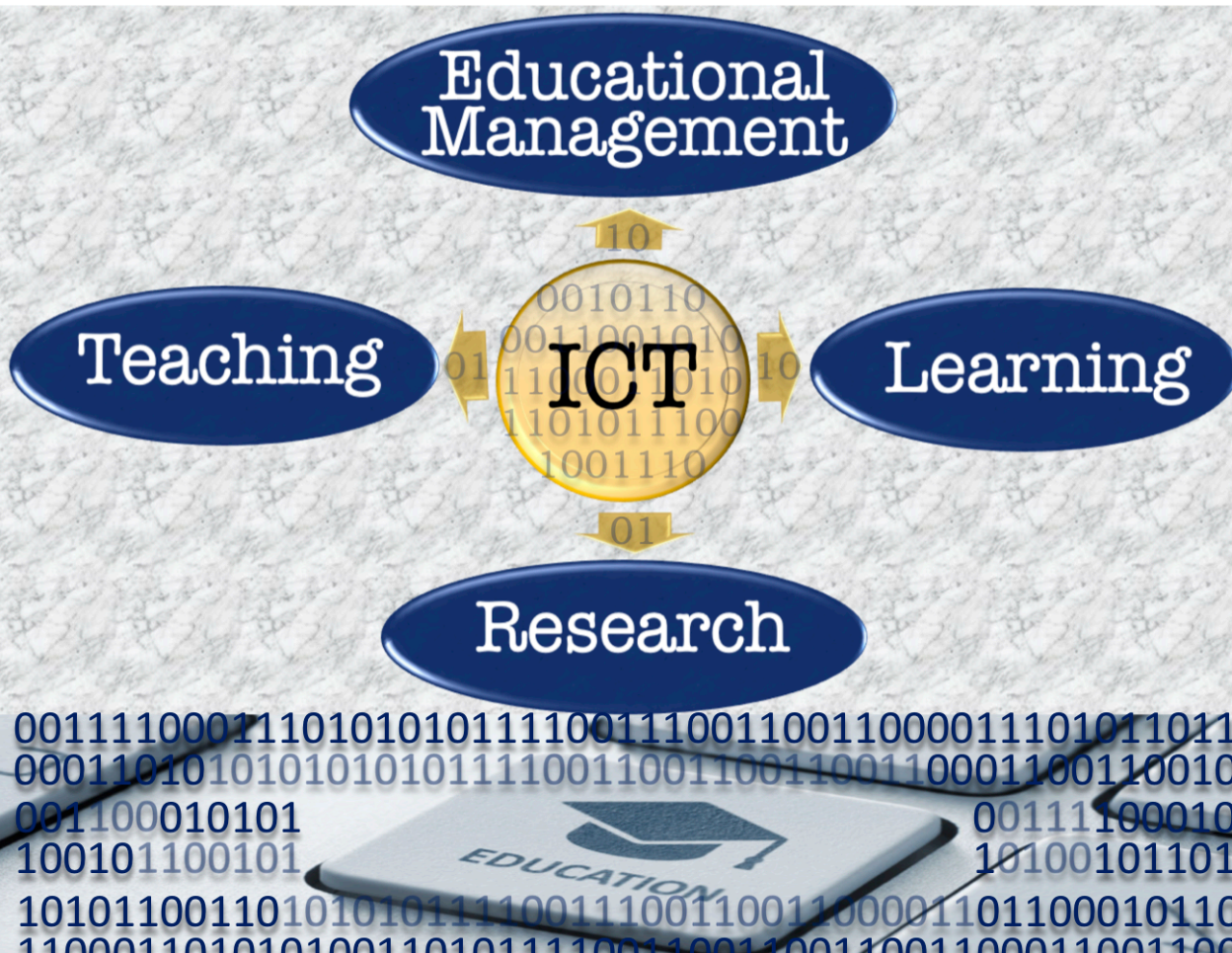Stockholm
University

Improving IT Integration for Higher Education Institutional Performance

Towards a Contextualised IT-Institutional Alignment Model

Jean Claude Byungura

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Abstract

The integration of information technology (IT) into service delivery is currently seen as an innovative strategy to support the modernising of universities worldwide. However, in some institutions in developing countries, including Rwanda, IT has failed to add the intended value to university services, despite huge associated investments in IT. Consequently, IT-organisational alignment continues to be a primary concern for university managers. This alignment is viewed in terms of its strategic, socio-cultural, and technological dimensions. For effective IT-institutional alignment, several antecedents (*alignment practices*) for creating an appropriate fit between IT and organisations have been suggested in the literature. However, several studies exploring IT alignment focused mainly on general business companies, and similar research with an emphasis on higher education institutions is still scarce. Therefore, the aim of this research was twofold: firstly, it attempted to understand the process of IT integration into universities; and secondly, to propose a contextual model for IT-institutional alignment within a higher education context. A design science research methodology (DSRM) was applied in this research, using surveys and case studies as research strategies. Preliminary findings at the exploration phase of this research indicated a strong misalignment between IT and the university services caused by the lack of clearly defined alignment practices. Furthermore, as the research main outcome, an IT-Institutional Alignment Model (ITIAM) was proposed after reaching an understanding of the current state and challenges related to IT integration into teaching, learning, research and university administration. This model includes 44 alignment practices, related to both technical and non-technical dimensions. These alignment practices were clustered under six categories: (1) *Communication, (2) Structure/Governance, (3) Technology Scope, (4) Competence/Value Measurement, (5) Skills, and (6) Partnership*. Alignment practices related to institutional structure and governance, skills and communication were found to have a strong positive influence on the institutional performance, as compared to those related to competence and value measurement, partnership, and technology scope. Based on the research findings, the proposed ITIAM, which was iteratively tested and evaluated using case study institutions, was found to be a relevant tool for guiding the implementation of IT systems towards the improvement of institutional performance. Hence, this thesis makes a theoretical contribution by applying the concept of IT alignment within a higher education context and by documenting the empirically tested contextual alignment practices as conveyed in the ITIAM Model. Additionally, as a practical implication, the results can serve as a reference for an effective IT integration process in university services and for how to improve performance through effective use of IT in teaching, learning, research and educational management.

Keywords: *IT integration, IT alignment, Alignment practices, Design science research, Innovation diffusion, Technology adoption, Institutional performance, Higher education, Artefact Evaluation.*

Department of Computer and Systems Sciences

IMPROVING IT INTEGRATION FOR HIGHER EDUCATION
INSTITUTIONAL PERFORMANCE

Jean Claude Byungura

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Towards a Contextualised IT-Institutional Alignment Model

Jean Claude Byungura

Dedication to:
My lovely Wife
Angelique Uwamwezi,
My son
Aldo Bryan B. Shema,
My daughter
Ange Audrey B. Sangwa,

And my entire family
and friends .....!

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Contents

Abstract

The integration of information technology (IT) into service delivery is currently seen as an innovative strategy to support the modernising of universities worldwide. However, in some institutions in developing countries, including Rwanda, IT has failed to add the intended value to university services, despite huge associated investments in IT. Consequently, IT-organisational alignment continues to be a primary concern for university managers. This alignment is viewed in terms of its strategic, socio-cultural, and technological dimensions. For effective IT-institutional alignment, several antecedents (*alignment practices*) for creating an appropriate fit between IT and organisations have been suggested in the literature. However, several studies exploring IT alignment focused mainly on general business companies, and similar research with an emphasis on higher education institutions is still scarce. Therefore, the aim of this research was twofold: firstly, it attempted to understand the process of IT integration into universities; and secondly, to propose a contextual model for IT-institutional alignment within a higher education context. A design science research methodology (DSRM) was applied in this research, using surveys and case studies as research strategies. Preliminary findings at the exploration phase of this research indicated a strong misalignment between IT and the university services caused by the lack of clearly defined alignment practices. Furthermore, as the research main outcome, an IT-Institutional Alignment Model (ITIAM) was proposed after reaching an understanding of the current state and challenges related to IT integration into teaching, learning, research and university administration. This model includes 44 alignment practices, related to both technical and non-technical dimensions. These alignment practices were clustered under six categories: (1) *Communication, (2) Structure/Governance, (3) Technology Scope, (4) Competence/Value Measurement, (5) Skills, and (6) Partnership*. Alignment practices related to institutional structure and governance, skills and communication were found to have a strong positive influence on the institutional performance, as compared to those related to competence and value measurement, partnership, and technology scope. Based on the research findings, the proposed ITIAM, which was iteratively tested and evaluated using case study institutions, was found to be a relevant tool for guiding the implementation of IT systems towards the improvement of institutional performance. Hence, this thesis makes a theoretical contribution by applying the concept of IT alignment within a higher education context and by documenting the empirically tested contextual alignment practices as conveyed in the ITIAM Model. Additionally, as a practical

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Keywords: *IT integration, IT alignment, Alignment practices, Design science research, Innovation diffusion, Technology adoption, Institutional performance, Higher education, Artefact Evaluation.*

