FACTORS INFLUENCING ADOPTION OF THIN CLIENT TECHNOLOGY IN PUBLIC UNIVERSITIES IN THE COUNTY OF NAIROBI

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Declaration and approval page

The below research work is my original output and has not been submitted for any award in the university

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The below project work has been submitted for fulfilment of Masters of Science degree in information technology management of the university of Nairobi with the approval of my university supervisor

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Professor Oboko

Dedication

The below research proposal goes out to my family for encouragement during these studies.

Acknowledgements

I thank God for this far with the guidance on the study and friends for the financial and emotional Support.

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List of abbreviations and acronyms

IS:	Information Systems
IT:	Information Technology
ICT:	Information Communication Technology
SMEs:	Small and Medium Enterprises
R&D	Research and Development
DOI	Diffusion of innovation
KIRDI	Kenya Industrial Research and Development Institute

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Most recently, technological and communication sector has undergone various innovations and inventions; this has invited various scholars to carryout research on the latest development on thin client. Thin client is commonly elaborated as the use of computer equipment's to provide services over networks (Technology & Communication, 2010). In present times, the term "thin client" has proved to be most important in the field of IT. Thin client, or better still server_based computing is appreciated as valuable area in business that depend on internet technologies (Goscinski & Brock, 2010; Tuncay, 2010; Armbrust et al., 2010).

Advancement in technology plays a big role in computing but minimal prospects have been integrated in various tertiary institutions and universities. As technology evolves, use of thin clients is getting more popular as another trend in cloud computing (Bayramusta & Nasır, 2016). Use of the virtual workspaces in institutions and businesses greatly reduces cost and improves the use of cloud computing regardless of geographical location nor time zone, Nguyo et al (2015). Thin client optimizes a remote connection using a computing environment that is server-based. The server carries out software launch of programs, data storage and number crunching. The thin client theory goes that, low cost terminals increase reliability. That is, having all your application programs and software on a centralized server system reduces the ICT and technical support burden experiences in cases where there are multiple computers in an office set up. Thin Client improves efficiency while maintaining compliance of organization.

This study aims to ascertain thin client technology as cost effective, secure and higher performance. It also aims at determining that thin client can be used to enhance information technology

advancement in public universities within Nairobi. ICT application in most African countries is not fully utilized (Williams 2015). Obtaining and sustaining ICT infrastructure is both expensive and seen as a luxury in developing countries and is a major contributor to limit purchase of the infrastructure. This makes it obligatory to conduct a study to determine a high performing, highly efficient and cost effective information technology system. Global Information Technology Report (2013, p. 13) indicates that insufficient skills, infrastructure in ICT, low education standards and unconducive business environment are barriers to the achievement of the best ICT systems potentials.

The study also aims at giving an input that thin clients achieve the advancement of information technology in public universities and other institutions, businesses and countries that are developing. It targets the predicament of adoption and implementation in developing countries taking Nairobi county universities as a case study.

1.2 Problem of the Statement

Martinez et al (2010) observed that the growing interest of providing solutions to the problems in learning institutions across the world is increasing. The study points out that conceptualized intention to use is contrary to the actual use of IT which remain limited at the public universities with few studies recording low adoption and usage of the technology. The study identifies a problem of low acceptance, challenges of changing from the traditional conventional desktops to Thin Client as the main barriers to adoption of Thin Client. In Kenya such studies are few and thus there is need to study on the levels and the facilitators as well as barriers of adopting Thin Client in learning institutions (Namisiko, Munialo, & Nyongesa, 2014).

Doyle and Deegan (2009) presents a study in Dublin highlighting the benefits of combined virtualization technology, cheaper high performance processors, and higher bandwidth availability. The study pinpointed a major problem of institutions of higher learning not adopting Thin Client because of low acceptance. Many organizations including institutions have not adopted Thin Client also because of the greater efforts in terms of resources and skills required to ensure efficient running of the technology. The study by Doyle and Deegan (2009) and supported by Bayramusta and Nasır (2016) concluded that the challenges facing acceptance and adoption of Thin Client was due to integration strategy and architectural design.

Adoption of Thin Clients is associated with tradeoffs many institutions are not ready for as observed by Kumar and Sukumar (2013) and by Namisiko, Munialo, and Nyongesa (2014). The study by Mbuki and Osero (2014) on education delivery by using Zero Client and Thin Client found that Kenyan education systems lagged behind in adopting innovative technologies like the Thin Client for enhanced performance. Their study pointed that technical issues like cost implementation, lack of qualified teachers to teach use of Thin Client and associated ICT equipment, and cost of maintenance and implementation were the most cited barriers for institutions not implementing the technology: thin client. Thin client has not been widely studied for scholarly purposes and reasons why many institutions have not adopted the technology have not been studied and published widely. It is the identification of the few studies done on the levels, facilitators and barriers to adoption and utilization of Thin Client that this study is based on.

1.3 General Objectives

General aim I needed to attain with this study is determine the various factors that would influence and affect the adoption of thin client technology in public universities in the county of Nairobi.

1.4 Specific Objectives

i. To determine technological factors that would affect the adoption of thin clients in public universities in the county of Nairobi.
ii. To establish the organizational factors that affects the adoption of thin client in the public varsities in county of Nairobi.
iii. To evaluate the environmental factors that affects the adoption of thin client in public universities, Nairobi County.
iv. To evaluate the role of research and development standardization in the adoption of thin client technology in public universities in the county of Nairobi.
v. To formulate and recommend a conceptual framework that would enhance the adoption of thin clients in public universities the county of Nairobi.

1.5 Justification of the research study

Most university establishments fail to employ some of the best practices in ICT technology that guarantee better performances; user experiences and profit maximization to both users and the institutions respectively. The study is expected to reveal that adoption of thin clients in these universities is necessary for comprehensive performance of their resources.

The research study is to inform organization this particular sector to comprehend how they can approach the factors influencing the adoption of thin client, make recommendations of the appropriate strategies in their respective organizations. Thin client technology has never been fully embraced and factors that hinder its utility in public university creates a need to be established and addressed to help keep up with the competitive advantage that tech savvy has in the world. Findings from this study will be important to policy formulators in regards to development of a proper policy for the adoption of thin clients in the universities in the public sector.

1.6 Importance of the research

This research work will benefit scholars involved in information technology (IT) and other areas of study, to benefit entrepreneurs in information technology, government bodies, and stakeholders who are likely to use the findings and the recommendations of the study. In most instances, organizations seek to employ technologies that reduce cost while improving performance. The

study will benefit organizations in terms of improving adoption of Thin Client and especially on the factors involved.

Since the technology is expected to reduce costs and create space among other benefits, organizations including governmental and non-governmental are likely to adopt the technology (Usman & Noordin, 2013).

Scholars and researchers in Thin Client are likely to adopt the research findings to advance computer use. The study will provide scholarly source information for other learners focusing on the public institutions among other organizations. The study will thus add to the scholarly literature about Thin Client, an area that is increasingly being adopted in large organizations.

Stakeholders in information technology will gain insights in that it will provide relevant issues and information that affect and influence use of Thin Client. Stakeholders are likely to use findings in the study to inform business decisions on the technology to use in advancing communication.

1.7 Scope of the study

Researcher will be confined only to University ICT managers, ICT Lectures and other ICT users. Lecturers and students are the end users of the instructional technologies used in teaching learning process (El-Alfi, Amin, & El-Hosary, 2016). The study will aim at establishing how thin client will be utilized by administration, teachers and students and which instructional procedures will

be most suitable for adoption of thin client technologies in conveying minimal cost effectiveness to the universities.

1.8 Summary of chapter one

Aspects of utilization, benefits and scope of Thin Client is explained in this section. The statement of the problem offers reasons and basis of the research work, pointing to the indicators that are likely to influence the conduction of the study.

Clarification is presented in terms of why the research is needed inclusive if benefits likely to be accrued from the project. The study will focus on sampled public universities in the county of Nairobi.

CHAPTER TWO: LITRATURE REVIEW

2.0 Introduction

A representational review of theories in conjunction to identifying and compiling relevant information on various literature review to give background detail and information on the topic we studying: the adoption of thin clients, context of thin client on cloud computing, client server computing, ICT in public universities adoption of thin clients under related work and the recommended model.

2.1 Theoretical Literature Reviews

The theoretical review focuses on the adopted theories that explain the circumstances behind the adoption of Thin Client. Three theories are discussed but a refined theory is selected to explain how the variables best fit in it.

2.1.1 Diffusion of Innovations (DOI)

Individuals adopt innovations to different degrees. According Murcia and Andreescu (2011) we can have five categories of willingness to adoption. innovators who have access to multiple information sources, are considered to be venturesome and educated, with many social informal contacts are early majority, early adopters who are perceived as popular, social leaders, and, educated; Laggards depend on neighbors and friends as source of information and who fear indulging in debt, skeptical Late with lower socio-economic status. Adoption and infusion which are important to IS successful implementation narrows down to relative advantage (perceived need), technical complexity (ease of use) and technical compatibility as the general model.

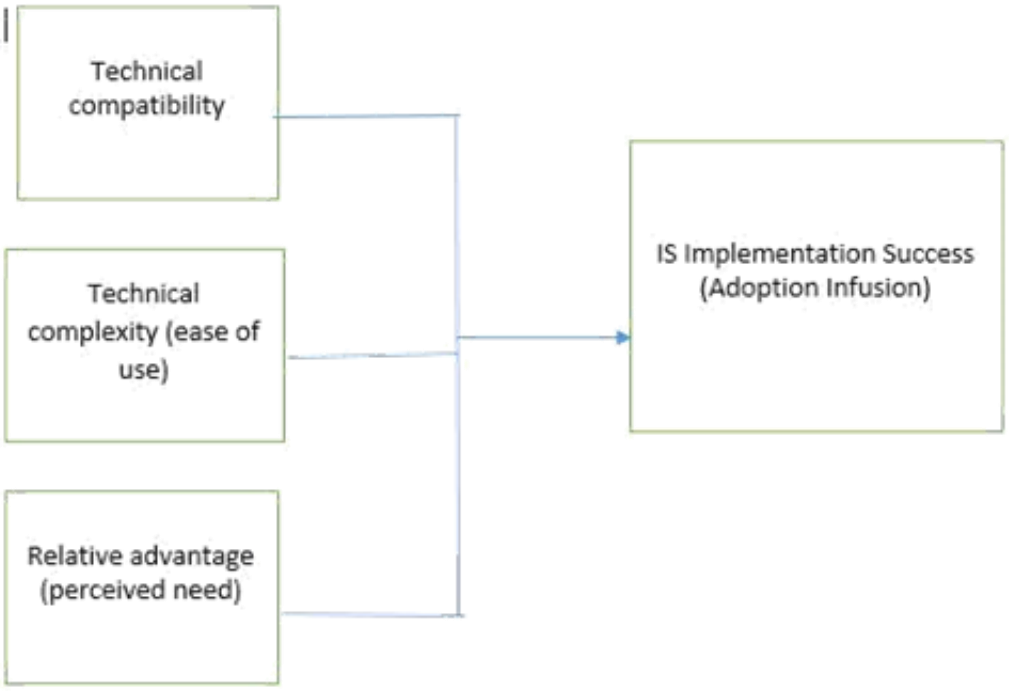


Figure 1 DOI Theory as by Zhu, K., & Kraemer, K. L. (2005)

Adapting to new technologies is the context elaborate on the DOI study about various individuals. However, thin client is a radical departure from the traditional methods of providing information services in an organization. This model may not fully address what may influence individual ICT officers to depart from the current mode of provisioning of IT services to cloud based solutions.

