

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
SCHOOL OF INFORMATION SCIENCES
DEPARTMENT OF INFORMATION SCIENCE

**Information System Innovation Adoption and Diffusion in Ethiopian
Higher Learning Institutions: The Case of Hawassa University**

**A Thesis Submitted to the School of Graduate Studies of Addis Ababa
University in Partial Fulfillment of the Requirements for
the Degree of Masters of Science in Information Science**

BY

NEBIYU GETAHUN

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Signature of Board of Examiner for Approval

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Acronyms Used

DoI – Diffusion of Innovation

HU – Hawassa University

ICT – Information and Communication Technology

ICTFA - Information and Communication Technology Facilities and Access

ICTP – Information and Communication Technology Policy

ICTU - Information and Communication Technology Use and Utilization

IS – Information System

LCD – Liquid Crystal Display

PAI – Perceived Attributes of Innovation

PLS – Partial Least Squares

PLSR – Partial Least Squared Regression

Abstract

This study has investigated the adoption and diffusion of IS by academic staff of Hawassa university by considering ICT use (for instructional and managerial purposes) as a major indicator. The research process made use of Roger's model of innovation diffusion as a core component for the proposed structural model, which was adapted from Usluel et al (2008), and that was checked using the Partial Least Square technique for its validity using SmartPLS 2.0 M3. It was found that the proposed model expressed 49 % of the variation in the utilization of the available IS infrastructure of the university and the overall model assessment was rated as moderate. The model has also shown that the perceived attributes of innovation has strong negative effect on the ICT use of the academic staff which strengthened the inefficiency of the model to show the adoption and diffusion of IS in different contexts. On the contrary, it was found that ICT facilities and access have strong direct positive impact on the use of ICT by the academic staff of the university.

Majority of the staff responded that they use ICT for searching information in the Internet about their course and as a means of communication considering the two dimensions of ICT use in higher learning institutions: instructional and managerial.

Key words: Diffusion of innovation, adoption, Higher education, ICT usage, Perceived attributes of innovation, Partial least squares

Chapter One

Introduction

1.1 Background

In the past few years, the penetration of information and communication technologies (ICT) has increased at an alarming rate which made ICT one of the most widespread technologies in all parts of the society. ICT technologies also become more prevalent in educational institutions in different forms at various educational levels which ranges from elementary schools up to universities (Zentel et al, 2004). It can also be inferred that almost there is no organization that is not impacted by communication technologies in one way or the other. According to Mohr (1987) as quoted by Swanson (1994), organizations of all kinds are being challenged by what has been termed as social sweep in which new, microelectronic information technology is spreading at an astounding rate to an amazing number of people, organizations, and applications.

Information communication technology (ICT) today has become a global issue as information plays a very vital role in any country's economic development. In recognition of this burning issue, the Ethiopian government has engaged in a full-fledged ICT capacity building program through out the country including ICT for education which paved the way for Ethiopian higher learning institutions the chance to acquire state of the art ICT technologies (MOE, 2005). The Ethiopian government has taken this decisive measure mainly because social and economic progress can be achieved through the build up of up to date and applicable knowledge, and higher education is the most powerful tool for the creation of that knowledge and hence the knowledge-based society. Recent researches on the implementation of ICTs in higher education institutions recommend the establishment of robust ICT infrastructure which is the most important factor for the development of knowledge-driven society. Tiene (2002) cited by Shaikh (2009), suggests in

his study that integration of ICT in the tertiary level education is very critical for social and economic progress of any country and if a country is planning for ICT integration in education, it should consider secondary and tertiary education levels first. The integration of different forms of ICT technologies in higher learning institutions is one of the major prerequisites for the occurrence of various information system innovations.

Information systems (IS) innovation may be broadly defined as innovation in the organizational application of digital computer and communications technologies for the main reason of facilitating day to day core activities of the organization so that its objectives can be successfully met. With respect to its scope IS innovation is fundamentally organizational whether it is analyzed from the vantage point of the entire organization, or from a lower level, that of one or more of the organization's adopting subunits, or even at the individual level among a subunit's secondary adopters (Swanson, 1994).

The IS innovation can happen in a given organization in different forms. According to Swanson (1994), there are certain criteria to group different IS innovations under their corresponding category. These criteria include new information technology (hardware and software) and new forms of human manpower and organization to apply the different innovations. Accordingly, the major types of IS innovation in general are IS administrative process innovation, IS technological process innovation, IS product and business administrative process innovation, IS product and business technological process innovation, IS product and business innovation and IS product and business integration innovation . Any of the aforementioned type of IS innovation can occur in any organization if the intended user of the innovation is willing to accept and apply the readily available innovation or in short if that user adopts the innovation. In relation to this concept Keengwe et al (2008) have stated in their research that to effectively use and utilize ICT in higher education environment the academic staff should be provided with effective ways that

support, motivate and equip them with the skills and abilities necessary to adopt the available ICT technologies in the university which significantly simplifies and speeds up the adoption of IS innovation. Further more, the researchers have recommended that Roger's diffusion of innovation model is appropriate to study ICT adoption and diffusion in higher education institutions as the model covers both the adoption and diffusion aspects of IS innovation.

The concept Diffusion is defined as the process by which an innovation is communicated and its existence is publicized through certain channels over time among the members of a social system that consists of the target adopters or users of the innovation (Rogers, 2003). This is the standard definition of diffusion in the field of innovation diffusion study (Tornatzky & Fleischer, 1990). Diffusion can also be explained as a model of change that focuses and bases its acceptance on individual decision making although the innovation is implemented to the entire organization. Simply stated, diffusion is concerned with the spread and adoption, or the rejection, of products, practices, programs, policies, or ideas that are assumed to be new. In the diffusion process, the key lever of change is the adoption of an innovation and the major components of the diffusion process are the innovation, the social system through which the innovation moves, the communication channels of that system, the time it takes for an innovation to spread through the social system, and the adoption of the innovation by the intended recipients. (Ashley, 2009). According to Roger (2003), the rate of adoption is partially strongly affected by the characteristics or attributes of the innovation as perceived by the adopter. The major characteristics of an innovation as identified by Roger (2003) are relative advantage, observability, trialability, complexity or ease of use and compatibility. Since innovation attributes refer to those broad characteristics of the innovation that influence the decision to adopt an innovation, educational innovations are likely to be positively diffused if the adopters perceive the innovation as having an advantage over other innovations, compatible with current practices,

not complex to use and able to assist the potential adopter in producing observable outcomes. This is something that can be examined before adoption decision is taken by any the would be adopter of an innovation (Rogers, 1995 as cited by Al-Mobaideen, 2009).

This research has made use of the innovation characteristics as depicted in the Roger's model of diffusion of innovation to study the IS innovation adoption and diffusion in Hawassa university with additional external variable called ICT policy (ICTP) which was believed to have considerable impact on the adoption and diffusion of IS innovation in the university.

1.2 Hawassa University (HU)

Hawassa university, formerly called Debub University, was established in April 2000 by combining those independent colleges which have been operational, namely, the Awassa College of Agriculture (ACA), Wondogenet College of Forestry , and Dilla College of Teachers Education and Health Sciences. Currently, the university consists of three campuses situated in the town of Hawassa: the Main Campus, Awassa College of Agriculture, and College of Health sciences, and out side Hawassa town the Wondogent college of Forestry; which all are geographically separated in a distance measured in kilometers. The university has acquired campus wide network that interconnected all the campuses in Hawassa town, and campus wide network at Wondogenet College of Forestry which is not connected to the other campuses . Fiber optic cable is used as a major backbone line forming the interconnection between major buildings within each campus and the campuses themselves. The network consists of all major standard network application services running on dedicated servers, namely, Web, FTP, Windows Active Directory, Mail, Samba File Sharing, Managed Antivirus, and Backup. The network is also connected to the Internet at a speed of 3 Mbps. The university's information and communication

(ICT) unit is responsible for managing and controlling of the network and other related issues of the university. The unit consists of the head, system administrator, mail and web administrators, and the technicians.

1.3 The University Activities

HU runs a wide range of academic, research and professional programs with an increasing number of undergraduate and graduate students. The courses range from Medicine and Health Sciences, Natural and Physical Sciences, Technology, Agriculture, Forestry and Natural Resource Management, to Law, Business, Economics, the Humanities and Arts.

In collaboration with national and international institutions, HU undertakes a range of research projects in the areas of Agriculture, Forestry, Food Sciences, Health, Education, Environment, Economics, Natural and Social Sciences. It has various libraries, classrooms, laboratories and workshops to run its programs. The different campuses of the university have computer centers equipped with facilities necessary to support teaching and research. The university also provides its staff and students access to the different ICT facilities such as the Internet/intranet, personal computer, LCD, Scanner, etc. According to the latest information obtained from the university during the execution of this research work, there were more than 20, 000 students who have pursued their education in different field of studies and programs, 950 academic staff and 1100 administrative staff in the university.

1.4 Statement of the Problem

Hawassa university has acquired and owns different ICT infrastructures through a variety of meanses such as project implementations, donations, government budget, etc. According to Riga (2006), the Ethiopian government has invested a significant amount of budget on the development and establishment of appropriate ICT technologies for its universities. Specifically, the government has spent its resources on the purchase of e-learning equipments such as computers, LCDs, Laptops, etc and the establishment of well designed and installed intra and inter campus computer network for each university with the provision of high speed broadband Internet.