Sammanfattning

Integrationen av informationsteknik (IT) ses idag som en innovativ strategi för att stödja moderniseringen av universitet över hela världen. På vissa universitet i utvecklingsländer, däribland Rwanda, har man dock misslyckats med att ytterligare öka det avsedda värdet av universitetstjänster med hjälp av IT, trots stora investeringar. Såldes kvarstår IT/verksamhetssamverkan som en primär angelägenhet för universitetsledningar. Denna samverkan är betydelsefull ur ett strategiskt, sociokulturellt och tekniskt perspektiv. Många förutsättningar (anpassningsförfaranden) för att kunna skapa en lämplig anpassning mellan IT och organisationer har föreslagits i litteraturen. Flera studier av IT-anpassning fokuserar emellertid huvudsakligen på privata företag; liknande studier med inriktning på institutioner inom högre utbildning är fortfarande få till antalet. Syftet med detta forskningsprojekt är tvåfaldigt: för det första att försöka förstå processen för IT-integration på universiteten, och för det andra att föreslå en kontextuell modell för IT- anpassning för institutioner inom högre utbildning. Som metodologisk grund användes Design Science med undersökningar och fallstudier som forskningsstrategier. De preliminära resultaten i undersökningsfasen pekade på en tydlig missanpassning mellan IT och universitetstjänster, orsakade av brist på väldefinierade anpassningsförfaranden. Givet situationen och utmaningarna i samband med IT-integration i undervisning, lärande, forskning och universitetsadministration, föreslås en anpassningsmodell för IT/verksamhetssamverkan (ITIAM). Denna modell innehåller 44 anpassningsförfaranden, relaterade till både en teknisk och en icke-teknisk dimension, grupperade under sex kategorier: (1) kommunikation, (2) struktur/styrning, (3) teknikomfattning, (4) kompetens/värdemätning, (5) färdigheter, samt (6) samarbete. Anpassningspraxis relaterad till en institutionell struktur och styrning, samt till kompetens och kommunikation, visade sig ha ett starkt positivt inflytande på den institutionella utvecklingen, jämfört med de som rör kompetens och värdemätning, samarbete och omfattningen av teknik. På grundval av forskningsresultaten bedöms den föreslagna anpassningsmodellen ITIAM, som iterativt testades och utvärderades med hjälp av fallstudier, vara ett relevant verktyg för att styra implementeringen av IT-system i

syfte att förbättra den institutionella utvecklingen. Därmed ger denna avhandling ett teoretiskt bidrag genom att tillämpa begreppet IT-anpassning inom sektorn för högre utbildning, samt genom att dokumentera de empiriskt testade kontextuella anpassningsrutinerna som förmedlas i ITIAM-modellen. Dessutom kan resultaten fungera som referens för en effektiv IT-integrationsprocess av universitetstjänster och hur man förbättrar prestanda genom effektiv användning av IT inom undervisning, lärande, forskning och utbildningsförvaltning.

Nyckelord: *IT-integration, IT-anpassning, Anpassningsförfaranden, Designvetenskaplig forskning, Innovationsdiffusion, Teknologiadoption, Institutionell prestanda, Högre utbildning, Artefaktutvärdering*

Acknowledgements

May the Almighty bless you all!

List of abbreviations and acronyms

AVE	Average Variance Extracted
CIO	Chief Information Officer
CIT	Centre for Instructional Technology
DSR	Design Science Research
DSRM	Design science research methodology
DSV	Data-Och Systemvetenskap
EDA	Exploratory Data Analysis
HEIs	Higher education institutions
IEMIS	Integrated educational management information system
ICT	Information and communication technologies
ICT-CB	Information and communication technology-capacity building
ISAE	Institut Supérieur d'Agriculture et de l'Elevage
IS	Information systems
IT	Information technology
ITIAM	IT-institutional alignment model
ITS	Integrated tertiary software
KIST	Kigali Institute of Science and Technology
KIE	Kigali Institute of Education
LMS	Learning management system
MIS	Management information systems
MINEDUC	Ministry of Education
MYICT	Ministry of Youth and ICT
NUR	National University of Rwanda
PDA	Personal digital assistant
RDB	Rwanda Education Board
SAM	Strategic alignment model
SciPro	Scientific process
SFB	School of Finance and Banking
TPACK	Technological, pedagogical, and content knowledge
UR	University of Rwanda
UTAUT	Unified theory of acceptance and use of technology

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List of Publications

Paper 1:
Byungura, J. C., Hansson, H., Masengesho, K., & Karunaratne, T. (2016). ICT capacity building: A critical discourse analysis of Rwandan policies from higher education perspective. *European Journal of Open, Distance and E-learning*, 19(2), 46-62.

Paper 2:
Byungura, J. C., Hansson, H., & Karunaratne, T. (2015). User perceptions on relevance of a learning management system: An evaluation of behavioral intention and usage of SciPro system at University of Rwanda. In *Proceedings of the European Distance and E-Learning Network (EDEN) 2015 Annual Conference, Barcelona, Spain, 9-12 June,* (pp. 549-562).

Paper 3:
Byungura, J. C., Hansson, H., Mazimpaka, O., & Thashmee, K. (2016, May). Exploring teacher adoption and use of an upgraded eLearning platform for ICT capacity building at University of Rwanda. In *IST-Africa Week Conference, 2016* (pp. 1-11). IEEE.

Paper 4:
Byungura, J. C., Hansson, H., Muparasi, M., & Ruhinda, B. (2018). Familiarity with technology among first-year students in Rwandan tertiary education. *Electronic Journal of e-Learning*, 16(1), 30-45.

Paper 5:
Byungura, J.C, Hansson, H., & Ruhinda, B. (2019). Integrated computer-based management information systems: The complexity and diffusion in Rwandan higher education institutions. *International Journal of Education and Development using Information and Communication Technology*, 15 (1), 55-75.

Paper 6:
Byungura, J.C, Hansson, H., Kamuzinzi, M., & Ulf, O. (2019). An exploratory study on the practices of IT-Institutional alignment for effective ICT integration in university services. *International Journal of Education and Development using Information and Communication Technology*, 15 (1), 76-98.

Paper 7:
Byungura, J. C. & Hansson, H. (2019). Development and validation of a holistic IT-institutional alignment model for higher education institutional performance. In K. Graziano (Ed.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 1279-1290). Las Vegas, NV, United States: Association for the Advancement of Computing in Education (AACE).

Paper 8:
Byungura, J.C.; Hansson, H. & Olsson, U. (*Under Review,*). Evaluating the Model of IT-Institutional Alignment Practices for Higher Education Institutional Performance. Stakeholders' insights. *Journal of Information Technology for Development*. Submitted in May 2019.

Papers not included in this thesis

Paper 1:
Muianga, X., Byungura, J. C., Hansson, H., Colombage, R. P., & Mutimucuio, I. (2016, November). Blended learning systems in tertiary education: A comparative analysis of two universities from Rwanda and Mozambique. In *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 1006-1015). Association for the Advancement of Computing in Education (AACE).

Paper 2:
Sneiders, E., Byungura, J. C., Henkel, M., & Perjons, E. (2017, March). Potential of language technology to support public organizations and their communication channels in a developing country. In *Proceedings of the 10th International Conference on Theory and Practice of Electronic Governance* (pp. 236-244). ACM.

Paper 3:
Karunaratne, T., & Byungura, J. C. (2017, May). Using log data of virtual learning environments to examine the effectiveness of online learning for teacher education in Rwanda. In *IST-Africa Week Conference (IST-Africa), 2017* (pp. 1-12). IEEE.

1. Introduction

This doctoral research investigates the alignment between information technology (IT) and higher education institutions (HEIs) from the perspective of developing regions, and in particular in the context of higher education in Rwanda. It focuses mainly on how institutional practices related to IT integration in university services can contribute to academic and managerial performance. The research setting of this thesis involves several cases of IT systems under implementation and the areas of IT integration within the university, which include teaching, learning, research and administration.

Hence, the research activities undertaken in this thesis are framed within the area of IT alignment practices and institutional performance. From here onward, terms such as IT, ICT, technology, and IT systems are used interchangeably to mean "information technology."

As a starting point, this section provides a description of the key terms used in this thesis. Following this, the research background and context, research problem, aim, significance, objectives, and research questions are also introduced. The research setting, motivation, scope and delimitations are also presented. This chapter ends with an outline of the overall thesis.

1.1. Description of Key Terms

The key terms used in this thesis are described in this section. The aim of defining these basic concepts is to provide a clear understanding of this research to the reader.

IT alignment: Also described as "alignment" or "IT fit" in the academic literature, this concept has been used with a variety of meanings (Chan & Reich, 2007; Chen, 2010; Henderson & Venkatraman, 1999; Luftman, 2003). Within the discipline of management information

systems, IT alignment is described as the degree of fit between IT and organisations. In general, this alignment is defined as the degree to which the organisational and IT missions, plans, objectives and strategies are in harmony. In this thesis, the concept of IT alignment can be understood as the extent to which the university's main activities of teaching, learning, research and administration are supported by institutional IT plans, strategies and operations. Following the definition of Henderson and Venkatraman (1999), IT alignment is used in this research as the fit between institutional and IT strategies on one side, and institutional and IT infrastructure on the other.

Alignment practices: All antecedents to achieving a particular degree of IS strategic alignment with organisations are conceptualised as "alignment practices" (Preston & Karahanna, 2009; Vermerris, Mocker, & Van Heck, 2014). This concept can be understood as the factors or conditions that can contribute to organisational business and IT alignment.

IT/ICT integration in education: This concept is described as the process of using IT tools such as computers (hardware, software), the internet and associated digital technologies to support teaching, learning, research and educational administrative processes (Bingimlas, 2009; Wagner et al., 2005).

Institutional performance: From a higher education perspective, this concept can be understood as referring to both academic and managerial performance (Wang, Mol, & Jongbloed, 2010). In this research, academic performance is described as the degree to which universities, teachers, and learners have achieved their education-related goals through the integration and use of IT tools. Managerial performance is defined in this research as the extent to which universities can satisfy their customers (students and other partners) by using IT in service delivery. While academic performance involves measurement criteria from the dimensions of teaching, learning and research (Lindsay, 1982; Wang et al., 2010), managerial performance indicators are considered from financial, student, and personnel administration perspectives (Wang et al., 2010; Zainally, 2008).

1.2. Research Background

Nowadays, organisations rely heavily on IT to support service delivery at every level and to improve institutional performance. Thus, huge IT-related investments are made for the creation of business value, but organisations do not always gain the associated positive returns (Bowen, Cheung, & Rohde, 2007). This trend is also evident in the education sector. Advances in technology have dramatically changed higher education systems over the past few years, and information and communication technologies (ICTs) continue to play an important role in modernising teaching, learning, research and administrative services in universities all over the world (Bates, 2000; Snyder, Marginson, & Lewis, 2007). Nevertheless, in some developing regions, education institutions have failed to gain competitive advantage from IT investments, and there is still no innovation in university processes (Bates, Bates, & Sangra, 2011; Buabeng-Andoh, 2012; Kirkup & Kirkwood, 2005; Sife, Lwoga, & Sanga, 2007). From a general viewpoint, one of the problems related to this failure is that the acquired IT systems are not aligned with an organisation's activities. Therefore, a failure to integrate IT into service delivery is a result of IT and organisational misalignment (Luftman, Ben-Zvi, Dwivedi, & Rigoni, 2012). Accordingly, the challenges related to IT-organisational alignment can be examined from both technical and non-technical perspectives, as the technology integration process involves IT, human, institutional structure, and policy factors, among others.

