



JÖNKÖPING INTERNATIONAL
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E-learning management system for thesis process support from a supervisor perspective

The case of SciPro System at University of Rwanda

Master's thesis within Informatics, 30 credits

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Jönköping, May 2015

Master's Thesis in Informatics, 30 credits

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Date: 2015-05-26

Subject terms: E-learning management system, higher education, thesis supervision, collaborative learning

Abstract

With the emerging use of technological interventions in education, e-learning systems contribute immensely in educational delivery. However, with substantial efforts from the Rwandan Government, there were still claims about the lack of online support systems for thesis process in Rwandan higher education, which significantly affect the quality of research. Furthermore, previously implementations of e-learning systems at University of Rwanda have failed because of a low adoption rate. This study follows the introduction of the learning management system “SciPro” used for supporting supervisors and students in thesis writing. The purpose of the study was to understand the adoption of the SciPro System in support of thesis process for bachelor and master’s programs from a supervisor’s perspective at University of Rwanda (UR). An embedded case study was used as a research strategy. The Unified Theory of Acceptance and Use of Technology (UTAUT) was used as the theoretical frame of reference for the study. Data was collected from 42 workshop participants using a questionnaire. Moreover, convenient interviews and participant observations were conducted at 5 of the 6 colleges during and after system testing. A researcher realized that the current thesis process is still manual-based and there is no holistic computer-supported system for thesis related activities. Results from correlation analysis and regression analysis for the questionnaire showed that the facilitating conditions provided by UR were the key factor that would influence the adoption of SciPro positively. Effort expectancy perceived by supervisors proved to have a significant correlation to their Behavioral Intention to use the system. The study also revealed that there were other factors outside SciPro System, such as management support, Internet access, lack of a clear ICT policy and E-learning policy; and to motivate innovators and early adopters that should be considered throughout the implementation process to enhance adoption.

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I Introduction

This chapter introduces the topic and research area. The reader is provided with an introduction to E-learning systems integration in higher education from developing countries in general and Rwanda in particular. The problem is stated and the research purpose is presented. After that, the research questions to be addressed are presented. Finally, the study delimitation is discussed and foremost concurring concepts are defined.

Since the introduction of computers in everyday human life, there has been a dramatic change in the way activities are performed. The educational sector has not escaped this phenomenon. Through the use of Internet and related technologies, a wide range of e-learning systems has been developed. According to Alkhatabi, Neagu and Cullen (2010), this trend has improved the teaching and learning activities in higher learning institutions, especially in developed countries. Researchers such as (Hansson et al., 2009; Alexander, 2001) have elucidated the role of information and communication technology (ICT) to improve the quality of education. There are a number of factors that can contribute to successful implementation of computer-supported systems for teaching and learning. Among these factors, teachers and students' level of appreciation and positive attitude to a particular newly introduced IT-based system are one of the most significant (Alhomod & Shafi, 2013; Sela & Sivan, 2009). Once implemented successfully, ICTs are having a positive influence on how online educational activities in higher education, such as thesis supervision process, are performed. Once positively implemented, IT-systems increase the quality of final theses submitted by bachelor, master and doctoral students (Aghae & Hansson, 2013).

In a number of universities and colleges in developing countries, and particularly in Rwanda, there is still a recognizable lack of IT supported systems for teaching and learning activities (Sife, Lwoga & Sanga, 2007; Rubagiza, Were & Sutherland, 2011). Furthermore, e-learning systems have been implemented some years ago in higher education but a number of them failed to produce the expected technological results (Guri-Rosenblit, 2005). It is also claimed by the academic community and the rest of the Rwandan society that there is a poor quality of theses produced by bachelor and master's students. This is particularly serious as, according to the higher education policy, the country expects that research outcomes should improve people's lives. Reasons for the poor quality of students' research are hypothesized to be lack of easy access to resources for students and supervisors, scarce time for supervision, high supervisor-student ratio and a lack of anti-plagiarism systems (Hansson et al., 2009).

The government of Rwanda (GoR), through its Ministry of Education (MINEDUC) has shown a strong commitment in ensuring the quality of education and research by putting in place policies that support the integration of IT-systems in education, research and the overall management of educational activities (MINEDUC, 2008). In addition to that, in order to improve efficiency, the public higher education system has been restructured since 2014. Thus, all the former state universities have been merged into one university of Rwanda with six colleges operating in different former campuses (Rwanda Official Gazette, 2013). Now, the university management is concerned with making sure that there is a harmonized e-learning platform and online supported research supervision system integrated with an anti-plagiarism control system. This is also due to that there is an increasing num-

ber of statements from university teachers that students, writing their final year theses, do plagiarize too much. This is considered as breaking academic conduct although there is no clear policy stating how to handle this at universities.

From this perspective and with the aim to improve quality of education, different e-learning systems are implemented to support teachers, students and the rest of the academic community regardless of the education discipline (Sife et al., 2007; Graf & List, 2005). These IT-systems, once well implemented and understood by users can assist universities to achieve their educational visions and aims, provided that the top management and other stockholders show commitment in the whole process.

Regarding systems designed to support learning and teaching, Cohen and Nachmias (2011) stressed that although there is still a challenge to implement e-learning environments, a high number of communication and assessment systems are available to harmonize teaching and learning activities. Thus, various aspects of educational activities are being supported by ICTs to increase efficiency in education delivery. The degree of a particular artifact usage normally depends on the level of users' familiarity and how positive they are about it (Cowen, 2009, Davis, 1993; Jonscher, 1983). User's positive attitude and acceptance of an IT-system is an essential factor if the implementers' aim is to gain productivity in a shorter time and with less financial investment. From this viewpoint, universities should evaluate students and teachers' perceptions about the usefulness of a particular e-learning system before embarking on its full implementation. If this is the case, it will lead to the system acceptance, intimacy and adoption, that as result, lead to system usability, better work performance and university overall productivity (Tsakonas & Papatheodorou, 2008; Holden & Rada, 2011).

One of the types of technology enhanced learning enabled by today's technological developments is online supervision systems designed to help the academic community in producing quality theses at undergraduate and postgraduate levels and improving quality of research. Today, there are a number of computer-supported learning systems to improve learning and communication among teachers and students during thesis processes (Topping, 1998, Hiltz, 1986, & Hansson et al., 2010). The academic community from Stockholm University's Department of Computer and Systems Science, DSV (Hansson, Collin, Larsson & Wettergren, 2010) for example, has developed and implemented a system called "SciPro" to achieve benefits like collaborative learning, research information exchange with the rest of the society (industry, business, government and Non-Government Organizations) and improved quality of students' theses. This system improves access to thesis related online resources and other learning materials, and increase flexibility by allowing students and supervisors to communicate anytime at any place, thereby enabling self-paced and lifelong learning (Hansson et al., 2011).

As the thesis process is still problematic at university of Rwanda, there is an interest to implement SciPro in its new colleges with the aim of helping thesis research supervisors and students in different research activities in the overall thesis process. Another objective of this initiative is to improve the quality of student theses. The choice of SciPro System, as an innovative solution on thesis supervision process at university of Rwanda, has been made because of its features and functionalities that improve transparency and collaboration between students and teachers.

1.1 Problem area

Most higher learning institutions are recognizing a high increase in the number of students

registering for both undergraduate and graduate programs. In Rwanda, according to the National Institute of Statistics of Rwanda's statistical year book (NISR, 2014), the number of students in higher education has been radically increasing at a rate of 58.76% from 19828 in 2008 to 33743 in 2013. This increase is not in line with the increase of qualified academic staffs. Because it is compulsory for students to write a thesis in most of the programs offered by the public university, supervisors are overloaded with a high number of final year students. Thus, communication and meetings with students during the thesis process become very challenging, as there is no proper online collaborative support system. Additionally, because of the high student-supervisor ratio, supervisors are not able to guide and check the manuscripts submitted by students. This in turn, results in of more plagiarized works and an overall poor thesis quality.

Previous systems implemented at University of Rwanda to support e-learning activities have failed because the rate of underuse or nonuse was very high. In brief, users did not use these e-learning platforms as intended by the university management. A recent example was the Educational Business Management Information System (EBMIS). This system was implemented for educational management in 2012 in the former National University of Rwanda. The economic commission of the Rwandan Parliament argues that, with the big amount invested in the project, the EBMIS is not effective as intended. Another case is the E-learning platform "elearn@UR" which was built on Moodle software. The level of usage of this open source system is still very low. Therefore, there are still large efforts to improve system awareness by the new University of Rwanda. There is also a plan for improvement and redesign of its features and continuous encouragement to use it.

To avoid that the same thing happens to the SciPro implementation, the university has opted on introducing this system to future key users so that they can try its usability and added value in improving supervision and production of theses. This process can be an opportunity to include the academic community who will use SciPro in the future. It also an opportunity to adapt the system to the current thesis process at the university of Rwanda. The process of pretesting SciPro before implementation can gain inspiration from the social cognitive theory (Bandura, 1986). This theoretical stand aims to analyze human behavior by attempting to predict human action that later develop an understanding of changes to a particular environment. Therefore, as a new learning management system SciPro environment is being introduced in a social structure such as the University of Rwanda and supervisors may have different actions and develop distinct considerations towards a new system introduced to them. Because SciPro is not a panacea, but instead a means to an end, it has to fit in the institutional context and current supervision process. This means that the way it is configured and designed for the Stockholm University doesn't guarantee its success at University of Rwanda. That is the reason it should be redesigned to ensure its most efficiency and effectiveness in order to meet the identified pedagogical needs from teacher and student perspectives.

The pretest and awareness of IT-systems to users is appreciated as an important strategy to meet user needs and institutional goals. The good starting point for an e-learning platform such as SciPro should consider both users and organizational issues. Hence, it is from the requirement analysis and test phases that the users create an intimacy and start to adopt a system. But this of course depends on if they find it useful and effortless to use. Research by Hardrave and Johnson (2003), Schewe (1976), Venkatesh, Morris, Sykes and Ackerman (2004), Chau (2001) and Kacmar, Fiorito and Carey (2009) state that, in order to avoid rejection of new introduced IT systems, it is advisable to strategize by anticipating user ac-

ceptance of an artifact before full implementation and usage. Thus, the user experience approach is important in order to avoid a high rate of reluctance and resistance from the users. From the university perspective, Jan and Conteras (2011) state that there is a high need to identify variables that influence information technology acceptance and adoption by employees. It is argued that the University of Rwanda (UR) and DSV opted for this strategic approach for SciPro implementation process at the UR colleges. However, it is still unknown whether its resources are needed or can be appreciated by the academic community of the University of Rwanda.

Several researchers have evaluated the usefulness of technology platforms in improving teaching and learning in higher education, (Park, 2009; Farahat, 2012; Keller & Cernerud, 2002; Yuen, Fox, Sun & Deng, 2009). Others such as Hallberg, Hansson, Moberg and Hewagamage (2011) and Hansson, Collin, Larsson and Wettergren (2010) have been empirically focusing on the SciPro system and the improvement of thesis supervision. However, no one has attempted to investigate the system from the user-supervisor perspective. In addition, the above-mentioned studies focused on existing settled education systems with no emphasis on a particular new restructured education institution. University of Rwanda has recently merged former government universities into colleges. This means that there is lack of knowledge on employee's acceptance and perceptions of a new introduced IT system in a new university setting from a developing country context.

1.2 Purpose

The purpose of this study is to understand the adoption of SciPro System in support of thesis process for bachelor and master's programs at University of Rwanda from the supervisor perspective. This purpose is achieved by exploring the current thesis process before the introduction of SciPro system; measuring the degree of behavior intention and use behavior towards the system and identify factors that positively influence the supervisors' acceptance and use of SciPro at University of Rwanda. Furthermore, the study concludes by pinpointing some aspects that may be considered for successful implementation of the SciPro System in the current university setting.

1.3 Research question

For the study to achieve its purpose, the following research questions were formulated:

- What is the current state of thesis process and supervision at University of Rwanda?
- To what extent do supervisors intend to use SciPro System?
- What factors can positively influence the acceptance and use of SciPro System in thesis process at University of Rwanda?
- What may be considered to ensure a successful implementation of SciPro System at University of Rwanda?

I.4 Delimitations

The main focus is on the SciPro System, which is used in supervising final year students when writing their thesis in undergraduate and graduate education. As a result, so-called learning management systems providing support for other types of teaching and learning activities are excluded from the study. The study is also geographically delimited to University of Rwanda. The study focuses on the perspective of the supervisors, not the students.

I.5 Definitions

In this section, definitions of basic concepts used in this thesis are given.

- **E-learning system:** This concept is defined as an integrated use of new multimedia and internet technologies to increase access to education and improve the quality of learning through a facilitated resources sharing and services within a remotely improved collaboration in a virtual environment. (Alkhttabi et al., 2011)
- **Thesis:** In the academic field, this concept is understood as a written report prepared and submitted by students for the completion of an academic degree. It encompasses the author's research and related findings for a particular subject. In some universities or research institutions, a thesis is used for bachelor or master's degree programs while for doctoral programs; the term "dissertation" is used. According to Rudestam and Newton (2014), dissertations are broader than theses in terms of research questions and the scope of research findings. A completed thesis is submitted for examination and grading.
- **Thesis supervision:** This is the process of providing possible guidance to junior researchers writing in their final year academic program (Magill & Frank, 1974). As a component of academic and research work, a thesis is always undertaken under the guidance of a senior person in the field of investigation (Rudestam & Newton, 2014).
- **Online thesis supervision:** With the introduction of ICT in education, the activities included in the supervision of theses can be also supported by a specific technology platform. Thus, this can be defined as a process whereby collaboration, peer review, sharing of thesis information and resources between an author and a supervisor are done via computer-supported systems or a regulated communication channel (Hansson, 2012).
- **Supervisor:** Though used in different domains, in the academic area, the concept describes a person who is in charge of coordinating and monitoring students or other junior research activities by providing practical guidance and potential resources. According to Aghaee and Hansson (2013), a student can be assigned a principal supervisor and a co-supervisor. The first one has the primary responsibility of the student thesis and the second may come with divergent relevant areas of expertise to the main supervisor.
- **Author:** This is defined as a person who originated something and owns the responsibility of what was created (Magill & Frank, 1974). In terms of writing, an au-

thor is someone who is the originator of any written work such as a thesis or a news magazine. For the academic purposes, students writing and undertaking their research projects for the academic degree or a professional qualification are considered as thesis authors.

- **Collaborative online learning:** This is defined as participatory network based learning where the academic community interact and collaborate via a specific learning platform (Fung, 2004; So & Brush, 2008). This type of learning supported by technology is based on constructivist theory (Jonassen, Davidson, Collins, Campbell & Haag, 1995, Thorpe, 2002, Tam, 2000 & Richardson, 2005). With online collaborative learning, knowledge is socially built within communities through a network-mediated interaction between students and teachers or authors and supervisors. In the thesis process, there is an increased need to use Internet and World Wide Web to enable a high level of interaction among students on one hand, and between supervisors and authors on the other hand. This innovation initiative, once well implemented, improves quality of theses as students are given more information, online resources and support from their supervisors and peers (Hansson, Collin, Larsson & Wettergren, 2010).
- **SciPro System:** The abbreviated word “SciPro” means the “Scientific Process” (Hansson, 2011). This is an online system developed at Department of Computer and Systems Sciences (DSV) from Stockholm University that supports the thesis course process by enabling collaboration and sharing of information and resources among students, supervisors and other stakeholders interested in research activities.
- **System relevance:** This is defined as system pertinence and is measured by the extent to which the system is capable to meet user’s needs and requirements to accomplish the tasks it was designed to perform (Adams, Nelson & Todd, 1992; Davis, 1993; Greisdorf, 2003; Tsakonas & Papatheodorou, 2008). Relevance also reflects the user’s perception and knowledge about the system, which in turn defines the degree to which it is useful in adding cognitive value to the business process it intends to support. In the academic sector, an online learning management system is claimed to be relevant when learners, teachers and other stakeholders perceive it pertinent to the process of teaching and learning activities in a particular setting. Hartman (2006) and Xie (2006) attribute the system relevance to the degree of usefulness in providing the right services to the users.

2 Methodology

This chapter discusses the research strategy, together with methods and techniques used for data collection. The data sources, the data analysis process and related ethical issues are also presented. Finally, aspects of research credibility are discussed.

The main research question of this study is a question beginning with “what” and it needs to be answered by empirical data. This means that there is a requirement to collect and analyze data and come up with quantitative and qualitative information that may help in answering the research question. Hence, this research requires the use of a systematic approach. A theoretical foundation is presented in the following section to understand how methods have been selected and applied in this study.

2.1 Research Strategy

A research strategy must be chosen wisely as it is crucial to answer the research question. Johanneson and Perjons (2012) describe a research strategy as an overall methodological approach adopted by a researcher in order to set up the framework that will guide the whole research process. A research strategy determines which data generation and analysis method to adopt for the research. There are different types of research strategies (Johanneson & Perjons, 2012, Yin, 2003 & Creswell, 2007). The taxonomy of Denscombe (2010), for example, presents six research strategies: surveys, case studies, ethnography, action research, grounded theory and experiments.

For the research purpose and the research questions of this study, the case study strategy has been chosen. The case study strategy is more appropriate when a phenomenon under investigation is new and there is a lack of enough previous research about the topic. According to Yin (2003), a case study enables a researcher to develop an in-depth understanding and comprehend deeply the interaction between the real phenomenon and the case. In addition, the case study strategy is also suitable for educational technology research domain (Randolph, 2008).

They are four types of case studies (Yin, 1994): single-case (holistic), single-case (embedded), multiple-case (holistic) and multiple-case (embedded). A research study can use a single case or a multi-case study (Randolph, 2008). The choice is based on what type of research question to address.

Choosing a single-case study is appropriate when the case enables to test a theory, when it is extreme and has a uniqueness character, when it is representative and typical or when it can be investigated on a longitudinal approach.

A case study can also include more than one case. This is called multiple-case designs where a study is undertaken in two or more entities that have similar phenomena or research interests under investigation. In educational technology research, a researcher may be interested in evaluating an e-learning system that is being implemented in different universities in its different schools at the same time. As for the single-case study design, multiple-case studies also can be holistic (when one sub-unit from each of more organizations

are investigated) or embedded (when different sub-units from different organizations are investigated). Figure 2-1 illustrates the four types of case study designs.