Despite huge investments in the development of IS systems, Fitzgerald (1997) argues that the introduced IS innovations through the establishment of necessary digital communication technologies cannot be a guarantee for the adoption and diffusion of the introduced IS innovations. In other words, the introduction of IS innovation in an organization through various ways does not necessarily mean that the innovation is accepted and used. This is so because of different reasons that are identified in related to innovation adoption and diffusion. Previous studies have indicated that there are several organizational, behavioral and contingent factors that significantly contribute to the inhibition of adoption of such innovations (Prescott & Conger, 1995). There is still shortage of empirical research on information system (IS) innovations that addresses the issue under discussion and as a result practitioners and academics in the field know little about what mechanisms are effective and which factors influence IS innovations adoption and diffusion. Mustonen-Ollila & Lyytinen (2003) concluded in their research that failure to address the factors that play considerable role in the adoption and diffusion of innovation leads to wastage of investments and failed introduction of innovation that could not meet its set

objectives.

Once an IS innovation has been adopted it is wise to identify the way it is being diffused in the environment where it has been adopted as this is a major means of paving the way for the proper use and utilization of the adopted innovation. Gaining accurate information about how to increase the adoption of innovations is critical to all fields of study including the field of IS. In particular, this information very critical for the build up of knowledge that is highly germane in planning and creating appropriate, cost-effective, sustainable technology and training initiatives in less-developed nations like Ethiopia (Richardson, 2009).

Considering the resource and budget scarcity to invest in information system innovation adoption, the adopted information system innovation should be well utilized and meet its intended goals through proper diffusion. To do so the current status, characteristics and rate of information system innovation diffusion should be explored and dealt with accordingly. This reality is more decisive in low resource, human capital scarce, international donor dependent less-developed nations (Richardson, 2009).

Adopting information technology such as computer - based information systems in higher learning institutions requires careful investigation of how the institutions as organizations and as individuals go through the adoption process of information technology in order to ensure the support expected from the implementation of the technology which further implies that without which the IS innovation cannot meet its intended objectives (Aboelmaged, 2000). In addition, it is the proper usage of the available IS in higher learning institution that clearly indicated the adoption and diffusion of the innovations that are resulted from the acquire of different ICT technologies (Usluel et al, 2008).

As to the knowledge of the researcher, Hawassa university's major tasks such as those core activities related to the teaching and learning processes are not computerized which implies that

majority of its day to day business processes are performed manually. Besides, its information and communication infrastructure is being used mainly to provide the staff with Internet service and the local mail, web and file sharing servers are not serving the service they were meant for. On the contrary, the university's IS infrastructure was meant for facilitating those major activities of the university through the process of computerization, and still the system has great potential to do so. Therefore, for the proper diffusion of the adopted IS innovations the factors and determinants of the diffusion process should be identified in terms of the usage of the available IS infrastructure in the university, and suggestions should be forwarded to take appropriate measures to increase the utilization of the available information system infrastructure.

1.5 Justification

Hawassa university currently possesses an information system with the appropriate infrastructure that was acquired through purchase and installation with budget allocated by the Ethiopian government. Even if the infrastructure is now in business, as to the knowledge of the researcher, it is under utilized and is not being used, at least, for the purposes and objectives it was established. In addition, no known research has been conducted focusing on the utilization and use of the infrastructure in line with IS innovation adoption and diffusion. In general, the following points were major reasons to conduct the research:

- The information system infrastructure is being under utilized for long time without any intervention measure
- No research that can contribute towards the proper utilization of the available information system infrastructure has been done before
- Conducting research in the area of IS innovation adoption and diffusion plays important role in determining and taking the appropriate action to speed up the appropriate diffusion

process.

1.6 Objective

1.6.1 General Objective

The general objective of the study was to explore and investigate the general nature of Hawassa university IS innovation adoption and diffusion considering its academic staff ICT usage and utilization for two core activities in higher learning institutions (instructional and managerial) as indicator of the adoption and diffusion of IS innovation in the university.

1.6.2 Specific Objective

The following were specific objectives of the study:

- To assess the purpose of use of university's IS by the academic staff with their respective ICT use experience
- To explore the current IS innovation adoption and diffusion status of the university
- To explore and validate the use of Roger's DoI theory in the study of IS innovation adoption and diffusion in Ethiopian higher education institution context
- To investigate and identify the major determinants of the IS innovation adoption and diffusion
- To validate the proposed research model in relation to the study of IS innovation adoption and diffusion in Hawassa university context
- To suggest better way of IS innovation adoption and diffusion in Hawassa university context

1.7 Research Methodology

To explore and investigate the university's information system innovation adoption and diffusion processes Roger's DoI theory was used.

Case study research was adopted with judgment sampling technique to select the appropriate respondents from the population of Hawassa university academic staff was used in the study and the research group consisted of those academic staff in institutes that teach technology courses that are related to IS directly or indirectly and as a result acquired better IS infrastructure compared to other departments. These institutes are the institutes of informatics, institute of physical science and the institutes of technology. In addition, that academic staffs of college of agriculture, who are senior researchers, were also included in the study.

1.7.1 Sample Size

As one of the objectives of this research was to test and validate a structural model, the sample sizes required to test and validate such type of model used to determine the sample size. According to Chin & Newsted (1999) the sample size between 150 and 200 are needed to test and validate a structural model in general. Hence, for this research a total of 161 questionnaires were collected and used in the analysis.

1.7.2 Survey Instrument

A questionnaire was developed as a method of data collection from the identified respondents. The questionnaire was structured into five parts with closed end questions and options: part one has three questions regarding the demographic data of the respondent, part two has fourteen questions with respect to Roger's model of DoI that are related to the five attributes of innovation (relative advantage, compatibility, complexity or ease of use, observability and trialability) and

the external variable ICT policy, part three has two main question with five different options regarding the purpose of ICT use, part four contains three question with seven options related to ICT facilities and access and part five has only one question with six option concerning the duration of ICT use. Two hundred (200) questionnaires were distributed to the above mentioned respondents and totally one hundred and sixty one (161) of the total two hundred questionnaires were filled out and returned to the researcher.

1.7.3 Questionnaire Development

During the design of the items in the questionnaire, the questionnaire used by Usluel et al (2008) was considered and modifications have been made so that the questions could be as relevant as possible to the Hawassa university context. A seven level Likert scale; Strongly Disagree=1, Disagree=2, Slightly Disagree=3, Neutral=4, Slightly Agree=5, Agree=6, and Strongly Agree=7; was used to measure the items related to the major structural model variables (ICT policy (ICTP), ICT facilities and access (ICTFA) and Perceived attributes of innovation (PAI)).

1.7.4 Data Analysis

To statistically analyze the collected data SPSS version 15 was used as it was easily available and for the structural model test SmartPLS 2.0 M3 path analysis application was employed since this application was the only structural model test software the researcher has got and for its robustness and clear output generation that were easy to understand.

1.7.5 Reliability of the Instrument

To ensure the reliability of the developed questionnaire, pilot survey was conducted for twenty (20) of target individuals. Based on the collected data from the pilot study, internal consistency and reliability of the questionnaire was tested by calculating the Cronbach's alpha coefficient of

the instrument as the instrument made use of the seven Lickert scale. According to Krippanont (2007) citing Sekaran (2000) a Cronbach's alpha coefficient value greater than 0.6 is acceptable and greater than 0.7 is good in explaining the reliability of a scale. Hence, the overall Cronbach's alpha coefficient of the instrument was 0.86 and the researcher has found it to be acceptable.

Table 1 shows the Cronbach's alpha coefficient for individual constructs in the questionnaire.

Table 1. Cronbach's alpha coefficient for constructs in the instrument

Construct	Number of Item	Cronbach's Alpha
Relative Advantage	2	0.96
Compatibility	2	0.61
Complexity or Ease of Use	2	0.85
Observability	2	0.69
Trialability	2	0.86
ICT Policy	4	0.90

1.7.6 The Proposed Structural Research Model and Hypotheses

In this study, a research model, which was based on Roger's model of diffusion of innovation (DoI), was developed to explore the IS adoption and diffusion in Hawassa university. It consisted of external variable ICT policy (ICTP) and five perceived attributes of innovation: relative advantage, compatibility, complexity or ease of use, observability, and trialability. Several previous studies have shown that there are various external factors that influence the adoption of innovation in addition to those identified by Roger (Davis, 1989; Venkatesh & Davis, 2000 as cited by Usluel et al, 2008; Venkatesh et al. 2003). In this research ICT policy (ICTP) was

expected to be an external factor affecting the adoption and diffusion of IS in Hawassa university. Adapting the structural model, which was used and validated in a similar study carried out by Usluel et al (2008), this research has proposed a new structural model that could explain the IS adoption and diffusion in Hawassa university context. The proposed model has been tested and validated to be rated as moderate by showing 49 % of variation in ICT usage and utilization among the research participants. The proposed research model is shown in Figure 1.