2.1.2 Technology-Organization-Environment Framework

Technological, organizational and environmental context helps an organization determines the process by which adoption is implemented. Technological includes both factors within and without (internal and external) technologies involved and related to organization. Firm size, human resource, amount of minimum resources, degree of formalization linkage among employees,

features and assets of the firm belong to organizational factors. Environmental gives the competitive niche and regulatory body.

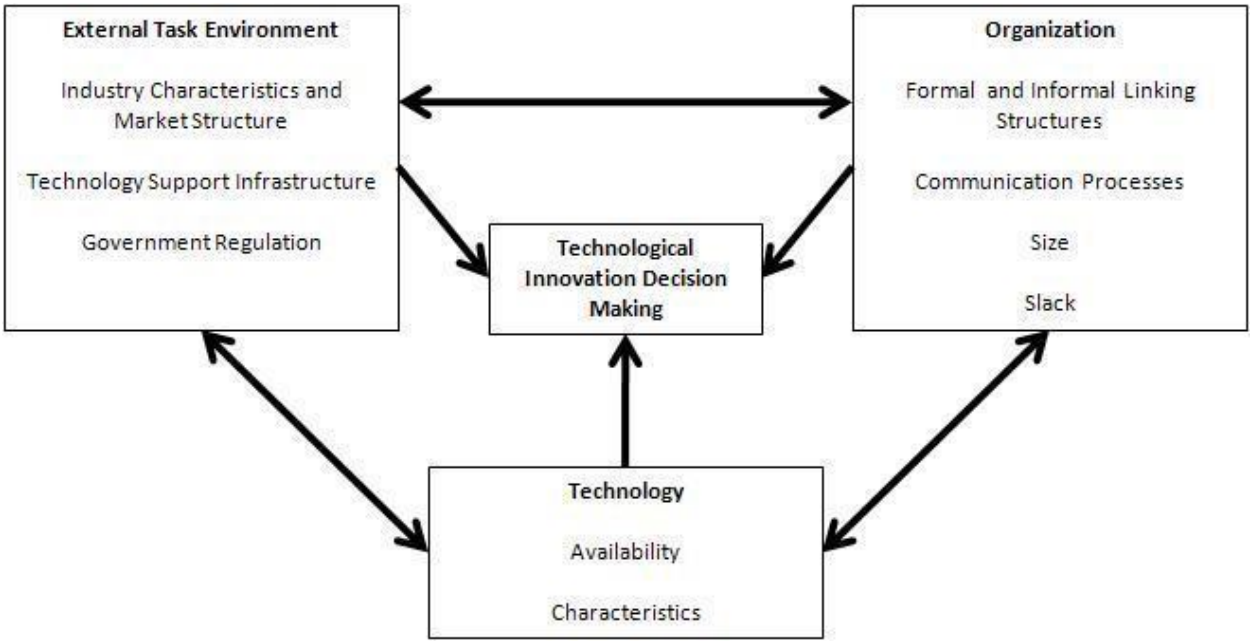


Figure 2 TOE Frameworks (Theory) by Freincher and Thwrtyzky 2009

2.1.3 Absorptive Capacity Theory

This is an organizations ability and capability to find out and establish, assimilate, transform and put in practice valuable knowledge at organizational level and limits to what level of technological information an organization can adjust and take in for absorbent use. When absorption capability is in existence, explanation for an organization to develop and accept exploration on Research and

development become a priority. Research and development enhance possible evaluation and incorporation of technical knowledge in the firm and does not only conduct development along the lines they are already familiar with. Research and development by organization is to work around capacity constrains as seen by Pavlou asawy, (2006) in there study on leveraging competence to competitive advantage In turbulence environment.

2.1.4 Justification of Selected Theory (TOE Framework and absorptive theory)

Scholars have studied the various factors that affect the assimilation criteria of different current technologies. DOI, TOE and absorption theory are used to explain factor that affects new technology by the organizations. This narrowed to the theory of TOE (technology, environment organization) framework and absorptive capacity theory because; the adoption decisions can be explained and predicted by these theories based on features of technology, environmental factors, users perception and organizational factors (Tashkandi & Al-Jabri, 2015) as well as research done on the technology and how it would help deal with development on a particular firm. DOI does not put into consideration the environmental factors. For these environmental factors to be put into consideration as they also affects the adoption of the innovation of technology, the research considered the Technology Organization Environment (TOE) and absorptive theory which considers the non-technological factor such as the environmental aspects (Computer-Aid-International, 2009) and absorptive that involve research before acquisition.

2.2 Empirical Literature Review

2.2.1 Thin Client Use in Africa and Kenya

Tremendous growth and implementation in the use of ICT in advanced or higher level of learning in Africa has been witnessed with anticipation for more improvement. Expanding the ICT use in African higher education has been hampered by poor ICT infrastructure, low penetration of telephony, very low internet bandwidth, and low internet connectivity, inadequate number of Personal Computers and very high costs of expanding the ICT use in African higher learning.

2.2.2 Organization factors and adoption of thin client

2.2.2.1 Resources and adoption of Thin Client

Doyle and Deegan (2009) in their study towards Adoption of Desktop Visualization Technology in learning– An instance study of Ncomputing in Tanzania, observed availability of e-readiness assessment tolls. Mutula and Brakwl (2006) concluded that, ICT training programs, quality of network access, internet; applications and services; good network speed; ICT regulatory policy; human power, computer literacy and relevant infrastructural content hinder the full implementation of the desktop virtualized technology. There was essentiality to assess to what extent does virtualized tech fit in Tanzania.

Macharia & Pelser, (2014) noted in their study that the rapidly changing of higher learning landscape that is affected by local and global forces, delivery of quality education and diversified flexible learning and teaching are the three major characteristics that influence ICT diffusion in higher learning education.

Globally, several studies have been done on ICT resource availability and utilization. There is evidence to prove that the top universities in the world have occupied their prestigious positions because of their high levels of investments in and adoption of ICTs. They have and continue to install latest, functional facilities and equipment in all offices and lecture halls and established data centers as well as fully interlinked campuses. Several studies have been undertaken on the impact

of university expansion on quality of service delivery and they seem to agree on the practicality of ICT as an aid for service delivery especially in the wake of explosive student enrolments. ICT allows for proper planning, monitoring, implementation and management.

2.2.2.2 User resistance on adoption thin client

Besides the performance issues, Doyle, P., & Deegan, M. (2009) notes the reluctant and minimal user acceptance of technology and this is reinforced by encouraging awareness and comprehensive onsite test by (Renatus, 2015) little motivation by students in Dublin done by the blind test carried out showed otherwise in acceptance percentage rate. Do we have good knowledge and thus faster acknowledgement of good technology to ensure the users realize the candid need to use than resist in our universities to enable use and adoption of a technology in our universities?

2.2.2.3 Influence of Financial Resources on Adoption of thin client

The adoption of thin client in public universities in Nairobi County is adversely affected by financial resources. The major hindrance is the high cost of acquiring technologies which affects adoption decisions. Financial resources are needed for: installation of technologies, the initial procurement, training personnel, for maintenance of the technology for covering operating expenses, and its enhancements in the present and future use of the technology.

Arendt, (2013) in her study to assess the rate of ICT adoption in academic libraries in Nairobi universities, various barriers to adoption were noted like: high cost of computer hardware and software, lack of skilled manpower, inadequate technological devices and equipment, poor attitude of the librarians were the major barrier for deployment. This would mean high cost implementation thus having a greater impact on organization financial resources. This acts as a good lead to affirm

the reason why Thin Clients adoption would minimize economies of spending and minimal castings than the traditional computers if universities accept to adopt real tradeoffs that will give the long term savings.

ICT strategy adoption is so costly and unavailability of funds makes it so hard attain entire potential ideology of adoption (Calman, Kitson, & Hauser, 2010).

Cost of implementation deters proper uptake and system growth of use in technology (Chesher & Skok, 2010). The adoption of ICT in public universities would significantly reduce paperwork in the institutions management which in turn translates to reduced paper trail, reduced cases of errors, reduced turnaround time in viewing reports and in the long run contributes towards lowering education costs.

2.2.3 Technological factors and adoption of thin client

2.2.3.1 Influence of skills and competency on adoption of thin client

Various notable factors were observed to be facilitators that could enhance improved ICT adoption in universities (Macharia & Pelser, 2014). Increased awareness and knowledge to users through trainings, ease of use of for the developing system, organizational support and vendor support increase the likelihood of using Thin Client technology.

Training cost of employees has continued to be a challenge in the acceptance and take up of technology strategy in Universities. Besides, facilities do not develop training plans. In most Kenyan public universities facilities, laxity amidst management to invest in training their employees because they are afraid of losing their employees to other institutions (e.g. private

universities) upon their completion of such trainings, when qualifications are increase (Arendt, 2013).

Yoo (2011), virtualization, models for delivery in cloud computing, service-oriented architecture/thin clients, and deployment strategies are the key concepts of cloud computing. (Merve B &V Nasir, 2016) in their study on "A fad or future of IT? A comprehensive literature review on the cloud computing" research noted that the four concepts by Yoo, individuals and organizations require competences and skills in order to Increase use of cloud computing services in their business.

Obare et al, (2015) in their study on public universities campaigns on clean ICT in Kenya suggested the use of thin clients as a potential for cloud computing applications to assist universities into green ICT at minimal costs compared to ancient ICT company solutions. Managing computer networks with thin client is quite easier since software issues require management from the server side unlike from each machine.

Martinez-Mateo et al. (2010), in their study on thin client technology on computer labs affirmed related infrastructures and Computer-based learning methodologies to be mandatory at most levels of the academic world. Computer laboratories and required ICT are a staff resource and economic barrier for most educational institutions. Efforts to provide effective solutions will have a tremendous impact on education. (Martinez-Mateo, Munoz-Hernandez & Perez-Rey, 2010) looked at different scenarios where thin clients would be of great impact in universities: Computer labs, distance learning, web based learning among other variables. Based on the findings of Ogutu,

(2017), he suggests further development and input in healthcare to include cloud-based interoperability solution that allows for seamless operations and can ensure that all healthcare systems are centrally managed and information be easily accessible across all healthcare institutions for the specific system users. This was the reason for his suggestion of Two-tier client–server architectures that would entail a thin-client model which is very simple to manage.

2.2.4 Environmental Factors and adoption of Thin Client

2.2.4.1 Government regulations

ICT procurement is a critical area of financial management systems which is continuously undergoing changes to enhance the utilization of public resources efficiently. In any government system procurement aims to satisfy real time delivery, acquisition of services and goods, accountability, transparency and value for money should be put into consideration (Christenson, 2010). These principles are essential for effective utilization of resources and reduction of poverty.