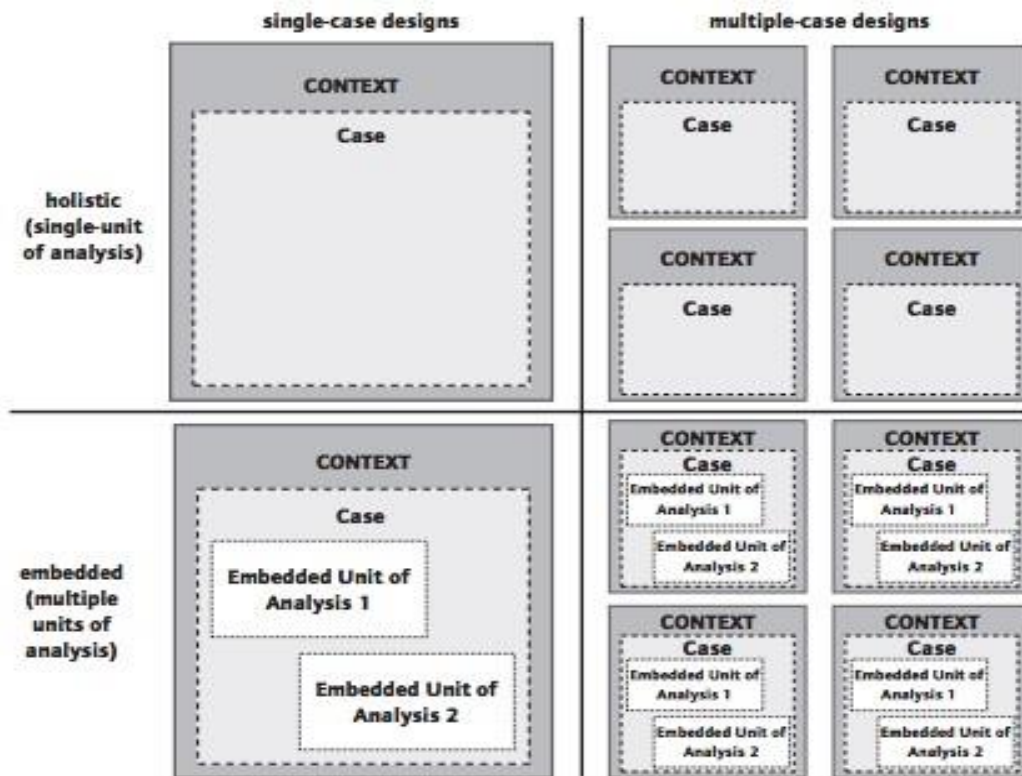


Figure 2-1 Basic Types of Design for Case Studies, (Yin, 2003)

In this study, the case is the implementation of SciPro at University of Rwanda (UR) and the units of analysis are the different colleges of UR. The research context is the Rwandan public university system, which is composed of all former state universities that have been merged to form one single public university with six colleges.

Within this research framework, an embedded case study approach is adopted. The SciPro System is being integrated in different colleges of the university and different perceptions from participants in the integration process will be explored. The figure below summarizes the case study, its context, and units of analysis.

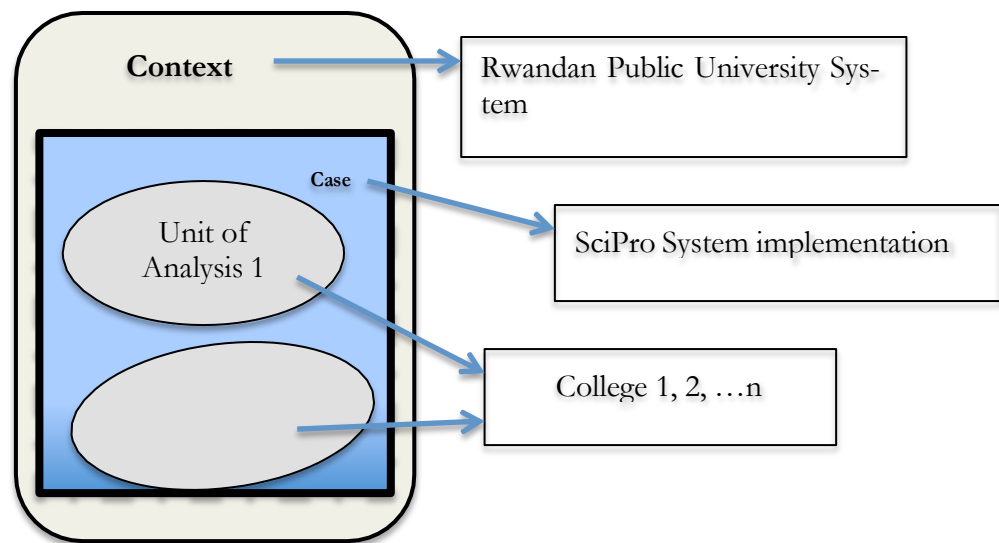


Figure 2-2 Case study of the SciPro System implementation at University of Rwanda

2.2 Research Design

A research design can be descriptive, explanatory or exploratory (Yin, 2003). It is descriptive when a study is about depicting accurately the case study and its elements such as people, systems, processes and culture. According to Saunders et al. (2009) a descriptive research study attempts to explicate deeply an element or a specific phenomenon. A research study is explanatory when the intention is not only to describe the phenomenon, but also to go in-depth to offer further understanding of relationship between cause and effect. The last category is the exploratory study where a research study intends to define, observe and clarify a research question or a phenomenon, which is new in a typical setting (Yin, 2003; Shields & Rangarajan, 2013). This also helps in designing a research and related data collection method to use. Sometime the intention of this type of study is to predict the future adoption and use of a technology or a new innovative tool in an organization.

For this particular study, the research design is exploratory. This is due to that this study aims to find out how supervisors view the importance of SciPro resources for thesis process, which has not been studied before. Hence, this help in examining the supervisors' behavior in using SciPro and get new insights on how they are adopting the SciPro and incorporating it in the thesis process.

Before the testing process of SciPro at UR commenced, the author conducted a literature review and observations to explore the existing thesis process and understand the the behavioral intention. The Unified Theory of Acceptance and Use of Technology (UTAUT) was used to explore the relationships between SciPro resources and the constructs of UTAUT.

2.3 Research Method

Generally, a research approach helps in setting procedures that guide the researcher to collect data relevant for the research problem and the research field. The method chosen will determine the data collection process and the data analysis. Thus, Randolph, (2008) posits that a method choice must refer to the aim of the research in order to know what types (quantitative, qualitative or both) of data to collect in order to answer to research questions.

In this study, both quantitative and qualitative approaches will be used. According to Saunders, Lewis and Thonhill (2007) these are the types of methods mainly used in social sciences and they can be mixed either in parallel or sequentially depending on the type of research questions. Quantitative data are needed to understand to what degree thesis supervisors interact with the SciPro system, the degree of acceptance of the system, how easy or difficult to use, how it might improve their performance and effectiveness during the thesis process.

On the other hand, because we are investigating a real case of a system being implemented, we believe that collecting supervisors and other stakeholders' views and interpretations, as qualitative information is also crucial to understand the previous thesis supervision process and provide a rich picture on the overall perceptions in regard to the current thesis process supported by SciPro system.

2.3.1 Abductive approach

Saunders et al. (2007) explain deductive and inductive approaches as two main methods of reasoning. While a deductive approach aims to test the existing theory by focusing on causality, an inductive approach concerns the generation of a new theory and understanding of the phenomena with reference to the collected data. From the standpoint of Babbie (2010), the induction starts with empirical observations first in order to find and theorize those related patterns whilst the deduction process begins with an anticipated pattern and develop hypotheses that are tested using the collected and analyzed data.

The combination of both approaches is an abductive approach (Saunders, Lewis & Thonhill, 2012). In this approach deductive and inductive approaches complement each other in order to get rich data and deeply understand the phenomenon by linking the theoretical framework used to the empirical findings (DeMast & Bergman, 2006).

In this study, the author used abductive approach (combination of both inductive and deductive approaches) to analyze collected data from respondents. Prior to system testing and distribution of questionnaires, the author conducted a number of pilot interviews with supervisors in order to understand and conceptualize the context where SciPro would be implemented. Perceptions of thesis supervision process in general were gathered through these interviews.

In addition, previous research about acceptance and the behavioral intentions to use technology in higher education have been explored to further understand real context.

Subsequently, the author proceeded to collect quantitative data regarding the importance of SciPro resources to the improvement of thesis supervision process. The same data helped in determining the supervisors' behavioral intention to use the system in the future when it would be fully implemented. Reasons, benefits and challenges for adoption and use of SciPro System for the thesis process was gathered to form the basis of understanding how this system will be integrated in the existing thesis process.

2.3.2 Study sample

There are various approaches for determining a sample; probability sampling and non-probability sampling, (Denscombe, 2010). Probability sampling includes randomization, systematization, clustering, multi-staging and stratification of the sample. This approach is characterized by the principle of randomness when selecting the sample, and it posits that

there should be no influence of the researcher on the people or objects to be included in the sample. On the other hand, non-probability sampling does not consider the random selection of the sample. This sampling approach includes quota sampling based on strata, convenient sampling, snowball sampling where a researcher is referred to other optional participants, theoretical sampling aiming at theory development and finally purposive sampling that focuses on deliberately selecting a relative small number of people or objects.

In this thesis, the population, in which to get a reachable sample, is composed of teachers and e-learning projects coordinators from the University of Rwanda. Therefore, with scarce resources in terms of time and funding, the researcher has chosen to use convenient sampling, which falls into the non-probabilistic sampling strategy. The convenience sampling technique is according to Saunders et al. (2007) an inexpensive strategy, which saves time in the data collection.

The sampling process was based on the requirements of the research problem. Although various categories of staff were included in the SciPro, only teachers and e-learning coordinators who had some teaching duties were selected as respondents. The reason for the choice was that the author expected them to have information about the existing thesis supervision process.

In order to get the sample on board, the Centre for Instructional Technology (CIT) from the University of Rwanda contacted the author before participants in the SciPro test workshop are selected. Together with delegates from the Centre, we set the prerequisites for those who should be invited for participating in the SciPro Test were set. The conclusion was made that participants in the test workshops should be selected from all colleges of the University of Rwanda. Furthermore, the participants should have supervised at least one bachelor's or a master's student thesis before.

Although invitations were sent to 68 academic staff who expressed an interest in participating in the SciPro System test, the sample finally included 42 participants who responded to the request from the Centre for Instructional Technology.

2.4 Data collection

There are some practical issues in data collection (Randolph, 2008) such as the credibility in the skills of the researcher and costs in terms of time and money. In addition to those issues, the choice of suitable method depends mainly on the research questions, the sample and the data sources. A selected method should allow a researcher to collect information that will answer research questions. In this study, interviews, observations and a survey questionnaire have been used to gather primary data while document reviews were used as secondary sources to collect secondary data.

2.4.1 Interviews

In this study, interviews have been conducted with the supervisors during the SciPro System test and after, in order to get a deeper understanding from the user's perspective. Interviews can be structured, semi-structured and unstructured (Denscombe, 2003). They are used when the purpose of the research is to get in-depth insights into the topic under investigation. When interviews are face-to-face, they allow a researcher to follow up closely on answers from respondents. In case of mixing inductive and deductive approaches, interviews are used prior to constructing a questionnaire or in case the latter has provided interesting findings that need more in-depth information to complement the data from a questionnaire. Moreover, an interview may be triangulated with other methods in order to

validate facts using another data collection approach (Denscombe, 2003).

Hence, during this research, face-to-face interviews have been conducted on respondent's convenient basis with the aim of deepening information and following up the responses to the questionnaire (during the SciPro System test) and as a triangulation by complementing the survey questionnaire (after system test). Each interview took approximately eight to ten minutes and the author managed to interview five teachers and one e-learning coordinator during and after the system test. The interview guide used questions regarding the current process of thesis supervision at different colleges, how they feel about SciPro system which is currently being tested. Participants were also asked what they think would be the challenges during full implementation of SciPro and what they think would be done by the top management and the project managers in charge of e-learning implementation to ensure that SciPro does not face same difficulties like other previous systems that are currently under used or not used at UR.

2.4.2 Direct observations

Observing research participants is a common and discrete way of collecting data. Hence, this approach allows a researcher to collect direct evidences from the real life situation, such as testing a system and observing how people tend to use it. In direct observation, a researcher observes the participants and note their different behaviors developed from using a system. This approach is frequently used in educational technology research (Denscombe, 2003). It can simply be done by being close to the participant while noting how he/she is interacting with a particular learning management tool on a continuous basis.

In this study, a participant observation data collection approach was used to study how supervisors interacted with the SciPro system interface and how they behaved in case of misunderstanding parts of the process.

2.4.3 Questionnaire

Questionnaires are intended to collect information written by respondents in response to questions proposed by a researcher and tend to gather facts, beliefs and opinion from respondents (Denscombe, 2010). Using questionnaires, a researcher has a chance to get a large quantity of data from a large sample. According to Randolph (2008) if the purpose is to determine the level of student satisfaction to an intervention for example, then a questionnaire is proposed as a suitable tool to gather relevant data. Thus, questions may be close-ended or open-ended and a researcher makes a choice between them, depending on the types of data, which are to be collected. Compared with interviews, questionnaires are economical, easy to arrange and provide pre-coded and standardized answers. However, there is a high risk of frustrating respondents with restricted pre-coded questions and the research findings depend mainly on the researcher rather than participants due to the high rate of close-ended questions. In addition, there is a restricted opportunity for the researcher to ensure the truthfulness and validity of answers when questionnaires are distributed at a distance. With all these issues mentioned above, interviews have been used to back up the data from the questionnaires and to ensure research validity and accuracy.

In order to answer to the research question of this study, the author collected different perceptions from supervisors in regard to the SciPro System during the testing process. Hence, the questionnaire was designed with a mix of open-ended and close-ended questions and distributed to participants. From the questionnaire, quantitative data regarding user perceptions was gathered to determine the overall degree of usefulness of different

SciPro System resources. The same data have been used to determine the degree of behavioral intentions of supervisors to use the SciPro System in the future.

To ensure accuracy and rigor in the study, the questionnaire was previously pilot-tested with some teachers and master students at Stockholm University and staff from the Center of Instructional Technology at University of Rwanda. A final version of the questionnaire was then developed. Both self-administered web-based and paper-based questionnaires have been prepared and distributed to respondents during and after the SciPro System test. The questionnaire is presented in appendix 1.

2.4.4 Literature study

Literature reviews are helpful in positioning a study by describing the knowledge gap with reference to previous research. Strauss and Corbin (1990) claim that the aim of the literature review is to explore appropriate and significant previous studies related to the topic under investigation. In the literature review process, sources such as books, journals and other library based-databases are explored (Denscombe, 2003). Thus, different database sources related to the current study area were explored to understand this gap and form the knowledge foundations of the study. The author was interested in defining and understanding the field of educational technology more specifically on e-learning systems that can support the thesis process in higher education.

During this study, books, journal articles, university websites and records about theses and government publications in the field of education have been reviewed. Other materials such as reports and training materials of the SciPro System were also explored. The secondary data sources were also used to formulate the frame of reference and understand the theoretical framework. Furthermore, the author explored the Unified Theory of Acceptance and Use of Technology, which have been used to determine the behavioral intentions of supervisors in regard to SciPro System. Later on, a researcher explored various sources regarding the online thesis supervision in higher education systems in general. Search engines have been used to access sources such as Google Scholar, the Web of Science database, the DIVA database and the online libraries from University of Rwanda, Jönköping University and Stockholm University. By exploring the literature review, search items such as e-learning systems, collaborative learning, thesis supervision, thesis writing process and technology acceptance and higher education have been used to retrieve relevant information for this study.

2.5 Data analysis procedure

In the research process, one of the very important steps is the data analysis. In general, a researcher collects raw data from participants. Either qualitative or quantitative, these data are examined, explained and interpreted to get a better understanding of the information that is used to answer the research question (Denscombe, 2010). In social research including educational technology, a researcher has a possibility to choose among several approaches for data analysis. These are dependent on a particular research question. The research questions for this study require both quantitative and qualitative data to be analyzed.

2.5.1 Quantitative data analysis

Quantitative data are primarily associated with research strategies such as surveys and experiments, using data collection methods such as questionnaires, observation and interviews with closed-ended questions (Denscombe, 2010).

This study collected nominal and ordinal quantitative data in the survey questionnaire. Nominal data such as gender, experience and colleges where supervisors came from have been gathered and descriptively analyzed. Ordinal data were used primarily to measure non-numeric concepts such as perceptions, satisfaction, attitudes, usefulness, intentions or happiness among others (Stevens, 1946; Creswell, 2003). Ordinal data were related to supervisors' perceptions about the importance of SciPro System resources for thesis process at University of Rwanda. The data have been collected and analyzed with the measurement of five and seven point Likert scales. (see Appendix 1. Survey questionnaire).

During the analysis procedure, nominal and ordinal data were processed using Statistical Package for Social Science (SPSS) software and Microsoft Excel for Mac. Initial data that were collected from paper-based questionnaires have been directly entered in SPSS while those collected from the Google survey form have been exported to SPSS in order to be analyzed together in one set. Then author performed regression analysis and correlation analyses to determine the degree of behavioral intentions to use SciPro System from supervisors' perceptions.

The same analysis was done to measure different relationships among the variables of UTAUT constructs that were measured in the survey instrument of this study. Those variables were SciPro Performance Expectancy (PE), Supervisor's Effort Expectancy (EE), Social Influence (SI), UR Facilitating Conditions (FC), Supervisors' Behavioral Intention (BI) and SciPro System's acceptance and usage behavior (UB).

2.5.2 Qualitative data analysis

According to Denscombe (2010) qualitative studies use words or visual images as data. As mentioned earlier, interviews and observations have been used to collect qualitative data. The author used narrative analysis (Creswell, 2013) and hermeneutical analysis (Van Manen, 1990) for the data collected from interviews and observations during the system test process. While narrative analysis combines views from the respondents' experience and the researcher's experience in a particular research context, hermeneutic analysis focus on interpreting the research context in a holistic view by the researcher.

Hence for this study, narrative analysis was conducted especially to find out what supervisors express about the SciPro System and how the system will be contextualized in the University of Rwanda. This analysis was done on views, opinions, assessments and interpretations of participants in the SciPro system test. Thus, the purpose of this analysis was to generate patterns that were repeatedly emerging from the interviews. A further hermeneutic analysis was conducted to explore the similarities from the researcher's observations during the system test process and the supervisors' narratives.

2.6 Research credibility

For research to be trustworthy, researchers must find ways of avoiding threats that may appear in any form during the research process. Hence, a researcher reduces the effects of these threats by ensuring validity and reliability during data collection and analysis procedures. The concepts of validity and reliability are extensively discussed in social research (Cresswell, 2013; Joy, 2007; Ritchie et al., 2013; Cohen, Manion & Morrison, 2007). In this section, the two concepts validity and reliability are briefly discussed. This section also discusses the way validity and reliability will be guaranteed during the research process and mainly during data collection.

