and 150-5-1= 144, therefore the table value = $F_{0.05}$ (5, 144) = 2.21.

Decision rule

The table value = $F_{0.05}$ (5, 144) =2.21 and the F-ratio = 188.66. Since the F-ratio > $F_{0.05}$ (5, 144), we reject the null hypothesis and accept the alternate hypothesis.

Consequently, we conclude that there is significant effect of the collective aspects of the costs on transition to current server hardware

Hypothesis 2

- H_{02}: There is no significant effect of each aspect of the costs on transition to current server hardware.
- H_{A2}: There is significant effect of each aspect of the costs on transition to current server hardware.

For Software Update Cost

- $H_{02(a)}$: There is no significant effect of software update costs on transition to current server hardware.
- $H_{A2(a)}$: There is significant effect of software update costs on transition to current server hardware.

From Table 4.2, at a significant level of 0.000 for software update cost, we reject the null hypothesis$H_{02(a)}$because the probability value is less than the 0.05 level of confidence ($p<0.05$) and accept the alternative hypothesis which states that there is significant effect of software update cost on transition to current server hardware.

For Power/ Cooling Cost

- $H_{02(b)}$: There is no significant effect of power/ cooling costs on transition to current server hardware.
- $H_{A2(b)}$: There is significant effect of power/ cooling costs on transition to current server hardware.

From Table 4.2, at a significant level of 0.000 for power/ cooling cost, we reject the null hypothesis $H_{02(b)}$because the probability value is less than the 0.05 level of confidence ($p<0.05$) and accept the alternative hypothesis which states that there is significant effect of power/ cooling cost on transition to current server hardware.

For Data transmission cable maintenance cost

- $H_{02(c)}$: There is no significant effect of data transmission cable maintenancecosts on transition to current server hardware.
- $H_{A2(c)}$: There is significant effect of data transmission cable maintenance costson transition to current server hardware.

From Table 4.2, at a significant level of 0.143 for data transmission cable maintenance cost, we accept the null hypothesis $H_{02(c)}$because the probability value is greater than the 0.05 level of confidence ($p<0.05$) and reject the alternative hypothesis which states that there is significant effect of data transmission cable maintenance cost on transition to current server hardware.

For RAM Maintenance Cost

- $H_{02(d)}$: There is no significant effect of RAM maintenance costs on transition to current server hardware.
- $H_{A2(d)}$: There is significant effect of RAM maintenance costson transition to current server hardware.

From Table 4.2, at a significant level of 0.000 for RAM maintenance cost, we reject the null hypothesis $H_{02(d)}$because the probability value is less than the 0.05 level of confidence ($p<0.05$) and accept the alternative hypothesis which states that there is significant effect of RAM maintenance cost on transition to current server hardware.

For Hard Disk Drive Maintenance Cost

- $H_{02(e)}$: There is no significant effect of Hard Disk Drive (HDD) maintenance costs on transition to current server hardware.
- $H_{A2(e)}$: There is significant effect of Hard Disk Drive (HDD) maintenance costson transition to current server hardware.

From Table 4.2, at a significant level of 0.034 for Hard Disk Drive (HDD) maintenance cost, we reject the null hypothesis $H_{02(e)}$because the probability value is less than the 0.05 level of confidence ($p<0.05$) and accept the alternative hypothesis which states that there is significant effect of Hard Disk Drive (HDD) maintenance cost on transition to current server hardware.

4.5 Result Discussion

Here, results are discussed based on the research questions and hypothesis testing.

Question One: What are the aspects of costs of retaining aging server hardware?

We identified aspects of costs of retaining aging server hardware as our independent variables. These includes Software update cost, Power/ Cooling maintenancecost, RAM maintenance cost, Hard Disk Drive (HDD) maintenance cost and data transmission cable maintenance cost. We identified from the test of hypothesis that Software update cost, power/ cooling cost, RAM maintenance cost & Hard Disk Drive (HDD) maintenance cost have very significant cost impact for aging servers.

Question Two: To what extent has each aspect of the cost affected transition to current server hardware?

From the test of hypothesis, we observed that software update, power/ cooling and RAM maintenance cost have significant value of 0.000. Hard disk drive maintenance has significant value of 0.034. These values areless than the 0.05 level of confidence ($p<0.05$). Consequently, these aspects of costs significantly affect transition to current server hardware. The data transmission cable cost as seen in the hypothesis test does not have significant cost impact in aging servers

To what extent have the collective aspects of the costs affected transition to current server hardware?