Despite considerable investments in IT, claims have been made by scholars and practitioners that there is still misalignment between new technologies and university services, more particularly in developing countries (Kashorda & Waema, 2011). This problem often arises in HEIs in developing countries. In some cases, there may even be no strategic framework or clear policies to guide the implementation of ICT within HEIs (Sife et al., 2007; Tedla, 2012), making it even harder to measure whether or not a particular technology has added value to the current university services. This concern is particularly noticeable in several Rwandan HEIs.

In general, IT-business alignment is described in the literature as the degree of fit between IT strategies and IT infrastructure, and business strategy and organisational infrastructure (Chan & Reich, 2007; El-Mekawy, Rusu, & Perjons, 2015; Luftman, 2003). This alignment is

effective when institutional goals and activities fit with the IT systems that are implemented within the organisation. In view of the importance of IT-business alignment, this is no longer a question that solely concerns the organisational leadership. Instead, current concerns for institutional top managers relate to how this alignment can be created, improved and maintained across all units (El-Mekawy et al., 2015; Leonard & Seddon, 2012).

Like any other type of organisation, universities are concerned with the planning, acquisition, implementation and management of IT applications to ensure their successful integration and positive impact on the institution's operations. As pointed out by Brown and Motjolopane (2005), technology and business alignment is a concern not only for general business companies but also for academic institutions. Aligning IT and educational activities is therefore viewed as an important key not only to gain value from IT investments but also to improve institutional performance. The integration of IT systems into some university structures continues to increase complexity (Wang, Han, & Yang, 2015), which in turn leads to low rates of adoption and use of new technologies. Thus, strategies, models and methods must be put in place to guide practitioners in creating and assessing the alignment of technology and university services. This alignment is achieved through a set of practices that can be understood from both social and technical perspectives.

1.3. Research Context

This research was carried out mainly in Rwanda, a landlocked developing country in the East African region. Although a broad perspective was adopted to develop a theoretical underpinning for this research, this work was primarily undertaken in Rwanda as a geographical research context. Hence, government institutions related to education and ICT, public and private universities, research participants, IT systems and ICT policies were selected in Rwanda. The participants in this research were drawn from technical, managerial and academic dimensions.

1.3.1. Overview of ICT in Education in Rwanda

Rwanda has experienced widespread tragedy, due to the 1994 genocide and civil wars in which millions of skilled people in various domains lost their lives. Likewise, the education sector was also affected by this catastrophe. It was after this genocide that the new government of Rwanda (GoR) put in place policies and strategies for rebuilding the country in all sectors, including education. One of the leading strategic plans at national level was the Rwanda Vision 2020 (MINECOFIN, 2000). This guiding document sets out the country's six strategic pillars for achieving the planned sector-level objectives, and education, and ICT are among these pillars.

As articulated in the Rwanda Vision 2020, one of the sectors to be focused on in transforming the country from an agricultural-based economy to a knowledge-based economy is the Rwandan education system. The integration and use of ICT are therefore considered to be key strategies for the above transformation. This statement is also emphasised in the national-level ICT in Education policy (GoR, 2008) in the following four major areas of focus:

- Preparing all sectors of the education system to understand the investment in and value of technology.
- Preparing schools to accept technology, and procuring and installing this technology.
- Implementing an education management information system (EMIS) and providing ongoing technical support.
- Developing and managing content and integrating the curriculum.

The Ministry of Education in Rwanda is responsible for the above-stated policy and for the implementation of ICT in education at the national level. Due to the effective integration of ICT, and since ICT takes the form of new artefacts being introduced to the academic community, the Rwandan higher education system has been experiencing systematic and radical institutional reforms. These transformations have taken place not only in teaching and learning, but also in research and administrative processes, with the primary aim of improving the quality of education and research, as well as innovation in administrative services. Similarly, to streamline the higher education system in Rwanda, both private and public universities operate under the supervision of the Rwanda Higher Education Council (HEC). The mandate of HEC is to

ensure the structure and functioning of HEIs in Rwanda and to monitor and evaluate the standard of provision and ensuring the quality of teaching and research.

As part of these educational reforms, all former public universities and higher learning institutes were merged together to form a single public University of Rwanda (UR). This decision was made by the Rwandan cabinet (GoR, 2013) to optimise the use of educational resources and infrastructure while also increasing the quality of education through innovation in service delivery. This new institution is made up of the following six colleges scattered across the country:

- College of Arts and Social Sciences
- College of Science and Technology
- College of Education
- College of Medicine and Health Sciences,
- College of Agriculture and Veterinary Medicine,
- College of Business and Economics.

In this institution, the integration of ICT into service delivery at the new university of Rwanda has therefore been seen as one of the most important aspects supporting various innovative reforms at this institution. Likewise, these institutional reforms were undertaken in the expectation that ICT resources would be a pillar supporting both managerial and academic processes (UR, 2014). It is from this perspective and based on the inspiration of the Rwandan ICT in Education policy that a number of IT support systems have been acquired to support teaching, learning, research and the general educational management of universities in Rwanda.

This doctoral research has therefore been mainly conducted across all the UR colleges. Other selected private universities were also involved in this research to some extent, based on their willingness to participate. In addition, preliminary field research visits were made in several universities in developing countries, with the aim of observing the process and perceiving the status of IT integration in service delivery. These research-based visits enabled to gather in-depth knowledge on the practices of aligning the IT systems being implemented with teaching, learning, research and administrative activities.

1.4. Research Problem

As the integration of IT tends to increase complexity within university service delivery, it needs to be managed properly. Despite the efforts made by HEIs to integrate IT systems and related IT investments, there are currently a number of concerns regarding how technology can best be aligned with educational activities (Brown & Motjolopane, 2005). Relevant practices for aligning technology with university operations to add value to teaching, learning, research and administration are not clearly understood. Consequently, this lack of alignment has led to the failure of a substantial number of IT projects in several HEIs in developing countries (Buabeng-Andoh, 2012; Byungura, Hansson, & Thashmee, 2015; Khan, Hossain, Hasan, & Clement, 2012; Mtebe & Raisamo, 2014).

Particularly in Rwanda, poor-quality ICT infrastructure and access to the internet, and a lack of adequate ICT skills are challenges that have affected the integration of technology in higher education (Farrell, 2007; Muianga, Byungura, Hansson, Colombage, & Mutimucuio, 2016; Mukama, 2009). In addition, the IT systems that are currently available at UR, for example, are not optimally used, despite massive investment. Likewise, system users such as teachers do not use the university's e-learning platform, even after training. Also, administrators are trained to use the integrated computer-based management information system, but this system is not used as intended, amid claims that users do not have adequate IT competence. Another system for research management and thesis support has been developed since 2014, but its implementation has not materialised (Byungura et al., 2015).

A study by Mukama (2009) reported several individual and institutional IT-related constraints from the students' perspective that hinder the adoption and use of IT systems within universities in Rwanda. These institutional constraints include internet outage, high student-computer ratios, and the low level of ICT literacy of teachers. Individual challenges mainly include late exposure to IT tools and the internet within the complex university learning environment, which make students, who are the novice IT users, passive and reluctant to use technology for learning purposes.

With the aim of benchmarking and guiding the implementation of technology within HEIs, several models, methods and frameworks have

been developed by researchers and practitioners (Graham, Woodfield, & Harrison, 2013; Kashorda & Waema, 2011; Machado, 2007; Motiwalla, 2007). However, these artefacts lack clarity, completeness and focus in terms of which practices should be undertaken to create and benchmark alignments between IT and institutional services. Hence, the concept of IT-business alignment is not clearly reflected in artefacts related to the integration of IT within educational institutions. Moreover, most of the existing models and frameworks in the literature need to be adapted to specific contexts, such as the higher education sector in Rwanda, for example.

However, the alignment between IT and business and related practices has been extensively explored in other sectors. Practices related to IT-organisational alignment are described as a set of antecedents or processes that are intended to improve the fit between IT and the organisational business (Chan, Sabherwal, & Thatcher, 2006; Kearns & Sabherwal, 2006; Luftman, 2003; Luftman et al., 2012; Preston & Karahanna, 2009; Vermerris et al., 2014). As a result, a substantial number of business-IT alignment models have been developed, typically for general business companies (Alaceva & Rusu, 2015; L. Chen, 2010; El-Mekawy et al., 2015; Leonard & Seddon, 2012). These models and frameworks are mostly related to a methodology for assessing organisational alignment proposed by Luftman (2003). The latter methodology proposed six strategic categories of IT-business alignment maturity: governance, communication, technology scope, competence/value measurement, skills, and partnership.

One research gap arises from the fact that the development of these models and frameworks has been particularly inspired in the context of companies in developed regions. Another is that these existing models and frameworks do not consider the higher education sector at all, Therefore, research into alignment practices in the context of higher education in developing countries is scarce, and this forms another research gap. It is difficult to apply the available models and practices of IT-institutional alignment in the literature when implementing IT systems in higher education environments, such as in Rwanda or similar contexts. A contextualised IT alignment model for the higher education sector could be important in guiding the process of IT implementation in Rwandan universities and similar settings.

In the area explored under preliminary studies of this research, no study has so far investigated the contextual practices of IT-institutional alignment within the context of higher education in developing regions, and more particularly in Rwanda. A research problem is therefore identified in that there is a misalignment between IT and institutional services in the context of Rwandan higher education, and there is no clear model of alignment practices in place to serve as a reference for the effective integration of IT into teaching, learning, research and administrative functions.

1.5. Research Aim, Questions, Objectives and Significance

Due to the complexity of the higher education sector, it remains a substantive challenge to build various ICT capacities through the integration of technology. As explained in the previous section, one of the most critical aspects of this challenge is the misalignment between IT and university activities such as teaching, learning, research and administration. In this section, the main research aim and specific objectives are presented as part of addressing this challenge. The research questions guiding the overall research process are also stated in this section.