2.6.1 Research validity

Validity entails that research findings should be rational in order to ensure the quality of research outcomes (Robinson, 2002; Creswell, 2013; Denscombe, 2003). It is basically the extent to which a measurement instrument represents an accuracy of the phenomenon or facets under investigation (Haynes et al., 1995). Validity is an important guidance for effective research and it can be applied to both quantitative and qualitative data (Cohen et al., 2007). In qualitative research, validity can be looked on in terms of depth, richness and scope of the collected data. It can also refer to the number of participants and the extent of triangulation and the degree of objectivity expressed by the researcher.

In quantitative research, a researcher confirms validity by determining the sample cautiously, preparing appropriate research instruments and selecting the proper statistical tools to analyze the data. Hence, that is the reason why researchers determine standard errors and confidence intervals to be followed when verifying and confirming research outcomes. For this research, the following types of validity will be guaranteed:

Internal validity: This type of validity refers to the establishment of variation in an effect produced by changes or intensity of an independent variable and not by other outside causal forces (Brewer, 2000). The internal validity is highly maintained and can be proved with high confidence when there is a direct causal relationship among constructs. In their book about experimental research, Campbell and Stanley (1966) explained eight types of inappropriate variables that can threaten the internal validity if not controlled rigorously during research process. Those are history variables for the studies that are done over a long-term period and maturation for example the more time that subjects are involved in the study, the more likely they are tired and bored (Isaac & Michael, 1971). Other factors are like the pretesting process (possible to reduce performance on later tests), instrumentation (changing the measurement methods during the research process), statistical regression issues, subjects' selection process over time; experimental morality over time of the research (drop out in the study) and selection interactions of the above unwanted variables.

In general, internal validity seeks to monitor how well the research was designed and how confident a researcher can conclude that there a strong relationship between dependent and independent variables. Thus, this type of validity measures the accuracy of the study with reference to data collected during the analysis process.

External validity: This seeks to prove how the particular study results can be generalized to other contexts, cases, situations and people (Calder, Phillips & Tybout, 1982; Campbell & Stanley, 1966). Some factors affect the research's external validity and they are called threats to external validity because they reduce the generalizability of results (Cook & Campbell, 1979). The most cited threats exposed by the above authors are like selection biases, constructs and methods and confounding, the real world versus experimental world and the history effects and saturation. The selection bias threat arises when determining the sample from the study population. The selected participants have different personalities that affect the research results. These characteristics are expressed in terms of gender, age, height, attitude, behavior and intelligence among others. So a research should make sure that respondents are equivalent before any step in the measurement process and understand with close control of some difference that may explain differences on the dependent variables. The second threat falls under the constructs, methods and techniques adopted in the research. This means that way a research process is operationalized will depend on the variables to measures and the treatments to make. The third threat is about the extent to which the generalization of findings from individuals that participated in the experiment

process can be extended to the people in the real world that were not experienced the same experiments. Same as for the internal validity, history effects such as events that occur in the research environment can affect the conditions of the study process. These can be like change in the change in the measurement scores and scales, drop out of participants and lost of interest in participating in the study.

Therefore, determining randomly the sample, designing prudently the research and using appropriate data collection and analysis instruments can ensure high internal and external validity of the study (Campbell & Stanley, 1966).

Construct validity: This abstract ensures that there is an agreement of the relationship between constructs and its variables. Hence, researcher controls construct validity in order to understand clearly the reasons for a particular variable to be included in a theoretical construct. An example can be that a researcher is exploring the importance of a learning management system from a student's perspective. A researcher could posit that some features of such a learning management system determine improved performance of students' learning activities. Consequently, the degree of agreement of this is what can be qualified as construct validity. Therefore, the establishment of construct validity might guarantee that the construction of a particular case or argument agrees largely with other constructions of the same fundamental case (Cohen et al., 2007).

Criterion-related validity: This type of validity entails that the outcome of one instrument is related to the other one from an external criterion (Cohen et al., 2007; Cook & Campbell, 1979). Thus, this validity is ensured when data collected from the first round of research correlate with the same data gathered for the second phase of an on-going research study. One case of this validity is called predictive validity when several pilot tests of a particular system in an organization yield the same results for different periods. The second case is called concurrent validity where data collected using one instrument (questionnaire) must correlate with those collected with another instrument (an interview guide or observation).

2.6.2 Research reliability

In research, reliability is described as the degree to which the same different instrument used in the process of data collection and analysis techniques repeatedly score the same results (Saunders et al., 2007; Creswell, 2013). In other words, it is to verify whether there is uniformity and stability of scores over time across all instrument constructs. Thus, the main criterion of reliability is to ensure that research instruments such as questionnaires or interview guides are objective in the whole research process. Reliability is measured in terms of the degree of replicability of research results and how similar these findings are when another study is undertaken using the same research instrument (Ritchie *et al.*, 2013).

In this study, validity and reliability measures were highly considered throughout the process data collection and analysis procedures. Henceforth, in order to ensure this, the author performed the following arrangements:

- First of all, the author used a triangulation approach in order to collect data from several sources providing relevant information to answer the research question with a high degree of validity. This means that data from interviews, questionnaires and observations were triangulated. This multi-method approach is claimed to be important to help a research explain in deep the complexity of the learning management systems (Reeves, 2000; MacDonald & Thompson, 2005; De Laat, Lally, Lip-

ponen & Simons, 2007), which is the case for thesis process support system at University of Rwanda.

- During the sampling process, participants in the SciPro System test were selected on the basis of their experience of the higher education systems and their level of IT skills. In addition, to ensure quality of the collected data, the selection of participants was consultative between the researcher and the Center for Instructional Technology, which had a deeper knowledge about presumptive participants.
- The questionnaire was carefully prepared and the interview questions were discussed with and tested on experts in the research field of information systems and educational technology in order to avoid confusion from respondents and secure internal validity. This was done to ensure the criterion-related validity whereby different data collection instruments are used in the same research study.
- Even if field notes were taken, all interviews were recorded for further reference during analysis and interpretation of the results.

To ensure construct validity when using dimensions of UTAUT model, convergent and discriminate validity are been determined from the survey measurement instrument. This was done using the factor loading analysis. The intention was to establish a relationship of SciPro System with UTAUT dimensions have been discussed with other users of this model and a related literature was explored before to establish a relationship between SciPro resources and UTAUT constructs. This has allowed a researcher to determine the behavioral intentions to use SciPro system with reference to the supervisors' perceptions corrected using the survey questionnaire.

2.7 Generalizability

Results from a research study are generalizable when results from a small sample can be applied to the whole population of the study (Denscombe, 2003). The extent to which results from the case study can be generalized to other settings depends on the extent to which such a case study is similar to others of this category in terms of size, location and sector of activity (Denscombe, 2003).

In quantitative research, generalizability is referred to the statistical data where the study findings from the selected sample are compared to the entire population to verify if there is a match. Hence, if this is done correctly, then the findings from the sample are reasonably generalizable. For qualitative research however, generalizability is referred to what extent a theory developed within one study setting can be replicated to provide descriptive theory from other individuals in other comparable settings (Lee & Baskerville, 2012; Yin, 1994; Baskerville & Lee, 1999).

This study adopts a case study (Yin, 1994) as a research strategy and the concept of generalization is applied on the sample and the population in the context of the Rwandan public university system and SciPro system implementation. Therefore, it is difficult, even impossible, to generalize findings to other universities outside the university of Rwanda. More specifically, because the participants in the SciPro System test at University of Rwanda were not selected randomly, but rather, through invitations to those specific individuals from a known number of colleges within the university, it might even be difficult to generalize the results to all colleges and teachers at UR.

2.8 Research ethical issues

As this research study involves human beings, ethical issues must be considered. Denscombe (2010) makes it clear that researchers are not privileged to have their job done at the cost of participants, regardless of the value attributed to the findings for the society. Thus, it is vital to protect participants' interests by ensuring that participation is voluntary as per the consent form standards. The research must be undertaken with a scientific integrity and confidentiality obeying the laws of the country and the codes of research ethics.

Consent and confidentiality are the two most significant ethical issues in social research that should be considered according to Cohen et al. (2007). During this study, these issues were considered while collecting and analyzing data. To ensure this, before engaging participants in the research, they were informed about the purpose of the study on an introductory consent form and their role as respondents was clarified. The scope of the study and the researcher's responsibility in the research process was also described to participants. The information to be provided on the consent form and on the survey questionnaire made it clear that participation was voluntary. The principles of anonymity and confidentiality were also highly considered in the data collection, analysis and publication of study results.

This chapter has presented the overall research strategy, methods and techniques used to collect and analyze data. Thus, the figure 3-3 below summarizes the adopted research methodology:

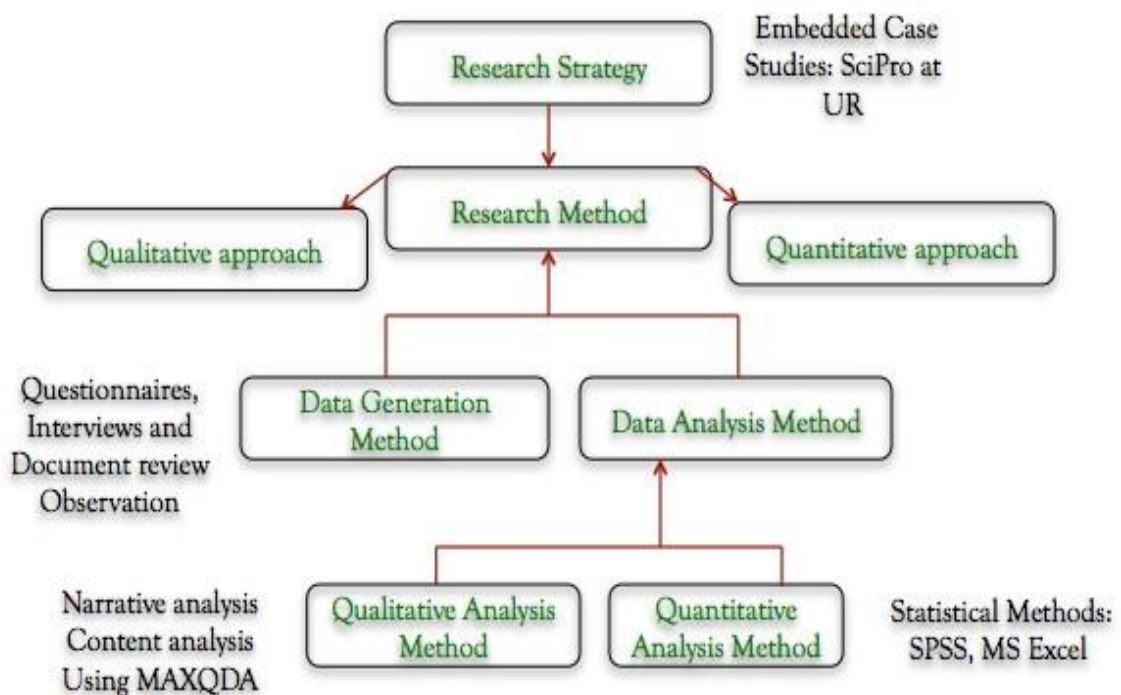


Figure 2-3 Basic Types of Design for Case Studies, (Yin, 2003)

3 Theoretical Framework

This chapter discusses different theories related to e-learning system and learning management system. It goes on exploring the concepts of online supervision system with reference to the SciPro System. Finally it reviews the models of the adoption, acceptance and behavioral intentions to use technology in the educational sector.

3.1 E-learning systems

The new trend in education has brought new facets that incorporate innovative learning technologies in the curriculum development and pedagogical activities (Wallace & Young, 2010). In higher education, especially, e-learning is a strategic alternative worldwide, though in some regions it still remains a challenge to plan and implement it. In a broader sense, e-learning is seen as technology-supported process that has replaced or mixed with the traditional teaching and learning methods. It creates new opportunities for learners either off or on campuses.

There are a number of definitions of e-learning system (Garrison & Andersson, 2003; Alkhtabi et al., 2011). The definition from Garrison (2011) maintains that e-learning is a mediated synchronous and asynchronous communication where electronic tools are used for the purpose of constructing and disseminating knowledge. In the same perspective, as defined by Alkhtabi et al. (2011) define e-learning as “the use of new multimedia technologies and the internet to improve the quality of learning by facilitating access to resources and services as well as remote exchange of collaborations.” (p. 2)

Therefore, from the above descriptions, e-learning can be understood as the delivery of learning activities or other educational programs via computer-supported tools to improve collaboration and resource sharing. With this new technology in education, courses and instructions are delivered by the use of IT-systems. This means that successful e-learning is enabled by a set of subsystems that are interconnected to accept input or data and process them to produce an output in a digital environment (Shih, Chen, Chang, Kao, 2010; Moore & Kearsley, 2011). Markus (2008) highlighted the concept of e-learning in three main dimensions as shown in the Figure 3-1 below:

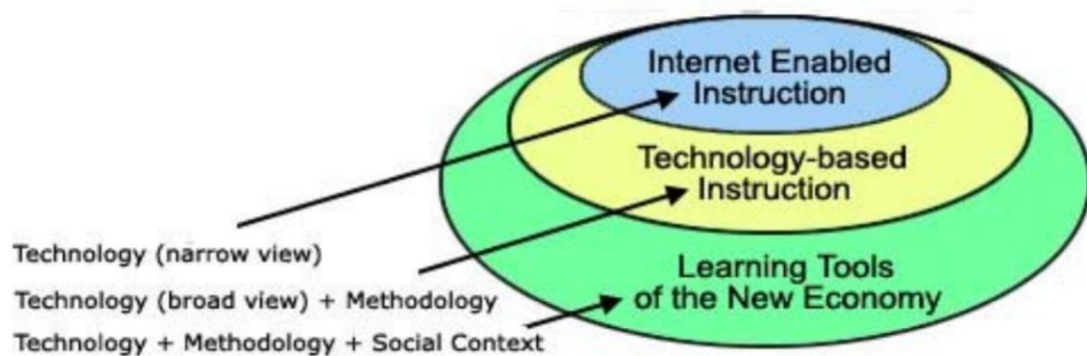


Figure 3-1 A conceptual view of e-learning definitions

As shown from the figure above, definitions of e-learning can take on different shapes. While some focus narrowly on technology view, others expanded by considering technolo-

gy and the methodological viewpoint. The last category of e-learning definitions includes the social context in which e-learning is integrated.

Therefore, within this research perspective, e-learning can be understood as the application of ICT tools to equip students with learning materials and teachers with coordination capabilities (Ellis, Ginns, Piggott, 2009; Ardito et al., 2006) and to improve online collaboration among learners and instructors. Therefore, this definition considers e-learning as the use of a learning management system (LMS) that enable the management of educational resources and the communication between students (authors) and teachers (supervisors) during a thesis process.

3.1.1 E-learning evolution

The pedagogical idea behind the use of e-learning systems is to adapt teaching and learning activities to the needs of a learner (Markus, 2008). This has been termed as individualization whereby several e-learning platforms have been focusing on transferring traditional courses and modules to the virtual learning environment. During the 1980s, innovations in e-learning technology were concentrating only on using standalone computers for content development. From 1995 up to 2000, with the advance in network technologies, new ways such as educational management, course delivery and collaboration technologies were expanded. This was also facilitated by the rise of Internet and World Wide Web that as a result, gave life to the advanced learning management systems. Due to the increased access of wireless technologies and portable devices from 2000 and up to now, the distance is no longer an issue in delivering education (Garrison, Anderson, 2003; Markus, 2008 & Bates, 2005). Nowadays, technological tools for asynchronous collaboration are in place to facilitate the learning process in a virtual environment (Piccoli, Ahmad, Ives, 2001; Carswell & Venkatesh, 2002).

The chart below shows the technological evolution of E-learning adapted from Stanford Markus (2008) and the Research Institute Consulting Business Intelligence Group.

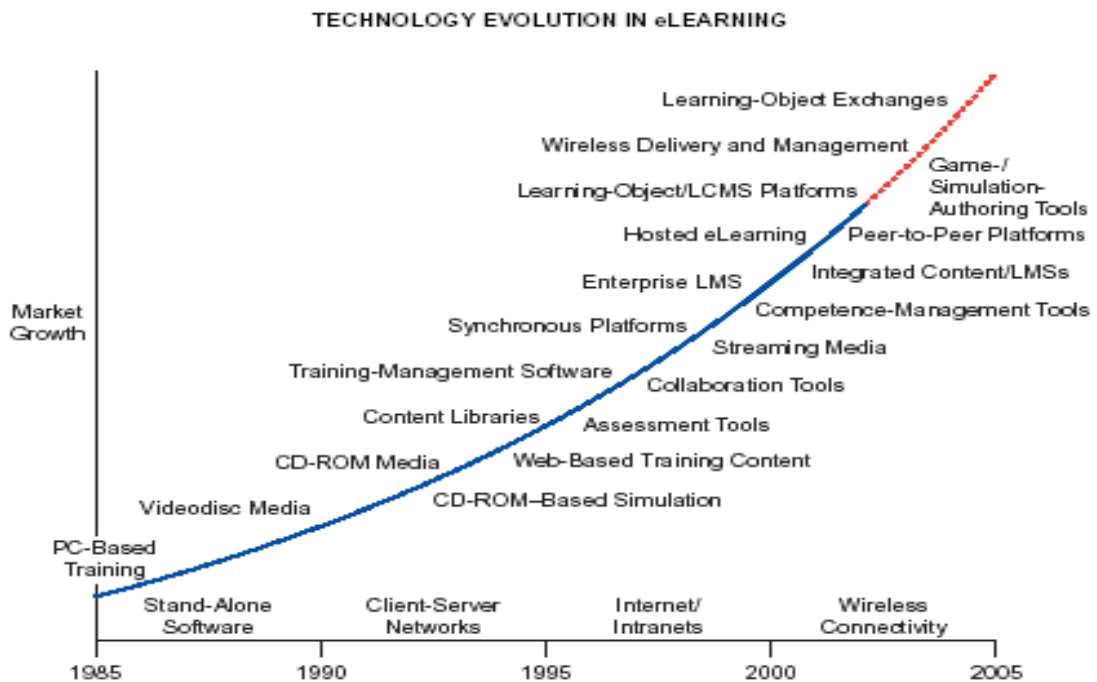


Figure 3-2 Technology evolution in e-learning (SRI Consulting Business Intelligence, 2002)

The work of Barron (2002) summarized in the figure above, reveal that after 2005, there is a remarkable trend in e-learning platforms that are customized to meet individual learners' needs and facilitate the overall learning process. From 2000 and on, the author highlights that there is a recognizable integration of wireless networks that are enabling other learning facilities such as mobile learning using phones and tablets. According to Zeng and Luyegu (2012), mobile learning has enable students learn using portable computers and other devices such as internet-enabled cellphones (smart phones). With this new technology, ubiquitous computing is advanced and people learn from anywhere at any time. Additionally, e-learning is embracing a trend in integrated content and game simulation tools, peer-to-peer learning platforms and learning object designs.