The Government of Kenya is constantly reviewing the performance of the public procurement system to offer efficient services to its people (Gatero, 2010). The emerging trends of technology scale and technical complexity of systems require a constant evaluation to ensure that the systems are up to date. External donors are often willing to financially assist the government to meet its ICT objectives in health care management as long as due process in procurement and donor obligations is adhered to (Frank, Shiv, & Faustin, 2012). In the study of technology adoption by

Mexican firms, Gladys (2011) reports an interesting finding. She found that the provision of employee training increases technology adoption in firms.

Calman, Kitson and Hauser (2010) in their study towards Acceptance of Desktop Visualization stated that stakeholders opt not for Ncomputing because of technological unfamiliarity (Renatus, 2015). Computer-Aid-International (2009) report pointed out that: schools in Africa find it impossible to purchase products like low power pc because of lack of research work.

2.2.5 The role of research and development in adoption of thin client

Several studies analysed the existing relationship between research and development, productivity and innovation as well. Research is seen as effort to push forward innovative capabilities of firms, especially in knowledge-intensive sector like technology measuring and evaluating the performance. R&D in organization is crucially important in making decision about the level and direction of public funding for technology to be acquired and be implemented.

(Ahmed &Hussain 2017) in there study on implementation of thin client in Jazan university in Saudi Arabia explained the importance of preliminary search on research before implementation. In their study on the managerial influence on technical skills on developing projects in various institutes like Kenya industrial institute (Adera & Omwenga,2017) conclude that effective leadership in R&D projects require skills and knowledge in the technical or core subject area for thin client technology adoption in universities to take effect.. Good skills and human relations boosts the ability to present the project within set contexts of operation from the

institutional to the global perspective. The project manager in the R&D Institution should therefore ensure that he updates his technical knowhow and skills on a regular basis. There should be training opportunities availed to the managers to build their capacity due to the constant change in trends.

A study done by Debra (august, 2004) on agricultural economics argued that a firm with research and development expenditure is more likely to adopt new technologies compared with one without. This is so because the research and development expenditure takes care of pilot projects in which the real life scenario is tested and all necessary changes required are made before actual deployment. Ability to process latest technologies arriving in the market is a way of viewing role of research and development by karshenas and stoneman.

(Magenegene, 2019)backed up research and development in adoption criteria to ensure transition capability and assessment of an organization in acquiring and implementing technology in business as a key factor in her study on IPV6 adoption.

2.3 Identified Research Gap

One of the research gaps identified was the high cost of resources and equipment required to set up and run Thin Client. Arendt, (2013) in her study to assess the rate of ICT adoption in academic libraries in Nairobi universities, various barriers to adoption were noted like: high cost of computer hardware and software, untrained personnel, inadequate technological devices and equipment, poor attitude of the librarians were the major barrier for deployment.

Cost of resources was also mentioned by Renatus (2015) as a source of barrier for implementing Thin Client equipment in organizations. In his research work on Tanzania educational sector on analysis of cost, Renatus, (2015) identified that the cost in implementation on the infrastructure to put up labs and thin client based computing would be a little cheaper than when you have to use the normal PC set up. His research also reveals that the traditional approach in adopting these Ncomputing devices depend on the needs and interests of the decision maker which falls to the usability issues (Renatus, 2015).

Azhar, (2011) in his research on analysis of thin client's performance recommended to advance the IT infrastructure at the magnetic resonance imaging (MRI) unit to improve performance. This study identified low performance and high costs of running the traditional thick computers as compared to Thin Client. Results showed that Thin Client had improved the performance due to the new configuration.

Doyle and Deegan (2009) pointed that most traditional (Think PCs) based work environment had problems of information leakage and failure, inefficient management and energy waste. Emission

of Carbon depended on usage of PC that was estimated at approximately 27 % of total IT area. Their research identified the need to continually establish benefits associated with virtual desktop for advantages like power saving, low TCO, and high security.

Another research gap identified was low knowledge and low uptake of Ncomputing in institutions of higher learning. Renatus (2015) discovered Ncomputing is not conversant to authorities and decisions makers who purchasing computers for NComputing and thin client in the near future. Lack of knowledge and management indecisiveness has become part of the reason educational institution not taking risks in buying Thin Clients (Mutula & Brakwl, 2006). In conclusion, lack of knowledge on the decisions to use Thin Client has been associated with low uptake of the innovation in higher institutions of learning. Lack of awareness of the technology hindered adoption and management decision making in acquisition of the cost economic infrastructures was some of the reasons the research brought out boldly.

Kiilu et al, (2011) suggested that exploration of thin cliet technology can be high on initial investment but the overal return on investment is higher in the long run for libraries because various eradication of unnecessary desktops but putting up serve based computing that can be accessible by most users.

There have been limited studies to show the compatibility of the thick and Thin Client systems (Chesher & Skok, 2010). Adamancy of users to migrate to the Thin Clients, Incompatibility of new and existing system, low motivation, and unwillingness to learning how to use it were some

of the reasons that derailed the adoption culture of the thin client technology (Boudreau, 2007; Macharia & Pelser, (2014).

The effective role of R&D in adoption of thin client technology requires project manager to know needs and to be conversant and competent in the specific area or subject of research in order to realize positive R&D outputs while leading the R&D team into investigating viable options and focus on what would enhance the organization competitive advantage and cost maximization

2.4 Conceptual Framework

This tries to explain the relationship between variables in the study by use of a diagram. Change or occurrence in independent variable will result in change or variance in the dependent variable.

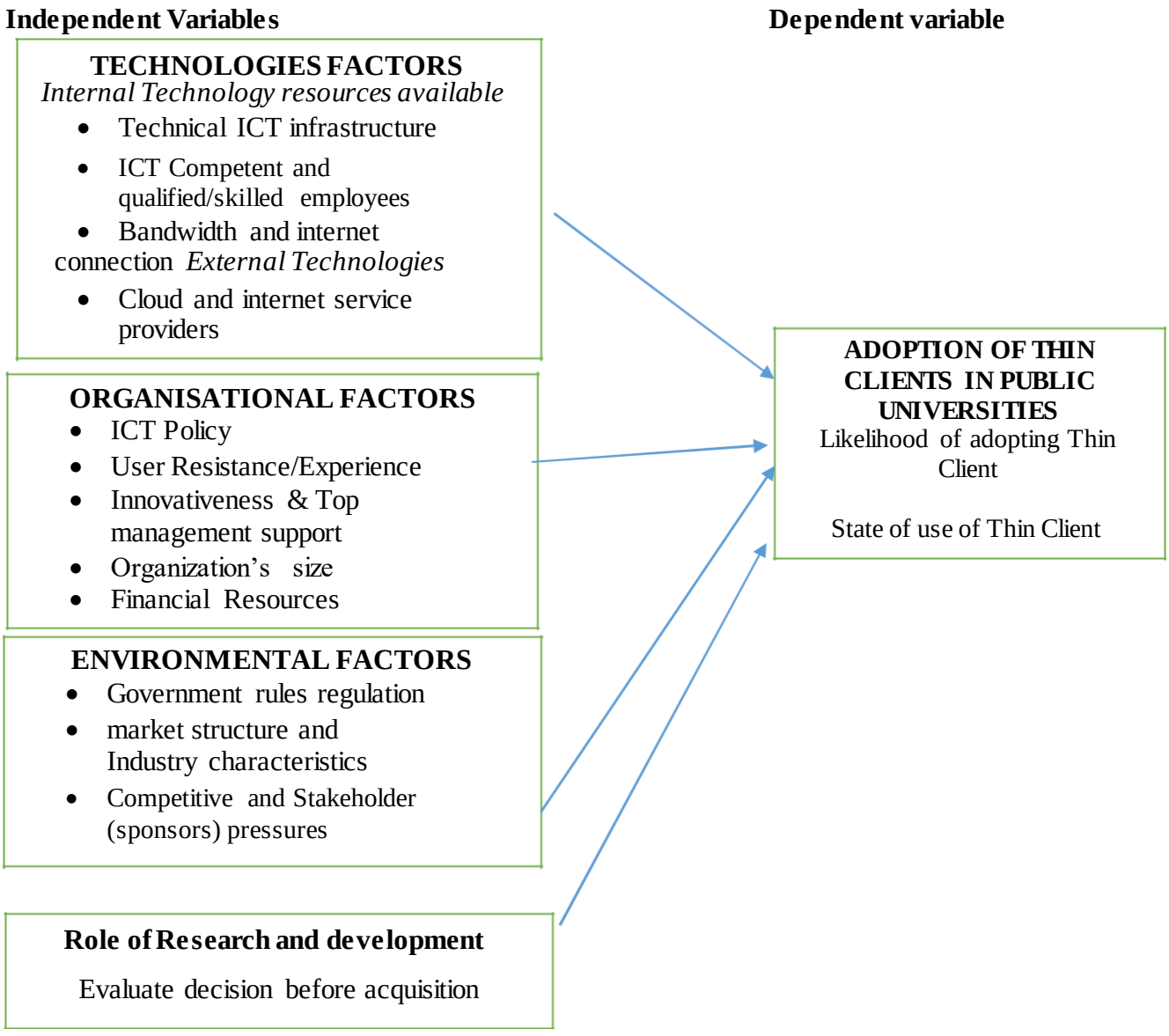


Figure 3 TOE (Tornatzky and Fleischer 1990, adopted by mucheni 2015) and absorptive capacity theory Cohen anlevinthal (1990)

This conceptual framework borrows from the TOE Framework and absorptive capacity theory that focuses on technology, organizational and environmental factors alongside research and development respectively. The study borrows from the absorptive capacity theory on the the role research and development on the adoption of technology and puts a need and balance to evaluate the variable as a key factor that would help organizations to understand before acquisition and implementation and failure of a technology. The study has borrowed industry (market) technology support infrastructure, characteristics and structure, and government regulations from the external task environment. The study also borrows the variable of size, formal and informal linking structures from the organizational factors. The study further borrows availability and characteristics of the market from the aspect (variable) of technology. The selected variables were further supplemented by other prevailing variables for each of the three major variables in environment, organization and technology.

The conceptual framework's environmental factors include government regulations, industry characteristics, competitive pressure, and stakeholder (sponsor) pressures. Other variables under environmental factors include industry characteristics and market structure. Government regulations influence whether or not an organization will adopt Thin Client technology. If government pressures a sector to increase its operational efficiency, then adoption of the latest technology would be an option. Competitive pressure from the market is likely to influence an organization to adopt Thin Client. Industry characteristics and market structures are possible influencers of whether a firm will adopt Thin Client or not. The environmental factors are likely

to influence whether an organization (in this case, public university) adopts Thin Client technology.

Internal and external technologies influence whether an organization influences adoption of Thin Client technology. ICT technical infrastructure and ICT competent ad skilled employees are likely to influence whether or not, the adapted Thin Client technology will be supported through the technical expertise. Internal connections and bandwidth are a key component for enabling adoption of Thin Client. Internet service providers and technical persons to enable connections from the central servers are likely to influence adoption of Thin Client. Power supplies and security influence whether the university is likely to influence energy consuming equipment in facilitating Thin Client.

Organizational factors including organizational ICT policy, user resistance/experience, institution innovativeness, and top management support are likely to influence adoption of Thin Client computers. Organizational culture is likely to influence whether the staff are appreciative of the need to adopt Thin Client. Resources are crucial in ensuring the equipment, training and running of the equipment in Thin Client.