1.5.1. Research Aim

The aim of this research is twofold. Firstly, it intends to understand how and to what extent IT is integrated into university processes. Secondly, it aims to develop a contextual IT-institutional alignment model that contains relevant practices for improving institutional performance through the effective adoption and use of technology in Rwandan HEIs.

1.5.2. Research Objectives

The main purpose of this research was achieved by addressing the following three research objectives. A summary of the research aim and objectives and the studies involved is presented in Figure 1.

(1) *To understand how and to what extent ICT is integrated into teaching, learning, research, and administration services at UR.*

This forms the starting point of the overall research. At this stage, the goal was to provide an in-depth understanding of the research area: in this case, the alignment of IT with teaching, learning, research and administration. We also aimed to identify the knowledge gap from the broad and contextual perspective of ICT integration in a higher education setting. The intention here was to contextualise the research and prepare for the next stage. The findings of this stage were reported in Papers 1 to 5.

(2) *To design and develop a contextual IT-institutional alignment model with relevant practices for effective technology implementation in Rwandan higher education.*

The studies carried out at this stage were based on the findings from Stage 1 of this research. After gaining an understanding of the context and the knowledge gap related to the integration of ICT within Rwandan higher education, alignment practices related to IT-institutional alignment were suggested and presented within a framework. Subsequently, a model for IT-institutional alignment for university performance was designed and developed. The findings at this stage were reported in Papers 6 and 7.

(3) *To evaluate a contextual IT-Institutional alignment model for higher education institutional performance in Rwanda.*

The last goal of this research was to evaluate the developed IT-institutional alignment model using a selected number of case study institutions in Rwanda. This goal was achieved by conducting an artefact (model) evaluation and reporting the outline of the evaluation results. The findings related to Research Goal 3 are presented in Paper 8.
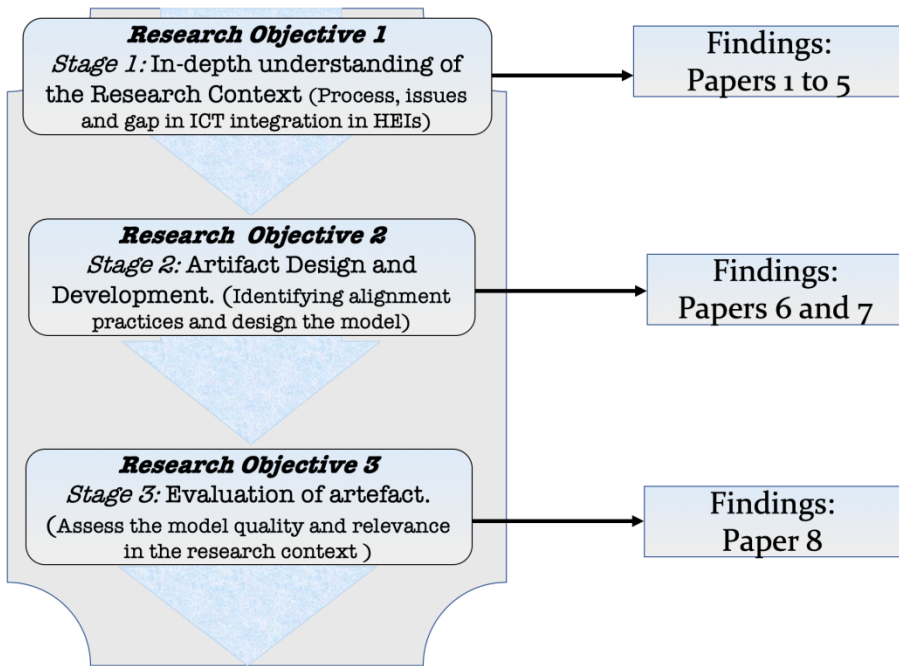
Figure 1. Summary of the research objectives and the studies involved

1.5.3. Research Questions

With reference to the above-described misalignment between technology and university core services, and the lack of related practices in the context of higher education, especially in Rwanda, this research was accomplished by addressing the following main research question (RQ): *How can IT and institutional activities be holistically aligned to support the effective integration of IT and performance improvement in Rwandan HEIs?*

In order to simplify the research process and related activities, the main research question was divided into eight sub-questions. The first five sub-research questions were answered during Research Activity 1, which was an exploration phase undertaken to understand the real-world context of IT integration processes.

(1) **(SRQ1)** To what extent do ICT policies within the Rwandan higher education system assert strategies for ICT capacity building?

(2) **(SRQ2)** What are the perceptions of teachers and researchers on the relevance of an online thesis management system for improving the research process at UR?

(3) **(SRQ3)** What are teachers' intentions towards the adoption and use of an upgraded e-learning platform at UR?

(4) **(SRQ4)** To what extent are first-year students at UR familiar with the new technologies used in higher education?

(5) **(SRQ5)** How complex is the integrated educational management information system, and to what extent has it been implemented at UR?

Since the research aim is to explore the problem by referring to the implementation of a number of existing IT systems, three sub-research questions (SRQ2, SRQ3 and SRQ5) correspond to the exploration of IT integration in teaching, learning, research, and educational management services. Moreover, SRQ1 is intended to provide an understanding of policies related to ICT in education that have been put in place to support and guide the integration of IT.

Afterwards, guided by SRQ4, another study was then conducted on the new students starting undergraduate programs at UR, in order to explore their level of familiarity with new technologies that are currently used in the higher education digital learning environment. In general, in this research phase, the aim was to obtain an understanding of the real-world setting and to be able to elucidate the problems and challenges related to the IT integration process in UR as case study institution.

The remaining three research sub-questions corresponded to the design, development and evaluation of a holistic IT-institutional alignment model within the context of higher education. The following three research sub-questions were answered within Research Activities 2 and 3.

(6) **(SRQ6)** What are the dimensions and practices for improving IT and institutional alignment in developing countries' higher education context?

(7) **(SRQ7)** How can a holistic and reliable instrument for creating and measuring IT-institutional alignment be developed within

the context of higher education institutional performance in Rwanda?

(8) **(SRQ8)** What are the perceptions of the university's IT implementation stakeholders on the proposed IT-institutional alignment model?

1.6. Research Significance

This research is significant from both a practical and theoretical perspective. From a theoretical point of view, this research contributes to the knowledge base of IT-organisational alignment with a focus on the higher education sector. Hence, some studies within this overall research were purposively undertaken to increase the awareness of IT-business alignment practices, with the aim of improving institutional performance as a result of the effective integration of information technologies in teaching, learning, research and administration.

From a practical standpoint, these research results can serve as a frame of reference for policy makers in the education sector, university executive managers, IT governance specialists and IT project managers at both senior and middle levels. More particularly, the IT-institutional alignment model (ITIAM) developed here can be used in the rational planning of IT integration within university activities, to enable universities and their partners to assess the state of IT alignment before establishing appropriate strategies for future IT implementation.

Overall, this research is meaningful in the sense that the results of this research aim to inform practitioners and academicians in creating effective IT-institutional alignment, while also improving the use of IT systems for innovation in teaching, learning, research and administrative processes in universities.

1.7. Research Setting and Motivation

This research was undertaken as a multiple-stage process involving a number of IT systems under implementation at UR. The research setting is visualised in Figure 2 below.
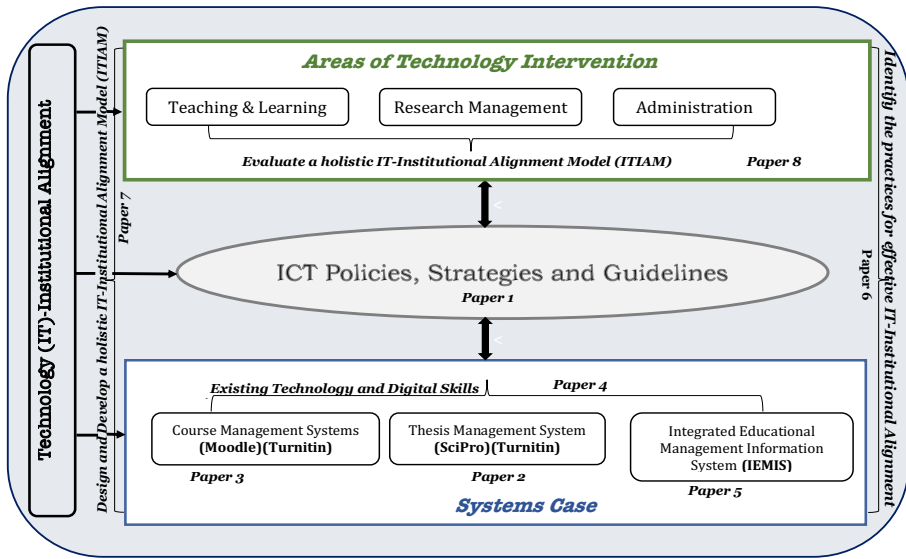
Figure 2. Overall research setting for this work

The point of departure for this research is the analysis of several cases of the implementation of IT systems from a higher education perspective, and most primarily at UR. This research first examines the nature of the ICT in Education policies that are currently in place, and assesses the process of integrating IT systems into teaching, learning, research and general administration.

For teaching and learning activities, an e-learning management system based on Moodle is used as a case study, while for research management, SciPro, a thesis management system is used as a case of an IT system. The integration of Turnitin, an online text-matching tool, which has been integrated with both Moodle and SciPro at UR, is also used. In terms of institutional management and administration, the implementation of an integrated educational management information system (IEMIS) is also explored in order to gain an understanding of how technology is aligned with the university's administrative services. These specific systems were chosen for study since they are currently under the process of implementation at UR.

After this explorative research phase, the next step focused on designing and developing a model for the practice of IT-institutional alignment. Following this, an evaluation of the proposed model was conducted with a selected number of IT governance specialists, faculty members with managerial responsibilities, and policy makers at

national and institutional levels. Before proposing the above research setting, an earlier exploration of the IT integration process within universities in sub-Saharan African developing countries was also conducted.