According to the theoretical framework provided by Roger (2003), it would be logically possible to hypothesize on the relationship that could exist between Roger's model of diffusion of innovation which is constructed from the five perceived attributes of innovation. Roger's theory suggests that relative advantage, compatibility, observability and trialability have direct positive impact and complexity direct negative impact on the adoption and diffusion of innovation.

1.7.7 The ICT Policy

A policy is a public statement of an objective and the kind of instruments that will be used to achieve it (Gornitzka, 1999). Galloway & Mochrie, (2005) explained the importance of policy in relation to ICT as policy is advocated (and observed) for a number of ICT-related issues, including raising awareness of ICT, providing advice and support for ICT use, and supporting infrastructure development. Malcolm and Godwyll (n.d) have found out that the lack of coherent ICT policy has significantly impacted the proper adoption and diffusion of ICT in Ghanaian Schools. Accordingly, ICT policy was considered to be included as external variable that affects the adoption and diffusion of IS in Hawassa university context. To determine the major core variables that the ICT policy possesses and play considerable role in the adoption and diffusion of IS in universities, thorough investigation and study was conducted by taking four universities ICT policies (International Islamic University of Malaysia, University of Westminster, University of

Cape of Coast and University of Ghana) . In the course of study of those policies mentioned above, it was found that all the studied policies incorporated the following major areas and these areas are then believed to be the major constructs of an ICT policy at tertiary level. Hence, these constructs were used in the proposed model to study the IS innovation adoption and diffusion at Hawassa university. The constructs are provision of ICT facilities, provision of relevant ICT training, control and management of ICT infrastructure and services; and acquiring and utilizing relevant ICTs.

Another study that was conducted by Usluel et al (2008) concluded that academic staff of higher learning institutions such as Hawassa university should be supported both technically and educationally and the process should be institutionalized through the implementation of policies and strategies. This conclusion further implied that the existence and implementation of ICT policy in higher education institutions paves significantly important way for the proper adoption and diffusion of the institutions' available IS infrastructure by the academic staff. In addition, researches carried out focusing on the barriers to use ICT revealed that absence of working ICT policy to be significant determinant in the adoption and diffusion of ICT (Beggs, 200; Bussey et al, 2000; Lee, 2000; Braak 2001 as cited by Usluel et al (2008)).

On the basis of the above discussed points, which led to the adaptation of the structural model of Usluel et al (2008), the following hypothesis was proposed in relation to ICT policy (ICTP):

H1: ICT policy (ICTP) has a direct positive effect on the ICT facilities and access (ICTFA)

The following hypotheses were directly adopted from the Usluel et al (2008) for the very reason that the research was done in similar environment which is in higher learning institutions in Turkey. Therefore, the justifications and description given by the researchers also hold true for

this research work.

H2: ICT policy (ICTP) has a direct positive effect on the ICT use and utilization (ICTU)

H3: ICT facilities and access (ICTFA) have a direct positive effect on the perceived attributes of innovation (PAI)

H4: ICT facilities and access (ICTFA) have a direct positive effect on the ICT use and utilization (ICTU)

H5: Perceived attributes of innovation (PAI) have a direct positive effect on the ICT use and utilization (ICTU)

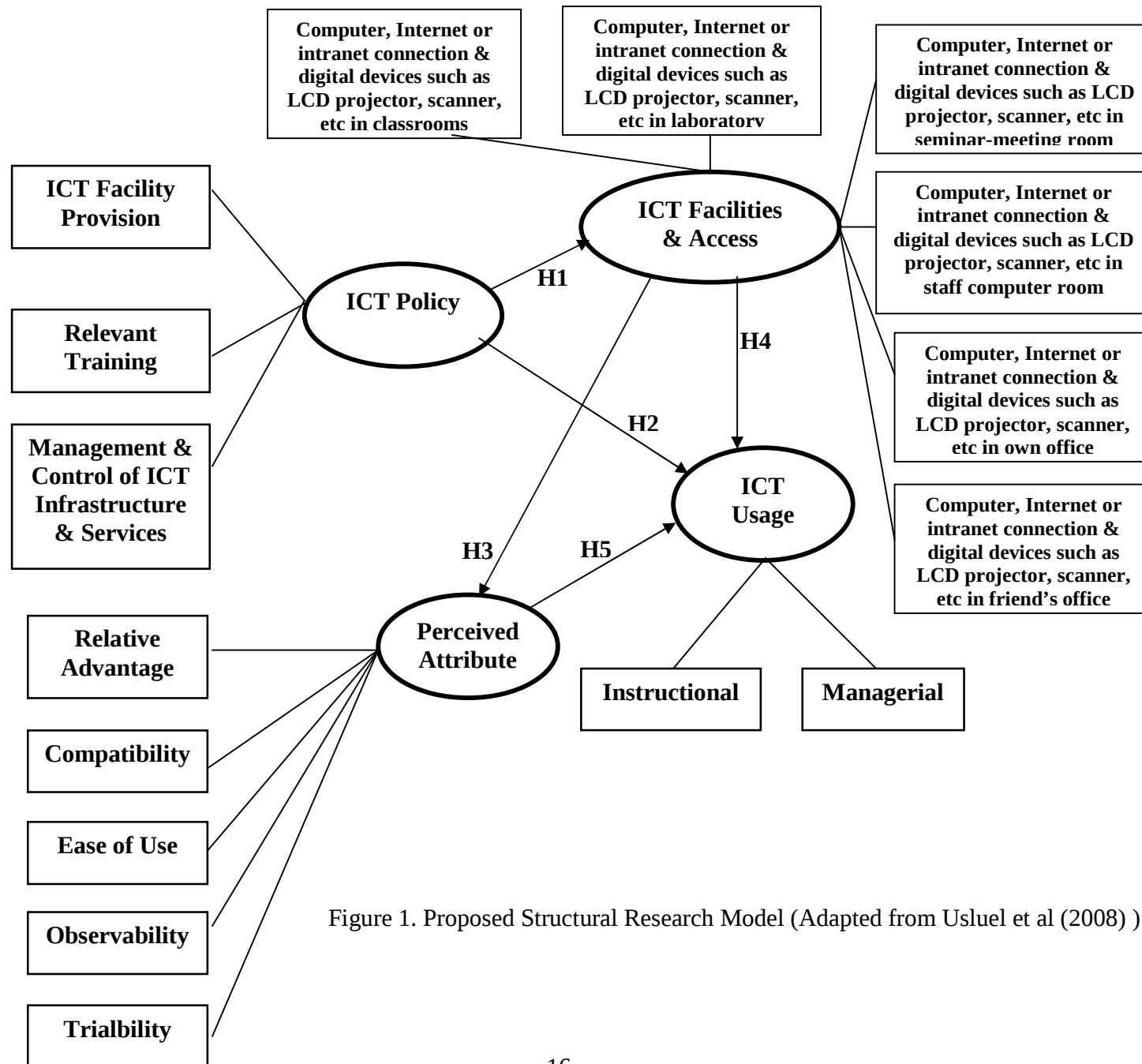


Figure 1. Proposed Structural Research Model (Adapted from Usluel et al (2008))

1.8 Scope and Limitation

The study was limited to the scope of studying the information system innovation adoption and diffusion processes in the context of Hawassa university working environment explained in terms of ICT use. Moreover, it was limited to only the domain of academic activities performed by the academic staff.

Budget and time were the major constraints of the study that contributed a lot to limit the study only to the study of IS innovation adoption and diffusion among the academic staff that were identified to teach and work around technology related to ICT in one way or another with respect to their use of ICT.

1.9 Significance

The study will have the following significance:

- It will clearly show the current status of the university's information system innovation adoption and diffusion
- It will identify the determinant factors accountable for the under utilization of the available information system of the university so that appropriate measure can be taken that guarantee significant improvement
- The research findings can also be applied and tested to the same institutions in the country in the same context
- It can serve as a spring board for further research in the same area

1.10 Strength and Weakness of the Research

The major strength of this research was that it has tried to check the relevance of Roger's model of diffusion in expressing the adoption and diffusion of IS in Ethiopian higher learning institutions particularly in Hawassa university context. In addition, it has proposed and validated a structural model and identified the important latent variables that could explain the determinant variables that played considerable role in affecting and prediction of the adoption and diffusion of IS in Hawassa university among its academic staff that were included in the research.

The weakness of this research would be the very slow rate of questionnaire return during the data collection time that contributed a lot to the reduction of the total number of questionnaire that was expected to be used in the data analysis. Further more, the serious difficulty in obtaining the relevant path analysis application software the researcher has encountered created a significant delay in starting the analysis process.

1.11 Organization of the Thesis

This thesis is organized in six chapters. Chapter 1 presents background of the study along with statement of the problem and its justification, research objectives, research methodology and hypotheses. In chapter 2, conceptual framework in relation to information system innovation, Roger's model of diffusion of innovation and review relevant literatures are summarized. Chapter 3 presents the statistical analysis of the collected data together with the result of the test of the structural model and test of the proposed hypotheses. Chapter 4 summarizes the major findings of the research with discussion. Chapter 5 presents the conclusions of the study based on the findings obtained and discussion made. Finally, Chapter six presents the recommendations forwarded based on the research findings and conclusions.