Based on the decision rule, the table value = $F_{0.05}$ (5, 144) =2.21 and the F-ratio = 188.66. Since the F-ratio > $F_{0.05}$ (5, 144), we reject the null hypothesis and accept the alternate hypothesis. Consequently, we conclude that there is significant effect of the collective aspects of the costs on transition to current server hardware.

What are the ranks of these aspects of costs in relation to their effect on transition to current server hardware?

Based on questionnaires issued, respondents ranked the different aspects of costs in relation to transition to current server hardware. Ranks are from one (1) to five (5). Aspects ranked one (1) implies most significant and five (5) implies least significant. The result on rankfrom SPSS software for each aspect of cost in relation to their effect on transition to current server hardware is as shown below.

```
RANK VARIABLES=Software PowerCooling RAM HardDisk DataCable (A)
  /RANK
  /PRINT=YES
  /TIES=MEAN.
```

RANK

[DataSet0]

Created Variables[a]

Source Variable	Function	New Variable	Label
Software[b]	Rank	RSoftwar	Rank of Software
PowerCooling[b]	Rank	RPowerCo	Rank of PowerCooling
RAM[b]	Rank	RRAM	Rank of RAM
HardDisk[b]	Rank	RHardDis	Rank of HardDisk
DataCable[b]	Rank	RDataCab	Rank of DataCable

a. Mean rank of tied values is used for ties.

b. Ranks are in ascending order.

Table 4.4 highlights the responses on rank from questionnaire for each aspect of cost.

	Responses from questionnaire							
Description	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total responses	% of highest number of response relative to total responses	Rank
Data transmission cable	0	2	12	29	107	150	71%	5
Hard disk drive (HDD) maintenance	5	9	37	91	8	150	61%	4
Power/ Cooling maintenance	1	101	34	12	2	150	67%	2
RAM Maintenance	4	38	95	9	4	150	63%	3
Software Maintenance	94	26	17	13	0	150	63%	1

Table 4.4

As stated in table 4.4 and SPSS output above, the rank of each aspect of cost in relation to their effect on transition to current server hardware is as follows:

1- Server Software update (SOFCOST)

2- Power/ Cooling cost (PWRCOST)

3- RAM maintenance cost (RAMCOST)

4- Hard Disk Drive (HDD) maintenance cost (HDDCOST)

5- Data transmission cable maintenance cost (CABCOST)

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

Based on the analysis of results, we summarize our findings as follows:

Five (5) factors affected collectively the transition to current server, it was found out that four factors: Software update, Power/ Cooling Cost, RAM maintenance cost and Hard Disk Drive maintenance had the most significant cost impact for aging server. Data transmission cable maintenance was considered insignificant

5.2 Conclusion

Based on our results from hypothesis test, as IT servers get older, hardware maintenance cost increases. Frequent maintenance may result to inadequate performance when compared to current server capabilities.Older server models will lack energy efficiency as power/ cooling have significant effect from result of hypothesis test for aging IT servers. This implies power and cooling costs will go up year by year for the usable server lifecycles. Software maintenance has significant effect for aging IT servers. Application software and IT system software will fall far behind newer versions on the IT marketplace. This means increased spend on security updates at a more frequent pace.

5.3 Recommendations

Based on the results and findings obtained in course of this research work, the following recommendations are proffered.

- IT Managers should carry out yearly retaining cost analysis of aging IT server infrastructure.
- IT Managers should be able to forecast from the yearly analysis the most appropriate time to upgrade to newer server models. Overall organizational profit and efficiency must be considered. IT Managers must also consider available support in the IT market for aging servers.