Level and direction of decision making on public funds is crucial and is established by measuring performance of research and development role in the organization. The quality of human resources an role of research and development done is likely to influence whether an organization adopts Thin Client technology or not. Human resources with the help of the research attained are likely to determine whether Thin Client computers are successful or not. The selection of TOE framework influences the provision of technology to the public universities. For instance, TOE advocates for consideration of organizational factors, external task environment, and technological factors. Research work done by the organization make a huge implication too.

The independent variable, adoption of Thin Client is likely to be influenced by environmental factors; internal and external environment; and organizational factors. The dependent variable will be measured by statements explaining the level of adoption of Thin Client at the public universities

2.5 Operationalization of variables and KPI

The section shows how the four major variables will be operationalized and how they will be measured. Indicators are provided as well as the mechanisms for measures

Table 1:
operationalization Of variables

Main Research variable	**Indicator**	**Mechanism of measure**
Technological Factors	*Internal Technology*	Options/prompts given and measured by Five point Likert scale
	Technical ICT infrastructure	
	ICT Competent and qualified skilled employees	
	Bandwidth and internet connection	
	External Technologies	
	cloud service providers	
Organizational factors	ICT Policy	Prompts/statements given and measured by Five point Likert scale
	User Resistance/Experience	
	Innovativeness & Top management support	
	Organization's size	
	Financial Resources	
Environmental factors	Government rules regulation	

	market structure and Industry characteristics	Prompts/statements given and measured by Five point Likert scale
	Competitive pressure	
	Stakeholder (sponsors) pressures	
Role of research and development	Evaluation of decision making before acquisition	Prompts/statements given and measured by Five point Likert scale
	Specialized R&D team to foresee new tech adoption and implementation	

2.6 Chapter two summary

Focus is on empirical and theoretical literature review are well covered. The study focused on the Technology, Organization and Environment (TOE) model as the best theory to inform the adoption of Thin Client technology in learning institutions. In empirical literature, the context for Thin Client use is expounded with options like cloud computing, client server computing, and thin client technology. ICT in public universities is also discussed with possible factors influencing the adoption of Thin Client. Factors discussed and supported by secondary literature include organizational factors (ICT policy), user resistance, influence of financial resources and influence of skills and competency. Identifies gaps form operationalized variables and a conceptual lens framework.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

This section outlines the methodologies used to identify the research design, target population, the sampling technique, sample size, sampling procedures, research instruments, validity of research instruments, reliability of research instruments and data collection procedures and data analysis techniques and ethical consideration.

3.1 Research Design

This is the conceptual structure within which research study is done: it involves the blueprint for data collection and the stipulated analysis. The research uses descriptive survey research design and inferential statistics through which the state of existing affairs was able to be depicted, Kothari (2004). The researcher collected quantitative data for analysis (Creswell, Plan Clark, et al., 2003).The study focused on the Technological, Organizational, Environmental, and Research and Development framework theory to inform adoption of Thin Client technology in higher learning institutions. The study was deductive research approach since it was anchored on an already existing theory and the researcher did not plan on coming up with any theory but to deduct the conclusions from used framework theory.

3.2 Target Population

A defined set of people, events, elements, groups of things being investigated is referred to as a population. Results are generalized from a set of universal objects, people or activities that a real or hypothetical that are intended to be investigated known as population (Borg and Crall, (2009).

Target population was all public universities in the county of Nairobi, from which a sample respondent of the universities was selected which focused on Specialists in ICT, networking experts, ICT administrators, information security officers, and general ICT experts at the selected universities.

A list of the public university that exist in Nairobi County were as below: The university of Nairobi, Kenyatta, Moi, Technical, Dedan Kimathi, Egerton, Jomo Kenyatta, South eastern university of Kenya, Masaai Mara ,Masinde Muliro ,Laikipia,Cooperative,Multimedia. The selections of the above was based on the various campuses that have huge future based ICT investment and curriculum and above all show great potentiality in growth and expansion on technologies like the thin client and virtualization which were my major study area.

Below represent the target population representative of the respondents in the respective universities

Target population

	Target population
Administrators	50
ICT lectures/staffs	150
Head of departments	25
Managers	70
TOTAL	**295**

3.3 Sample Size and Sampling Process

The number of objects, items, or individual selected to represent the population is known as a sample size. The total number of the personnel's that were identified as the ICT staff were 295 in number in the public sector universities in the county of Nairobi alone.

The focus was on ICT staff who could influence decision making on the adoption of thin client technology in the particular selected universities as a representative for the rest. The whole population wasn't going to be involved in the sample and inferential statistics was used to ensure an acceptable representative sample was randomly incorporated to represent the various campuses that were involved in the study. Hossan-Chowdhury (2011) calculated the size of the sample because it works well for a larger population criteria and is ideal given as below: estimated proportion, desired confidence level, level of precision.

$$n = \frac{z^2pq}{e^2}$$

n -Desired sample size *n* less than 10, 000

z -Standard normal deviate at 1.96 corresponding to 95% confidence interval (z value got in Z table which contains area under the normal curve)

P - Estimated proportion of target population (the ICT officers and the information security estimated to contribute 10% that gave us a workable sample size with the given level of significance and accuracy).

Q - I – p

e- - The error margin 0.05

$$n = \frac{z^2pq}{e^2}$$

$$n = \frac{1.962 \times 0.1 \times 0.9}{0.0025} = 70.632$$

= 71 respondents

To obtain reach out to the 71 respondents, a simple random sampling was used to settle for three public universities within county of Nairobi. The researcher then conveniently sampled the respondents proportionately from the selected universities. The three universities were The University of Nairobi -chiromo campus, Kenyatta University-town campus, and Technical University of Kenya (TUK).

The selected universities were settled on giving the acceptable value because of the high technological savvy they have invested on and this would give a better picture of the upcoming universities who were also piloting and putting in place new technologies like thin client technology. In as much as most of them fall under the category of campuses, thin client technology had been put in place in this particular campuses and this was after my visit to each of the places and confirmed use. The use of thin client on this campuses was to enhance cost maximization and efficiency on resources. Adoption and use of the thin client technology on this campuses would ensure profit were fully maximized and insightful decisions making for the entire major campuses/entire universities involved would see the advantage of embracing the thin client technology especially on maintenance and imposing security aspect on various users of the applications installed.

Table 2: Sampled Respondents

University	Estimated Population of ICT staff	Sampled Respondents	Percentage
University of Nairobi	80	30	42%
Kenyatta University	90	34	47%
Technical University	20	8	11%
Totals	**190**	**71**	**100%**

Majority of the sampled persons were IT officers who contribute about 50% of the ICT staff, while an estimated 35% were ICT managers and directors, and the remaining 15% were deans/directors or unit managers. This representation gives a cluster of those influencing decision making in various universities and could influence the adoption of thin client technology in study.

3.4 Data collection: Instruments and Techniques

First hand primary data is information gathered from the field when conducting research, while secondary data is gained through comprehensive literature review (Brinkmann, 2014). Before the beginning of data collection, the student gathered all the required documents, like introductory letter from universities. Authorities involved were also audience to clarify the purposed study. Various email address and contacts for the lab technicians was given in exchange to ensure correct samples are done before the main data to be collected to the various ICT personnel that were to be involved in the study. The researcher collected primary data using structured questionnaires (Appendix III) to record respondents' responses. Physical questionnaire became so hard to work with because of the existing Covid 19 pandemic and the contacts that I gathered during pre-study became very helpful to ensure all those who were going to be involved in the study would be the right people for the same and that was evident by confirmation on work emails they used to respond and the profiles on LinkedIn. The questionnaire included six parts starting with demographic information and followed by questions based on the research objectives. They were; demographic information,

Questions on organizational factors, technological factors environmental aspects, role of research and development and the likelihood of thin client adoption. The researcher used a five point Likert scale with the range: Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Stongly Agree = 5.

3.5 Validity and reliability of the research instruments

a representation of the data before the main data collection gives the validity analysis. Piloting in one of the universities in the study area was carried out to pretest the instruments (Arain, Campbell, Cooper & Lancaster, 2010). Piloting was done in Masinde Muliro because it is an averagely existing university, not so old nor new and the growing capability of technology within the university has been commendable ok. The pilot study covered 7 respondents (10% of the sampled respondents).

Reliability was attained by running the Cronbach's Alpha statistics as it provided a background for proving internal data consistency. The reliability test results have been presented below.

Table 3: Reliability Statistics

Variables	Cronbach's Alpha	N of items
Organizational Context	.702	5
Technological Context	.825	4
Environmental Context	.588	3
Other Factors	.785	2
Likelihood_of_Thin_Client_Adoption	.788	2
Research_and_Development_Role	.702	2

Organizational Context had five items with an alpha of 0.702 indicating that all items were reliable. Technological Context had four items with an alpha of 0.825 implying that all items were also reliable. The Environmental Context had three items with an alpha of 0.588 which is a low value meaning it had some reliability issues. However, the researcher revised some of the questions in the environmental context to improve reliability. Other factors comprising of two items had an alpha of 0.785 indicating reliability of all items. The likelihood of Thin Client adoption had two variables with an alpha of 0.788 which implied that all items were reliable. Lastly, the role of Research and Development had two factors with an alpha value of 702 indicating that all the variables were reliable in the study.

3.6 Data Analysis

Data editing to remove errors was done then coded before being entered into computer software SPSS for quantitative analysis. Descriptive statistics were carried out which included measures of Central tendency, absolute and relative (percentages) frequencies, and dispersing (standard deviation and mean). Showing the degree and association among two variables, regression analysis and correlation was used. It also helped explore patterns, confirm hypothesis or reduce the many variables to a manageable number respectively in terms of magnitude and direction.

Pie charts, graphs and tables was used to represent the data obtained. From five-point Likert scale scores, mean of the statements were provided to show the direction of the score. The aggregated mean was incorporated to give meaning and interpretation of the research. Based on the larger variables, their means were used to provide results for regression analysis.

3.7 Ethical Considerations

Participants involved in answering the data questionnaires were informed that the research purpose before being requested to respond to the questionnaire. All the data collected was confidential and used for scholarly purposes only. The University also granted permission before the start of data collection. There was a lot of challenge to get the data due to Covid 19 but the Google forms helped much and in verifying the respondent by confirming that they were ICT staffs through linked in.

CHAPTER 4: DATA ANALYSIS, RESULTS AND DISCUSSION

4.0 Introduction

This chapters presents an analysis of the data collected. The results presented include the response rate, descriptive analysis, qualitative analysis and other observations related to the research questions. Research aimed at determining the factors that affect the take up of thin client technology in the varsities in the public sector in the county of Nairobi.

4.1 Response Rate

The research sample size comprised of 71 respondents. Out of the distributed questionnaires, 74 were fully filled and submitted. There were neither duplicates nor missing data. The valid responses were 74 respondents, hence the response rate of more than 100%. These valid responses were statistically representative of the study population. Therefore, aligning to the requirements of (Mugenda and Mugenda, 1999).