Chapter Two

Conceptual Framework and Literature Review

2.1 The Conceptual Framework

2.1.1 Information System (IS) as Technological Innovation

According to the definition of IS innovation given by Swanson (1994), the core of IS innovation is the digital technology in different forms. The different forms are the digital technology used as a stand-alone tool by individuals or the interconnected form of the different digital technologies. This concept leads to the concept of ICT, which consists of those digital devices such as computers, scanners, LCDs, etc. used for the capture, process, storage and communication purposes. ISs are technology-based innovations that are created and used by individuals, organizations, and societies. The popularity of the technological innovation approach in IS research testifies to its usefulness. Theories of innovation have been used to explain the adoption patterns of information technologies ranging from personal computers to business computing and inter-organizational systems such as electronic data interchange. It is fair to say that research on technological innovation, particularly on the adoption and diffusion of innovations, has become the dominant approach to adoption, implementation, and use issues in IS research (Allen, 2000).

2.1.2 Roger's Theory of Diffusion (DoI)

There is no single, unified, universally accepted theory of adoption and diffusion with the literature being made up of numerous, unrelated theories, each addressing a different aspect of the diffusion process or a different type of innovation or organization (Surry, 2002 as cited by Jones et al, 2003). Rogers' (1995) work forms the basis of most studies related to adoption and

diffusion, including this paper. This work grew out of work in rural sociology and in particular a 1943 study by Ryan and Gross at Iowa State University . Since that time over 3800 papers on diffusion theory have been published in a range of fields including education, marketing, anthropology, public health and rural sociology .

Diffusion is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system". An innovation is an idea, practice or object that is perceived as new by the individual. The diffusion theory framework involves four main elements: innovation, communication channels, time and the social system. Each of these elements influence the adoption or rejection of an innovation in a complicated, inter-dependent way (Rogers, 1995 as cited by Jones et al, 2003).

Four of Rogers' theories seem to be common elements of most diffusion theories including (Surry, 2002 as cited by Jones et al, 2003):

1. **Diffusion process.** Diffusion is a process that occurs over time and can be seen as having five distinct stages – knowledge, persuasion, decision, implementation, and confirmation.
2. **Adopter categories.** Members of a population vary greatly in their willingness to adopt a particular innovation. Individual characteristics can be used to divide the population into categories – innovators, early adopters, early majority, late majority, and laggards.
3. **Perceived Attributes.** How people perceive an innovation influences their adoption decision. Five perceived attributes of an innovation have been shown to have strong influence – trialability, observability, relative advantage, complexity, and compatibility.

4. **Rate of Adoption.** The relative speed with which an innovation is adopted by members of a social system. Innovations are diffused over time in a pattern that resembles an s-shaped curve.

In view of technological innovation theories, Roger's (1995) model appeared to be the most widely accepted model by researchers in identifying "perceived" critical characteristics for innovations in IS research and identified five characteristics of the innovation that influences its adoption: relative advantage, compatibility, complexity, trialability, and observability (Al Qirim, 2007).

Diffusion theory highlights five innovation characteristics that determine whether an innovation is appealing to the potential adopter (Rogers, 2003):

- **Relative advantage** is the extent to which the innovation is perceived to have significant advantages over current alternatives. Adoption is more prevalent when the innovation is considered superior to current practice.
- **Compatibility** refers to the degree to which the innovation is seen as being consistent with past practices, current values, and existing needs. Innovations that fit within the current context are more likely to be adopted.
- **Complexity** expresses the level at which the innovation can be readily understood and implemented. The more complex the innovation is, the less likely it is to be adopted.
- **Trialability** refers to the extent to which portions of the innovation can be tried out before full adoption. This allows potential adopters to have early exposure to the innovation and increases the likelihood of adoption.
- **Observability** of the innovation is the degree to which its use and benefits are visible to others. Adoption is more prevalent when the benefits of adoption are exposed.

According to Rogers (2003), the above listed and discussed items partially influence the rate of adoption of an innovation. Accordingly, the theory states that the relative advantage, compatibility, trialability, observability of an innovation, as perceived by members of a social system, are positively related to its rate of adoption and the complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption.

Diffusion theory emphasizes the important role of understanding the evaluand since characteristics of the evaluand can have a direct impact on its adoption (Ashley, 2009).

2.1.3 ICT Use and Utilization as Indicator of Adoption and Diffusion

The use and utilization of technology by the target user is considered as major indicator of that technology's adoption and diffusion within the given social system. Shaikh (2009) in his study strengthens this issue by stating that

“ ICT “usage & need” is highlighted because all the three parameters viz. adoption, acceptance and diffusion are covered under this umbrella. ”

Usluel et al. (2008) carried out study focusing on the adoption and diffusion of ICT in higher learning education in Turkey by considering the ICT usage as main indicator of adoption and diffusion. The researchers explained the ICT usage as indicator of adoption and diffusion in the following statements:

“ In this study, the concept ICT “usage” is preferred since it is believed that usage is an indicator of adoption, acceptance as well as diffusion. ”

Besides, the usage of ICT and the effect this usage is generating is a determinant factor of ICT diffusion. From the diffusion literature perspective, users can play an important role in diffusing a new technology (Noha, 2009).

2.1.3 The Structural Equation Modeling (SEM)

Structural equation models (SEMs), also called simultaneous equation models, are multivariate (i.e., multiequation) regression models. Unlike the more traditional multivariate linear model, however, the response variable in one regression equation in an SEM may appear as a predictor in another equation; indeed, variables in an SEM may influence one-another reciprocally, either directly or through other variables as intermediaries. These structural equations are meant to represent causal relationships among the variables in the model (Fox, 2002).

Gefen et al, n.d. , defines SEM as second generation data analysis technique that can be used to test the extent to which IS research meets recognized standards for high quality statistical analysis. That is to say, they test for statistical conclusion validity.

Contrary to first generation statistical tools such as regression, SEM enables researchers to answer a set of interrelated research questions in a

- single,
- systematic, and
- comprehensive analysis

by modeling the relationships among multiple independent and dependent constructs simultaneously .

In information systems (IS) research, the application of structural equation modeling (SEM) is widespread. Today, it has become a well-known technique (Henriksen & Pedersen, n.d.).

2.1.4 Partial Least Squares (PLS) or Partial Least Squared Regression (PLSR)

Partial Least Squared Regression (PLSR) or partial least squares (PLS) is the most widely used method of structural model analysis technique. This technique is an extension of multiple regression analysis in which the effects of linear combinations of several predictors on a response variable (or multiple response variables) are analyzed. Associations are established with latent factors extracted from predictor variables that maximize the explained variance in the dependent variables. These latent factors are defined as linear combinations constructed between predictor and response variables, such that the original multidimensionality is reduced to a lower number of orthogonal factors to detect the structure in the relationships between predictor variables and between these latent factors and the response variables. The extracted factors account for successively lower proportions of original variance (Hubert and Branden 2003, Tobias 2003, Maestre 2004 as cited by Carrascal et al., 2008). PLSR is especially useful when (1) the number of predictor variables is similar to or higher than the number of observations (i.e. overfitting) and/or (2) predictors are highly correlated (i.e. there is strong collinearity) (Carrascal et al. , 2008).

Partial least squares (PLS) or partial least squared regression (PLSR) is sometimes called "Projection to Latent Structures" because of its general strategy. The X variables (the predictors) are reduced to principal components, as are the Y variables (the dependents). The components of X are used to predict the scores on the Y components, and the predicted Y component scores are used to predict the actual values of the Y variables. In constructing the principal components of X, the PLS algorithm iteratively maximizes the strength of the relation of successive pairs of X and Y component scores by maximizing the covariance of each X-score with the Y variables

(Ringle et al., 2005).

Partial least squares (PLS) is a method for constructing predictive models when the factors are many and highly collinear. Note that the emphasis is on predicting the responses and not necessarily on trying to understand the underlying relationship between the variables. For example, PLS is not usually appropriate for screening out factors that have a negligible effect on the response. However, when prediction is the goal and there is no practical need to limit the number of measured factors, PLS can be a useful tool. PLS was developed in the 1960's by Herman Wold as an econometric technique, but some of its most avid proponents (including Wold's son Svante) are chemical engineers and chemometricians. In addition to spectrometric calibration as discussed above, PLS has been applied to monitoring and controlling industrial processes; a large process can easily have hundreds of controllable variables and dozens of outputs (Tobias, 1997).

2.2 Literature Review

Sandberg & Wahlberg, (n. d.), carried out a research on model of acceptance of ICT in small business in rural areas of Sweden using the Unified Technology Use and Acceptance model and stated that the model explained about 70 % of the ICT use and acceptance behavior in the areas which in turn implied the following conclusions:

- The perceived usefulness of the technology is crucial to the acceptance of the ICT technology. A problem is that the attitude to ICT is more reactive than proactive in many small businesses. The ICT is not seen as a strategic resource, and this hampers the ICT acceptance.

- The ICT acceptance in small business is hampered by a fundamental lack of usability. The use of the technology requires an initial learning process. This is a problem to the acceptance of the technology since time is a very scarce resource and learning takes time.
- The acceptance of the ICT technology is hampered by a lack of result demonstrability. This makes it difficult to convince small business managers that an investment in ICT is worth while – and worth investment. The efficiency gains of investing in and using the ICT is not clear to these managers. In addition to this, the acceptance of the ICT is hampered by the lack of IT infrastructure in rural area contexts. This lack of IT structure makes the use of the technology combined with annoyance and anxiety.