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APPENDICES

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  /SHEET=name 'Sheet1'
  /CELLRANGE=full
  /READNAMES=on
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EXECUTE.
DATASET NAME DataSet2 WINDOW=FRONT.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA ZPP
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT Y
  /METHOD=ENTER X1 X2 X3 X4 X5
  /RESIDUALS DURBIN.
```

Regression

Notes

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Comments		
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	150
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /DESCRIPTIVES MEAN STDDEV CORR SIG N /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOVA ZPP /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT Y /METHOD=ENTER X1 X2 X3 X4 X5 /RESIDUALS DURBIN.
Resources	Processor Time	00 00:00:00.031
	Elapsed Time	00 00:00:00.038
	Memory Required	4928 bytes

Notes

Output Created		01-Oct-2015 21:27:03
Comments		
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	N of Rows in Working Data File	150
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /DESCRIPTIVES MEAN STDDEV CORR SIG N /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOVA ZPP /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT Y /METHOD=ENTER X1 X2 X3 X4 X5 /RESIDUALS DURBIN.
Resources	Processor Time	00 00:00:00.031
	Elapsed Time	00 00:00:00.038
	Memory Required	4928 bytes
	Additional Memory Required for Residual Plots	0 bytes

[DataSet2]

Descriptive Statistics

	Mean	Std. Deviation	N
Y	18.86	1.726	150
X1	19.38	1.500	150
X2	19.48	1.422	150
X3	19.42	1.406	150
X4	19.52	1.365	150
X5	19.42	1.332	150

Correlations

		Y	X1	X2	X3	X4	X5
Pearson Correlation	Y	1.000	.884	-.538	.348	-.336	.210
	X1	.884	1.000	-.369	.172	-.176	.051
	X2	-.538	-.369	1.000	-.484	.120	-.256
	X3	.348	.172	-.484	1.000	-.419	.152
	X4	-.336	-.176	.120	-.419	1.000	-.320
	X5	.210	.051	-.256	.152	-.320	1.000
Sig. (1-tailed)	Y	.	.000	.000	.000	.000	.005
	X1	.000	.	.000	.018	.016	.269
	X2	.000	.000	.	.000	.073	.001
	X3	.000	.018	.000	.	.000	.031
	X4	.000	.016	.073	.000	.	.000
	X5	.005	.269	.001	.031	.000	.
N	Y	150	150	150	150	150	150
	X1	150	150	150	150	150	150
	X2	150	150	150	150	150	150
	X3	150	150	150	150	150	150
	X4	150	150	150	150	150	150
	X5	150	150	150	150	150	150

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	X5, X1, X3, X4, X2	.	Enter

a. All requested variables entered.

b. Dependent Variable: Y

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.931	.868	.863	.639	1.723

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.931	.868	.863	.639	1.723

a. Predictors: (Constant), X5, X1, X3, X4, X2

b. Dependent Variable: Y

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	385.249	5	77.050	188.660	.000[a]
	Residual	58.811	144	.408		
	Total	444.060	149			

a. Predictors: (Constant), X5, X1, X3, X4, X2

b. Dependent Variable: Y

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	6.104	2.771		2.202	.029			
	SOFCOST	.894	.038	.777	23.373	.000	.884	.890	.709
	PWRCOST	-.231	.047	-.190	-4.921	.000	-.538	-.379	-.149
	CABCOST	.070	.047	.057	1.473	.143	.348	.122	.045
	RAMCOST	-.165	.046	-.130	-3.621	.000	-.336	-.289	-.110