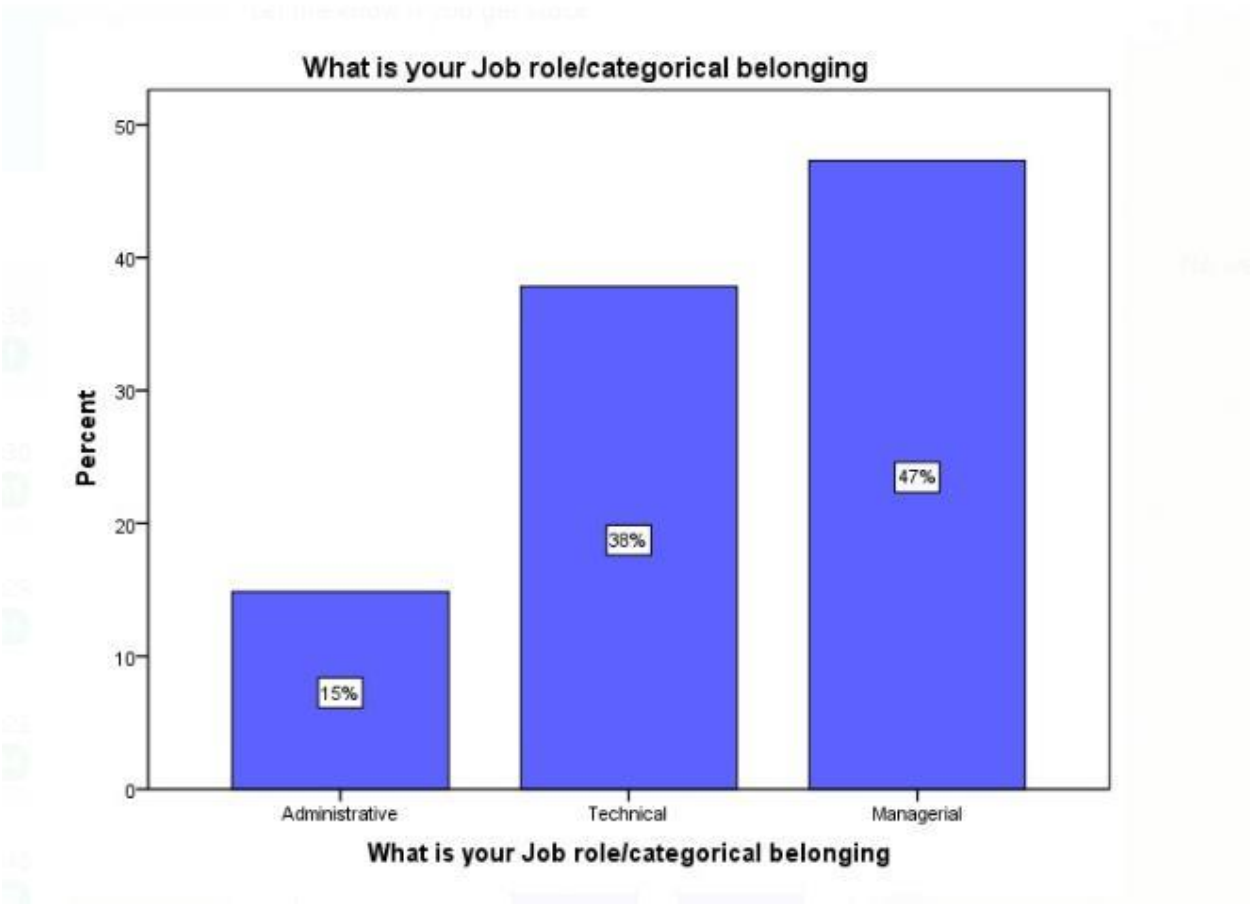
4.2 Demographic Data Analysis

This section presents an analysis of the respondent's job role, gender, length of time worked in the organization and organization operational years.

4.2.1 Participant's Job Role/ Category Belonging

The respondents were requested to report their job roles. The results are displayed in the bar chart in figure 4. Most respondents were from managerial positions (47%), followed by Technical (38%), and lastly Administrative (15%).

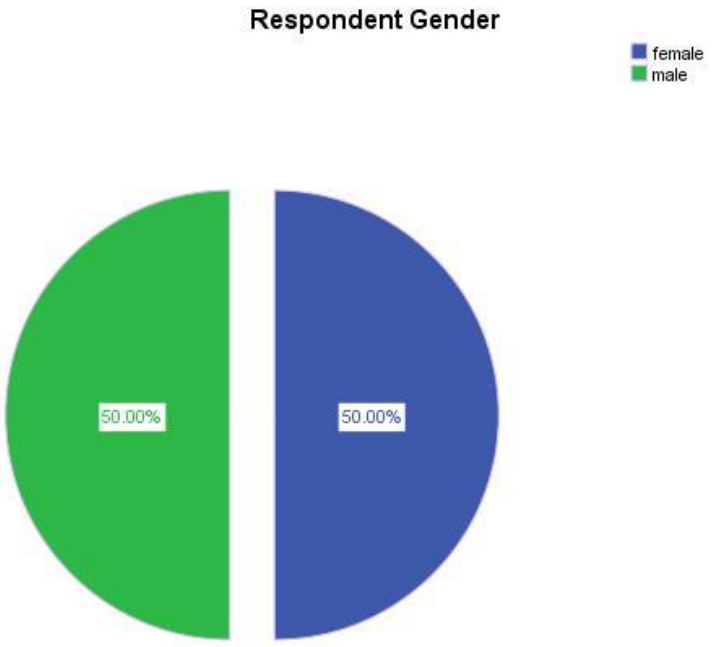
Figure 4 Participant's Job Role/ Category Belonging



4.2.2 Participant's Gender

The participant gender shown in figure 5 pie chart. It shows an equal distribution between the males and female participants each taking 50% of the total participants.

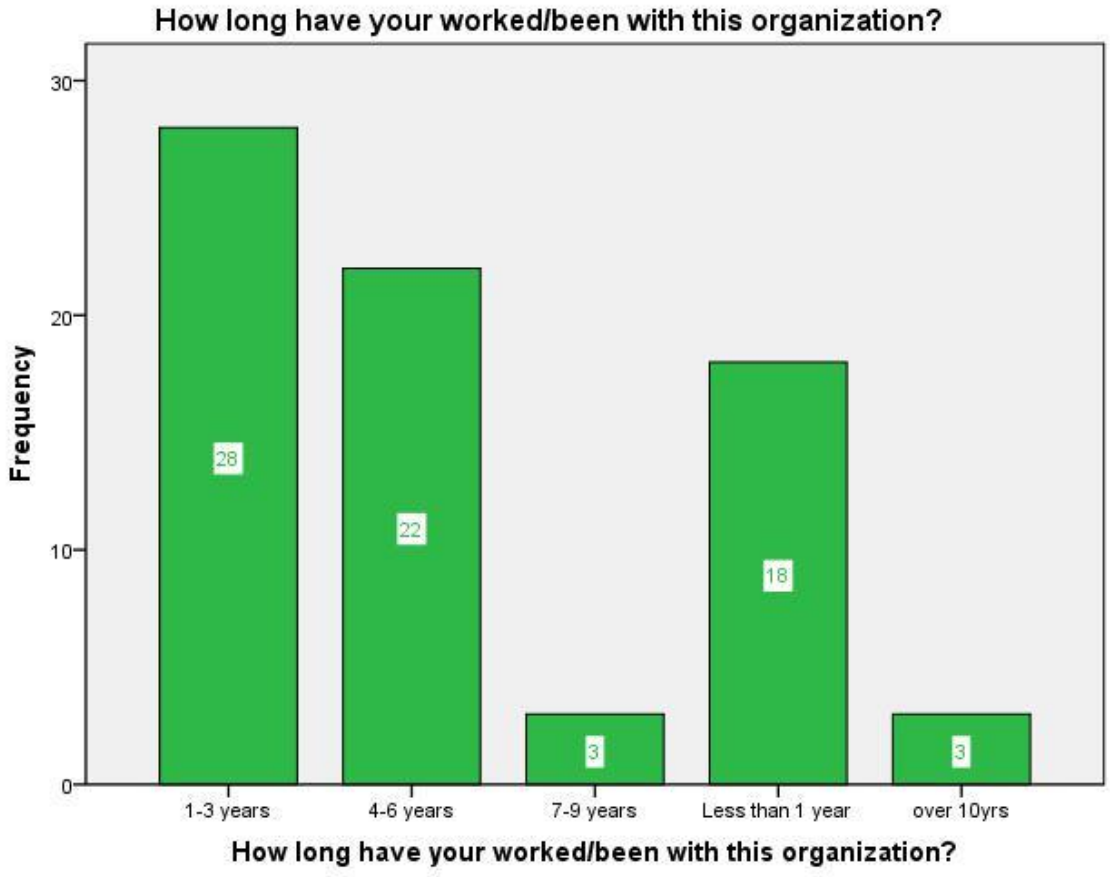
Figure 5 Participant Gender



4.2.3 Participant's years in the organization

The participants were asked the time period they had been in Organization. Their responses are shown in figure 6 bar chart. The majority, 38% had been in the organization for 1-3 years, 30% for 4-6 years, 24% for less than a year, and 4% in a tie for both 7-9 years and over 10 years.

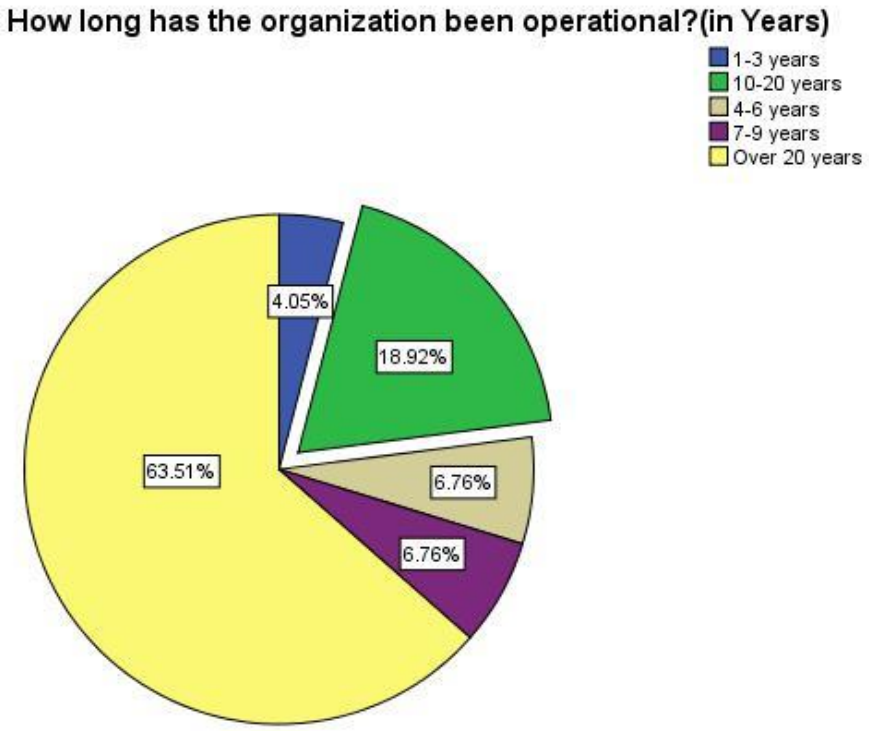
Figure 6 Participant years in the organization.