In another study, Richardson (2009) conducted a research to test the applicability of the theory of diffusion in explaining technology adoption in Cambodia. The findings of the current study indicate that the diffusion of innovations theory is an effective mechanism to understand how and why users choose to adopt a given ICT innovation. The likelihood of sustainability, spread, and replicability is increased by using this theory to plan and implement future ICT innovations.

Chiasson & Lovato (2001) conducted a research to identify factors that influence the formation of a user's perceptions and use of a database software. These researchers used the Roger's diffusion of innovation theory, the perceived characteristics of innovation, to interpret the user's perception of the software in use and found that all the major characteristics of the innovation, namely, observability, trialability, complexity, relative advantage and compatibility, did really impacted the use of the database software and its diffusion through time which confirmed their existence in technology adoption and diffusion. Usluel et al (2008) carried out ICT usage study based on the diffusion of innovation theory in developing and validating a model which included additional external variable within the framework of DoI using SEM technique - the ICT

Facility. In this research, the researchers have found out the underlying relationship between ICT facilities, perceived attributes, and ICT usage for higher education and provided further evidence of the appropriateness of DoI to measure the ICT usage in Higher Education .Besides, all the proposed hypotheses were also validated and implied that the attributes or characteristics of innovation defined in DoI have positive impact on the utilization of ICT in higher education context and the model supposes that the perceived attributes of ICT and ICT facilities in the universities predict the ICT use.

Azam (2007) has carried out a study that attempted to explore the effects of different factors influencing the adoption of Internet in Bangladesh Rogers model of Innovation Diffusion has been utilized as theoretical framework to measure the effects of the factors that account for adoption of the Internet, assuming the Internet as an innovation. A multiple regression analysis was computed to determine the attributes that affect the intention to adopt the Internet, where adoption intention is considered as the explained variable. The study has revealed that relative advantage, compatibility and complexity appeared to be significant among the five attributes of innovation, relative advantage, compatibility, complexity, trialability and observability that were considered as explanatory variables .

Specific to the tertiary level education system which is the university context, the researcher has found out that compatibility emerged as an important factor affecting the adoption of Internet by the academics and the compatibility issue is significant because it deals with their perception on the importance of Internet to various tasks performed by them at present and future, and relative advantage was also identified as an important factor in explaining Internet adoption in universities.

In another research that was conducted by Al-Gahtani (2003) to investigate the rate of adoption of computer technology in Saudi Arabia, it was found that as perceived by members of a social system, relative advantage, observability, trialability and compatibility of an innovation were positively associated with the rate of the adoption and only the perceived complexity of an innovation was negatively associated with the rate of adoption.

Olatokun and Igbinedion (2009) have conducted a research in Nigeria to investigate the adoption Automatic Teller Machine by in the country with the application of the theory of diffusion of innovation. This study tested the attributes of the theory empirically using Automatic Teller Machines (ATMs) as the target innovation and found out that the constructs Relative Advantage, Complexity, Compatibility, and Trialability were all found to have a significant impact on the attitude towards ATM, which in turn had a significant impact on the intention to use it. Relative Advantage and Compatibility had almost the same weight of impact on Attitude; while Observability had the highest impact on attitude. For better diffusion of ATMs, the study recommended that banks should ensure enhanced salience of ATM to customers' needs, greater compatibility of ATM to customers banking norms and lifestyle, less complex and easy to use system and opportunity for adopters to experiment with the system before using ATMs.

Askar et al (2006) have conducted a research to survey the impact of perceived attributes of innovation in using ICT for different task among high school teachers in Turkey. The tasks were categorized as teaching preparation, teaching delivery, and management and used Logistic stepwise regression analysis for the purpose of showing the association between the perceived attributes and use of ICT. The analysis showed that complexity or ease of use was found to be a common perceived innovation characteristic for teaching delivery, preparation and managerial tasks in schools. Another result of this survey lead one to conclude that observability is a perceived attribute in teaching delivery in some specific tasks performed during the class period

whereas relative advantage and compatibility are for teaching preparation tasks. This research also confirmed that the perceived attributes of innovation have clear impact on tasks that are different in the way ICT is used.

Chapter Three

Data Analysis

3.1 Demographic and Descriptive Statistics of the Respondents

From the total number of research respondents 19 (11.8%) were female and 142 (88.2%) were male academic staff of Hawassa university.

Table 2. Gender of Respondents

Gender	Frequency	Percent
Female	19	11.8
Male	142	88.2
Total	161	100

Among the academic staff participated in the research 43 (26.7%) were between 20 and 25 year of age range, 40 (24.8) in 26 to 30, 20 (12.4%) between 31 to 35, 17 (10.6%) between 36 to 40, 13 (8.1%) between 41 to 45, 14 (8.7 %) between 46 to 50, 12 (7.5 %) between 51 to 55 and 2 (1.2%) above 65 years of age. As the table clearly shows the age group 20 to 25 was the most populated group in the research.

Table 3. Age of Respondents

Age Range	Frequency	Percent
20 - 25	43	26.7
26 - 30	40	24.8
31 - 35	20	12.4
36 - 40	17	10.6
41 - 45	13	8.1
46 - 50	14	8.7
51 - 55	12	7.5
65+	2	1.2
Total	161	100

As table 4 shows 13 (8.1%) of the respondents were Associate Professor, 15 (9.3%) Assistant Professor, 68 (42.2 %) Lecturer, 16 (9.9 %) Assistant Lecturer, 26 (16.1 %) Graduate Assistant and 23 (14.3 %) Laboratory Assistant. Hence, the highest percentage of the respondents' were Lecturer at Hawassa university.

Table 4. Academic Position of Respondents

Academic Position	Frequency	Percent
Associate Professor	13	8.1
Assistant Professor	15	9.3
Lecturer	68	42.2
Assistant Lecturer	16	9.9
Graduate Asst.	26	16.1
Laboratory Assistant	23	14.3
Total	161	100

3.2 University Staff Access to ICT Facilities

The respondents' access to the ICT facilities was measured in terms of their access to computer system, Internet or intranet connection and to digital devices such as LCD projector, digital camera and video, scanner, etc. The analysis for the staffs' access to the ICT facilities was made based on each staff's selection among the proposed seven options in the questionnaire. Their response with respect to access to ICT facilities is summarized as follows.

3.2.1 Access to Computer System

Analysis made to determine the staff access to computer system based on individual proposed options in the questionnaire. As stated in table 5 most staff, 96 (59.6 %), have access to the computer system in their own office in the university.

Table 5. Respondents' Access to Computer System

I have access to Computer System:	Frequency	Percent
In classrooms	44	27.3
In Laboratory	63	39.1
In Seminar-meeting room	39	24.2
In staff computer room	51	31.7
In my own office	96	59.6
In my friend's office since I don't have computer at mine	43	26.7
I don't have any access at all	1	0.6
Total	161	100

In addition, staff computer access was analyzed based on multiple option selection to assess if they had access to computer system in more than one point in the university. Accordingly, it was found that 79 (49.06%) indicated that they have only one option to get access to computer system in the university, 53 (32.92%) two options, 15 (9.32%) three options, 5 (3.11%) four options, 6 (3.73%) five options and only 3 (1.86%) had six options.

3.4 Access to Internet or intranet Connection

As depicted in table 6 most of the respondents, 96 (59.6%), have access to Internet or intranet connection in their own office in the university. Moreover, to explore the availability of multiple access options to the staff to the Internet or intranet connection, analysis of the respondents' response based on their multiple selections of the proposed options in the questionnaire was carried out. The analysis found out that 51 (31.7 %) had only one option to get access to the

Internet or intranet connection, 49 (30.4 %) two different options, 20 (12.4 %) three options, 19 (11.8 %) four options, 11 (6.8 %) five options and 11 (6.8 %) got six different access options to the Internet or intranet connection in the university.

Table 6. Respondents' Access to Internet or intranet Connection in the University

I have access to Internet or intranet Connection:	Frequency	Percent
In classrooms	45	28
In Laboratory	71	44.1
In Seminar-meeting room	22	13.7
In staff computer room	62	38.5
In my own office	96	59.6
In my friend's office since I don't have computer at mine	36	22.4
I don't have any access at all	0	0
Total	161	100

3.5 Access to ICT Devices

Table 7 summarizes the analysis made based on single selection response to assess the staff access to ICT devices such as LCD projector, digital camera and video, scanner, etc.

Accordingly, majority of the staff, 46 (28.6%) have access to the ICT devices in the laboratory, 43 (27.7%) in classrooms, 42 (26.1%) in seminar or meeting room, 30 (18.6%) in their own office, 30 (18.6%) in their friend's office and 33 (20.5%) did not have any access at to the ICT devices.