The motivation for conducting this overall research is derived from the fact that there are several challenges related to the integration of ICT into higher education institutions (Sife et al., 2007) and more particularly in Rwanda (Farrell, 2007; Mukama, 2009). Hence, this research responds to the gap in the existing theoretical and practical knowledge of practices for effectively aligning current and emerging IT with university services. Likewise, this research is inspired by the desire to understand the process of IT value addition within university service delivery, while also contributing to the improvement in IT integration in HEIs from the perspective of developing regions.

1.8. Research Scope and Delimitations

Certain limitations of this research are set out in this section, including limitations on time, geographical location and the IT systems under investigation.

Firstly, this research focused exclusively on IT alignment within HEIs. The concept of IT alignment includes several areas of research focus, such as the dimensions and levels of alignment (Chan & Reich, 2007), and the practices of or antecedents to IT alignment (Chan et al., 2006; Preston & Karahanna, 2009; Vermerris et al., 2014; Yayla & Hu, 2009). Other studies have explored the role of IT alignment within organisational performance, mainly within business organisations (Wu, Straub, & Liang, 2015; Yayla & Hu, 2012). However, similar studies focusing on HEIs are still scarce. Accordingly, this doctoral research is limited to examining alignment practices that can contribute to institutional performance from a higher education perspective.

The scope of this research is also restricted to HEIs within developing regions, and more particularly within the Rwandan higher education sector. Although several types of IT systems have been implemented in Rwandan educational institutions, since this research plan had a five-year timeline, not all of these currently implemented IT systems fell within the scope of this research. Hence, only four IT systems, the UR

Moodle e-learning platform, SciPro, IEMIS and Turnitin, formed the primary focus of this research. The findings of this research are expected to be useful mainly in terms of improving the university's innovation and performance by implementing the best IT-institutional alignment practices. For this reason, other general business companies are not considered in this research.

Furthermore, the effective alignment between IT and an organisation is a dependent factor of several technical and non-technical aspects (Alaceva & Rusu, 2015; Chan & Reich, 2007; Preston & Karahanna, 2009). This research applies this concept to understand and propose relevant practices for effectively aligning IT with the university's activities by considering both technical and non-technical dimensions.

In brief, the central focus of this research is on an understanding of IT-organisational alignment practices within a higher education context, from the perspective of developing countries. More specifically, Rwanda, as a developing country in which ICT is considered an engine for the innovative delivery of education, is a particular focus of this research.

1.9. Outline of the Thesis

This thesis is composed of seven chapters. The first presents the introduction, including the research background, research problem, research aim, objectives, questions and significance. This is followed by a discussion of the research setting and motivation. The scope and limitations of this research are also described in this chapter. Chapter 2 presents the theoretical foundations of this research, and Chapter 3 describes the research methodology and the approaches that have been applied in this research. The overall research process and the activities involved in this research are presented in Chapter 3, followed by the ethical considerations of this research. Chapter 4 summarises and discusses the results of this research, while Chapter 5 discusses the contribution, limitations and further research directions. Chapter 6 examines the validity, reliability and transferability of this research. The last chapter provides general concluding remarks. The eight research papers (Studies 1 to 8) and some research instruments used in this research for data collection are provided in the appendices.

2. Theoretical Background

In this chapter, a theoretical foundation of the integration and alignment of IT with organisations is presented, with a focus on the higher education sector. The first section in this chapter discusses the integration of IT in higher education, including issues related to improvement and sustainability, diffusion of innovation, and the adoption and acceptance of technology in HEIs.

The second section covers the concepts of IT-organisational alignment. These include maturity criteria for IT alignment, a socio-technical perspective on IT alignment within university services, a strategic framework for IT governance, and IT-institutional alignment practices for performance within HEIs. This section also describes the need for research on the relationships and effects of IT-alignment practices on the performance of HEIs in a developing country. A summary of the theoretical background for this research is given in Figure 3.
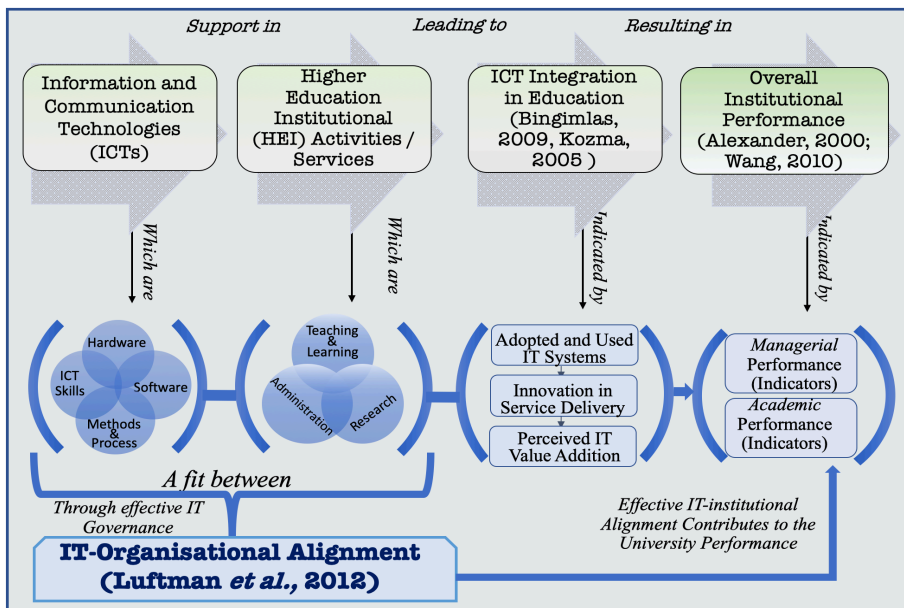
Figure 3. Summary of the theoretical background to this research

2.1. Improving IT Integration and Sustainability in Higher Education

Worldwide, the integration of IT is seen as an important element for educational innovation and improving the quality of education (Bingimlas, 2009). ICTs are also integrated into education to support the achievement of one of the sustainable development goals set by the United Nations: "*Goal 4: Ensure inclusive and quality education for all and promote lifelong learning*" (United Nations, 2015).

However, the integration of IT into university services continues to be a major concern for governments and HEIs (Kozma, 2005; Sife et al., 2007). From a pedagogical perspective, one reason for this is the complexity involved in the IT integration process, as it requires reshaping teaching and learning practices, curriculum reform and developing and acquiring new IT support tools for teaching, learning, research and administration (Khan et al., 2012; Marshall & Ruohonen, 1998). Hence, in some cases, universities have been pushed into institutional reforms to ensure the effective adoption and integration of IT in their activities (Kozma, 2005; Vaira, 2004).

In most universities in developing countries, a number of factors have been involved in the failure to integrate IT within service delivery. A study by Sife et al. (2007) identified the lack of a systemic approach to ICT implementation, low awareness and attitudes towards ICT as the key challenges to IT integration within university services. To address these challenges, the authors suggested putting in place a clear ICT policy and strategic plan for the proper implementation of ICT projects.

In the context of higher education, some prior studies have suggested that the process of integrating IT into service delivery needs to consider aligning the three domains of practice: the organisation, education and technology (Marshall, 2010; Snyder et al., 2007). Accordingly, the suggestion has been made that successful and sustainable ICT integration within universities is a result of alignment between organisational, educational and technological objectives. Institutional support is a backbone for sustainable ICT-mediated innovation in university services (Marshall, 2010). Moreover, IT integration is effective only if there are strong ICT policies, a clear leadership style and sufficient managerial support to enable sustainable ICT-based change. Therefore, technology is not enough in itself to drive positive value in universities without a

conducive institutional environment and educational plans that are ready to be aligned with IT. This is also maintained by Harris (2000) that educational and technological factors always coincide with both organisational and individual factors to guarantee an effective institutional performance though the integration of IT.

2.1.1. IT Integration as an Innovation Diffusion Process

The process of IT integration within education services has been linked with the innovation diffusion process (Rogers, 2010). This theory is widely used in research to understand the state of ICT integration in universities. According to Sahin (2006), the theory of innovation diffusion is the most appropriate concept for exploring the integration of IT into higher education services. This author shows that Rogers' theory of the diffusion of innovation has been applied by scholars from various disciplines, such as economics, political sciences, communications, technology, health sciences and education, among others.

Scholars have considered the integration of IT into university activities as a process whereby individuals with certain characteristics follow a set of stages to integrate a particular IT system in the form of an innovation (Ankem, 2004; Kirkup & Kirkwood, 2005; Tabata & Johnsrud, 2008) Similarly, if innovation is considered as a technology comprising both software and hardware (Rogers, 2010), the potential perceived value of an innovation will affect the individual's decision on whether to adopt it at an early stage of the integration process or to ignore it. Thus, in order to speed up the innovation process across university services, staff and students must be prepared to adopt emerging forms of IT with minimal or no resistance to change.

In a departure from the concept of innovation diffusion, the integration of IT within educational activities starts with the awareness of a newly introduced technology and then proceed with the formulation of attitudes towards this technology. Afterwards, after being introduced to new technologies, people across the organisation make the decision as to whether or not to use that technology. The last stage of the diffusion of innovation is the confirmation of using a new technology to improve university services (Rogers, 2010; Sahin, 2006). At the confirmation stage of an innovation diffusion process, institutions are able to gain an innovative value addition and increase their return on investment in IT. Within a university setting, faculty, students and administrators may

have distinct characteristics that can affect the integration of IT. Therefore, an understanding of these characteristics can form the basis for preparing them to be fully involved in the initial stages of the innovation diffusion process.

2.1.2. Adoption, Acceptance and Use of Technology in Higher Education Institutions

IT integration in higher education also involves an understanding of how people adopt and accept the use of various IT systems in teaching, learning, research, and educational management. Departing from previously established generic models and frameworks for technology adoption and acceptance, several scholars have proposed specific technology acceptance models that have been developed within the context of higher education (Buchanan, Sainter, & Saunders, 2013; Lee, 2006; Usluel, Askar, & Bas, 2008). These scholars have used the concept of technology acceptance to develop contextual models involving new constructs explaining how IT can be effectively adopted and integrated into HEIs.