	HDDCOST	.092	.043	.071	2.139	.034	.210	.175	.065

a. Dependent Variable: Y

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	13.71	21.09	18.86	1.608	150
Residual	-2.441	1.236	.000	.628	150
Std. Predicted Value	-3.201	1.388	.000	1.000	150
Std. Residual	-3.820	1.934	.000	.983	150

a. Dependent Variable: Y

SUMMARY OF FACTOR SCORES

Respondents	Y	X1	X2	X3	X4	X5
1	21	21	17	21	21	20
2	20	21	21	20	20	18
3	19	20	20	18	19	19
4	17	18	19	19	21	17
5	18	19	21	17	21	20
6	16	17	21	21	19	20
7	18	21	20	20	18	19
8	19	19	18	21	19	21
9	21	21	19	21	17	21
10	21	21	17	21	21	20
11	21	21	21	20	20	18
12	19	19	20	18	19	18
13	18	18	19	19	21	17
14	18	19	21	17	21	21
15	14	14	21	20	20	20
16	21	21	20	20	18	19
17	19	19	18	19	19	21
18	21	20	19	21	17	21
19	21	21	17	21	21	20
20	21	21	21	20	19	18
21	19	20	20	18	19	19
22	17	18	19	19	21	17
23	18	19	21	16	22	19
24	16	17	21	21	20	20
25	18	18	20	20	18	19
26	20	20	18	19	19	20
27	21	20	19	21	16	21
28	21	21	17	21	21	20
29	19	21	18	20	20	19
30	19	20	20	18	19	19
31	17	18	21	19	21	17
32	18	19	21	17	21	21
33	16	17	21	21	20	20
34	21	21	20	20	18	19
35	19	19	18	19	19	21
36	19	19	19	21	17	20
37	21	21	17	21	20	20
38	19	21	21	20	19	18
39	19	20	20	18	19	19
40	17	18	20	19	20	17
41	18	19	21	17	21	20
42	16	17	21	18	20	20

Respondents	Y	X1	X2	X3	X4	X5
43	18	18	19	20	18	21
44	19	20	18	19	19	21
45	21	19	17	21	17	21
46	21	21	17	21	20	20
47	19	20	21	19	20	19
48	19	20	19	18	19	19
49	17	18	19	19	21	16
50	18	19	21	17	21	21
51	21	21	17	21	21	20
52	20	21	21	20	20	18
53	19	20	20	18	19	19
54	17	18	19	19	21	17
55	18	19	21	17	21	20
56	16	17	21	21	19	20
57	18	21	20	20	18	19
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60	21	21	17	21	21	20
61	21	21	21	20	20	18
62	19	19	20	18	19	18
63	18	18	19	19	21	17
64	18	19	21	17	21	21
65	14	14	21	20	20	20
66	21	21	20	20	18	19
67	19	19	18	19	19	21
68	21	20	19	21	17	21
69	21	21	17	21	21	20
70	21	21	21	20	19	18
71	19	20	20	18	19	19
72	17	18	19	19	21	17
73	18	19	21	16	22	19
74	16	17	21	21	20	20
75	18	18	20	20	18	19
76	20	20	18	19	19	20
77	21	20	19	21	16	21
78	21	21	17	21	21	20
79	19	21	18	20	20	19
80	19	20	20	18	19	19
81	17	18	21	19	21	17
82	18	19	21	17	21	21
83	16	17	21	21	20	20
84	21	21	20	20	18	19
85	19	19	18	19	19	21
86	19	19	19	21	17	20

Respondents	Y	X1	X2	X3	X4	X5
87	21	21	17	21	20	20
88	19	21	21	20	19	18
89	19	20	20	18	19	19
90	17	18	20	19	20	17
91	18	19	21	17	21	20
92	16	17	21	18	20	20
93	18	18	19	20	18	21
94	19	20	18	19	19	21
95	21	19	17	21	17	21
96	21	21	17	21	20	20
97	19	20	21	19	20	19
98	19	20	19	18	19	19
99	17	18	19	19	21	16
100	18	19	21	17	21	21
101	21	21	17	21	21	20
102	20	21	21	20	20	18
103	19	20	20	18	19	19
104	17	18	19	19	21	17
105	18	19	21	17	21	20
106	16	17	21	21	19	20
107	18	21	20	20	18	19
108	19	19	18	21	19	21
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111	21	21	21	20	20	18
112	19	19	20	18	19	18
113	18	18	19	19	21	17
114	18	19	21	17	21	21
115	14	14	21	20	20	20
116	21	21	20	20	18	19
117	19	19	18	19	19	21
118	21	20	19	21	17	21
119	21	21	17	21	21	20
120	21	21	21	20	19	18
121	19	20	20	18	19	19
122	17	18	19	19	21	17
123	18	19	21	16	22	19
124	16	17	21	21	20	20
125	18	18	20	20	18	19
126	20	20	18	19	19	20
127	21	20	19	21	16	21
128	21	21	17	21	21	20
129	19	21	18	20	20	19