Table 7. Respondents' Access to Digital Devices in the University

I have access to ICT devices such as LCD projector, digital camera and video, scanner, etc:	Frequency	Percent
In classrooms	43	26.7
In Laboratory	46	28.6
In Seminar-meeting room	42	26.1
In staff computer room	31	19.3
In my own office	30	18.6
In my friend's office since I don't have computer at mine	30	18.6
I don't have any access at all	33	20.5
Total	161	100

3.5.1 Multiple Response Analysis of Access to ICT Devices

To assess the availability of multiple different access to the ICT devices in the university, respondents' response analysis was made based on their multiple selection of the proposed options in the instrument. Hence, it was found that 76 (47.2 %) have only one access option to the ICT devices, 30 (18.6 %) two different access options, 23 (14.2 %) three different options, 21 (13 %) five different options and 11 (6.8 %) have six different access options to the ICT devices in the university.

3.6 ICT Usage Duration

As summarized in table 8 the longest duration of ICT usage was found to be eleven year and above. Accordingly, 26 (16.15 %) of the respondents indicated that their duration of ICT usage is less than one year, 35 (21.7%) between one and three year, 38 (23.6 %) between four and seven

year, 31 (19.3 %) between eight and eleven year and 31 (19.3 %) above eleven years of ICT usage.

Table 8. ICT Usage Duration of the Respondents

Range of Usage Duration	Frequency	Percent
Less than 1 year	26	16.15
1 - 3 years	35	21.7
4 - 7 years	38	23.6
8 - 11 years	31	19.3
11+ years	11	19.3
Total	161	100.0

3.7 Purpose of ICT Usage

The purpose of using ICT by the respondents was assessed in terms of the use of ICT for instructional and managerial purposes. Those activities considered to be instructional and managerial were listed for selection in the questionnaire and their analysis is showed in table 9.

Table 9. Purpose of ICT Use of the Respondents

Purpose of ICT Usage		Frequency	Percent
Instructional	Searching information in the Internet about the course	98	60.9
	Preparing the course and lecture notes	93	57.8
	Making presentations in the course	91	56.5
	Making use of ready-made software	69	42.9

	packages about the subject matter		
	Carrying out studies in the laboratories or workshops, and making experiments	69	42.9
Managerial	Publishing the lecture notes and the announcements (assignments, projects, etc) concerning the course on the WWW	69	42.9
	Preparing exam questions	71	44.1
	Statistical analysis of exam results	67	41.6
	Official correspondence	90	55.9
	As means of communication	87	54

3.7.1 Multiple Response Analysis of the Purpose of ICT Usage

Statistical analysis was also made for the multiple responses to the questions related to the instructional and managerial use of ICT by the respondents to determine whether ICT is used for more than one activity. With respect to instructional usage of ICT by the respondents, the analysis showed that 24 (14.9 %) used ICT only for one task related to instructional activities, 27 (16.8%) for two different activities, 34 (21.1 %) for three different activities, 34 (21.1 %)

for four different activities and 42 (26.1 %) for five different activities which are listed in the instrument. Regarding the managerial usage of ICT 34 (21.1 %) used ICT for only one activity related to managerial tasks, 32(19.9 %) for two different activities, 33 (20. 5%) for three different activities, 29 (18 %) for four different activities and 33 (20.5 %) for five distinct activities that are related to the managerial use of ICT.

3.8 Analysis of the Structural Model

A partial least squares modeling technique was used to test the model. The SmartPLS version 2.0.M3 program was employed for this purpose. To arrive at the model that is well fitted to the research data, the model run was repeatedly tested for quality of model fit statistically. The model testing results are shown in Figure 1. It was found that ICT policy, ICT facilities and access; and perceived attributes have direct impacts on the ICT usage of the academic staff of the university. According to the tested model, which contains the path coefficients for all connections, the latent variables ICT policy, ICT facilities and access; and the perceived attributes of innovation are accounted for the 49 % variation of the use of ICT among the university staff who was involved in this research.

The figure also shows that the paths from ICT policy to ICT use and ICT facility and access, perceived attributes to ICT use, from ICT facilities and access to perceived attributes and ICT use have the absolute regression value beta that indicates the existence of relationship which is one affects the other one.

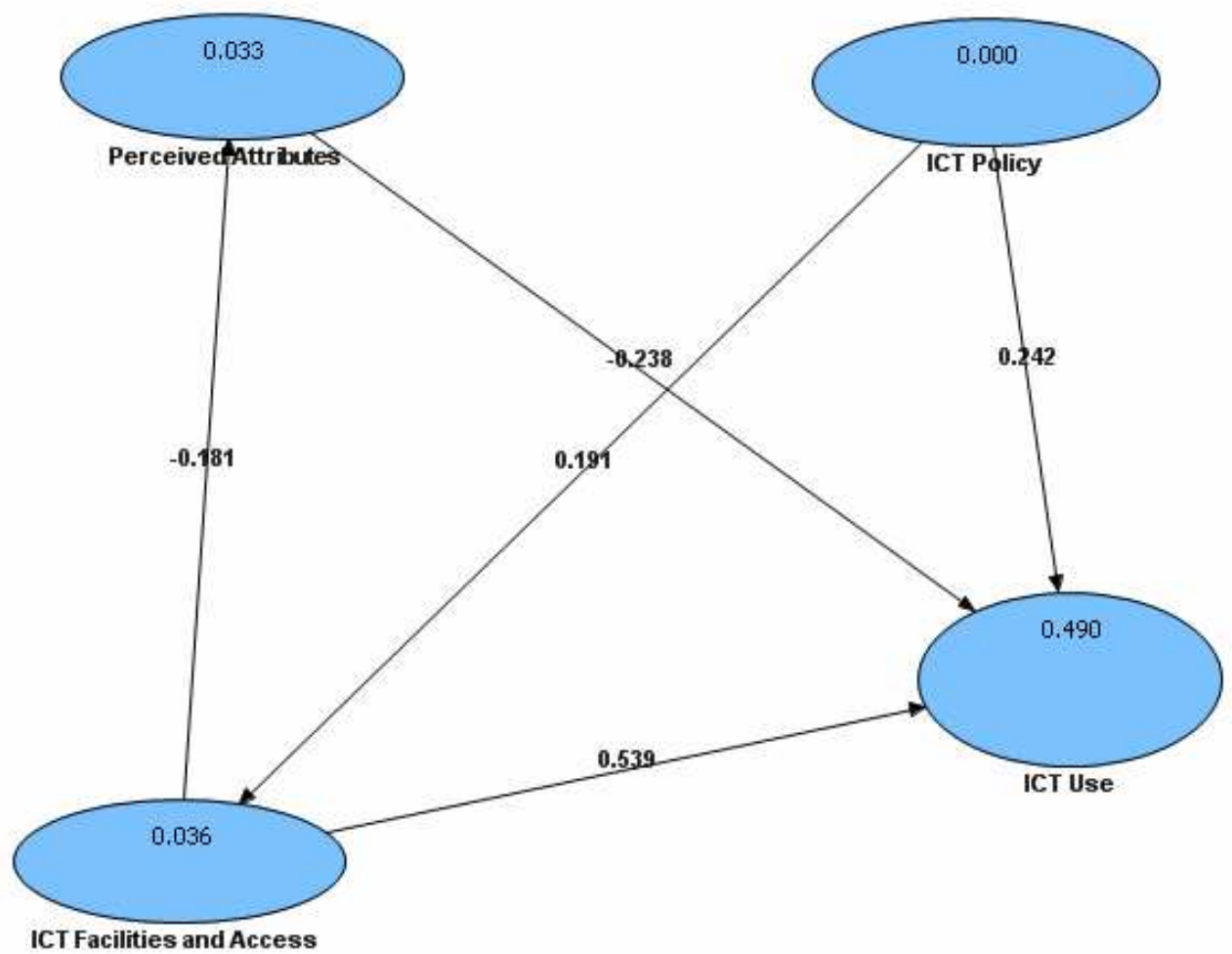
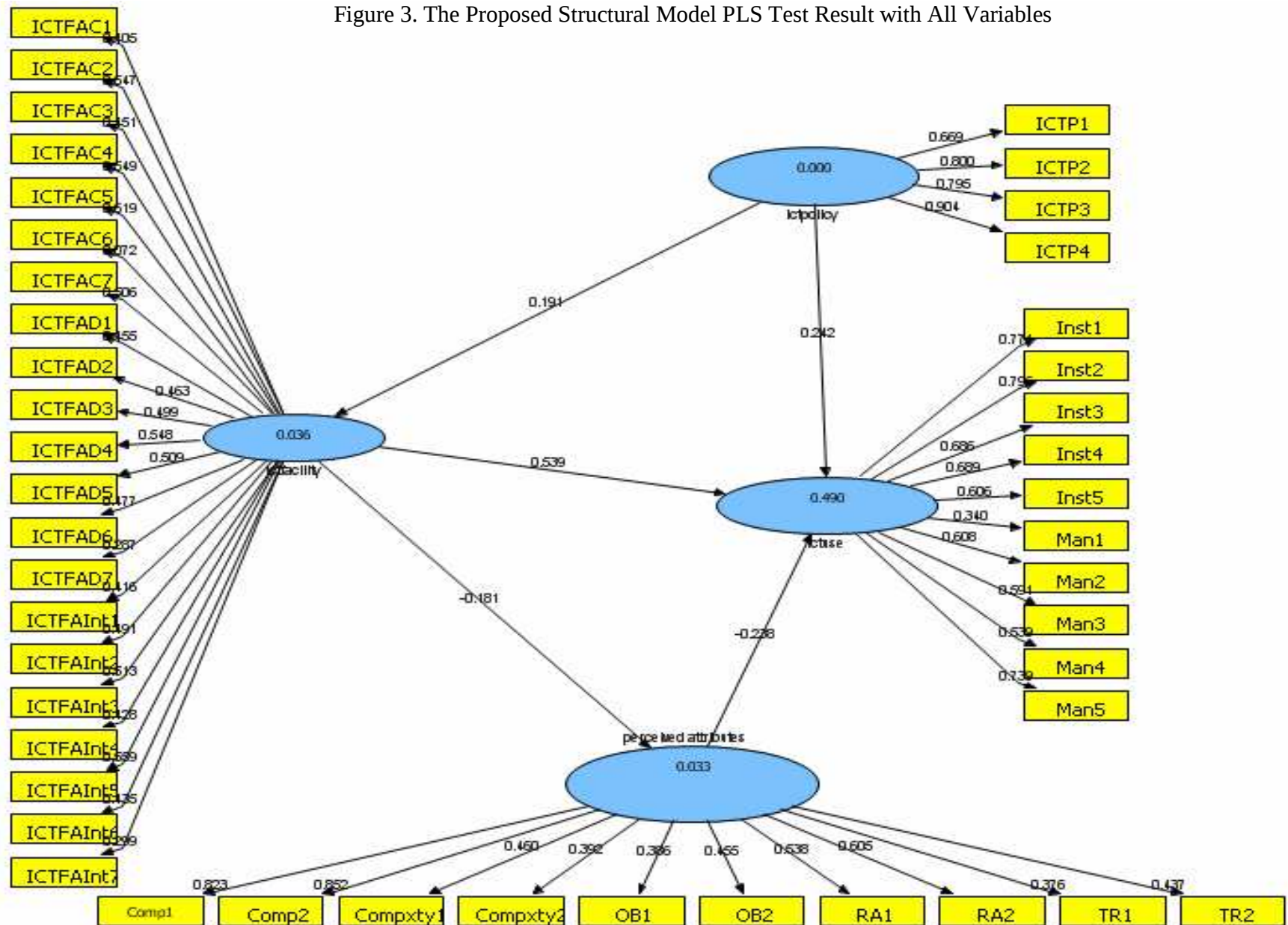