As an example, using previously established technology acceptance models, Gefen & Straub, 1997; Venkatesh, 2000; Venkatesh & Davis, 2000), Lee (2006) developed a model that included specific factors contributing to the acceptance of e-learning systems. Other scholars have also extended their models to explore the adoption, acceptance and use of course websites and other learning management systems (LMSs) within a higher education context (Edmunds, Thorpe, & Conole, 2012; Park, Lee, & Cheong, 2007; Persico, Manca, & Pozzi, 2014; Schoonenboom, 2014; Selim, 2003; Usluel et al., 2008).

Overall, the results of the above studies focusing on the higher education domain have shown that for successful integration of IT within educational services, the degree of adoption and acceptance of the introduced IT systems is dependent on a number of technical and social factors. The latter include the content quality, perceived network externality, computer self-efficacy, course attributes, subjective norms, perceived usefulness, perceived ease of use, voluntariness and the behavioural intentions to use technology.

The determinants of successful IT adoption and acceptance identified above are primarily psychologically oriented, and have to do with

individual intention and behaviour. However, there are also institutional and technological factors that may affect the adoption and integration of information technology. Institutional factors may include technology leadership and governance, managerial support, the policies and strategies that are in place, the level of training provided and the IT skills available to support teachers and administrators (Buabeng-Andoh, 2012). According to Franklin (2007) and Sandholtz and Reilly (2004), teachers' digital skills and continuous IT-related training are the key determinants of the integration of ICT into teaching and learning activities.

In terms of technological factors, criteria such as the compatibility, relative advantage, observability, trialability and complexity of an innovation are widely discussed in the literature as attributes that determine the likelihood and rate of its adoption and acceptance across an institution (Buabeng-Andoh, 2012; Perry, 2006; Rogers, 2003; Sahin, 2006). From a higher education perspective, researchers such as Buchanan et al. (2013) have claimed that the institutional ICT infrastructure and adequate technical support must be put in place across the university to enable the effective adoption of technology. Thus, although there are several models and mechanisms for effective technology acceptance and use in HEIs, they all state that there is a need to align institutional activities with IT and the organisation itself. The creation and assessment of synergy among these three elements are therefore essential to the effective integration of IT within university services.

2.2.   IT-Organisational Alignment

Over the past decade, the concept of IT alignment with organisations has been discussed in the literature as a primary managerial concern (Aversano, Grasso, & Tortorella, 2012; Luftman, 2004; Vermerris et al., 2014). This concept is posited to explain how a fit can be created and assessed between IT and organisations, meaning that the IT function is in harmony with the business function and vice versa (Chan & Reich, 2007; Chen, 2010; Luftman, 2000). Achieving effective IT-business alignment is a process that continuously evolves based on a set of organisational alignment practices (Vermerris et al., 2014). Hence, this alignment is an adaptive process involving a continuing effort of strategic organisational planning and the implementation of best practices

in terms of both IT and business, to support the achievement of organi-
sational goals.

As postulated by Johnson and Lederer (2010) and Luftman (2000), the
effective IT-organisational alignment is dependent on the degree of un-
derstanding of business objectives and strategies by IT staff and then
the IT function by organisational managers. These researchers also hold
that this alignment requires strong support from senior managers, effec-
tive communication across organisational units, strong IT governance
and institutional leadership, a high degree of trust, a good working en-
vironment, and the appropriate service prioritisation. Alignment prac-
tices related to the above factors can therefore contribute to the institu-
tional harmony with IT.

Based on the same viewpoint, previous studies have found that IT align-
ment with the organisation has an impact on the overall organisational
performance (Chan et al., 2006; Cragg, King, & Hussin, 2002; Lee,
Kim, Paulson, & Park, 2008; Yayla & Hu, 2012). The stronger and
more effective the alignment, the greater the likelihood of positive in-
stitutional performance.

Correspondingly, several IT alignment practices have been proposed by
scholars to support effective institutional alignment with IT. The earli-
est developed and most well-established model of the practices of IT-
organisational alignment was proposed by Luftman (2000). This strate-
gic alignment maturity (SAM) model includes six alignment maturity
categories (practices), as shown in Figure 4, including communication,
competence/value measurement, governance, partnership, scope and
architecture, and skills. The SAM model is designed for assessing the
maturity of IT-business alignment, mainly within general business
companies. In a later work exploring the literature and using Luftman's
model of measuring IT-business alignment, Vermerris et al. (2014)
summarised these alignment practices into four categories that have an
impact on creating the business value of IT projects: management com-
mitment, communication, shared understanding, and the evaluation of
IT investment.
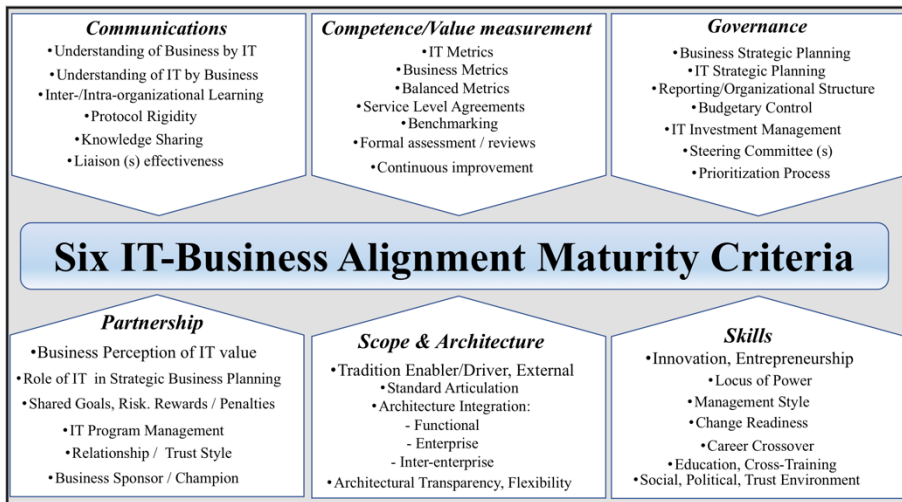
Figure 4. IT-business alignment maturity criteria (taken from Luftman, 2000)

Since the SAM model shown in Figure 4 was introduced, it has been used in different domains and from various perspectives to assess the alignment of IT with services such as supply chain management (Gutierrez & Serrano, 2008), e-business in small and medium enterprises (Pedraza, Guerrero, & Lavín, 2011), educational services (Brown & Motjolopane, 2005) and strategic alignment in information systems (Preston & Karahanna, 2009), among others.

In summary, the concept of IT-business alignment and the related models in the literature mainly refer to general business companies, while HEIs have not been adequately considered in research in this field.

2.2.1. A Social-Technical Perspective on IT-Institutional Alignment

The process of aligning IT with institutional activities involves not only technical aspects but also non-technical dimensions (Lee et al., 2008). Proposed by Emery and Trist (1960), the social-technical system framework has attracted scholars who have applied it to understand the complex phenomena of information systems design and systems engineering (Baxter & Sommerville, 2011). Similarly, alignment practices can be grasped within a social-technical system framework since they involve people, institutional structures, methods and machines in terms of software and hardware (Baxter & Sommerville, 2011). All the categories of alignment practices described above involve both technical

and non-technical elements when creating and measuring the relationship between IT and institutional services and processes.

With reference to the literature related to management information system (MIS), the non-technical aspect of IT alignment has been categorised into four main dimensions of alignment: social, structural, cultural and strategic (Chan & Reich, 2007).

The social dimension of alignment is described as a state of understanding and commitment from both IT and business executives to accomplish both the business and IT missions, plans and objectives (Chan & Reich, 2007; Reich & Benbasat, 2000). In recent years, the social dimension of IT alignment has been explored by a number of researchers (Martin, Gregor, & Hart, 2005; Preston & Karahanna, 2009; Reich & Benbasat, 2000). Preston and Karahanna (2009) developed a model describing the social dimension of IS strategic alignment by positing that the shared understanding between the Chief Information Officer (CIO) and the top management team in the organisation is a proximal antecedent of the social dimension of IS strategic alignment.

In their study, Reich and Benbasat (2000) found that the shared domain of knowledge between business and IT executives was the key factor in the social dimension of IT-institutional alignment. The results of their study showed that the greater the shared domain knowledge between these two groups, the higher the effectiveness of the communication across the institution, resulting in a higher level of IT-institutional alignment. These scholars also discovered other determinants of the social dimension of IT alignment, including: (i) a prior history of success in IT implementation; (ii) communication between IT and business executives; (iii) the connection between business and IT executives; and (iv) the connection between IT and business planning. Prior to the integration of IT systems in any institution, it should therefore be ensured that the social dimension of IT alignment is strongly maintained across all units.

Intellectual (strategic) alignment is the second dimension of IT-institutional alignment (Chan & Reich, 2007), and is described as the level to which IT strategies and plans are in harmony and interrelated with organisational strategies and plans (Chan et al., 2006; Teo & Ang, 1999; Wang & Tai, 2003). Another study by Henderson and Venkatraman (1999) proposed a model of strategic alignment that encompasses

business strategy and IT strategy as the central domains of strategic IT-organisational alignment (Figure 5). This model has been extensively used to analyse the strategic alignment between IT and business organisations.
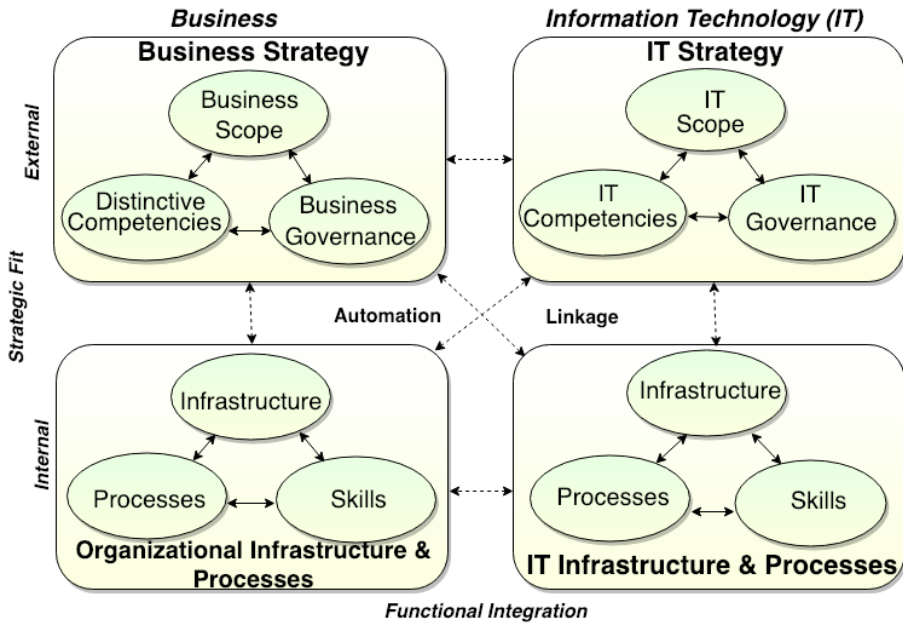
Figure 5. Strategic alignment model (taken from Henderson & Venkatraman, 1999)

In this model, the internal domain of IT strategy comprises elements such as IT architecture, skills and processes, while the external domain includes IT governance, systemic competencies and the overall scope of the technology. In terms of business strategy, the internal domain of this strategic alignment model considers the administrative structures, processes and personnel skills, while the external domain includes the business governance, distinctive competences and the business scope.