4.2.4 Organization operation years

The participants were also asked about the time period in years in their respective organizations had since existence. Figure 7 shows the results in a pie chart. Most participants' organization had been in operation for the longest period of over 20 years which represent 64% of the total participants. The other proportions include 19% whose organization were in operation for 10-20 years, 7% represented two groups; 4-6 years and 7-9 years. Lastly, 4%, the least proportion of respondents had the minimum number of operation years (1-3 years).

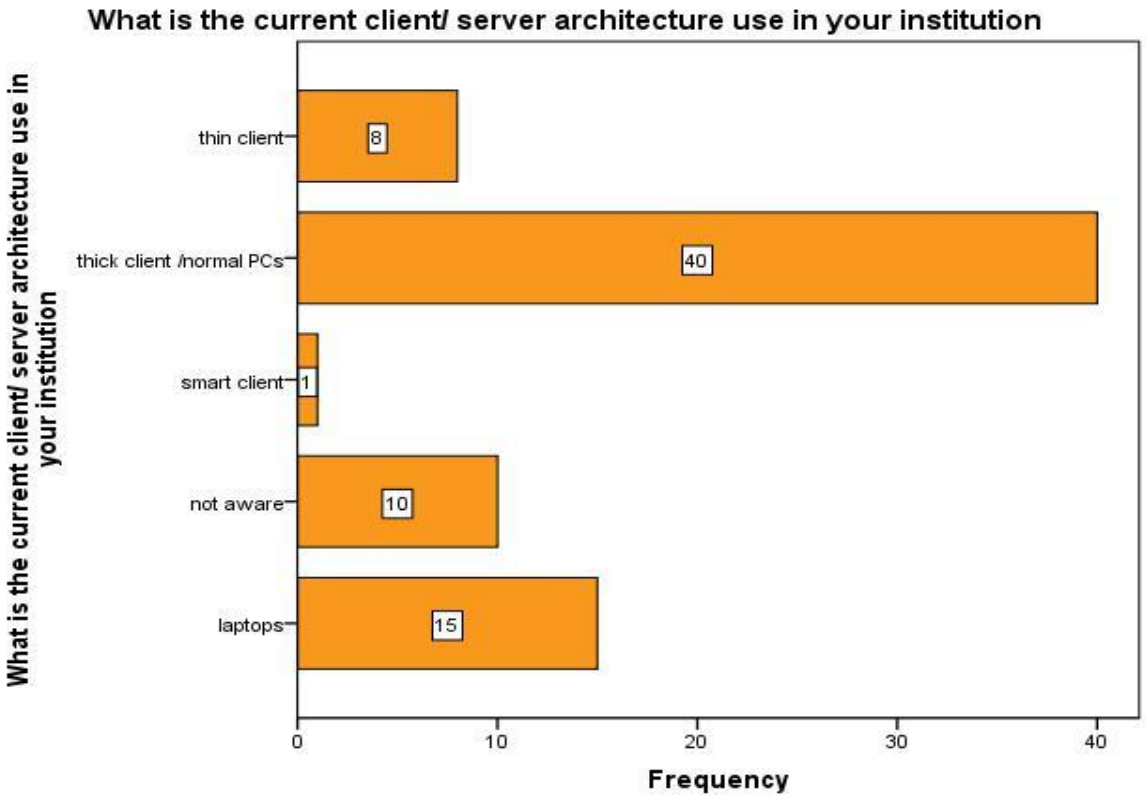
Figure 7 Participant Gender



4.2.5 Current Client/Server Architecture Use in the Participant Institution

Figure 8 shows a horizontal bar chart of the current client server architecture use in the participant institution. 54% stated that their organizations use thick client/ normal PCs, 20% use laptops, 14% are not aware, 11% use thin client, and 1% use smart client. It seems that the thick client/ normal PCs is the most used client/server architecture among most participants' institutions. There is also evidence of unfamiliarity of the client/server architecture use among respondents with 14% stating that they were unaware.

Figure 8 Current Client/Server Architecture Used in the Participant Organization



4.3 Descriptive Statistics of the Variables

This section shows the descriptive statistics of the variables. They include technological context, organizational context, environmental context and the Role of Research and Development factors which influence the likelihood of adoption of thin client technology. The descriptive statistics presented include mean, standard deviation, minimum and maximum values. The percentages are also included to show the level of agreement and to what extent they don't agree among the respondent are consistent with the 5 Point Likert Scale.

4.3.1 Technological perspective

The technological perspective comprises the internal and external factors as shown below.

- Internal Technology resources available
  - Technical ICT infrastructure
  - ICT Competent and qualified skilled employees
  - Bandwidth and internet connection
- External Technologies
  - Cloud service providers

The respondent's summary result on technological factors are presented in Tables 4 and 5.

Table 4: Descriptive Statistics for Technological context 1

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The university has good internet connection or better Wi-Fi facility and bandwidth to handle and sustain upcoming technologies like thin client	4.1%	18.9%	14.9%	44.6%	17.6%
The university have reliable cloud and internet services to handle and sustain upcoming technologies like thin client	2.7%	13.5%	33.8%	35.1%	14.9%
The university have the best ICT technical infrastructure to enhance virtualization and adoption of better technologies like thin client technology	5.4%	18.9%	20.3%	40.5%	14.9%
The university have trained competent and skilled ICT employees to enhance the handle of upcoming technologies like thin client	1.4%	10.8%	27.0%	41.9%	18.9%

The results show that majority of the respondents (Mean = 3.46, Std Dev = 1.113) agreed that the university has good internet connection or better Wi-Fi facility and bandwidth to handle and sustain upcoming technologies like thin client. In addition, most participants (Mean = 3.46, Std Dev = 0.996) agreed that the university have reliable cloud and internet services to handle and sustain upcoming technologies like thin client. The participants also agreed (Mean = 3.41, Std Dev =1.122) that the university have the best ICT technical infrastructure to enhance virtualization and adoption of better technologies like thin client technology. Moreover, the respondents agreed (Mean = 3.66, Std Dev = 0.995) that the university have trained competent and skilled ICT employees to enhance the handling of upcoming technologies like thin client. Generally, the respondents agreed that Technological

aspects that influence the uptake of thin client technology in the public sector varsities in the county of Nairobi.

Table 5: Descriptive Statistics for Technological context 2

		The university have the best ICT technical infrastructure to enhance virtualization and adoption of better technologies like thin client technology	The university have trained competent and skilled ICT employees to enhance the handle of upcoming technologies like thin client	The university have reliable cloud and internet services to handle and sustain upcoming technologies like thin client	The university has good internet connection or better Wi-Fi facility and bandwidth to handle and sustain upcoming technologies like thin client
N	**Valid**	74	74	74	74
	Missing	0	0	0	0
Mean		3.41	3.66	3.46	3.53
Std. Deviation		1.122	.955	.996	1.113
Minimum		1	1	1	1
Maximum		5	5	5	5

4.3.2 Organizational context

The organizational context comprised the following factors:

- ICT Policy
- User Resistance/Experience
- Innovativeness & Top management support
- Organization's size (number of clients)
- Financial Resources

Table 6 and 7 show the results from the respondent's feedback with regard to organizational factors affecting the adoption of thin client Nairobi county public universities.

Table 6: Descriptive Statistics for Organizational Context 1

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	Row N %	Row N %	Row N %	Row N %	Row N %
The organization have positive staff attitude towards use, user experience minimal resistance towards adoption of new resources like thin client technology	.0%	8.1%	20.3%	45.9%	25.7%
The organization have an ICT policy and strategy of migrating that would enhance adopting use of thin client technology	.0%	12.2%	28.4%	48.6%	10.8%
The organization size influence approvals that enhances of adoption of new technologies like use of thin client technology	1.4%	5.4%	28.4%	39.2%	25.7%
The organization have a transparent financial planning for the resources during adoption of new technologies like use of thin client technology	1.4%	17.6%	31.1%	37.8%	12.2%
The organization have top management support on innovativeness continuity like use and adoption of thin client technology	1.4%	5.4%	24.3%	54.1%	14.9%

Most participants agreed (Mean = 3.89, Std Dev = 0.885) the organization have positive staff attitude towards use, hence user experience minimal resistance towards adoption of new resources like thin client technology. Still most participants agreed (Mean = 3.58, Std Dev = 0.844) that the organization have an ICT policy and strategy of migrating that would enhance adopting use of thin client technology. Also, majority of the participants agreed (Mean = 3.82, Std Dev = 0.927) that the organization size influence approvals that enhances of adoption of new technologies like use of thin client technology. More so, most respondents agreed (Mean = 3.42, Std Dev = 0.965) that the organization have a transparent financial planning for the resources during adoption of new technologies like use of thin client technology. Lastly, in this category, respondents agreed (Mean = 3.76, Std Dev = 0.824) that the organization have top management support on innovativeness continuity like use and adoption of thin client technology. For most part, the respondents agreed that the organizational factors significantly influence the adoption of thin client in public universities in county of Nairobi.

Table 7: Descriptive Statistics for Organizational Context 2

		The organization have an ICT policy and strategy of migrating that would enhance adopting use of thin client technology	The organization have positive staff attitude towards use, user experience minimal resistance towards adoption of new resources like thin client technology	The organization have top management support on innovativeness continuity like use and adoption of thin client technology	The organization have a transparent financial planning for the resources during adoption of new technologies like use of thin client technology	The organization size influence approvals that enhances of adoption of new technologies like use of thin client technology
N	Valid	74	74	74	74	74
	Missing	0	0	0	0	0
Mean		3.58	3.89	3.76	3.42	3.82
Std. Deviation		.844	.885	.824	.965	.927
Minimum		2	2	1	1	1
Maximum		5	5	5	5	5

4.3.3 Environmental context

The environmental context comprised of the following factors:

- Government regulations and policy
- Market structure and Industry characteristics
- Stakeholder (sponsors) pressures

The participant feedback results are as per table 8 and 9.

Table 8: Descriptive Statistics for Environmental Context 1

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	Row N %	Row N %	Row N %	Row N %	Row N %
Government and stakeholders pressure in the organization regulation and policy support thin client	1.4%	13.5%	21.6%	45.9%	17.6%
Market structure and technological industry competition positively impact adoption of thin client technology in universities	1.4%	1.4%	16.2%	52.7%	28.4%
Government regulation and policy are aimed at supporting of ICT adoption of new technologies	.0%	9.5%	23.0%	51.4%	16.2%

Majority of the participants agreed (Mean = 3.65, Std Dev = 0.971) that government and stakeholders pressure in the organization regulation and policy support thin client. Further the respondents agreed (Mean = 4.05, Std Dev = 0.792) that market structure and technological industry competition positively impact adoption of thin client technology in universities. Furthermore, the participants agreed (Mean = 3.74, Std Dev = 0.845) government regulation and policy are aimed at supporting of ICT adoption of new technologies. In agreement with all other factors, a large chunk of participants in general were in agreement that environmental factors also had a key substantial role in adoption of thin client in public universities in county of Nairobi.