Figure 2. The SmartPLS 2.0 M3 test result of the proposed structural model

Figure 3. The Proposed Structural Model PLS Test Result with All Variables



3.8.1 Model Fit Criteria Test

The partial least squared technique of model test has different model fit standard or goodness of fit values and these values are summarized in the table below.

Table 10. The PLS model test goodness of model fit statistics

Latent Variables	AVE	Composite Reliability	R Square	Cronbach Alpha	Communality	Redundancy
ICT Policy	0.541980	0.744034		0.745593	0.154980	
ICT Use	0.614200	0.943129	0.336109	0.683454	0.146200	0.035581
Perceived Attributes	0.809258	0.710404	0.151668	0.724110	0.092857	0.012127

3.8.2 The PLS Model Test Standard Goodness of Fit Statistical Values

Based on the evaluation of the model test values and the standard goodness of fit statistical values the proposed model was accepted and validated as all the statistical values generated during the model testing process satisfied the standard goodness of fit values of PLS model test. As a result, the proposed model is found to be acceptable in explaining the relationship between those latent endogenous and exogenous variables.

Table 11. The PLS model test standard goodness of model fit statistical values

Statistics	Standard Values
AVE	Greater than 0.5
Composite Reliability	Greater than 0.6
R Square	Greater than 0.67, greater than 0.33, greater than 0.19
Cronbach Alpha	Greater or equal to 0.6

3.9 Hypotheses Testing

Hypotheses regarding the relationship between the latent variables that predict the IS innovation adoption and diffusion were made and their statistical tests are discussed below.

3.9.1 ICT Policy

It was hypothesized as hypotheses 1 and 2 that the ICTP has direct positive effect on the ICTFA and the ICTU. The PLS test of the structural model indicated that ICTP has direct positive impact on the ICTFA and ICTU with path regression coefficients of 0.191 and 0.242 respectively that supported hypotheses 1 and 2. Hence, hypotheses 1 and 2 were accepted.

3.9.2 ICT Facilities and Access

Hypothesis 3 stated that ICTFA has direct positive effect on PAI. However, the tested structural model indicated that ICTFA has direct negative impact on PAI with path coefficient of -0.181 which clearly implied that hypothesis 3 was not supported by the PLS model analysis and as a result rejected. On the contrary, it was found that ICTFA has direct positive impact on the ICTU with path coefficient of 0.539 which in turn supported hypothesis 4 that stated the direct positive effect of ICTFA on ICTU.

3.9.3 Perceived Attributes of Innovation

Hypothesis 5 of this research proposed that PAI has direct positive impact on ICTU. The structural model test revealed that PAI has direct negative effect on ICTU with regression path coefficient of -0.238 which has become enough reason for the rejection of hypothesis 5.

Chapter Four

Findings and Discussion

4.1 Findings

According to results obtained from the data analysis and the proposed structural model test, the following points were obtained as major findings of the study:

- The statistical analysis made on the demographic data of the respondents showed that majority of them, 98 (60.9%) and 93 (57.8%), use the university's IS for the specific purposes of searching information in the Internet about the course and preparing lecture and course notes respectively.
- One hundred and ten (69.3%) and 95 (59%) of the academic staff included in the research were found to be users of the university's IS for three and more different major tasks listed in the questionnaire in relation to instructional and managerial activities respectively.
- Majority of the respondents, 96 (59.6%), indicated that they have access to computer system and the Internet or intranet connection at their own office. In addition, 76 (47.2%) of the respondents replied that they have only one access point to the different digital devices in the university among the listed ones in the instrument.
- The ICT usage duration of the respondents found to be equal or more than four years for about 100 (62.2%) of the total respondents.
- The proposed model was validated using the PLS test technique and found to be acceptable in showing the different external and internal determinants of ICT use and utilization of Hawassa university academic staff.

- The Roger's model of diffusion, which is the perceived attributes of innovation, has been checked and confirmed for its power of showing the adoption and diffusion of IS innovation in Hawassa university context.
- The exogenous variable, ICTP, has been found to be influential and determinant in the process of IS innovation adoption and diffusion in Hawassa university environment.

4.2 Discussion

This research has found out that the academic staff of Hawassa university that were included in the research process have good basic ICT use experience with the required skill. This result is in line with the research finding that was conducted by Azam (2007) in trying to explore Internet adoption and usage in Bangladesh in which the research sample were all drawn from the country's universities. It is also possible to logically infer from this point that this is true because all academic staff in Hawassa university have gone through some kind of basic ICT training during their university study time as all are required to have at least diploma in related field to be employed in the university.

The purpose of ICT use and access to the computer system of academic staff of Hawassa university were as identified by similar study conducted by Usluel et al (2008) in Turkish higher learning institutions. It is implied that providing an academic staff with computer system at office with Internet access is one of the standards that must be met in any higher learning institution as this in turn motivates the academic staff to adopt and utilize the provided IS for tasks related to major academic activities of teaching and learning.

The study has investigated the underlying relationship among the external variable ICT policy (ICTP), ICT facilities and access (ICTFA), perceived attributes of innovation (PAI) and ICT usage and utilization (ICTU) in Hawassa university context. Empirically the underlying relationship was tested using structural modeling technique. In this test it was showed that the relationship between ICT facilities and access (ICTFA) and ICT use and utilization (ICTU) was direct, positive and strong the same as the finding of Usluel et al (2008). It further strengthened and justified the significant role that the provision of ICT facilities with enough access to them plays to really alleviate the academic staff problem of adopting and using the IS infrastructure in

higher learning institutions. However, the relationship between perceived attributes of innovation (PAI) and ICT use and utilization (ICTU) was found to be negative. The negative relationship supported the study of Roger's diffusion of innovation model in different contexts which concluded that the model may not be able to predict technology use across all contexts with differences in culture (Straub et al, 1997). Moreover, critics of innovation theory stated that almost all innovation theories and researches suffer from a pro innovation bias in that an innovation should be adopted and there is something wrong with those who adopt slowly and not at all, the innovation research is stuffed with studies of discrete influences on individual's decision to adopt neglecting other social and cultural influences and the existing models do not explicitly provide academic staff of higher learning institutions to explain the larger institutional context in which a technology innovation is introduced (Aboelmaged, 2000).

The empirically tested external variable, ICT policy, has showed its significant role that it plays in IS adoption and diffusion in Hawassa university environment. It further justified those researches that have identified the inadequacy of the variables stated by Roger's diffusion of innovation model in explaining individuals' difference in adopting and utilizing innovations (Beggs, 2000; Bussey et al, 2000; Lee, 2000; Braak 2001 as cited by Usluel et al 2008; Straub, 1997) which also implied the need of empirically testing other external variables assumed to be determinant in the process of IS adoption and diffusion in higher learning institutions in Ethiopian context.