Another type of alignment is the structural dimension, which refers to the degree of fit between the IT structure and the institutional structure. This type of alignment is predicted by factors such as IT decentralisation, the rights of IT-related decision making, reporting relationships, and the positioning of IT personnel across the institutional units (Chan, 2002).

There is also a cultural dimension of alignment, which is described as the extent to which the IT staff culture is aligned with the business

personnel culture in terms of the implementation of IT (Chan, 2002). This exposes the need for a positive mindset from the highest to the lowest levels of IT, and business personnel that are ready to accept the changes brought by new IT. Correspondingly, prior research has discovered that both individual and organisational cultures can play an important role in the performance of IT governance, which in turn also affects the institutional performance (Kappos & Rivard, 2008; Leidner & Kayworth, 2006; Nfuka & Rusu, 2011). In the cultural dimension of alignment, cultural and behavioural changes within the informal structures across the institution must be managed to ensure effective IT integration and adoption, leading to greater overall institutional performance.

In summary, all four of the dimensions of IT alignment explained above must always be associated with each other to ensure institutional performance (Chan & Reich, 2007). Finally, it can be posited that IT-business alignment includes both technical and non-technical aspects. This means that organisational practices related to creating and maintaining a high level of IT alignment need to include hardware and software as the technical dimension and structure and people as the non-technical dimension.

2.2.2. IT Governance: A Strategy for Aligning IT with Organisations

Since the mid-nineties, IT governance has attracted both researchers and practitioners (Simonsson & Johnson, 2006), and several definitions of the concept of IT governance exist in the literature. IT governance is defined as "*specifying the frameworks for decision rights and accountabilities to encourage desirable behavior in the use of IT*" (Weill & Ross, 2004). This concept therefore forms part of the overall governance of the enterprise, as it consists of the organisational structure, leadership and process that ensure that the organisational strategies and objectives are effectively sustained by IT (De Haes & Van Grembergen, 2015; Weill & Ross, 2004). Effective IT governance has also been deemed to be a factor contributing to the effective alignment of IT and organisational goals (Ali & Green, 2012).

As part of the IT strategy visualised in Figure 6, effective IT governance is established by combining processes and structures that operate under predetermined relational mechanisms. These three components can be

summarised in a framework for IT governance elements (Van Grembergen & De Haes, 2008a; Peterson, 2003).
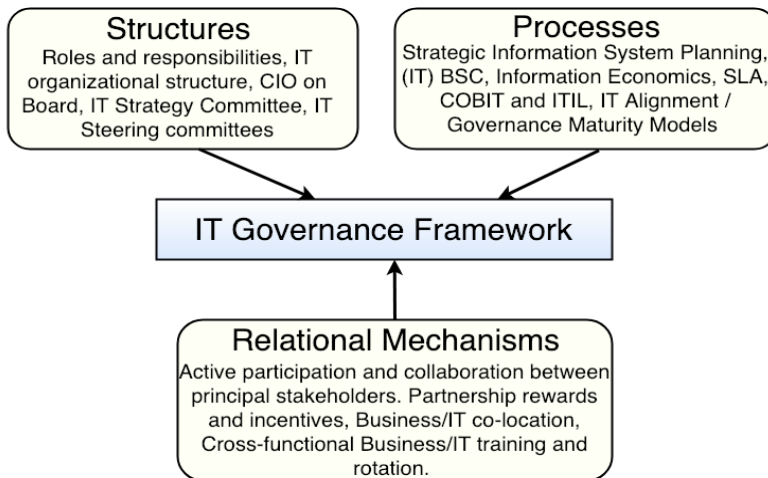
Figure 6. A framework for IT governance (Van Grembergen & De Haes, 2008b)

In another study, it was revealed that organisations that have highly matured in terms of IT governance structures, processes and relational mechanisms can achieve a greater level of maturity of IT-business alignment (De Haes & van Grembergen, 2008). Thus, IT governance has a positive impact on the strategic alignment between IT and organisational services, leading in turn to better overall organisational performance (Luftman et al., 2012).

From an educational perspective, once a relationship between IT governance and IT alignment has been established by putting in place an effective IT governance structure, this leads to the addition of value for technology in teaching, learning, research, and educational management. Currently, in several universities, the role of IT governance has been given a strategic position by the management boards and committees, as suggested in the IT governance framework proposed by Van Grembergen and De Haes (2008b) (Figure 6). Accordingly, staff positions such as CIOs, IT governance directors, and senior IT managers have been created at these universities. At UR in particular, these strategic IT-related positions are occupied by experienced staff with strong IT expertise.

Models and frameworks have also been developed by universities in line with overall institutional ICT plans to ensure the effective

implementation of IT strategy and congruence between university operations and IT resources. IT alignment and governance models must be contextually developed and implemented to support both university governance and IT governance structures for the effective integration of technology in teaching, learning, research and administration.

2.2.3. IT-Institutional Alignment within a Higher Education Context

Although the concept of IT alignment is not largely discussed with reference to HEIs, a study by Snyder et al. (2007) focused on the alignment between the educational, technological and organisational domains of practice. This study concluded that the organisational, technological and educational areas must be in harmony to ensure an effective use of ICTs and related innovation within universities in Australia. More precisely, these scholars argued that a failure to align the educational, technological and organisational objectives limits the benefits of ICT innovations, which also means that no value is added from the integration of technology into university services. Hence, the most effective integration and use of IT in HEIs is dependent on the degree of fit between the educational and organisational objectives, and then with the objectives and functions of IT.

From a pedagogical point of view, another study by Koehler & Mishra (2009) proposed a framework that describes the alignment between technology, pedagogy and content knowledge (TPACK) as a critical element in effective teaching by means of information technologies. The authors conceived the innovation in the instruction as a diagram consisting of three aligned bodies of knowledge that a teacher must be equipped with: content knowledge, technology knowledge and pedagogical knowledge (Voogt, Fisser, Pareja Roblin, Tondeur, & Van Braak, 2013).

The TPACK framework has been applied in several studies focusing on how technology can be effectively integrated into online instruction and teacher professional development (Hammond & Manfra, 2009; Jimoyiannis, 2010; Niess, 2011; Voogt et al., 2013). However, this framework focuses only on the operational level of teaching and innovation in teaching practices, and does not reflect the strategic alignment of IT with other university activities such as learning, research and administration.

Given the importance of IT alignment in HEIs, another study by Brown & Motjolopane (2005) examined the alignment between business and IT strategies within an educational environment. Since IT-business strategy alignment is viewed as the key element for gaining value from IT investments, the authors explored the factors affecting strategic alignment in an HEI. The findings of this study indicated that the integration of business planning and information systems (IS) planning, rationality and adaptation in IS strategic planning, the quality of IT managerial resources, and the success of IT implementation are factors likely to influence the strategic alignment of business and IT.

Accordingly, given the multi-faceted position of ICT in the current dynamic higher educational environment, this study suggested that it is always necessary to ensure a continuous adjustment of both IT and business strategies in order to maintain a high level of strategic alignment. However, the study was limited to the identification and measurement of IT-business strategic alignment factors within a higher education context. Hence, it is not clear which alignment practices the universities should focus on to ensure a higher level of strategic alignment.

2.2.4. IT Alignment and Institutional Performance: A Higher Education Context

IT alignment has been considered as a contributing factor to institutional performance through its degree of value addition to service delivery (Byrd, Lewis, & Bryan, 2006; Kearns & Sabherwal, 2006). Hence, the value addition of IT investments should be perceived based on a particular degree of institutional performance (Lee et al., 2008). There are also certain antecedents or "alignment practices" that contribute to effective IT alignment (Chan et al., 2006; Preston & Karahanna, 2009; Yayla & Hu, 2009). These IT alignment practices also differ between general business companies and HEIs (Chan et al., 2006), and the indicators for institutional performance that result in effective IT alignment are also supposed to be different, depending on the type and the context of an organisation.

Since ICTs have taken the lead in supporting the innovation process, universities worldwide have begun the process of integrating different IT systems as an alternative strategy for adding value and quality to teaching, learning, research and administration. Hence, one condition

for ensuring that IT investments add value to service delivery and improve institutional performance is the IT-institutional alignment with the above university services. This alignment must always be maintained at a high level during the process of IT integration within university services, and universities must ensure that certain IT-institutional alignment practices are performed across all units in order to improve the university's performance in terms of both its academic and administrative functions (Brown & Motjolopane, 2005; Chan et al., 2006).

With reference to the types of alignment discussed earlier (Chan & Reich, 2007), the practices of IT alignment with university services may be reflected in the dimensions of social, cultural, intellectual and structural alignment when it comes to the integration of IT into service delivery. This is because the acquired IT systems must be integrated into an institution with specific objectives and plans, a particular institutional structure, different categories of people, and various social-cultural perspectives. If all of these institutional properties are fully taken into consideration under the IT governance mechanisms, the adopted IT systems can contribute positively to the overall performance of the university.