3.1.2 E-learning and the higher education systems

The introduction of e-learning has not been embraced to the same degree at different levels of education systems. The tertiary education is more advanced in using ICT tools in education as compared to other systems. Traditional universities and other higher learning institutions are equipping themselves with e-learning systems to provide a common digital learning platform for course delivery and management (Laurillard, 2006). Some others add the feature of virtual space storage for keeping effective communication and capability to share educational resources amongst the academic community (McBrien, Cheng, Jones, 2009; Koskela, Kiltti, Vilpola & Tervonen, 2005).

Today, the plans, policies and programs of higher learning institutions have recognized e-learning as a prospective way to transform knowledge and skills and increase performance and quality of education (Henry, 2001). From a university managerial point of view e-learning provides an opportunity for educational business development and quality improvement in learning and teaching activities. However, the implementation and use of e-learning systems are still not very well spread in some parts of the world (Ssekakubo, 2011; Njenga & Fourie, 2010; Andersson, 2008; Sife et al., 2007). The reason for this issue is because e-learning is a complex system that involves holistic consideration of individual, organizational and infrastructure changes (Jochems, Kope & Van Merrienboer, 2004; De Freitas, & Oliver, 2005).

Noteworthy, the developing world in general has experienced success from the introduction and expansion of existing e-learning tools (Dublin, 2003). Some uptakes are observable and several remarkable transformations in some tertiary education systems regarding education delivery and the related support process are quite obvious.

However, for other universities, the level of technological infrastructure has not allowed the optimum uptake of new innovative e-learning platforms. In addition, other reasons have led to failure in integrating new learning technologies. Among them, the lack of trained university academic staff in the use of technology and collaboration in virtual learning environment, teachers' attitudes and lack of intentions to use technology, learner's low skills in basic ICT skills, learners' expectations and attitudes to use e-learning and the lack of strategic plans and policies for e-learning implementation are mostly expressed (Nachmias et al., 2004; Persico, Manca & Pozzi, 2014).

For some countries, the basic ICT infrastructure and human capacities are still scarce and those are grave constraints that lead to failure in some e-learning projects. Alongside those constraints, some universities are lacking practical guidelines and policies to facilitate the development of effective pedagogical e-learning environments.

As far as e-learning is also concerned with research and the overall management of educational activities, the integration of e-learning in higher education systems has brought several types of capabilities to support pedagogical and management of educational activities (Madhav et al. 2010):

- Internet access to search, and transactional services
- Interactive diagnostic or adaptive tutorials
- Interactive educational games
- Remote control access to local physical devices
- Personalized information and guidance for learning support
- Simulations or models of scientific systems
- Communications tools for collaboration with other students and teachers
- Tools for creativity and design
- Virtual reality environments for development and manipulation
- Data analysis, modeling or organization tools and applications
- Electronic devices to assist disabled learners
- Internet access to digital versions of materials unavailable locally

According to Salmon (2005), all these capabilities of e-learning are achieved by universities in two transitional stages. The first stage is thought to move to electronic classrooms where physical learning environments are replaced by new ways of learning and teaching, but only to some extents. This means that in some higher education systems, some processes of teaching and the primary assumptions about learning and knowledge sharing remain unaffected. This is argued to have delayed the adoption and use of virtual learning environments (VLE) in some universities. The second stage implies that learning technologies are used in an innovative way to upgrade to a classroom integrated fully with e-learning in an effective way to meet intended university objectives, learners needs and instructors' goals.

3.1.3 E-learning in developing countries

As mentioned earlier, the uptake of innovative technologies is not on the same level worldwide. In the higher education sector, there are a number of commercial e-learning system tools such as WebCt and Blackboard while others are based on open sources commonly known as learning management systems (LMS) such as Moodle, Sakai and Atutor, among others (Ssekakubo, 2011). The use of open source tools is an important consideration, particularly in higher education in developing countries. The reason for this is that customizable LMS with less cost and without a license fee are needed in this context. In this situation, the quality of learning, using these open source tools, remains also problematic in some institutions (Laurillard, 2006; Mott, 2010). Due to the inadequate customization of these tools and lack guidance, teachers and learners fail to use effectively these learning management systems (Mumtaz, 2000).

Regarding different initiatives of e-learning in developing countries, this innovation is still at its infancy stage as compared to in developed countries (Grönlund & Islam, 2010). With an interest to integrate e-learning in traditional methods of teaching, developing countries' education systems try to borrow best practices. But this has not succeeded in some countries because the need to customize the borrowed systems to the local contexts is still challenging (Nawaz, Awan & Ahmad, 2011; Sife et al., 2007).

In Africa especially, the integration and use of learning management systems are still big challenges despite the opportunities provided by the open source innovations and the amounts of investments in the higher education sector for some countries. The process of

implementing e-learning in African higher education systems is limited to the following challenges (Sife et al., 2007; Omwenga, Waema & Wagacha, 2004; Lwoga, 2012):

- **Strategy for transforming higher education:** Some institutions fail to integrate ICT in pedagogical activities because there is no proper strategy to support or migrate from traditional practices. They just imitate the new technology without analyzing the institutional process. In some cases, universities are driven by just introducing ICT without considering the pedagogical and institutional design aspects. However, the innovation in higher education requires a strategic transformation process where all stakeholders from technical, managerial to pedagogical are called to review the existing structures and practices (Bates, 2000).
- **Managerial and administrative support:** In higher education, support from administration is a key to successful integration of e-learning and improvement of pedagogical processes. Administrators are responsible for providing policies, rules and regulations that guide e-learning users. They also plan for incentives and other resources to motivate e-learning adopters. Thus, this is a one of the challenges that is emerging in many universities in developing countries. The interest and involvement of the top leadership and other decision-makers at each level in an institution is a crucial factor for the effective implementation of e-learning systems to enable positive change and diffusion of innovation in higher education.
- **Technical support:** Universities in developing countries are always challenged by the lack of technical experts to handle the installation, configuration and maintenance of e-learning systems. Some systems work for one to two years and after that they collapse because there is no technical support available for instructors and learners. Moreover, there is always a higher level of dependence from system vendors, which also hinder the pervasive usage of e-learning systems. The technical support is an important element to ensure effective e-learning systems. Therefore, there is a high need to consider employment recruitment, training and retention strategy to enhance the implementation of e-learning systems (Sife et al., 2007; Bate, 2000).
- **Attitudes toward using E-learning:** Positive attitudes to e-learning has been recognized as a key challenge to adoption and use of e-learning systems in developing countries (Sife et al., 2007). However, in some higher learning institutions, e-learning is not embraced as expected by the top management. People express negative attitudes to new innovations in pedagogy and tend not to use available ICT facilities. This is also a result of lack of motivation and lack of awareness to existing e-learning facilities. Inadequate basic ICT skills are also a challenge, which create fear of using these technologies (Kennedy, Judd, Churchward, Gray & Krause, 2008; Pelgrum, 2001; Czerniewicz & Brown, 2009).
- **Lack of systematic approach to e-learning integration:** The innovation in learning has come to, at least partially, replace the traditional learning approaches. Therefore, as a complex process, the integration of e-learning and its requirements needs to be clearly defined and documented before embarking on e-learning deployment. However this is another story in developing countries' higher education

systems. In developing countries, the integration and implementation process of e-learning systems start without a proper plan and policy and end up by recording high-level incompatibility and reliability with other traditional systems in place. Thus, universities should have a clear e-learning policy and strategic institutional plans to guide the implementation process (Sife et al., 2007; Cross & Adam, 2007; Kozma, 2005).

3.2 Learning Management Systems

The concept of learning management system (LMS) has been used as virtual learning environment (Keller, 2005). Others also consider it as learning platforms, instructional management systems, course management systems, content management systems or instructional management systems (Coates, James, & Baldwin, 2005). From different terminologies, LMS can be described as a set of interconnected systems used to facilitate the management of teaching and learning activities in an interactive and efficient manner. In this case, learning can be blended or fully online. Therefore, those technological tools differ from one institution to another, but in most cases, they share some similar settings such as the course administration, curriculum and pedagogical purposes that are customized depending on the type of course to be offered. They also provide a virtual space for interactions between learners and instructors, which can take in form ranging from videos, chat rooms, emails and links to electronic resources.

In general, learning management systems are used much more in tertiary education than in primary and secondary schools. The reason is that they are designed for adults who can apply self-regulated learning and engagement in pedagogical activities. To have it successfully implemented at any institution, there are some important considerations that might be taken care of (Hanna, 1998; Segrave & Holt, 2003; Coates et al., 2005).

- **Easy to use:** A good LMS should be a user-friendly system that allow everyone from teachers, learners and education managers to perform their tasks effectively and achieve expected results.
- **Longevity of LMS:** Universities should ensure that an LMS is always available and accessible for the long run.
- **Cost-effective:** A learning management system should be relevant but not expensive for the university (Paulsen, 2002). This needs to be examined with the system provider to set some guidelines before implementation. Further actions should be planned if the LMS is not serving the purpose it was planned for.
- **Adaptability:** The opted learning management should be able to comply with disruptive new technologies in the future. As technology is changing rapidly, LMS must be designed to accommodate such changes and keep performing as beneficially as possible for the organization using different types of technological devices. In addition, it must also be integrated to match the university culture, teaching structure and strategy (Chung, Pasquini & Koh, 2013)
- **High-level functionality:** In order to increase positive insights and behavioral intentions from learners and instructors, the adopted learning management system should meet the stakeholders needs by providing high level performance and sev-

eral options of dealing with teaching and learning in a digital environment (Chung et al., 2013).

In brief, effective learning management systems are able to allow reliable and centralized learning and to improve performance of overall educational activities in particular the course delivery and the associated assessment processes.

In a broad view, learning management systems are designed and integrated to support different courses from different disciplines. However, the integration process is not the same for all types of courses from social sciences to applied sciences. Like any other course offered in the higher education systems, a thesis course can also be delivered via a learning management system. When integrated with tools for collaborative learning, peer learning is made possible between students and teachers can coordinate learning activities by interacting with learners. During the thesis course process, the LMS allows thesis authors and supervisors to communicate and share different documents, research ideas and other resources that are pertinent to research undertakings (Hansson, et al., 2011). On the author's side, the LMS can be considered as an online or technology-supported thesis writing systems while on the supervisor's side, it can be described as an online thesis supervision system.

3.2.1 Collaborative online learning

Collaborative learning can be described as an instructive approach to learning and teaching by involving groups of learners and the rest of the academic community (Richardson, 2005; Jonassen et al., 1999 & Huang, 2002). This can be considered as a social activity where participants are called to interact either face-to-face or in a distance mode. Thus learning occurs when people interact. The process of collaboration becomes ubiquitous when technological tools are integrated as facilitators. The collaboration in an online environment has a different setting as compared with the four walls classroom environment.

As discussed by Moore (1991), philosophy in distance learning adopted by the institution determines the type of interaction of individuals or networked groups in the online environment. In this framework, knowledge is created and shared in an interactive process either between learners themselves or instructors. From the constructivism point of view, knowledge is constructed by learners through social interaction in a collaborative learning (Vygotsky, 1978 & Bruner, 1996). The constructivist theory supports highly the design and development of collaborative online learning environment and the educational technology in general (Moller, 1998 & Jonassen et al., 1999). In collaborative online learning process, the learner interacts also with the interface and content because the learning materials and the environment are made available to the learner before the learner starts interacting with them (Petraglia, 1998; Stein, Wanstreet, Calvin, Overtoom & Wheaton, 2005).

In the collaborative learning environment, the role of an instructor is limited, whereby instead of being a teacher, he/she becomes a facilitator (Garrison & Andersson, 2003). Thus, in a collaborative learning setting, learners have the opportunity to interact with peers and to exchange various beliefs in a highly active engagement and open environment. In an online enabled environment, knowledge is effortlessly shared among users more than in physical setting. This easy access to electronic resources has a strong influence on individual performance (Roschelle & Teasley, 1995). With an advance in ICTs, teachers and students are offered such an open collaborative learning opportunity, which facilitate the interaction in a virtual learning environment. This technology is called the online learning

management system (Keller, 2005). Hence, students can communicate with their peers or with teachers when the level of interaction is technically improved.

In the thesis course process, one could also argue that ICTs can provide an a collaborative environment through forums between the academic community and industry or organization outside of academia, who can interact using communication tools integrated in the learning platform that support thesis process. For a thesis supervision standpoint, this is considered as an innovative way for supporting dynamic discussion anytime from different places (Hansson, et al., 2011 & Armstrong, 2004).

3.2.2 Online thesis supervision system

Like any other learning management system, there are systems that are designed to assist students and teachers during the thesis process at all program levels from bachelor to doctoral level (Hansson, et al., 2011). Normally, for many academic programs, students are requested to perform a research project that results in writing a thesis or a dissertation. This work involves a lot of student and the supervisor activities. One of the features that are enabled by online collaborative tools is the peer interaction amongst students during thesis writing.

Hence, once the thesis supervision process is automatized, the system allows to increases transparency and communication amongst involved stakeholders. As a result, this leads to efficiency, and improved quality of students' research (Hansson, et al., 2011; Aghaee & Hansson, 2013). One of the activities in the thesis process is the peer review done by students themselves (Aghaee & Hansson, 2013). When conducted via an online platform, the peer review improves the quality of research as students exchange new ideas in a collaborative environment with upgraded communication facilities.

The online supervision system for theses can gain inspiration from the social constructivist concept, as the learner is central to learning process. Jonassen et al. (1999) maintain that learning is a social activity through dialogues, communication, discussion, collaboration and interaction where students acquire the meaning. Henceforth, from the peer review and thesis resources uploaded in a thesis supervision system, learners are able to perform well in writing their theses without always meeting the supervisor face-to-face. Additionally, the supervisor is also not overloaded with the burden of face-to-face meetings with each student under supervision.

Hence with an integrated computer-supported system, people can interact in many ways as shown in figure 3-3 below from the SciPro system conception by Hansson et al. (2011).

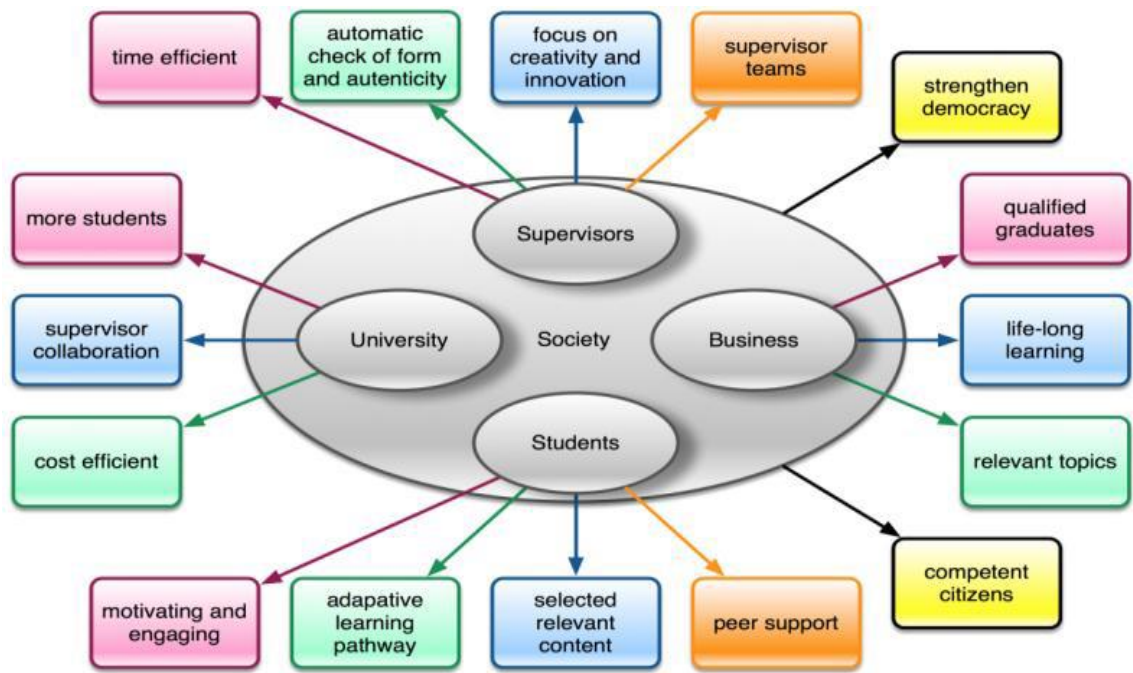


Figure 3-3 Group interaction during thesis process and associated benefits in SciPro system setting (Hansson et al., 2011)

As can be observed from figure 3-3 above, with an online supervision system, not only the university community has access to the research output, but also the business outside participate in the research process and benefit from it. Thus, there is an open collaboration between research and industry and government can gain a lot in terms of research via an adaption of the SciPro system.

3.3 Technology acceptance in education

Like any other sector, the higher education has embraced the potential of innovative technologies to enhance the process of learning and teaching. However, success or failures of artifacts are observed in educational technologies (Gibson, Harris, Colaric, 2008; Teo, 2011). The use of a particular technology depends on whether it adds value to the current process. Therefore, the level of technology integration in the traditional learning process depends on the extent to which individuals adopt and use the available e-learning platforms in their institutions. This study deals with the application of a technological platform in a social setting to improve the thesis process, which is considered as a learning activity.

The degree of acceptance and use of technology depends mainly on the degree of behavioral intention expressed by people since they are introduced to a particular technology (Agarwal, 2000; Legris, Ingham & Collerette, 2003; Venkatesh, Morris, Davis & Davis, 2003). In the academic environment, without the academic community's acceptance and perception of value addition, learning management systems may not deliver whatever value it is capable of by its functionalities (Park, Nam & Cha, 2012). The motivations of learners and other stakeholders in the educational sector to accept and use learning management systems can be evaluated and determined by the use of a number of models, frameworks and theories.

There are various models and instruments that have been developed to investigate the user

acceptance of information technology. Though many of them have been used in a general business/industry, some studies have used them to investigate and predict the adoption and use of learning management systems (Moran, Hawkes & El Gayar, 2010). In the following section, the technology integration as a driving change in a social setting activated by the acceptance of the technology will be described. For thesis supervisors and authors, the acceptance and use of an online thesis supervision system are the causes of acknowledged beliefs that lead to a particular degree of user intentions.