Table 9: Descriptive Statistics for Environmental Context 2

		Government regulation and policy are aimed at supporting of ICT adoption of new technologies	Market structure and technological industry competition positively impact adoption of thin client technology in universities	Government and stakeholders pressure in the organization regulation and policy support thin client
N	Valid	74	74	74
	Missing	0	0	0
Mean		3.74	4.05	3.65
Std. Deviation		.845	.792	.971
Minimum		2	1	1
Maximum		5	5	5

4.3.4 Research and Development Role

The role Research and Development comprised of the following factors:

- Role of Research and Development in decision making before acquisition of new technology
- Role of Research and Development teams in thin client adoption

The researcher also questioned the respondents on the role of research and development factors to assess their influence on adoption of thin client by public universities in city of Nairobi. The summarized responses are presented in table 10. Majority of the participants agreed (Mean = 4.32, Std Dev = 0.62) that role of research and development on decision making before acquisition of new technologies and their use contribute to better leverages and cost maximization by public university. In addition, the respondents agreed (Mean = 3.86, Std Dev = 0.865) that the role of the research and development team in the firm influences the adoption of thin client technology in enterprises.

Table 10: Descriptive Statistics of the Research and Development Role

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Mean**	**Standard Deviation**
	Row N %	Row N %	Row N %	Row N %	Row N %		
Role of Research and development of new technologies contribute to better decision before acquisition in public University.	1.4%	.0%	9.5%	43.2%	45.9%	4.32	.760
Research and development team in the firm influences adoption of thin client technology in Enterprises.	1.4%	6.8%	16.2%	55.4%	20.3%	3.86	.865

4.3.5 Likelihood of Thin Client Adoption

The Research and Development Role comprised of the following factors:

- The current existing infrastructure
- Likelihood of thin client adoption in near future

Table 11: Descriptive Statistics of Likelihod of Thin Client Adoption

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard Deviation
	Row N %	Row N %	Row N %	Row N %	Row N %		
The current existing Network layout and ICT Infrastructure drift/enhances likelihood of adoption of thin client technology in public universities to attain best results and service delivery.	2.7%	10.8%	12.2%	55.4%	18.9%	3.77	.973
Public Universities are likely to adopt thin client technology in the near future.	1.4%	5.4%	21.6%	50.0%	21.6%	3.85	.871

Most respondents reported in agreement (Mean = 3.85, Std Dev = 0.871) that Public Universities are likely to adopt thin client technology in the near future. More so, the respondents agreed (Mean = 3.77, Std Dev = 0.973) that the current existing Network layout and ICT Infrastructure drift/enhances likelihood of adoption of thin client technology in public universities to attain best results and service delivery.

4.4 Correlation Analysis of Variables

Relationship between two variables is assessed by correlation analysis. The Pearson correlation coefficient is used to examine the strength and direction of the linear relationship between the dependent and independent variables. The correlation coefficient can range in value from −1 to +1. The larger the absolute value of the coefficient, the stronger the relationship between the variables. Table 12 shows the results of a correlation in a matrix.

Each of the variables correlations with the likelihood of Thin Client adoption are; Technological context ($r = 0.365$, $p = 0.001$), Organizational context ($r = 0.468$, $p = 0.000$), Environmental context ($r = 0.418$, $p = 0.000$), and Research and Development Role ($r = 0.324$, $p = 0.005$).

This shows that each of the independent variables has a moderate positive correlation with the likelihood of thin client adoption. The associations are also statistically significant with p values less than 0.05 level of significance.

Table 12

		Likelihood_of_Thin_Client_Adoption	Technological_Context	Organizational_Context	Environmental_Context	Research_and_Development_Role
Likelihood_of_Thin_Client_Adoption	Pearson Correlation	1	.365**	.468**	.418**	.324**
	Sig. (2-tailed)		.001	.000	.000	.005
	N	74	74	74	74	74
Technological_Context	Pearson Correlation	.365**	1	.486**	.038	.168
	Sig. (2-tailed)	.001		.000	.748	.152
	N	74	74	74	74	74
Organizational_Context	Pearson Correlation	.468**	.486**	1	.306**	.309**
	Sig. (2-tailed)	.000	.000		.008	.007
	N	74	74	74	74	74
Environmental_Context	Pearson Correlation	.418**	.038	.306**	1	.291*
	Sig. (2-tailed)	.000	.748	.008		.012
	N	74	74	74	74	74
Research_and_Development_Role	Pearson Correlation	.324**	.168	.309**	.291*	1
	Sig. (2-tailed)	.005	.152	.007	.012	
	N	74	74	74	74	74

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

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

4.5 Regression Analysis

Linear association was assumed between independent and dependent variables. To ascertain the relationship of the linear, a multiple regression was carried out to assess the extent to which the predictor variables could predict the likelihood of adopting thin client and or the state of use of thin client by public universities in county of Nairobi.

4.5.1 Multiple Linear Regression for all factors

The regression model, as shown in Table 13, incorporates the coded demographic data as well as the mean variables based on context grouping. The value of R yielded is 0.717 which indicates a stronger correlation between the independent variables and dependent.

4.5.1.1 R Squared

Table 13: Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.717[a]	.514	.506	.827

a. Predictors: (Constant), Research and Development, Technological Context, Environmental Context, Organizational Context

The model results in Table 13 yielded an R square of 0.514. This means that the predictor variables account for 51.4% of the variation in the thin client adoption likelihood. This is a good base model. It means that the Organizational, Technological and Environmental and Research and Development influences the likelihood of adoption of thin client by 51.4%

4.5.1.3 Regression Coefficients

Table 14: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.062	.771		-1.377	.173
	Technological Context	4.262	.126	.229	2.075	.001
	Organizational Context	3.322	.194	.199	1.656	.000
	Environmental Context	2.436	.157	.289	2.782	.007
	Research and Development	1.264	.150	.187	1.763	.002

a. Dependent Variable:

The current existing Network layout and ICT Infrastructure drift/enhances likelihood of adoption of thin client technology in public universities to attain best results and service delivery.

The beta coefficients show the changes in the dependent variable (likelihood of Thin Client adoption) generated by the independent variables Other Factors, Technological Context, Environmental Context, and Organizational Context. The Technological context had the greatest

deviation of 4.262, followed by Organizational context at 3.322, then Environmental Context at 2.436 and Research and Development at 1.264.

In the regression equation, the beta values (B) were substituted into the linear equation;

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon_0$ to forecast the effect of the independent variables on the dependent variables. In the equation, β_0 is represents the constant value, $B_{1,\ 2,3,4}$ represent the beta coefficients, $X_{1,2,3,4}$ represent the independent variables and ε represent the error term. The resulting equation is as follows:

$Y = -1.0662 + 4.262X_1 + 3.322X_2 + 2.436X_3 + 1.264X_4$

The results of the individual regression coefficients have been presented in Table 14. Interpretation of beta coefficients is as follows: for every unit 1-unit increase in the predictor variable, the dependent variable will increase or decrease by beta coefficient value units. For instance; for every unit 1-unit increase in the Technological Factors, the likelihood of thin client adoption in public Universities will increase by 4.262 units. The four predictor variables are statistically significant in the model since their p –values are less than the level of significance (0.05).

4.5.2 Regression Model with Individual Factors

This section shows the individual contribution of each factor in predicting the likelihood of thin client by public universities.

4.5.2.1 Technological Factors

Table 15: Model Summary with Technology factors

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.700[a]	.751	.706	.91220

a. Predictors: (Constant), Technological Context

Table 15 show that technological factors without considering any other variables contribute about 75% of the likelihood in thin client adoption by public universities in the Nairobi County.

4.5.2.2 Organizational Factors

Table 16: Model Summary with Organizational Factors

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.648[a]	.630	.625	.86555

a. Predictors: (Constant), Organizational_Context

Table 16 show that organizational factors without considering any other variables contribute about 63% of the likelihood in thin client adoption by public universities in the Nairobi County.

4.5.2.3 Environmental Factors

Table 17: Model Summary with Environmental Factors

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.518[a]	.561	.540	.88981

a. Predictors: (Constant), Environmental_Context

Table 17 show that environmental factors without considering any other variables contribute about 56% of the likelihood in thin client adoption by public universities in the Nairobi County.

4.5.2.4 Research and Development Role

Table 18: Model Summary with Research and Development Role

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.324[a]	.450	.447	.92668

a. Predictors: (Constant), Research_and_Development_Role

Table 18 show that Research and Development Role without considering any other variables contribute about 45% of the likelihood in thin client adoption by public universities in the Nairobi County.

Summary

The analysis of data collected provided insights of the aspects and factors that affect likelihood of Thin Client adoption by public sector varsity in Nairobi County. Further discussions, and recommendations are featured in chapter 5 of this project.

CHAPTER 5: CONCLUSION, RECOMMENDATION AND FURTHER WORKS

5.0 Introduction

This chapter summaries the conclusions made from the results and findings in the chapter 4. It further gives recommendations and further works that can be deduced from the study.

5.1 Research Objectives Achievements

The general motive of the research was to determine the aspects and factors that affect the adoption of thin client technology in public universities in the county of Nairobi.

5.1.1 Technological Factors

The first specific objective was to determine technological aspects that affect the take up and adoption of thin clients in public universities in the county of Nairobi. The analysis of the respondent's data showed that indeed technological factors influence the adoption of thin clients by public universities. This was affirmed by the positive moderate association between the likelihood of thin client adoption and the technological factors. Further, the regression model feedback showed that technological factors were statistically important and significant in predicting the adoption thin clients. The technological factors were in two categories, the internal and external technologies. The internal technological factors constituted of the presence technical ICT infrastructure, availability of competent and skilled ICT employees, and internet connection reliability. The external factor constituted the cloud service providers which in recent times are both affordable and accessible. The findings concur with Macharia & Pelser, (2014) who, in their research found that technological factors were key in determining likelihood of Thin Client adoption in public universities. However, a key drawback noted was on the availability of competent and skilled ICT employees. This was an issue as organizations

were reluctant to offer required training to their ICT employees for fear of losing them later to private sectors. Hence, the low rate of thin client adoption.

5.1.2 Organizational factors

The organizational factors were also analyzed to assess their influence of the adoption of thin client in public sector varsities in the county of Nairobi. The specific factors included the ICT policy on adoption on new technologies, User resistance to technology change, the level of innovativeness and top management support, the proportion of the organization and financial resources availability. From the analysis all the stated factors had significant influence on thin client adoption. The most emphasized factors included the top management support on innovativeness continuity, positive staff attitude towards use of thin clients, and ICT policy and strategy of migrating to use thin clients.

Based on Renatus, (2015) research on thin client's adoption, the organizations should reinforce the positive staff attitude toward adoptions of thin clients by encouraging awareness and comprehensive onsite tests. Sometimes it is the fear of the unknown that hinders the adoption of thin clients. Therefore, organizations should set their policies and strategy towards migration to thin clients use, and support innovations continuity.

5.1.3 Environmental factors

Further, this project also aimed at evaluating the environmental factors that affects the adoption of thin client public universities in county of Nairobi. The factors investigated included stakeholders pressure, market structure and technological industry competition, and government regulations. The results depicted that the Government of Kenya has a crucial role in constantly encouraging public institutions to adopt new trends in technology like thin clients. Also, other industry competitions like private institutions also affected adoption of thin clients by public universities to stay relevant in terms of technology trends.