Chapter Five

Conclusion

The above listed findings led the researcher to make the following conclusions regarding the IS adoption and innovation of Hawassa university academic staff.

- It was found that majority of the academic staff, (60.9% and 57.8%), of Hawassa university use the university's IS for the purpose of searching the Internet about their course and preparing lecture notes and course materials. This clearly implied that most academic staff use the university's IS for tasks related to the academic activities of the university which in turn implies that the university's available IS is being used and utilized for the intended major purpose, that is, assisting the academics. Besides, more than half of the respondents, (greater than 50%), were found to be users of the university's IS for different major activities listed in the questionnaire which is a good ground to conclude that Hawassa university academic staff are users of IS for multiple purposes other than those tasks related to academics.
- With respect to different access to the digital devices in the university, it was indicated that for nearly half of the staff, (47.2%), there is only one access point among the listed ones in the questionnaire. This justifies the conclusion that states access to digital devices such as LCD projector, Scanner, digital camera and video, etc is very limited and can be considered to be one of the major determinants of IS utilization in the university.
- The ICT usage duration of the academic staff, (62.2%), was found to be equal or more than four years and this clearly showed that the staff have good experience in using

ICT. This conclusion also indicates that majority of the staff have good technical knowledge of the university's available IS as to how to use for at least academic purposes.

- The Roger's model of innovation diffusion has clearly showed that it can be used to explore and assess the IS innovation and adoption in Ethiopian higher learning institutions context.
- The proposed and validated model has indicated that the exogenous factor, ICTP, has significant effect on the ICT utilization by Hawassa university academic staff. This fact can be used further to conclude that there will be other unidentified and untested exogenous factors that affect the IS utilization in Hawassa university context.
- Based on the standard statistical values for the PLS model test, the proposed model was tested and validated to be in line with the standard values. Therefore, the model has been rated as moderate model in explaining IS adoption and diffusion in terms of ICT use in Hawassa university with 49 % of R^2 .

Chapter Six

Recommendation

Based on the findings obtained and conclusions made the following recommendations are forwarded.

- The research has unveiled that most of the academic staff included in the research use the university's IS infrastructure for the purpose of searching information about their course in the Internet. This finding indicated that most staff rely on the Internet as a major source of information regarding their course which always requires connection to the Internet. But the university should make available additional offline information sources such as well organized and structured electronic information sources that include searching electronic information on compact discs, mirroring of some frequently used education sites, for example, the Massachusetts Institute of Technology's online resources, digitization of some important and frequently needed text and reference books in its library so that the electronic form can be accessed and used by the staff.
- One of the findings of this research was the highly limited access of digital devices such LCD projector, scanner, digital camera and video, etc. In connection with this, the university should take appropriate measure so that the access to these resources can be significantly improved and their utilization is increased.
- The research has confirmed that most of the academic staff of Hawassa university do not use the local web and mail server for at least tasks related to academics. Based on the close observation carried out by the researcher this is mainly due to the ignorance of the university's ICT office in making these resources ready for use by the academic staff. Therefore, concerned responsible body of the Hawassa university should take immediate

action to make use of these resources so that such resources can be used for the purpose intended.

- The proposed and tested model in this research, which expressed 49 % variation, should be used in related researches so that the model can be used to show the adoption and diffusion nature of Ethiopian higher learning institutions at national level.
- The Roger's model of diffusion with additional exogenous variable, ICTP, has showed that there will also be other exogenous variables that express the adoption and use of IS in Ethiopian higher learning institutions. Hence, further similar researches considering those exogenous factors should be conducted in order to arrive at the exact exogenous factors that are responsible for the adoption and diffusion of IS in Ethiopian higher learning institutions context. The topics of such research could be the following:
 - o IS innovation and adoption in governmental and private higher learning institutions in Ethiopia
 - o IS innovation and adoption in Ethiopian governmental institutions such as ministry offices
 - o Assessment of ICT infrastructure utilization in Ethiopian higher learning institutions with the help of diffusion of innovation model

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Annex

Dear Respondent:

I am MSc student in the department of Information Science, Faculty of Informatics, Addis Ababa University and staff of Hawassa University currently conducting a thesis research under the title *Information System Innovation Adoption and Diffusion in Ethiopian Higher Learning Institutions: The Case of Hawassa University*. This study requires that you complete a questionnaire survey below (5 pages) and I kindly request you to fill the questionnaire with at most care and honesty.

Your name and any of the information you provide will be kept strictly confidential and will not be attributed to the individual or organization. All responses will be stored in a secure environment. The results of this research would be used for academic purposes only. Your help would be greatly appreciated.

Thank you very much for your time and cooperation.

Part I

Demographic Data

1.1 Gender (Please, ✓ one)

Female ☐

Male ☐

1.2 Age (Please, ✓ one)

☐ 20-25

☐ 26-30

☐ 31-35

☐ 36-40

☐ 41-45

☐ 46-50

☐ 51-55

☐ 56-60

☐ 61-65

☐ 65+

1.3 Academic Position (Please, ✓ one) ☐ Professor ☐ Associate Professor

☐ Assistant Professor

☐ Lecturer

☐ Assistant Lecturer

☐ Graduate Assistant

☐ Laboratory Assistant

Part II

Perceived Attributes of ICT and ICT Policy Scale

Please, use the scales listed below (1 = Strongly Disagree to 7 = Strongly Agree) when answering the questions that follow by circling one of the options.

1= Strongly Disagree

3= Slightly Disagree

5= Slightly Agree

2= Quite Disagree

4= Neutral

6= Quite Agree

7= Strongly Agree

Relative Advantage	
2.1 ICT usage ensures that I carry out my task more rapidly	1 2 3 4 5 6 7
2.2 ICT usage facilitates the fulfillment of my tasks	1 2 3 4 5 6 7
Compatibility	
2.3 ICT usage is appropriate for my profession in all aspects	1 2 3 4 5 6 7
2.4 ICT usage is appropriate for my working style	1 2 3 4 5 6 7
Complexity/ease of use	
2.5 It is easy for me to learn to use ICT	1 2 3 4 5 6 7
2.6 It is easy for me to carry out my tasks by using ICT	1 2 3 4 5 6 7

Observability	
2.7 I see what my colleagues do by using ICT	1 2 3 4 5 6 7
2.8 I observe easily that others in the department use ICT	1 2 3 4 5 6 7
Trialability	
2.9 I can have access to and try ICT and other relevant applications	1 2 3 4 5 6 7
2.10 I had the opportunity to try out how I can make use of ICT in my profession	1 2 3 4 5 6 7
ICT Policy	
2.11 The ICT policy of the university plays decisive role in the provision of necessary ICT facilities in classrooms, offices, laboratory, etc	1 2 3 4 5 6 7
2.12 The ICT policy of the university plays decisive role in the provision of relevant ICT training to the academic staff which helps the utilization of the ICT infrastructure of the university	1 2 3 4 5 6 7
2.13 The ICT policy of the university plays decisive role in implementing rules and regulations as to how to control and manage the university's ICT infrastructure and services	1 2 3 4 5 6 7
2.14 The ICT policy of the university plays decisive role in paving a way to acquire and utilize relevant ICT in the university	1 2 3 4 5 6 7

Part III

Purpose of ICT Usage

3.1 I use ICT for

3.1.1 Instructional (Select (✓) all applicable)

- ☐ Searching information on the Internet about the course
- ☐ Preparing the course and lecture notes
- ☐ Making presentations in the course
- ☐ Making use of ready-made software packages about the subject matter
- ☐ Carrying out studies in laboratories or workshops, and making experiments

3.1.2 Managerial (Select (✓) all applicable)

- ☐ Publishing the lecture notes and the announcements (assignments, projects, etc) concerning the course on WWW
- ☐ Preparing exam questions
- ☐ Statistical analysis of exam results
- ☐ Official correspondence
- ☐ As a means of communication

Part IV

ICT Facilities and Access

4.1 Where do you have access to Computer in the university?

(Select (✓) all applicable)

- ☐ In classrooms
- ☐ In laboratory
- ☐ In seminar-meeting room

- ☐ In staff computer room
- ☐ In my own office
- ☐ In my friends' office since I don't have computer at mine
- ☐ I don't have any access at all

4.2 Where do you have access to the Internet/intranet connection in the university?
(Select (✓) all applicable)

- ☐ In classrooms
- ☐ In laboratory
- ☐ In seminar-meeting room
- ☐ In staff computer room
- ☐ In my own office
- ☐ In my friends' office since I don't have at mine
- ☐ I don't have any access at all

4.3 Where do you have access to the LCD Projector, Digital Camera and Video, Scanner, etc in the university? (Select (✓) all applicable)

- ☐ In classrooms
- ☐ In laboratory
- ☐ In seminar-meeting room
- ☐ In staff computer room
- ☐ In my own office
- ☐ In my friends' office since I don't have at mine
- ☐ I don't have any access at all

Part V

ICT Usage Duration

**5.1 How long since you have been using ICT for personal, organizational, etc purposes?
(Please, ✓ one).**

- ☐ **I do not use**
- ☐ **Less than 1 year**
- ☐ **1-3 years**
- ☐ **4-7 years**
- ☐ **8-11 years**
- ☐ **11+ years**

Thank You Very Much!!!