One of the factors that hinder the integration of e-learning systems is the teachers' beliefs about a technology and the non-supportive culture in different universities (Keller, 2009; Moran, 2010). It is in this regard that this study applies the Unified Theory of Acceptance and Use of Technology (UTAUT) model to analyze and predict the behavioral intention and use of SciPro System at University of Rwanda.

3.3.1 UTAUT and related theories and models

The reviewed literature revealed that people investigated the acceptance, adoption and use of new technologies by using concepts and frameworks from information system and psychological perspectives. In social sciences, such as sociology and organizational behavior (Holland & Light, 1999), use also these concepts. The unified theory of acceptance and use of technology is one of the models that are used for this purpose as well. It is used to measure behavioral intentions from an individual perspective in regard to a particular system. Venkantesh et al. (2003) have developed this model by investigating and matching the previous related models such as:

- **Diffusion of Innovation theory (IDT):** This theory was first proposed by Rogers in the 1960s to explain how an innovation spreads through a particular social system over time. In 1991, Moore and Benbasat highlighted the role of DIT as a concrete model for investigating the level of adoption of information systems. As the level of adoption of a technology does not happen for all individuals at the same time, within this theory, five adaptors categories are clarified. Those are innovators, early adopters, early majority, late majority and laggards. Studies in the field of diffusion of technology, maintain that it is a responsibility of the organization to understand individual characteristics before embarking on introducing a new technology. Therefore, the diffusion of innovation theory by Rogers deems to be the most appropriate for exploring the adoption and use of technology in tertiary education (Sahin, 2006; Straub, 2009; Sahin & Thompson, 2006).
- **Theory of reasoned action (TRA):** First proposed by Fishbein and Ajzen (1975), its aim is to explain and predict human behavior vis-à-vis the technology introduced in a social setting. The TRA is originated in a social psychology setting although its usage has been extended to the analysis of beliefs and attitudes towards the use of technology in society. In this theory, the individual's behavioral intention is affected by two variables of attitude (A) and the subjective norm (SN) toward that behavior. Hence, while attitude involves beliefs about the emerging effects of performing the behavior, subjective norm is delivered from people or groups from someone's social environment on his behavioral intentions. The beliefs of people, weighted by the importance of attributes to each of the social setting's opinions have a great impact on someone's behavioral intention. Thus, in terms of technology trend, someone's behavioral intention will determined the actual use of a tech-

nology that is introduced to an organization for changing the traditional way of performing tasks. Several studies (Straub, 2009; Lee, Hsieh & Hsu, 2011; Lee, 2010; Park, 2009; Lim, Lee & Nam, 2007) have been performed using TRA.

- **Technology Acceptance Model (TAM):** Davis et al. (1989) were the first to propose this model. By focusing mainly on information systems research, the aim of this model is to predict how users accept and use technological interventions. TAM was developed by adding the theory of expectancy to the attitude towards behavior of the TRA. This model suggests that there are factors that influence the attitude, behavior and use of an information system. Hence, those factors are divided into two main constructs “Perceived Usefulness (PU)” and “Perceived Ease of Use, (PEU)”. Just as TRA, TAM has received much attention in studies on the acceptance and use of e-learning systems (Park, 2009; Liaw, 2008; Roca, Chiu & Martínez, 2006; Lau & Woods, 2008; Saadé & Galloway, 2005). As time went on, TAM has been expanded to the updated model of TAM2 (Venkatesh & Davis, 2000). Based on previous researchers’ conclusion in the adoption and use of technology and the initial TAM, Venkatesh and Davis added the concepts brought in the concept of social influence and cognitive influence processes. Hence, perceived usefulness explain usage intention in terms of social influence by considering the subjective norm, voluntariness, experience and image. Secondly, the cognitive processes are also explained in terms of job relevance, output quality, result demonstrability, perceived ease of use.

Within the purpose of extending the applicability of the above models, Venkatesh et al. (2003), reviewed eight technology acceptance models, including different models having a close relationship to technology acceptance including innovation diffusion. From this review, they developed the Unified Technology Acceptance and Use of Technology model (UTAUT). This model doesn’t contradict the previous ones but rather, it compliment them and provide a unified model of integrating technology in the social setting. The UTAUT model is composed of three direct determinants that are interdependent variables related to intention to use technology; Performance Expectancy, Effort Expectancy and Social Influence. It has also two direct determinants of usage behavior, Facilitating Conditions and Behavioral Intention. The last category of constructs is about four control variables that are significant moderators of the behavioral intention to use technology. Those include Age, Gender, Experience and Voluntariness of use. The core constructs of UTAUT and their relationships are presented in detail in figure 3-4 below:

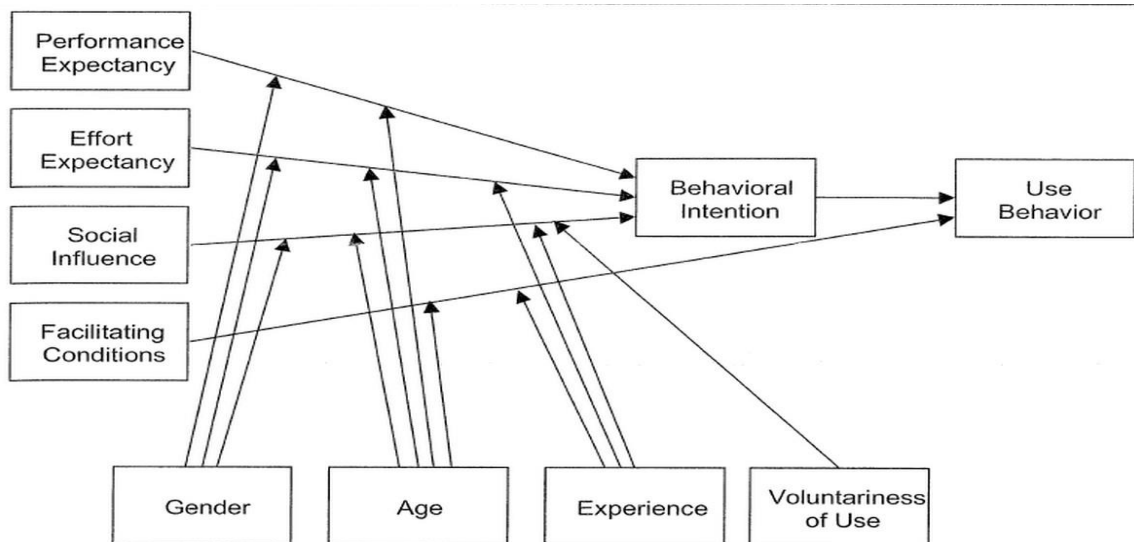


Figure 3-4 Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003)

Performance Expectancy (PE)

Venkatesh et al. (2003) define this concept as the degree to which a user believes that using a system will increase performance at job. This construct of UTAUT model is delivered from the user perception on the system usefulness from Technology Acceptance Model (TAM), which is “*the degree to which a person believes that using a particular system would enhance his or her job performance*” (Davis, 1989 p. 320). Performance Expectancy is also originated from the construct of Relative Advantage from the Diffusion of Innovation Theory (IDT), which is expressed as the “*degree to which an innovation or a technology is perceived as being better than its precursor*” (Moore and Benbasat, 1991 p. 195). Many studies about innovation diffusion focused mainly on factors that provide a stimulus for users to adopt new technologies.

The other constructs that relate to the performance expectancy from different other models are Extrinsic Motivation from Motivational Model, (Davis, Bagozzi & Warshaw, 1992), Outcome expectations from Social Cognitive Theory (Bandura, 1986) and Job-fit from Model of PC Utilization (MPCU) (Thompson, Higgins & Howell, 1994).

3.3.1.1 Effort Expectancy (EE)

According to Venkatesh et al. (2003), this concept is defined as the extent to which the user finds it easy to use a particular system. As one of their research outcome, they concluded that the influence of effort expectancy on behavioral intention by the system user is affected by different user background factors such as age, gender and work experience. Thus, for example, effort expectancy assumes that if the user is a young female with less experience; there will be high chance to adopt and use the new technology.

This construct was assembled by the concepts of perceived ease of use from (TAM/TAM2), complexity from (MPCU) and ease of use from (IDT) as all the latter express a significant similarity from their definitions and measurement scales (Venkatesh et al., 2003).

Social influence (SI)

The use of a new technology can depend on social factors such as organizational culture and beliefs. Thus, this dimension is defined in UTAUT as the degree to which a person recognizes that other people in the organization believe that he or she should use the sys-

tem. From this point of view, that person will be conditioned by the fact that other fellow employees are using the system. Hence, a stimulus will be increased for him as well and, as a result, this will determine the degree of adoption and use of the system.

The social influence is considered as a direct determinant factor of the behavioral intention and it was developed using previous concepts of subjective norm from TRA and TAM2, the social factor from MPCU and the image factor from IDT (Venkatesh et al., 2003).

Facilitating conditions

Facilitating conditions is a direct determinant of usage intention in the UTAUT model. It is defined as the extent to which someone believes that there exist a technical and organizational infrastructures designed to support the use of the systems. This means that the organizational working environment and the system features and resources can have a lot of influence on the individual's behavior to adopt and use that system.

This construct is originated from the concepts of Perceived behavioral control from TPB, facilitating conditions from MPCU and compatibility from IDT (Venkatesh et al., 2003). All these concepts are embodies a common understanding regarding the state of the technological and organizational environment and to what extent they will facilitate the system integration process.

Behavioral intention

Like the facilitating conditions determinant, behavioral intention is also assumed to have a significant influence on the actual usage of a technology. This construct is delivered from the theory of planned behavior and the theory of reasoned action (Fishbein & Ajzen, 1975), which mainly maintain that the individual's attitude toward an artifact will have an influence on the behavior or motivation to use it in the future.

To summarize this section about the research theoretical research model, it is important to stress that the selection of the UTAUT model is not only based on its usefulness in measuring the acceptance of IT systems, but also on the advice from different researchers in the field of education technology and e-learning systems. Previous studies discovered that for example TAM was capable only to predict technology adoption and use at 40% and the other theories and models discussed above are found to be inapplicable in some research contexts (Venkatesh & Davis, 2000). For this reason, according to Venkatesh et al., (2003), UTAUT model is suitable for predicting user acceptance of technology and innovation at an accurate rate of 70%. The model also includes not only the human factor but also the social variable in determining the behavioral intention to use information systems as it consider the social influence and facilitating conditions.

Even if UTAUT and other related models have been immensely used for evaluating technology acceptance in general business by managers, it has also been used in predicting and determining the degree of behavioral intention from teachers and students to adopt various e-learning systems (Lee et al., 2011, Chen, 2011; Keller, 2005; 2009). From this perspective, UTAUT is found also relevant for this research to determine the degree of agreement of supervisors about SciPro system and to predict their behavioral intentions to use this system at University of Rwanda.

4 Case study description

This section describes the case of University of Rwanda. The current process for thesis supervision and related services are also presented. Finally, the learning management system called « SciPro » is briefly described.

4.1 University of Rwanda and the thesis supervision process

According to the law no 71/03 of 10/09/2013 of the official gazette no 38 of 23/09/2013 of the Republic of Rwanda, the University of Rwanda (UR) is the only public higher learning institution that has merged all the former universities, institutes and schools that were previously operating separately (Rwanda Official Gazette, 2013). The purpose of merging these institutions was to deliver quality education and develop innovative teaching and research. This mission drives distinct initiatives that are taking place in terms of improving research including the integration of an innovative supervision system to support students' thesis writing on undergraduate and graduate levels. UR is composed of six colleges, which are also made of different schools and departments operating in multi-campus structure.

These colleges are College of Business and Economics (CBE), College of Education (CE), College of Medicine and Health Sciences (CHMS), College of Arts and Social Sciences (CASS) and College of Agriculture, Animal Sciences and Veterinary Medicine (CAVM). All these colleges have several educational programs that run from different campuses around the country. When it comes to students' research supervision, it is obvious that one teacher can be assigned students from different campuses to supervision, especially for those in their final year of study. Therefore, this requires an automated platform to facilitate communication and thesis resources sharing among authors and supervisors.

As UR is under a transition period of two years, there are still old systems and processes that are used, including the supervision of theses. Therefore in the process of innovating this process, the SciPro system, was being tested in order to see how it could innovate the thesis writing and supervision process. The current process for thesis supervision was done through different channels and systems. Hence, most of the current processes were still traditional (manual or based on blended learning). This means that, apart from Microsoft office packages such as spreadsheet, word processing and presentation programs that are used during the thesis process, there were no holistic ways to support students and thesis supervisors for effective communication during the thesis process. Figure 4-1 and 4-2 describe the service blueprints that summarize the current service for the bachelor and master level thesis process at University of Rwanda.

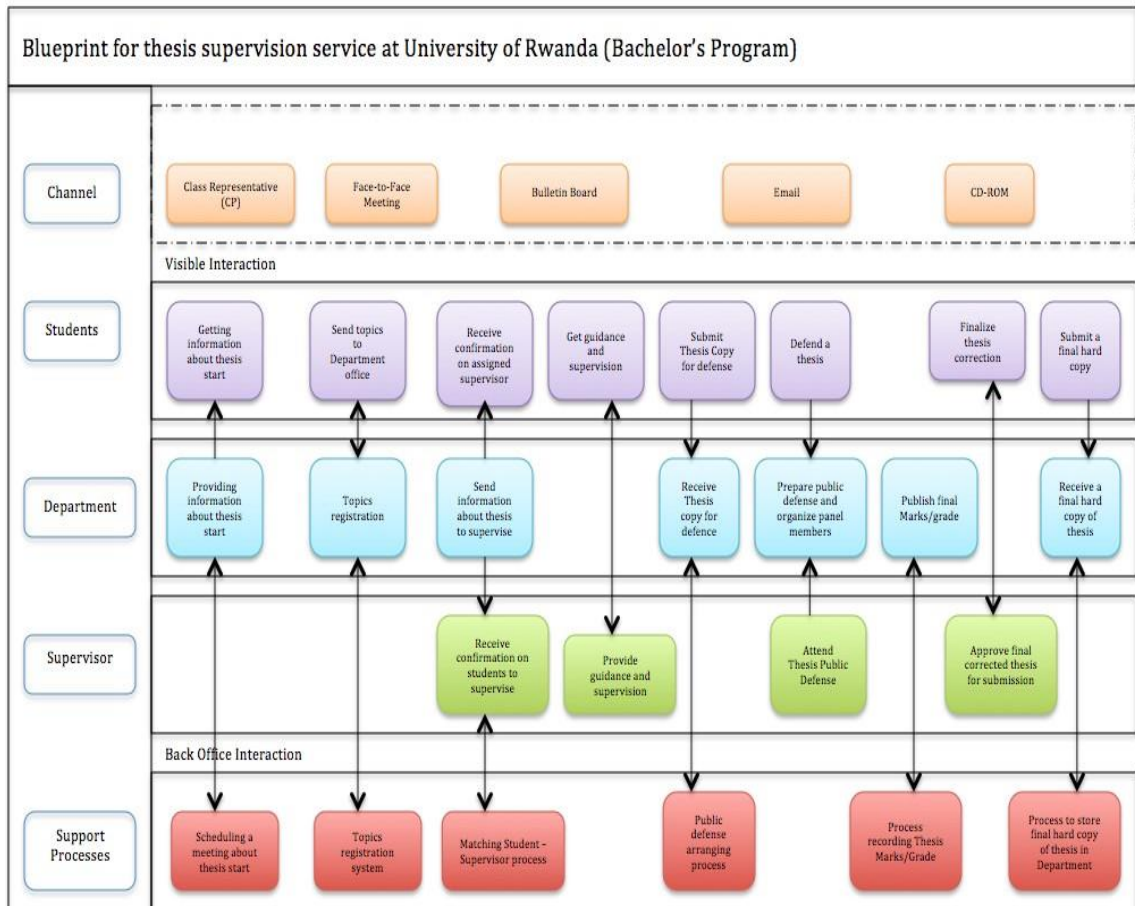


Figure 4-1 Thesis supervision service and its process for Bachelor's Level at University of Rwanda

As observed from figure 4-1 above, the whole process includes visible and back office interactions by a number of actors including students, department and supervisors. Therefore, depending on the department structure, some use class representatives to communicate with students and supervisors about the thesis information. Others can use face-to-face interaction with individual students who choose to come to the department while others opt on using bulletin boards. Regarding formal communication, emails are used and for some programs, CD-ROMS are used to submit final thesis reports after the public defence. The master's programs process is shown in figure 4-2 below:

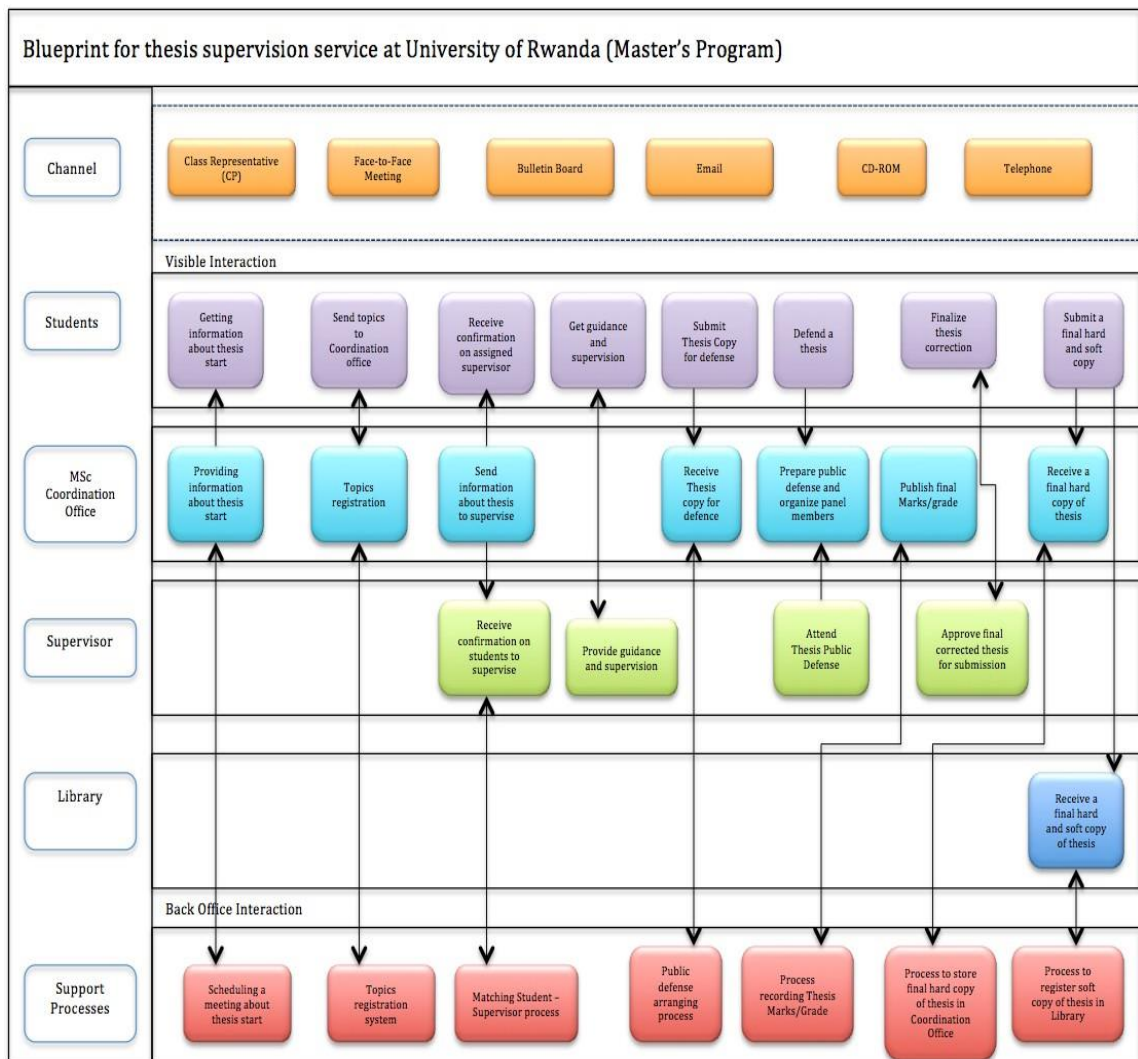


Figure 4-2 Thesis supervision service and its process for Master's Level at University of Rwanda

From figure 4-2, which is the service blueprint for thesis process at the master's level, the only difference from the bachelor level is that the master's coordination of this activity is in charge of the Master's coordination office at each college (faculty) level. Thus, regarding communication channels, telephone can also be used for interaction between students and supervisors. In addition, the University library also comes in as a database that collects and store both hard and soft copies of theses for future reference.