5.1.4 Role of Research and Development

The researcher also investigated the Role of Research and Development on the likelihood of thin clients by public sector varsities in the county of Nairobi. The participants claimed that the role of research and development of new technologies before acquisition of the technology gives leverage for better decision making of the firm thus avoiding loophole or drawback that would be impacted in cost and withdrawals from the technology. Previous studies shows that alongside technological factors, Research and Development is a major contributing factor in organizations while settling for a particular technology whereby the whole team will be involved plus the factors therein. Financial resources and managerial approval also influence research and development of a new technology. Hence, public universities should use Research and Development as a tool to help while adopting a technology such as thin client technology.

5.2 Limitations of the research

Although, this project achieved its objectives, there were a number of limitations encountered. Some include inadequate resources to expand on the scope of research to other public universities in other counties in Kenya. This affected the generalization of the study results to all public universities from different counties in Kenya.

5.3 Research implication

The study will be of great benefit to users of information technology in public institutions requiring insights on factors influencing the adoption of thin clients. Also, the researchers conducting further research related to adoption of thin client.

5.4 Conclusion

The study's main objective was to evaluate the aspects factors influencing take up of thin client in public universities in the county of Nairobi. The findings have shown that the likelihood of thin client adoption by

public institutions is influenced by technological, organizational and environmental factors relating to the particular institution. Other factors included the benefits that come along with thin clients.

From the analysis resource was a key influence for instance finances to purchase thin client, and human resources in terms of skilled and qualified ICT personnel. Management support, willingness to acquire new technology and staff attitude towards technology changes also has an effect on not only new technologies but also thin client adoption. Government has a role in setting regulation to encourage adoption on new technology. Stakeholder's pressures and competition from other institutions also encouraged the public institutions to adopt new technologies like thin clients to enhance change with emerging technology trends. Lastly, the institution management focused on the advantages that come with new technologies like thin clients for them to adopt them.

5.4 Recommendation

This study recommends the adoption of thin clients due to their benefits in large institutions like public institutions. One of these benefits include cost reduction in software installations hardware deployment and management, administration and operating costs. Also, the high security level as data is maintained centrally, and ensured privacy levels.

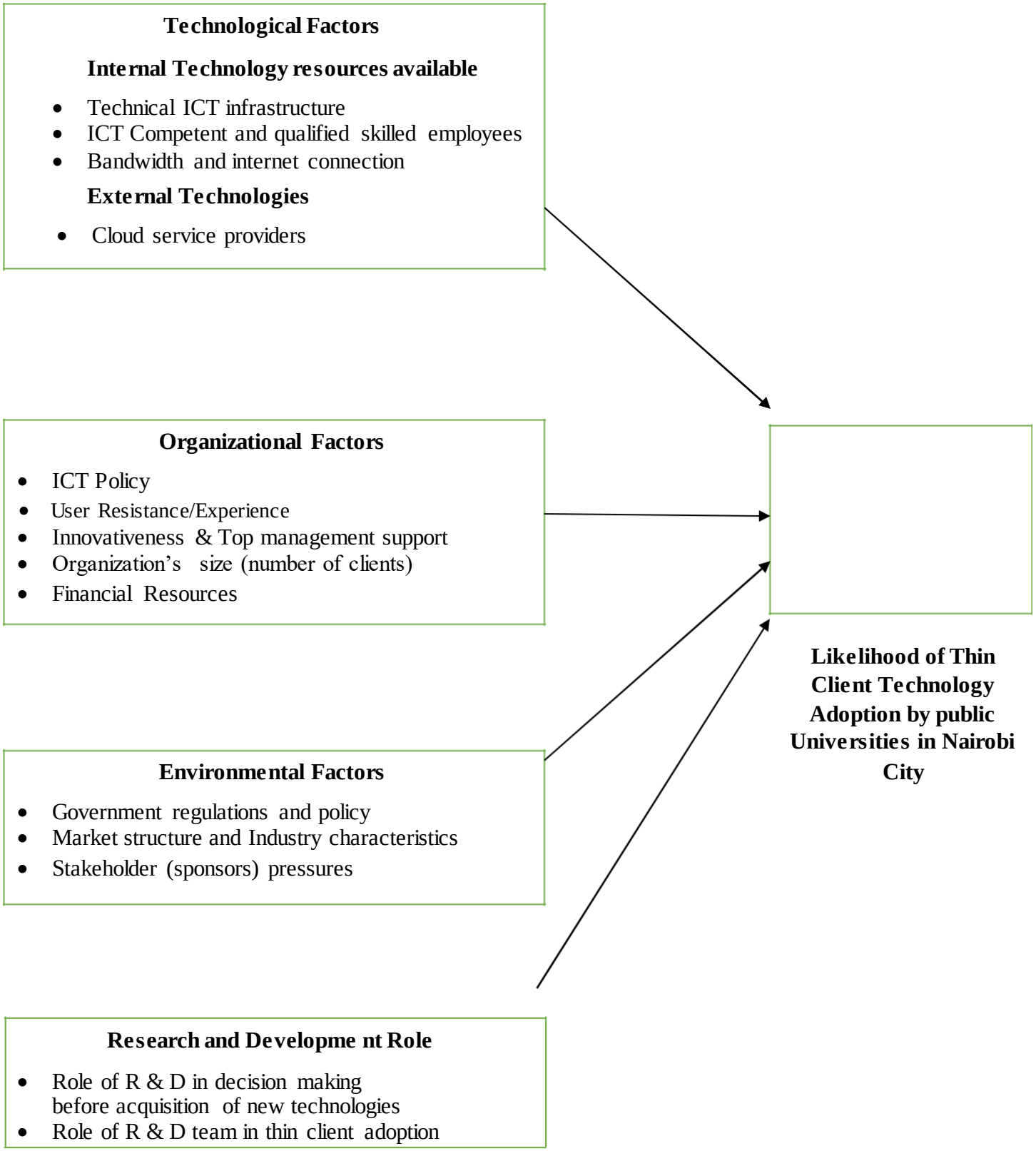
This study, therefore, recommends the following to facilitate the adoption of thin clients in public sector varsities in the county of Nairobi:

1. The institutions should continuously train their staff mainly ICT personnel to stay relevant with changing trends hence easing adoption on new technologies.
2. The public universities top management should be support, institution's innovativeness, by allowing comprehensive test pilots and increasing awareness on new technologies to encourage adaptability of employees.

3. The Government of Kenya has a crucial role in constantly encouraging public institutions to adopt new trends in technology like thin clients. This can be informing of subsidies and incentives to acquire new technologies.
4. The universities should fund research and development on adoption of new technologies and how their use contribute to growth of public university.

Furthermore this study recommends the following conceptual framework in figure 9 as a guide to adopting thin client adoption.

Figure 9 Recommended Conceptual Framework



5.5 Further works

In this study, the researcher focused on three major universities in Nairobi; The University of Nairobi, Kenyatta University, and Technical University of Kenya (TUK). Hence future researchers are encouraged to incorporate other major institutions in the other counties for generalization of results. Also, scholars can assess any distinguishing factors on thin client adoption between private and public universities. Future studies can also add qualitative analysis of thin client adoption by adding open ended question to enhance their study.

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APPENDICES

Appendix I: WORK PLAN

This is a representation of things that will occur procedurally in the project as progress implementation goes

Activity	Duration, 2019-2020											
Year and Months	Dec 2019, Jan 2019				Feb, March				April		May-Aug	
Weeks (Each box represents two weeks)	Wk 1,2	Wk 3,4	Wk 1,2	Wk 3,4	Wk 1,2	Wk 3,4	Wk 1,2	Wk 3,4	Wk 1,2	Wk 3,4	Wk 1,2	Wk 3,4
1. Preparatory work – (Topics search, concept paper writing)												
2. Presentation of concept paper for approval												
3. Literature Research and preparing for writing												
4. Writing Project Proposal												
5. Presentation of Proposal to Supervisor for correction												
6. Presentation of Proposal to panel												
7. Preparation of research tools (KII and Questionnaire)												
8. Data collection (Field Work)												
9. Data cleaning, processing and analysis												
10. Completing writing of the project												
11. Presenting Project for correction												
12. Correction and final presentation												

Appendix II: Research Budget

Activity	Total cost
Stationery	8,000
Typesetting	5,000
Photocopying	4,000
Data collection	50,000
Printing and photocopying services	10,000
Internet	10,000
Logistics and Communication	2,000
Data entry services	20,000
Binding services	1,000
Consultancy services	10,000
Contingency 10%	12,400
Total	**134,400**

Appendix III: Research Study Questionnaire

This questionnaire is designed to investigate Factors Affecting the adoption of thin client in public Universities in Nairobi Country in Kenya.

Kindly answer the questions by putting a tick in the appropriate box.

Section A: General Information

1. Employment Level

Student [ ]

Technical [ ]

Managerial [ ]

Administrative [ ]

2. Gender

Male [ ]

Female [ ]

3. Work Experience in Years

Less than 5 years [ ]

5-10 years [ ]

10-15 years [ ]

Above 15 years [ ]

4. Operational years

1-3 years [ ]
4-6 years [ ]

7-9 years [ ]

10-20 years [ ]

Over 20 years [ ]

Section B: Whether Technological factors affect the adoption of thin client in public Universities

Please indicate to what extent you agree or disagree that technological factor affects thin client Adoption in public Universities?

Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Public Universities have good ICT Technical infrastructure					
The institutions have trained, Competent and skilled ICT employees					

Internet connections and bandwidth in the public Universities can sustain adoption of thin client					
The cloud service providers are available and reliable.					

Section C: Whether organization factors affect the adoption of thin client in public Universities

Please indicate to what extent you agree or disagree that organization factor affects thin client Adoption in public Universities?

Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Public universities have provided ICT policy that guides technical and operational processes on the use and service pertaining organizational policy					
Staff have good user Experience and are not user resistant					
Public universities have a transparent resources and financial planning for the projects					

Public universities organizational sizes influence the adoption of thin client adoption					
The public universities top management are willing and supporting Institution's innovativeness					

Section D: Whether Environmental factors affect the adoption of thin client in public Universities

Please indicate to what extent you agree or disagree that environmental factor affects thin client adoption in public Universities?

Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Government regulation and policy are aimed at supportive of ICT.					
Market structure and technological industry competition positively impact adoption of thin client technology in universities					
Government regulation and policy are aimed at supporting of ICT adoption of new technologies					

Section E: Research and Development Role

Please indicate to what extent you agree or disagree that research and development role in the university affect adoption of thin client by the public universities?

Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Role of Research and development of new technologies and their use contribute to beter decision before acquisition of technology by public university					
Role of Research and development of the acrossboard team participation helps in influencing adoption of new / thin client Technology in enterprises.					

Section F: Likelihood of Thin Client Adoption

Please indicate to what extent you agree or disagree that the public university will adopt thin client in the near future?

Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The current existing Network layout and ICT Infrastructure drift/enhances likelihood of adoption of thin client technology in public universities to attain best results and service delivery					
Public Universities are likely to adopt thin client technology in the near future.					