130	19	20	20	18	19	19

Respondents	Y	X1	X2	X3	X4	X5
131	17	18	21	19	21	17
132	18	19	21	17	21	21
133	16	17	21	21	20	20
134	21	21	20	20	18	19
135	19	19	18	19	19	21
136	19	19	19	21	17	20
137	21	21	17	21	20	20
138	19	21	21	20	19	18
139	19	20	20	18	19	19
140	17	18	20	19	20	17
141	18	19	21	17	21	20
142	16	17	21	18	20	20
143	18	18	19	20	18	21
144	19	20	18	19	19	21
145	21	19	17	21	17	21
146	21	21	17	21	20	20
147	19	20	21	19	20	19
148	19	20	19	18	19	19
149	17	18	19	19	21	16
150	18	19	21	17	21	21

Source: administered Questionnaire, Field Survey

Respondent	Software	Power/ Cooling	RAM	Hard Disk Maintenance	Data transmission cable
1	2	1	2	1	5
2	2	5	2	1	5
3	2	5	2	1	5
4	2	4	2	1	5
5	2	4	2	1	5
6	2	4	2	4	5
7	2	4	2	4	5
8	2	4	2	4	5
9	2	2	2	4	5
10	2	2	2	4	5
11	2	2	2	4	5
12	2	2	2	4	5
13	2	2	2	4	5
14	2	2	2	4	5
15	2	2	2	4	5
16	2	2	2	4	5
17	2	2	2	4	5
18	2	2	2	4	5
19	2	2	2	4	5
20	2	2	2	4	5
21	2	2	2	4	5
22	2	2	2	4	5
23	2	2	2	4	5
24	2	2	2	4	5
25	2	2	2	4	5
26	2	2	2	4	5
27	3	2	2	4	5
28	3	2	2	4	5
29	3	2	2	4	5
30	3	2	2	4	5
31	3	2	2	4	5
32	3	2	2	4	5
33	3	2	2	4	5
34	3	2	2	4	5
35	3	2	2	4	5
36	1	2	2	4	5
37	1	2	2	4	5
38	1	2	2	4	5
39	1	2	3	4	5
40	1	2	3	4	5
41	1	2	3	4	5
42	1	2	3	4	5
43	1	2	3	4	5
44	1	2	3	4	5

Respondent	Software	Power/ Cooling	RAM	Hard Disk Maintenance	Data transmission cable
45	1	2	3	4	5
46	1	2	3	4	5
47	1	2	3	4	5
48	1	2	3	4	5
49	1	2	3	4	5
50	1	2	3	4	5
51	1	2	3	4	5
52	1	2	3	4	5
53	1	2	3	4	5
54	1	2	3	4	5
55	1	2	3	4	5
56	1	2	3	4	5
57	1	2	3	4	5
58	1	2	3	4	5
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60	1	2	3	4	5
61	1	2	3	4	5
62	1	2	3	4	5
63	1	2	3	4	5
64	1	2	3	4	5
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66	1	2	3	4	5
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70	1	2	3	4	5
71	1	2	3	4	5
72	1	2	3	4	5
73	1	2	3	4	5
74	1	2	3	4	5
75	1	2	3	4	5
76	1	2	3	4	5
77	1	2	3	4	5
78	1	2	3	4	5
79	1	2	3	4	5
80	1	2	3	4	5
81	1	2	3	4	5
82	1	2	3	4	5
83	1	2	3	4	5
84	1	2	3	4	5
85	1	2	3	4	5
86	1	2	3	4	5
87	1	2	3	4	5
88	1	2	3	4	5

Respondent	Software	Power/ Cooling	RAM	Hard Disk Maintenance	Data transmission cable
89	1	2	3	4	5
90	1	2	3	4	5
91	1	2	3	4	5
92	1	2	3	4	5
93	1	2	3	4	5
94	1	2	3	4	5
95	1	2	3	4	5
96	1	2	3	4	5
97	1	2	3	2	5
98	1	2	3	2	5
99	1	2	3	2	5
100	1	2	3	2	5
101	1	2	3	2	5
102	1	2	3	2	5
103	1	2	3	2	5
104	1	2	3	2	5
105	1	2	3	3	5
106	1	2	3	3	5
107	1	2	3	3	5
108	1	2	3	3	4
109	1	2	3	3	4
110	1	4	3	3	4
111	1	4	3	3	4
112	1	4	3	3	4
113	1	4	3	3	4
114	1	4	3	3	4
115	1	4	3	3	4
116	1	4	3	3	4
117	1	3	3	3	4
118	1	3	3	3	4
119	1	3	3	3	4
120	1	3	3	3	4
121	1	3	3	3	4
122	1	3	3	3	4
123	1	3	3	3	4
124	1	3	3	3	4
125	1	3	3	3	4
126	1	3	3	3	4
127	1	3	3	3	4
128	1	3	3	3	4
129	1	3	3	3	4
130	3	3	3	3	4
131	3	3	3	3	4
132	3	3	3	3	4

Respondent	Software	Power/ Cooling	RAM	Hard Disk Maintenance	Data transmission cable
133	3	3	3	3	4
134	3	3	1	3	4
135	3	3	1	3	4
136	3	3	1	3	4
137	3	3	1	3	3
138	4	3	5	3	3
139	4	3	5	3	3
140	4	3	5	3	3
141	4	3	5	3	3
142	4	3	4	5	3
143	4	3	4	5	3
144	4	3	4	5	3
145	4	3	4	5	3
146	4	3	4	5	3
147	4	3	4	5	3
148	4	3	4	5	3
149	4	3	4	5	2
150	4	3	4	5	2

Response on ranks for aspects of costs in relation to their effect on transition to current server hardware. One (1) is the most significant and five (5) is the least significant.

Source: administered Questionnaire, Field Survey