During the author's field visit at some of the campuses, he noted that services are not computerized and sometimes it is hard for actors involved in the process to interact. This hinders the students to finish their theses on time. It is also very difficult to interact and access students' manuscripts in one single and integrated channel of communication especially as the supervisors have a big number of students under supervision. Consequently, this has been affecting the quality of research published at the University of Rwanda. This is one of the reasons why the new university system is looking to innovate the process in the coming years with the implementation of an integrated online thesis supervision system. The university believes that this initiative will enable online resource sharing and effective collaboration and communication with students and supervisors during the thesis process.

4.2 Overview of the SciPro System

A system for managing thesis process called SciPro “Scientific Process” has been developed at the Department of Computer and Systems Science (DSV), from Stockholm University (Larsson, Hansson, 2012; Aghaee & Hansson, 2013). Looking at its features and functionalities, the SciPro system can be categorized as a computer-based Learning Management System (LMS). The SciPro system is a process support system, which is connected to the Idea Bank. The later is a sub system, which collect and match research ideas from different sources such as students, supervisors, business industry and the rest of the society. The main role of this system is to support a self-managed student thesis process and to enable feedback from peers and supervisors by increasing transparency (Larsson & Hansson, 2012). Figure 4-3 below illustrates how the Idea Bank assists in matching different research ideas within the SciPro System.

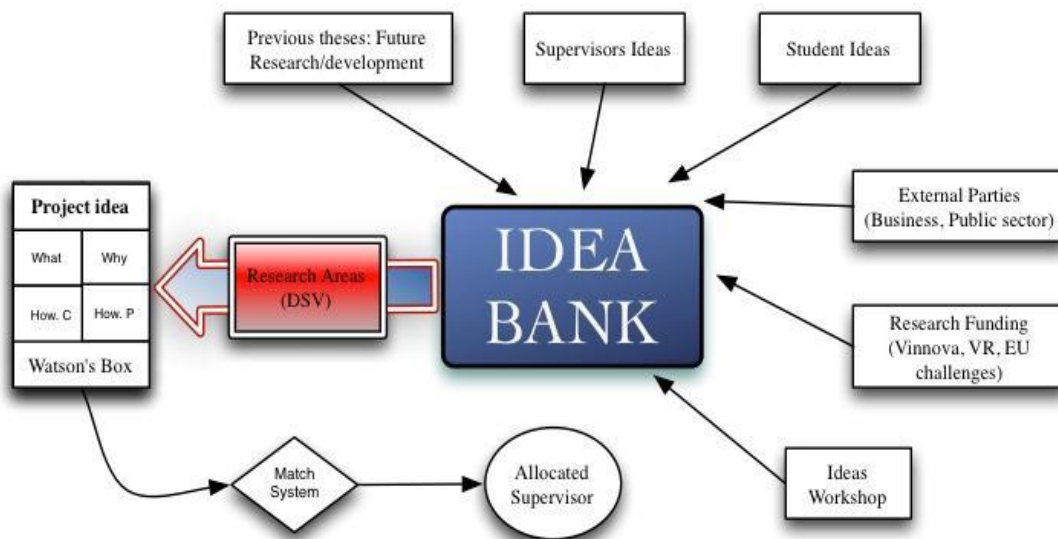


Figure 4-3 Structure of Idea Bank (Hansson et al., 2012)

The idea bank is a sub system that receives and stores research ideas. It includes a module of matching ideas between authors and supervisors. Therefore, it is linked to the SciPro system that has a number of other functionalities that support the thesis writing and supervision process. Together with the Idea Bank module, the SciPro System becomes a complete IT-supported platform for learning and communication and management of the thesis related activities. The simplified structure of the overall SciPro System is shown in figure 4-4:

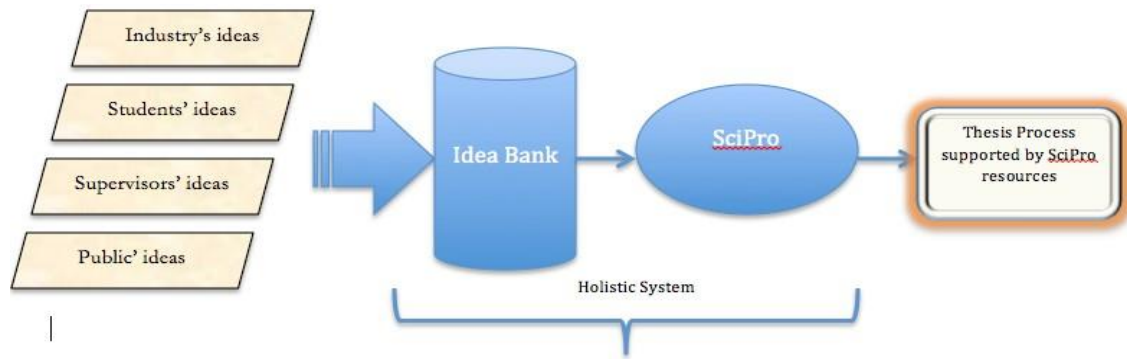


Figure 4-4 Simplified structure of SciPro system

Figure 4-4 illustrates the logical structure of SciPro system. The idea bank receives research ideas from a range of sources such as final year students in their respective study programs, teachers and researchers and the rest of the society including business and industry as well as public institutions. In addition, it hosts all the previous theses and manuscripts that have been submitted by students during the whole thesis process.

4.3 SciPro System, a Rwandan version for pilot integration

One of the mandates of the new University of Rwanda was to improve its services to students and stakeholders. In order to improve research process including thesis supervision, a specific SciPro system has been developed from the Department of Computer and Systems Sciences (DSV), Stockholm University. This system is a customization of the one that is currently used at Stockholm University. Therefore, it has been customized without prior system requirement analysis for the new university of Rwanda. The system is being implemented on a pilot basis whereby future users (students and supervisors) test and evaluate it for its efficiency.

It is also an opportunity for SciPro developers and programmers to get new user suggestions for improvement of the system to fit into the current University of Rwanda setting. The university has merged former institutions and all their systems and infrastructure. Each former university used to have a system and process for thesis supervision, which are still being used. Therefore, the initiative of introducing SciPro System was to support the thesis process at UR in an innovative way. In order to make it a success, the option selected was the pilot integration as shown in figure 4-5:

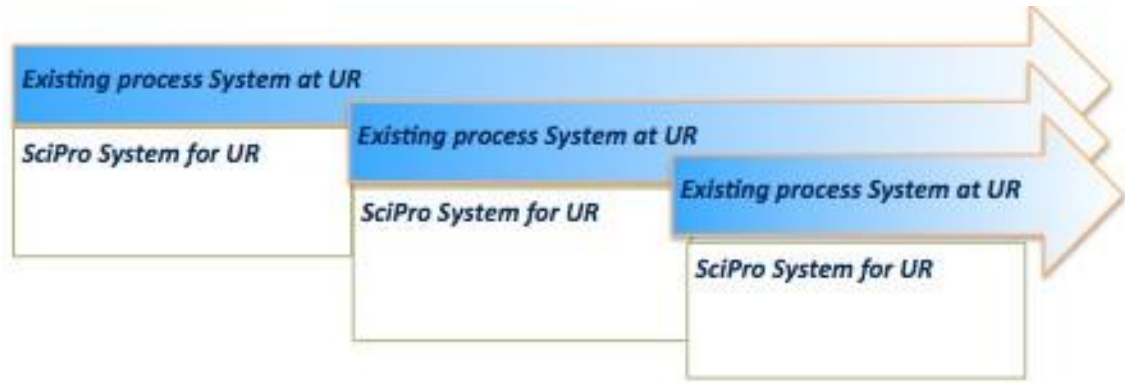


Figure 4-5 Pilot integration process for SciPro at University of Rwanda

As observed from figure 4-5, the intention of introducing the SciPro System at the University of Rwanda was not to remove completely the current existing process, but rather to try to see how it could be integrated to remove some bottlenecks of the traditional system. Thus, in some colleges of UR, the SciPro system was tested and selected supervisors were requested to start using it in parallel with the existing thesis process.

5 Empirical findings, analysis and discussion

This chapter presents the empirical findings of the study from the use of questionnaires, interviews and participant observations during the test of SciPro System at University of Rwanda. The data analysis is presented. The chapter ends with conclusion and discussion for further research in the same field.

5.1 Research model and hypotheses development

This study was conducted on a system pilot integration process where respondents were called to use SciPro System in various workshops. Thus, after having used it for a while, they were requested to provide their perceptions and views on how it worked and how it would impact on their supervision routines at UR. In order to understand these perceptions and provide answers to the research questions, a conceptual model of Scipro System adoption and use was developed to guide the researcher. Referring to the UTAUT model, a new customized model including the four independent variables (Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions) of the UTAUT model, were used to accommodate different supervisors' perceptions. In addition, the supervisor's behavioral intention and SciPro acceptance were also conceptualized as dependent variables that would be determined by testing the following research hypotheses.

5.1.1 Hypothesis development

In the field of information system, the individual performance expectancy is defined, as the degree to which an individual believes that using an Information System will help to attain gains in job performance. In this study we hypothesized that using SciPro System in thesis supervision process will affect positively the behavioral intention of supervisors at UR.

H1: SciPro System perceived performance expectancy will positively influence supervisors' behavioral intention.

The second construct considered in this research was the Effort Expectance, which is explained as the degree of ease associated to the use of a particular information system. Thus, we postulated that the supervisors' effort expectancy on SciPro System will have an effect on their behavioral intention toward this system introduced at University of Rwanda.

H2: The supervisors' perceived effort expectancy will positively influence their behavioral intention toward SciPro System.

The third independent construct adopted from UTAUT was Social Influence. This is defined as the degree to which an individual perceive that other important people believe he or she should use the new introduced system. We postulated that the social-cultural environment of the University of Rwanda where SciPro is being integrated will have an effect on supervisors' behavioral intention. The following hypothesis was formulated:

H3: A high degree of Social Influence will positively influence the supervisors' behavioral intention

The forth construct was Facilitating Conditions, and according to UTAUT model, is the degree to which a person believes that an organizational and technical infrastructure exist to support the use of an information system. Hence, it is significant to hypothesize that the

University of Rwanda’s institutional structures, policies and technical infrastructures will have an influence on the acceptance and use of SciPro System.

H4: A high perceived degree of Facilitating Conditions will influence the degree of acceptance and use of SciPro in thesis process positively.

The last hypothesis was formulated from the behavioral intention determinant of UTAUT Model. This concept refers to the degree of an individual's indication to readiness of performing a given behavior. Being as an individual’s perceived likelihood, the behavior intention can be understood as the subjective probability that he/she will express a given attitude. For this study, this variable is considered as the extent to which an individual develops an attitude toward an innovative technology like the SciPro system. Hence, the behavioral intention is a dependent variable to performance expectancy, effort expectancy and social influence. In order to measure the degree of acceptance and use of SciPro System at University of Rwanda, another hypothesis is formulated by postulating that supervisors’ behavioral intention will influence the SciPro System acceptance to support thesis process at University of Rwanda.

H5: Supervisors’ positive behavioral intention will have a positive influence on SciPro System acceptance and usage to support thesis process at University of Rwanda.

The above-developed hypotheses are highlighted in the conceptual research model in 5-1.

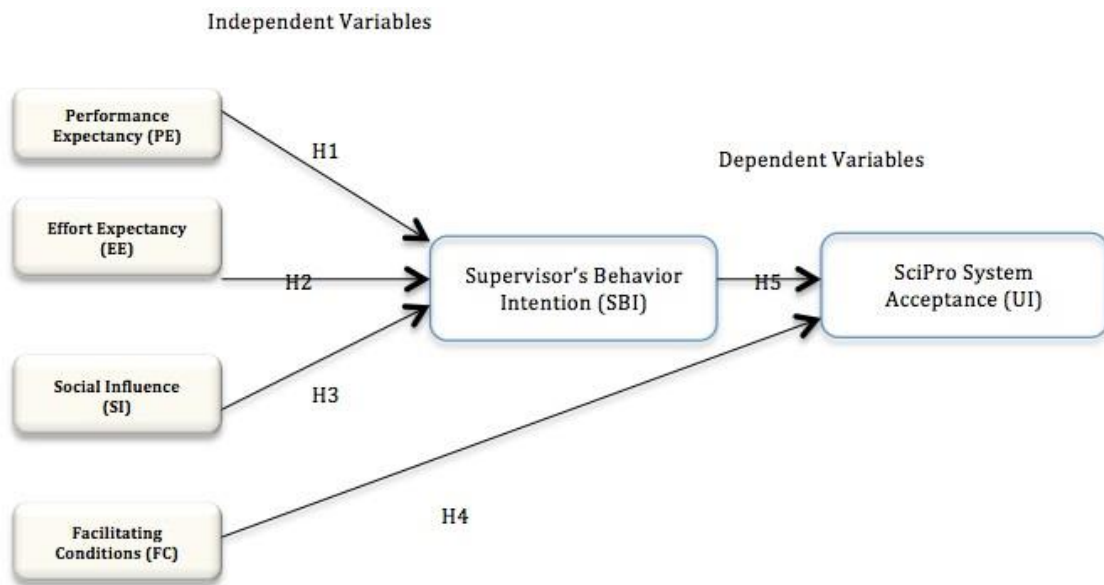


Figure 5-1 Conceptual research model

5.2 Data analysis

Before embarking on analyzing the corrected data, the author analyzed the construct validity and reliability of the research variable measurements.

5.2.1 Construct validity

This research model applied in this study measured the relationships between different constructs. Thus, regression analysis was used to understand the relationship and their validity (Rawlings, Pantula, Dickey, 1998; Gefen, Straub & Boudreau, 2000). According to the research model developed, conditional variables such as PE, EE, SI and FC were used to

identify the two independent determinants of supervisor’s behavioral intention and SciPro System acceptance.

The construct validity was proved by measuring convergent and discriminate evidences (Hair, Black, Babin, Anderson, Tatham, 2006; Campbell & Fiske, 1959). To determine these components, the author evaluated the survey instrument by using the principal component analysis (Straub, 2009) one of the extraction methods from the SPSS package.

For this study, the discriminate validity was measured to ensure that there was an internal consistence of the survey instrument.

Table 5-1 Construct factor loadings

UTAUT Constructs	Number of Questions	Factor Loadings
Performance Expectancy	10	.874
Effort Expectancy	10	.715
Social Influence	6	.442
Behavioral Intention	5	.785
Facilitating Conditions	8	.728
Use Behavior	5	.709

Normally, discriminate validity is adequate when the constructs of the model have an average loading variance greater than 0.5 which means that 50% of the measurement was reached by items in a particular construct (Campbell & Fiske, 1959; MacCallum, Widaman, Zhang & Hong, 1999). Hence, in the table 5-1 we observe that apart from the Social Influence construct, the other five constructs of the model score a factor loading which is greater than 0.5 indicating an effective validation. In order to increase the validity of the Social influence construct, which scores 0.44 of factor loading, the researcher completed the survey questionnaire by conducting interviews with respondents.

The convergent validity was measured by using the correlation matrix between constructs that were used for this study with reference to the general UTAUT model. All the constructs used for this study were significantly correlated because all the values observed were greater than zero. This means that when the minimum collection in the matrix is greater than zero, the convergent validity is supported.

5.2.2 Reliability analysis

In this study, a reliability analysis was conducted for the items by using Cronbach’s Alpha (Sijtsma, 2009; Coakes & Steed, 2009). As reported in the table 5-2, it appears that apart from Behavioral Intention and Social Influence, the other constructs have expressed a highly significant degree of reliability, which was greater than or close to .70. Thus, BI and SI fall below the measurement level but still they are greater than .35, a measurement that is also accepted for significant reliability as half of the generally accepted level of .70.

Table 5-2 Reliability analysis using Cronbach's Alpha (n=42)

UTAUT Constructs	Cronbach's	
	Alpha	Number of Items
PE	.730	10
EE	.830	10
SI	.360	6
FC	.696	8
BI	.425	5
UB	.677	5

5.2.3 Descriptive data

The study was carried out at University of Rwanda from June 2014 to January 2015 during the first introduction of SciPro system test and implementation. The author participated actively in the three tests that were done at four different colleges of UR. From the university point of view, the purpose of this test was to investigate how the system would fit in the university context and effectively support the thesis process and add value to the quality of research.

The population of this study was composed of the academic and research staffs from five of the six colleges of the recently created University of Rwanda (CASS¹, CBE², CE³, CHMS⁴ and CST⁵), which are involved in the supervision of bachelor and master research projects. The descriptive data from the study is presented in figure 5-2.

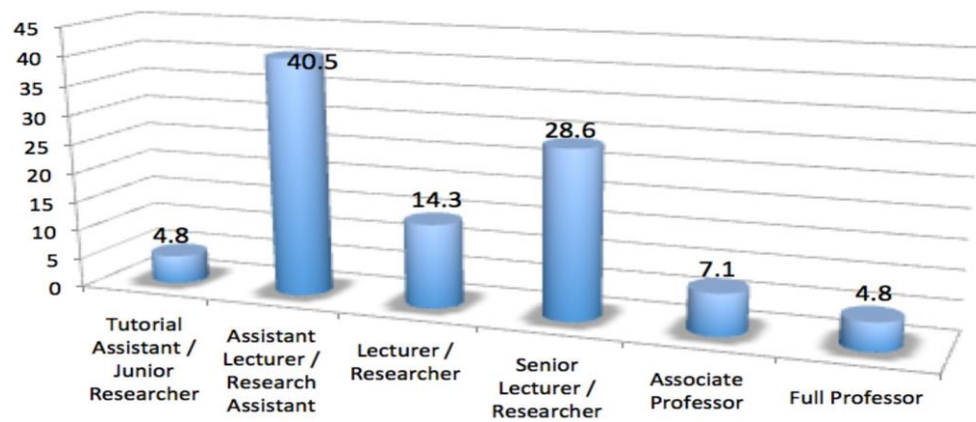


Figure 5-2 Respondents' academic rank

¹ College of Arts, Social Sciences

² College of Business and Economics

³ College of Education

⁴ College of Medicine and Health Sciences

⁵ College of Science and Technology

The results from the clustered cylinder figure 5-2 reveal that respondents are highly represented by assistant lecturers and research assistants with (41%) while senior lecturers and lecturers follow with 28% and 14% respectively. Associate professors obtain 7% while tutorial assistants and full professors represent the lowest percentage (5%).

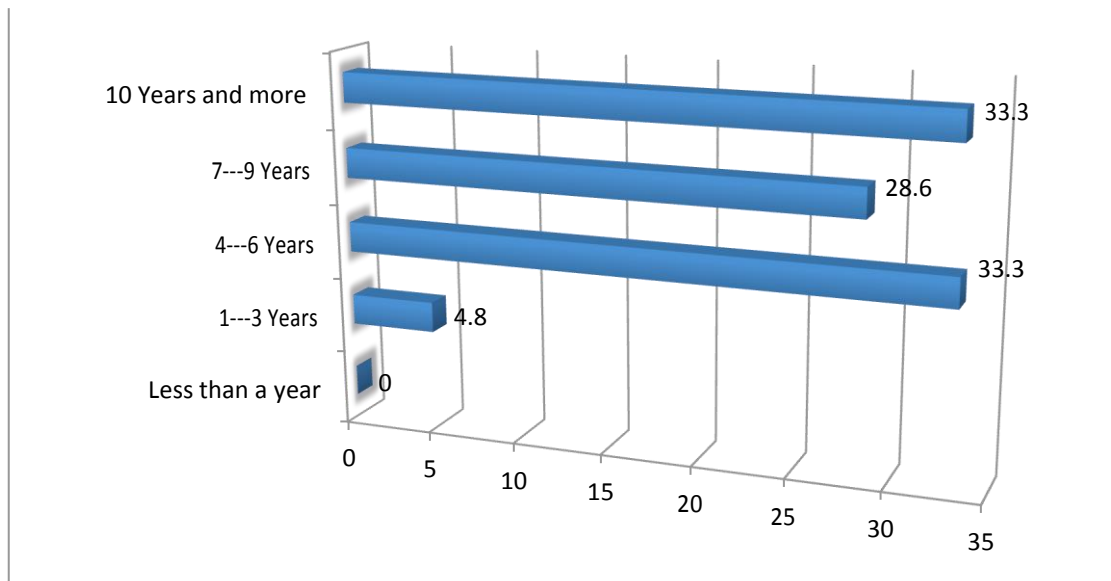


Figure 5-3 Respondents' experience in higher education

Reading figure 5-3, 95% of the respondents have been teaching in higher learning institutions ranging from four to ten years and more. This proves that they have a long experience in research related activities including thesis supervision.

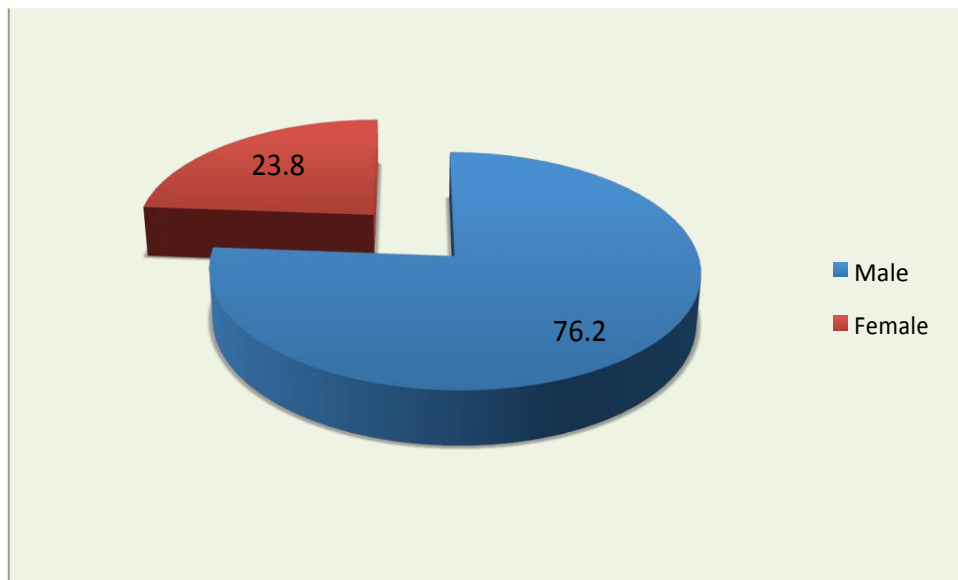


Figure 5-4 Gender of respondents

Figure 5-4 presents respondents' gender statistics. Males were highly represented with 76% of the total respondents, while females occupied a smaller segment of 24% only.

5.2.4 Correlation analysis

The research hypotheses were tested to understand how supervisors expect the acceptance and usage of SciPro system at university of Rwanda. Hence, the Spearman's correlation analysis was used to measure the relationship among the UTAUT model constructs considered for this research. Although the original model proposes a positive relationship between PE, EE, SI and BI, data did not support a significant relationship between all these three constructs. However, a significant relationship was observed between Facilitating Conditions and Use Behavior at a 0.01 level of significance and the original UTAUT model by Venkantesh et al., (2003) proposes this situation. Behavioral Intention and Use Behavior did not show any positive significant correlation.

Among the four main independent variables (PE, EE, SI and FC), only Performance Expectancy and Effort Expectancy were significantly correlated at the level of 0.01. This means that the relationship between these two constructs was strong and that the University should take this as an opportunity for the SciPro System implementation process.

Table 5-3 Spearman's correlation coefficients (n=42)

	PE	EE	BI	FC	SI	UB
Performance Expectancy	1.000	.	.	.	.	.
Effort Expectancy	.430**	1.000	.	.	.	.
Behavior Intention	.055	.303	1.000	.	.	.
Facilitating Conditions	.047	.367*	.202	1.000	.	.
Social Influence	.215	.162	.122	.277	1.000	.
Use Behavior	.106	.389*	.303	.520**	.321*	1.000
	.504	.011	.051	.000	.038	.

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

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

5.2.5 Regression analysis

According to Chatterjee & Hadi (2013), regression analysis is a process of examining the relationship between variables. This statistical approach is used in research to investigate functional relationship amongst two or more dependent and independent variables to predict the degree of existence of one variable depending on the state of one or more other constructs. A regression can be bivariate when there is only one predictor and multivariate in case the estimation involves a single regression model with more than one aftereffect variable.

In this study, the research conceptual model included two sets of regressions. The first included three hypotheses related to Behavioral Intention (PE→→BI, EE→→BI and SI→→BI). The second set of regression included two hypotheses associated with Facilitating Conditions to Use Behavior (FC→→UB) and Behavioral Intention to Use Behavior (BI→→UB).

In order to test the five hypotheses, a multiple regression analysis was used. The outcome of the regression analysis (Appendix 3) provides important data that are summarized in the following paragraph. In this summary, four kinds of data are generated from the regression analysis.

The first type of data is B, which stands for Beta standardized coefficient. The Beta coefficients are the estimates that result from an analysis involving an independent variable that has been standardized to a variance of one. A coefficient is standardized when a researcher aims to know the degree of effect or value of an independent variable on the dependent variable in a multiple regression analysis process. The second item is the Beta, which stands for standardized Beta coefficient. Beta indicates the degree of alternative independent predictors. Though B data are the ones that have been used for this research, Betas are normally used to weigh different B coefficients to see which one has a greater impact on the overall dependent value. The regression analysis has provided also ANNOVA table and the only information used in the P-value that stands for the Significance level of value attributed to a dependent variable from the predictors. This value is commonly set at .05 and when Sig. value is less than this number, then it is a significant effect on the dependent variable; otherwise there will be no significant influence.

Another key important item that has been considered to understand the intention to acceptance and use the SciPro System at UR is the R Square. This item is described as the percentage of variable variation resulting from its independent variables (Myers, 1990; Draper & Smith, 2014). This is explained by a linear model. Depending on a researcher's choice and the research size and the amount of collected data, someone can use either R Square of Adjusted R Square. Using the data from the regression analysis, the five hypotheses were tested.

The survey instrument was designed with reference to the original UTAUT model. Thus, the first regression analysis measured the relationship between three dependent variables (PE, EE and SI) and one independent variable (Supervisors' BI). Results from the analysis indicated that the B coefficients or weights for PE, EE and SI to supervisors' behavioral intention were (.287), .449** and .173 and the P-values were .139, .006 and .126 respectively. This means that, only EE was statistically significant while other factors were not. By comparing the B coefficients for PE, EE and SI, EE had a greater impact on supervisors' behavioral intention toward SciPro System. It was also indicated that PE, EE and SI had jointly an R² Square of .245, which means that they explain about only 24.5% of variability in BI. Based on analyzed data, the H2 was supported, as the P-value for EE (.006) was less than .01, whereas H1 and H3 were not supported because the P-values for PE (.139) and SI (.126) were relatively greater than .05, meaning that their weights on BI were not statistically significant.

In the second regression analysis, the author determined the relationship between BI and FC as dependent variables to UB as an independent variable according to UTAUT. The B coefficients for each dependent variable were .354 for BI and .639** for FC. For FC, this finding is consistent with UTAUT as the research reveals that the university's facilitating conditions influenced positively the acceptance and use of the SciPro System. This statement was confirmed by its P-value of .00, which was less than .01. From these results, it could be concluded that the facilitating conditions variable was proven to be the most essential factor for the acceptance and use of SciPro System at University of Rwanda. Combined together, FC and BI attributes to about .396 (39.6%) of the R² coefficient, which are their percentages of the variability in the use and acceptance of SciPro System. Therefore, with reference to the above described data (seen also Appendix 5), H4 is supported while

H5 is not supported. An overview on all hypotheses used in this study is given in the table 5-7 below:

Table 5-4 Hypothesis testing with regression analysis

Code	Tested Hypothesis	Result
H1	SciPro System performance expectancy will positively influence Supervisors' behavioral intention.	Not supported
H2	The supervisors' effort expectancy will positively influence their behavioral intention toward SciPro System.	Supported
H3	Social Influence will positively influence the supervisors' behavioral intention	Not supported
H4	UR's facilitating conditions will positively influence the degree of acceptance and use of SciPro in thesis process.	Supported
H5	Supervisors' behavioral intention will have a positive influence on SciPro System acceptance and usage to support thesis process at University of Rwanda.	Not Supported

Table 5-4 shows the outcome of the tested hypotheses using multiple regression analysis. Hypothesis 2 and 4 were supported, while hypothesis 1, 3 and 5 were rejected.

6 Conclusion

The main purpose of this study was to understand the adoption and use of SciPro System in support of the thesis process at University of Rwanda. Therefore, during three workshops for SciPro System test, supervisors' perceptions were explored in order to clarify how it could be integrated in the current thesis process. The study subsequently adopted the Unified Theory of Acceptance and Use of Technology (UTAUT) and its constructs have been used to investigate supervisors' expectations on SciPro System. The research purpose was achieved by answering the following four research questions by using the corrected data:

What is the current state of thesis process and supervision at University of Rwanda?

With the help of the test sessions and fieldwork conducted in the five colleges of the University of Rwanda, it was found that the current process of thesis supervision is almost manual-based. This question has been answered by the designed blueprints (see figures 4-1 and 4-2) for thesis services showing the current activities of the thesis process at University of Rwanda.

As observed from Appendix 1, there are still many face-to-face physical interactions between all actors involved in the thesis process. For bachelor programs, students interact with the Department and their supervisors using channels such as students' representatives, emails (for a few people) and face-to-face meetings.

In master programs, students interact with Master's Coordination Office, their supervisors and the libraries when it comes to the submission of finally corrected versions of theses to be published online and stored by the library. The only communication channel that is here, beside face-to-face meetings is the telephone.

To what extent do supervisors intend to use SciPro System?

After getting to know the current thesis process at University of Rwanda, the study went on to determine the degree of behavioral intention toward SciPro System, for which, together with the working environment have helped to measure the expected degree of acceptance and use of this introduced new system to support the thesis process. Therefore, based on the UTAUT model, supervisors' perceptions have been integrated in different constructs of this model in order to measure their degree. According to the Appendix 3, the B coefficients numbers indicates that the supervisors' effort expectancy on using SciPro positively influences their behavioral intention toward SciPro System (.449**) while the Social influence and Performance Expectancy are not significantly correlated with the supervisors' behavioral intention. Hence, the degree of Behavioral intention is at 24.5% ($R^2 = .245$), as the variability explained by the Performance Expectancy, Effort Expectancy and Social Influence.

By comparing the above degree of BI with the information from the correlation table, PE, EE, SI and BI are not significantly correlated in the case of SciPro System at University of Rwanda. This means that, supervisors may expect SciPro System as easy to use and expect gains for job performance during thesis process, but these are not the only sufficient factors to increase their behavioral intention and use of SciPro System. Hence, from the author's point of view, there should be other prerequisites to be put in place to increase the

acceptance and use of SciPro System. An additional regression analysis was conducted to determine the degree of acceptance and use (adoption) of the SciPro System. Results indicated that 39.6% ($R^2 = .396$) of the variability in acceptance and use of SciPro was explained by BI and FC.

The same regression results from Appendix 2 show also that there is a significant correlation between UR's facilitating conditions (.639**) and the Use Behavior. This means that there is a positive influence on the acceptance and use of SciPro System from facilitating conditions. The author's conclusions from this is that having an effective system for thesis process support at UR is not good enough to guarantee that it will be successfully integrated and used. The university's working environment should be improved by ensuring strong facilitating conditions to ensure a successful implementation of SciPro. The figure 6-1 below summarizes the above discussed findings from the regression analysis:

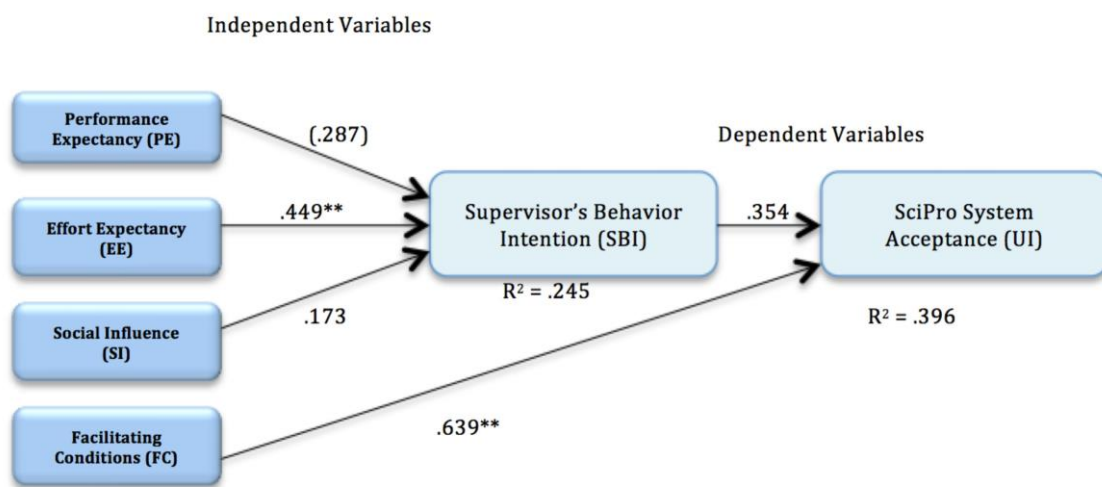


Figure 6-1 SciPro System acceptance model for University of Rwanda

This conclusion can also be confirmed by findings from the observations and interviews conducted during the fieldwork in Rwanda. There has been a remarkable non-use or low use of other IT-systems such as the EBMS and e-learning platforms, not because they are not performing or easy to use, but mainly because there were no facilities to sustain the usability and no motivation from the users.

What factors can positively influence the acceptance and use of SciPro System in thesis process at University of Rwanda?

Results prove that facilitating conditions (.520**) were the most critical factor for the adoption of SciPro System at University of Rwanda. Although UTAUT model doesn't suggest a direct relationship between effort expectancy, acceptance and use of the system, findings from the Spearman's correlation analysis prove that effort expectancy (.389*) is also a key factor to be considered for SciPro System acceptance and usage. The last determinant that correlated significantly with use behavior was social influence (.321*).

As a conclusion, the SciPro system seems to be perceived as easy to use and important in thesis process. Although, to enhance system acceptance and use, the facilitating conditions

of the system use at UR needs to be ensured. This was also evident from the interviews with respondents during the workshops while testing the SciPro system.

What may be considered to ensure a successful implementation of SciPro System at University of Rwanda?

This research question has been answered mainly by qualitative data. In the interviews one teacher from the College of Science and Technology mentioned the following:

“...this is one of the systems that comes here to support thesis supervision process, as I see it, it will solve some of the problems. But on the other side, here we have different working environment as from Stockholm University. Teachers have a heavy normal teaching workload and we spend a lot of time preparing courses, teaching and marking. On top of that, I don't really see how this system shall be used because we don't have a good internet connection and it is still expensive to have our modems aaahh even students are not able to access IT-facilities anytime”

During the workshop, a researcher also interviewed another participant from the College of Education, which stated:

“.... The system itself looks good and can solve many problems of thesis supervision. But I think for this to be successfully integrated in the other UR systems and be used by both students and teachers; there is a need for the university to increase easy and affordable access to wireless internet and even cable networks...aaaahh I don't know about other campuses but this is a serious problem in my place.”

From the above quotations, Internet access and heavy teaching workloads are the factors that may hinder the use of SciPro System in thesis process. Another respondent from the former National University of Rwanda mentioned the following as well:

“.....what I am well aware about is that, even before the merging of our former universities, there have been other systems that failed not because they are not good, but you know.... Just because there is no clear e-learning Policy and ICT policy in place.”

This extract shows that facilitating conditions is a key factor to be improved to support not only SciPro System integration but also other innovations, by availing strong policies.

Generally, it was observed that the implementation of SciPro system requires a number of prerequisites. It appears likely that these can range from managerial, technical and coordination of different pilots that are planned. Regarding technology, even during the test process, there were power outages from time to time and in some cases, the system had supposed to be rebooted. Internet access was also not always there and participants expressed that this may hinder the synchronous communication between students and supervisors via the SciPro system. There is also a need for a high degree of engagement and commitment from the UR management to support not only SciPro System but also other similar innovative systems to support learning and teaching activities. One respondent stressed this:

“.....since I started working in Rwandan higher education, there has been always very good initiatives of implementing IT-support systems in pedagogical activities. What surprises me most is that from the start

up, the management shows a strong commitment but when it comes to operationalization, people loose momentum and some projects fail to excel at their early stages. But, hhhhaaaa, please bear with me, that this may be the case also for this SciPro if the management does not consider ICT as a priority to innovate the way we teach at our colleges.”

To summarize the answer to the last questions, most of the issues observed and taken from interviews are highly related to the facilitating conditions and some others to social influence and attitudes toward using technology. Table 6-1 below summarizes these issues in regard to some constructs of UTAUT model:

Table 6-1 Issues for consideration for future implementation of SciPro System

No	Issue	UTAUT Construct
1	E-learning/ICT policy	FC
2	Inadequate ICT infrastructure	FC
3	Low basic ICT skills for some teachers	FC - SI
4	Lack of organizational support	FC
5	Negative attitude to using technology	BI - UB
6	Low motivation and incentives to adopt technology	BI - UB
7	Low basic ICT skills for final year students	FC - SI

7 Discussion

This section discusses in brief the results of this study, the method used and the implication for practice and further research.

7.1 Results discussion

As the purpose of this study was to understand the adoption of SciPro System in support of thesis process from supervisors' perspective, their perceptions have been collected during the workshop on SciPro System test at the University of Rwanda. As this was an explorative study, the author first explored the current state of the thesis process at the university and went on to develop five hypotheses to be tested while answering the research questions. The development of hypotheses was based on UTAUT model, which is currently proven as useful for analyzing the acceptance and use of information technology in different domains including educational technology research.

To test the hypothesis, a multiple regression analysis was applied. Two out of five hypotheses were supported, while the others were not. Results show that facilitating conditions will have a positive influence with the highest significance level on the use behavior (adoption) of SciPro System at University of Rwanda. Social influence also had a high significant relationship with the supervisors' behavioral intention to use the system.

Being an innovative and effective system doesn't automatically mean that this system will be positively accepted and used at UR. Facilitating conditions need to be improved to enable the adoption of SciPro and improve the quality of thesis process. Besides looking for improving facilitating conditions at UR, SciPro System developers, teachers and the UR top management should endeavor to make SciPro System meaningfully permeated with the real context in order to increase the intentions of supervisors and students to accept and use it in thesis process.

7.2 Methods discussion

Based on the research questions, both qualitative and quantitative methods were used to achieve the research purpose. Qualitative data were collected by interviews and participant observations during SciPro system test. Interview data, field notes data and different reports and manuals about SciPro system were analyzed.

The review of the literature helped in knowing how previous research used different models and frameworks to study the acceptance and use of technology and the innovation diffusion process in an organization. Hence, from this knowledge, the author was able to investigate the perceptions of supervisors with the use of the Unified Theory of Acceptance and Use of Technology (UTAUT).

For the quantitative data, Microsoft Excel and SPSS version 21 was used to conduct a descriptive analysis of different perceptions from the supervisors who attended the three sessions of SciPro test. Then, a correlation analysis and a multiple regression analysis were conducted to determine relationships within variables adopted in this study. The SPSS software used was not so suitable for construct validity (convergent and discriminate) because the module of Partial Least Squares was not installed in the version that a researcher used. Thus, it required to have a commercial version of SPSS or another customized separate PLS-Graph software version 3.0 which is most considered in the research about acceptance and use of technology (Chin, 1996).

Though the UTAUT model is proven to predict 70% of user behavior and acceptance of information technology, the way this model is constructed doesn't suggest a direct relationship of some variables that could be expected to be correlated in e-learning systems such as the SciPro system. However, social influence and effort expectance have been directly and significantly correlated with use behavior for the case of this study on SciPro System at UR.

The measurement instrument was tested against validity and reliability. The study lacks the characters of statistical generalizability. In order to generalize this study, the sample of respondents to the survey, observations and interviews should have been randomized instead of convenient sampling.

7.3 Implications for research

This research has contributed to new knowledge by investigating an e-learning system implementation in a new university setting from a developing country context. Thus, there was no prior knowledge about supervisors' perceptions on a thesis supervision system such as SciPro from a new institution such as the University of Rwanda. Although prior research revealed some factors from experienced traditional universities in developed countries (Park, 2004; Taher, 2012; Keller & Cernerud, 2002; Yuen, Fox, Sun & Deng, 2009), this study discovered different other factors outside SciPro System that may affect the integration of an e-learning system especially in a developing country's higher education systems.

Because SciPro System is still at its infancy stage of integration in the thesis process in Rwandan higher education system and probably in the region, this study open doors for new perspectives for exploring the applicability of information technology in coordination of research activities including the thesis supervision. In particular for Rwandan higher education system, new adapted knowledge and models should be created to enable future research in investigating the factors affecting the culture, attitudes and acceptance of technology for the academicians and practitioners in the Rwandan specific context.

7.4 Implication for practice

The research has brought important information on different SciPro resources that were proposed to the University of Rwanda and some of them need to be customized for the University of Rwanda SciPro version. As the system is still under refinement from Stockholm University, DSV, the recent system developments have used the findings from this study to improve the system interface and its notifications that are generated to supervisors and students. Based on the results of this study, a new study is also going to analyze the state of ICT policies and e-learning policies as some of the identified facilitating conditions' factors for the effective implementation of online learning systems. This study will not only focus on SciPro System but all other e-learning platforms in Rwandan public institutions will be taken into consideration.

Furthermore, it has been observed that some features such as peer review and final seminars are not handled the same way as set in the first version of SciPro system proposed to the University of Rwanda. Therefore, this has opened a debate with participants, the UR top management and officers in charge of research and postgraduate studies to evaluate the peer review process and to see whether it can be retained or left out of the SciPro Rwanda version. If retained, this will lead to updating the current thesis regulations and research policy at University of Rwanda to include the peer review process, which was not a regular practice before.

As an implication for practice, this research has been an opportunity for the University of Rwanda to view its existing e-learning systems and support systems such as the library services and other technical aspects. In addition, the university is now much concerned on analyzing holistically how its e-learning systems can be adapted to meet the users' needs and to achieve its mandate of improving quality research and innovation in teaching and learning.

This study suggests that the appropriate IT-systems planning in the context of scaffolding the innovative thesis process should refer to the following:

- There should be an active participatory approach allowing all key stakeholders (supervisors, management and students) to get involved in the e-learning implementation initiatives at an early stage of the implementation process.
- Provision of necessary educational opportunities to equip system users with adequate digital skills for interacting easily with the new e-learning systems and increase develop positive attitudes toward using these system.
- Provision of adequate technical support to ensure that e-learning systems that support thesis process are sustainable and can adapt to the real working environment.
- Provision of motivational factors to early adopters and innovators of a new innovative e-learning system for thesis process as a way of increasing effort expectancy and social influence factors to increase the acceptance and use of these systems.

7.5 Limitation and future research

This study was limited in time and financial resources. A number of aspects could have been explored to get a rich picture about the implementation of SciPro system in a developing country's higher education system. Hence, this opens opportunities for further research undertakings. As informed earlier in this thesis, the study focused only on supervisors who were invited to attend the system test. This sample is very limited and further studies should extend this research on student and the university management perspectives.

Furthermore, this study used only the four main constructs of UTAUT model to determine the degree of behavioral intention and use of the supervisors in using SciPro system. Hence, other UTAUT independent variables such as gender, age, experience and level of voluntariness from users should be considered for future research because these variables may have some influence on the actual usage of a particular system.

Also private universities should be considered for further research to compare different perceptions in adoption and use of innovative IT-support systems in higher education in a regional perspective.

Finally, with reference to the existing technology acceptance models, further studies should focus on developing a specifically adapted model for evaluating several other e-learning platforms at University of Rwanda. This is because the UTAUT model itself couldn't capture all factors significant in the Rwandan higher education system.

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Appendix I. Survey Questionnaire

Survey Instrument

Title: Evaluation of supervisors' perceptions about SciPro System resources at University of Rwanda

Part 1: Introduction

Dear Respondent,

I'm Jean Claude Byungura, a PhD Candidate from Stockholm University (DSV) and an Academic Staff from College of Business and Economics (UR-CBE) in the field of Business Information Technology.

This questionnaire is designed to collect data regarding the evaluation of Supervisors' perceptions about the importance of SciPro resources. These perceptions are used to measure the behavioral intentions and use of this system for thesis supervision process. Hence the study intends to know how the new System called SciPro, being currently tested at University of Rwanda, will be used for online thesis supervision in an effective way and ensure future full implementation at all colleges of the University of Rwanda for Bachelor's and Master's Programs. Filling this questionnaire takes only about 10 minutes. In case you have any problem, please contact me at byungura@gmail.com or +250788599675.

Thank you for cooperation!

Part 2: General Information

1. Gender

Male

Female

2. Age group

Below 30

31-40

41-40

51-60

60 and above

3. Your academic rank

Full Professor

Associate Professor

Senior Lecturer / Researcher

Lecturer / Researcher

Assistant Lecturer / Research Assistant

Tutorial Assistant / Junior Researcher

4. Which college of University of Rwanda are you from?

CE

CBE

CST

CHMS

CASS

CAVM

Any other Unit/Department

5. Experience in the academic and research field

Less than a year

1-3 Years

4-6 Years

7-9 Years

10 Years and more

6. How many times do you use a computer for different educational activities?

Daily

Twice a week

Weekly

Monthly

Rarely

Never

7. Do you have an IT-support system (s) for management and supervision of thesis at your college?

Yes

No

8. How did you know about SciPro System test as a thesis support system at University of Rwanda?

From College Principal

From the University Website

From the Center for Instruction Technology at UR

From a colleague

Another source not mentioned here

Part 3: About Performance Expectance (PE) for SciPro System (“1” Strongly agree - “7” Strongly Disagree)

How do you agree on the following statement?

“Using SciPro System in supervising student's thesis would....”

1. Enable me to accomplish tasks more quickly.
2. Improves the quality of the supervision work I do
3. Gives me greater control over my supervision work
4. Increases my productivity
5. Make it easier to do the supervision work
6. Enable me save my time for other academic work
7. Increase communication with my students during research
8. Supports critical aspects (Thesis info)
9. Allow me to accomplish more work than would otherwise be possible

Part 4: About Effort Expectance (EE) for SciPro System (“1” Strongly agree - “7” Strongly Disagree)

How do you agree on the following statement?

1. Learning to use SciPro is easy for me
2. It is easy to get SciPro to do what I want it to do
3. SciPro resources are easy to explore

4. SciPro interface is a user-friendly
5. I find easy to see the research project state
6. SciPro resources are easy to understand their purpose for supervision process
7. I find easy to use SciPro forum to communicate
8. With SciPro it is easy to plan activity of the thesis process
9. It is easy to produce thesis grading report in SciPro
10. I find it easy to use Anti-plagiarism in SciPro

Part 5: About Social Influence (SI) for SciPro System integration at UR (“1” Strongly agree - “7” Strongly Disagree)

How do you agree on the following statement?

1. My fellow academicians believe that I should use SciPro System
2. The University is much concerned about the use of SciPro System
3. Using SciPro System for thesis supervision will be a status symbol in my college
4. SciPro Team has been helpful in getting familiar with the system
5. The center that invited me think that I should use SciPro after test
6. The technical team is very supportive for the training and use of SciPro during test

Part 6: About behavioral intentions (BI) regarding SciPro System

How do you agree on the following statement?

1. I intend to use the SciPro in thesis supervision if other prerequisites are fulfilled.
2. I perceive using SciPro System as not obligatory
3. I plan to use SciPro System in the next few months.
4. I would use SciPro System to perform other tasks than only thesis supervision
5. To the extent possible, I would use SciPro System to improve quality of research at UR

Part 7: About Facilitating Conditions (FC) regarding SciPro System integration at UR

How do you agree on the following statement?

1. I have the resources necessary to use SciPro System at UR
2. I have the knowledge necessary to use the SciPro System at UR
3. Using SciPro System fits into my work style
4. The training manual is well documented to enable me master SciPro System

5. The technical support is available for help with the SciPro System difficulties
6. The SciPro System is compatible with other computer facilities at UR
7. The E-learning policies are available and supportive to use SciPro System at UR
8. There are incentives to motivate me use SciPro System
- 9.

Part 8: About Use Behavior (UB) on SciPro System at UR

How do you agree on the following statement?

1. I will use SciPro System on a daily basis
2. I will use SciPro System to train other fellow staff
3. I will use SciPro System because it is an innovative tool
4. I will use SciPro System because it is adapted to modern devices (Tablet, Laptop and Desktop)
5. I will use SciPro System on different web browsers

Further suggestions for improvements of SciPro System for the University of Rwanda Context:



Thank you very much for your input!

Appendix 2. Summary of statistical regression analysis

Appendix for regression analysis conducted:

Constructs and Hypothesis	Code	B	Beta	R Square	Adjusted R Square	Sig. (P-Value)
PE - BI						
SciPro System performance expectancy will positively influence Supervisors' behavioral intention.	H1	(.287)	(.243)	.245	.185	.139
EE - BI						
The supervisors' effort expectancy will positively influence their behavioral intention toward SciPro System.	H2	.449	.470			.006
SI - BI						
Social Influence will positively influence the supervisors' behavioral intention	H3	.173	.227			.126
FC - UB						
UR's facilitating conditions will positively influence the degree of acceptance and use of SciPro in thesis process.	H4	.639	.543	.396	.365	.000
BI - UB						
Supervisors' behavioral intention will have a positive influence on SciPro System acceptance and usage to support thesis process at University of Rwanda.	H5	.354	.164			.237

Appendix 3. Statistical regressions for hypotheses and variables

→ Regression

[DataSet1] /Users/jeanclaude/Documents/Work/JIBS2013/Courses Year 1/Master Thesis/Final MSc Thesis/Thesis Data/Advanced Data analysed.sav

Warnings

For models with dependent variable Behavior Intension, the following variables are constants or have missing correlations: Performance Expectancy. They will be deleted from the analysis.

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	Social Influence, Effort Expectancy ^b	.	Enter

a. Dependent Variable: Behavior Intension

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.597 ^a	.356	.323	.34343

a. Predictors: (Constant), Social Influence, Effort Expectancy

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.543	2	1.272	10.781	.000 ^b
	Residual	4.600	39	.118		
	Total	7.143	41			

a. Dependent Variable: Behavior Intension

b. Predictors: (Constant), Social Influence, Effort Expectancy

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.295	.285		1.033	.308
	Effort Expectancy	.223	.251	.115	.889	.379
	Social Influence	.506	.115	.570	4.392	.000

Appendix

Output4 [Document4] - IBM SPSS Statistics Viewer

REGRESSION
 /MISSING LISTWISE
 /STATISTICS COEFF OUTS R ANOVA
 /CRITERIA=PIN(.05) POUT(.10)
 /NOORIGIN
 /DEPENDENT UB
 /METHOD=ENTER FC BI.

► Regression

[DataSet1] /Users/jeanclaude/Documents/Work/JIBS2013/Courses Year 1/Master Thesis/Final MSc Thesis/Thesis Data/Advanced Data analysed.sav

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	Behavior Intension, Facilitating Conditions ^b		Enter

a. Dependent Variable: Use Behavior
 b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.645 ^a	.416	.386	.70673

a. Predictors: (Constant), Behavior Intension, Facilitating Conditions

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.854	2	6.927	13.869	.000 ^b
	Residual	19.479	39	.499		
	Total	33.333	41			

a. Dependent Variable: Use Behavior
 b. Predictors: (Constant), Behavior Intension, Facilitating Conditions

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.108	.375		-.289	.774
	Facilitating Conditions	.448	.107	.535	4.201	.000
	Behavior Intension	.518	.275	.240	1.880	.068

a. Dependent Variable: Use Behavior

Appendix 4. Statistical correlations for the UTAUT constructs with SciPro System

→ Nonparametric Correlations

[DataSet1] /Users/jeanclaude/Documents/Work/JIBS2013/Courses Year 1/Master Thesis/Final MSc Thesis/Thesis Data/Advanced Data analysed.sav

Correlations

			Use Behavior	Facilitating Conditions	Social Influence	Effort Expectancy	Performance Expectancy	Behavior Intension
Spearman's rho	Use Behavior	Correlation Coefficient	1.000	.563**	.102	.384*	.	.303
		Sig. (2-tailed)	.	.000	.521	.012	.	.051
		N	42	42	42	42	42	42
	Facilitating Conditions	Correlation Coefficient	.563**	1.000	.107	.290	.	.164
		Sig. (2-tailed)	.000	.	.502	.063	.	.300
		N	42	42	42	42	42	42
	Social Influence	Correlation Coefficient	.102	.107	1.000	.169	.	.416**
		Sig. (2-tailed)	.521	.502	.	.284	.	.006
		N	42	42	42	42	42	42
	Effort Expectancy	Correlation Coefficient	.384*	.290	.169	1.000	.	.254
		Sig. (2-tailed)	.012	.063	.284	.	.	.104
		N	42	42	42	42	42	42
	Performance Expectancy	Correlation Coefficient	.	.	.	.	1.000	.
		Sig. (2-tailed)	.	.	.	.	.	.
		N	42	42	42	42	42	42
	Behavior Intension	Correlation Coefficient	.303	.164	.416**	.254	.	1.000
		Sig. (2-tailed)	.051	.300	.006	.104	.	.
		N	42	42	42	42	42	42

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

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