Furthermore, the overall institutional performance for higher education institutions involves the performance of both academic and managerial functions (Alexander, 2000; Lindsay, 1982) through the effective integration of IT systems. This has been also described in the pyramidal performance measurement framework for universities (Wang et al., 2010). These authors posited that both academic and managerial indicators are linked with the overall vision and goals of the university, as shown in Figure 7.
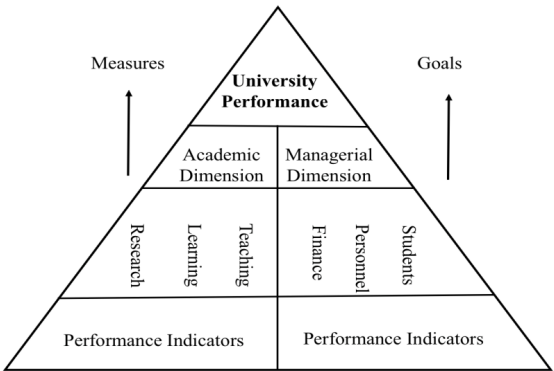
Figure 7. A pyramidal performance measurement framework for universities, (adapted from Wang et al., 2010)

While the academic functions include teaching, learning and research activities, the managerial functions involve the administration of university resources, such as personnel, institutional data and other ICT infrastructure (Hölttä, 1998). Hence, the indicators that should be considered when exploring performance in the context of an HEI should consider both the academic and managerial dimensions (De Boer, Ender, & Leisyte, 2007; Wang et al., 2010). These measurement indicators may include but are not limited to: (i) the ability to attract external funding and technology partnership: (ii) the relative institutional position in international rankings; (iii) graduate career placement and employability within the labour market (Hölttä, 1998); (iv) the quality and quantity of ICT infrastructure available to improve efficiency in academic and administrative service delivery (Castillo-Merino & Serradell-López, 2014; Sampath Kumar & Manjunath, 2013); and (v) the quality and quantity of academic publications (Lindsay, 1982; West, Hore, & Boon, 1980).

From the above examples of performance indicators, it can be noted that the measurement of institutional performance for universities focuses mainly on effectiveness and efficiency as the two main factors (De Boer et al., 2007; Lindsay, 1982). Efficiency refers to the relationship between inputs and outputs, whereas effectiveness is measured by comparing the service outputs and goals set by the university.

IT alignment practices related to institutional performance therefore contribute immensely to what an organisation accomplishes (effectiveness) and how well the related tasks are executed (efficiency) (Lindsay, 1982) through the adoption and use of IT. Thus, the improvement of IT integration in HEIs depends on how the IT mission, plans, structure and activities are aligned with the institutional mission, plans, structure and activities.

A high degree of alignment is also a result of putting effective IT-institutional practices in place, which in turn can contribute to the overall institutional performance. This is summarised in Figure 8. The performance of the university due to the use of IT can be measured in terms of how effective the institution is in terms of attaining its vision and goals, and how efficiently the available IT systems and other resources are used to support its services.
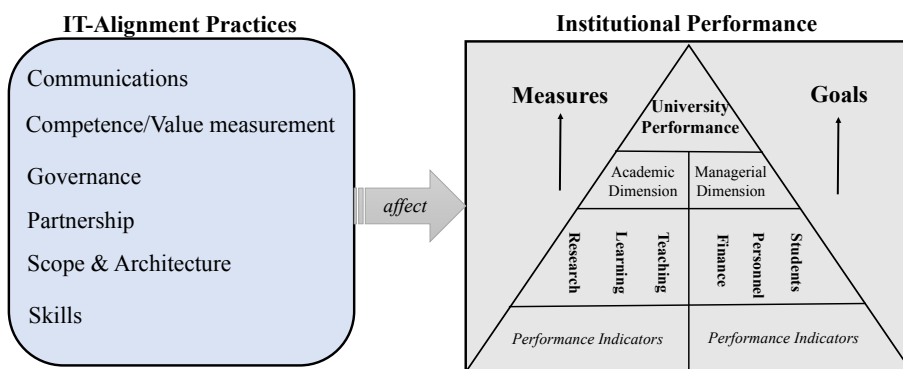
Figure 8. Relationship between IT-alignment practices and performance of a higher education institution

2.2.5. Research Gap in Terms of IT Integration and Alignment in Higher Education Institutions

In the related literature, there are no recent studies of IT alignment that consider the higher education sector, and there is a particular lack of studies on how IT alignment practices can improve institutional performance. One earlier study by Sabherwal & Kirs (1994) discussed the alignment between critical success factors and IT capabilities in academic institutions. In this study, the relationships between these factors and IT success are identified. However, this study focused specifically on the higher education system in the United States. In addition, the framework of Sabherwal and Kirs (1994) is not explicit in terms of which practices should be done by universities to ensure effective IT-institutional alignment and organisational performance.

The concepts of IT alignment, relevant to this research, have been discussed in the previous sections in order to highlight the research area under investigation, and it is important to clarify the need for further studies of which alignment practices can contribute to university performance through the effective integration of IT into institutional service delivery.

The literature on IT alignment explored above has shown that most scholars have focused on commercial and business organisations. This was also found by Brown & Motjolopane (2005), who called for further research into IT alignment to be conducted in HEIs. In addition, the existing literature on alignment practices related to institutional

performance has mainly focused on developed countries, and specifically on business companies.

Hence, this work intends to fill both the theoretical and contextual research gaps on the practices of IT-institutional alignment for improving performance in HEIs. A synthesis of the overall research gap and the reasons why more research is needed in this area is given in Figure 9.
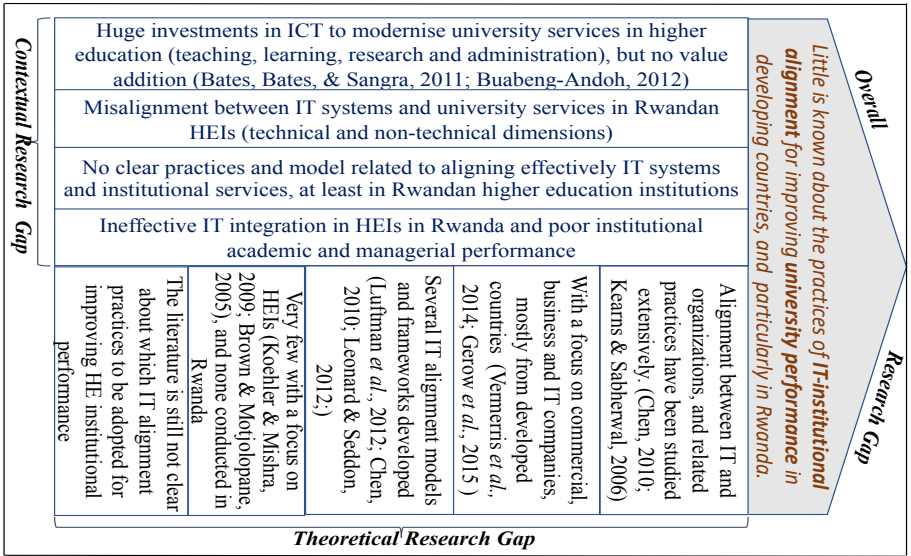
Figure 9. Synthesis of the research gap

The current research therefore attempts to bridge this gap by extending the understanding of IT-institutional alignment in universities in developing regions, and in Rwanda in particular. Having identified the existence of a research gap related to IT alignment within universities, this research is motivated by the need to extend the investigation of the effect of IT-institutional alignment practices on institutional performance in terms of both the academic and managerial dimensions.

Hence, this research focuses on institutional practices with the aim of effective IT integration into HEI services.

3. Research Methodology

This section briefly describes the research strategies and techniques adopted for data collection and analysis. The philosophical assumptions of the research are also presented, as are the multiple-stage processes followed for each undertaken research activity.

3.1. Philosophical Assumptions of the Research

The activities and processes of each scientific research study contribute to the finding and validation of knowledge. Knowledge is therefore acquired by following one or more philosophical assumptions (Myers, 2009). With guidance from the selected philosophical beliefs, a researcher defines the nature of this knowledge (ontology), the values of the knowledge (axiology), how it is known (epistemology) and the approaches (methodology) to enquiry used to obtain this knowledge (Creswell, 2013; Lincoln, Lynham, & Guba, 2011; Myers, 2009).

From an epistemological perspective, assumptions are made about knowledge and how it is acquired (Hirschheim, 1992). Based on the type of this study, the two philosophical assumptions that were selected to guide this research were interpretivism and positivism. These are two philosophical traditions that have attracted great interest from scientific researchers in the field of IS (Lee & Baskerville, 2003; Orlikowski & Baroudi, 1991). These two assumptions are described in terms of four philosophical beliefs, as presented in Table 1 below.

Table 1. Matrix of research philosophical assumptions (adopted from Creswell, 2013; Lincoln et al., 2011; Myers, 2009; Yin, 2003)

Philosophical Assumptions	Philosophical Beliefs			
	Epistemology	Epistemology	Axiology	Methodology
Positivism	• Existence of a single reality out there	• Objective, • Minimum or no interaction with the subjects	• Preconception Controlled. • Testing of hypotheses for prediction	• Quantitative, • Statistical measurements, • Observations (*Deductive methods*)
Interpretivism	• Multiple realities constructed through social interactions	• Subjective, • Individual experiences, • Reality is known and co-constructed through the research-participant interaction	• Values negotiated among individuals. • Exploration and description for understanding	• Qualitative, Participation (Consensus), • Interviews, Text analysis, • Observations. (*Inductive methods*)

From the perspective of interpretivism, a researcher explores a topic of study by aiming to deeply understand the meaning within a particular context. Thus, knowledge about reality is subjective and socially constructed through interactions between individuals (Myers, 2009; Saunders, Lewis, & Thornhill, 2009). Additionally, within interpretive research, independent and dependent variables are not predefined. Since IS as the field of social science into which this research falls, interpretivist research is advocated by several scholars (Chen & Hirschheim, 2004; Klein & Myers, 1999). In this research, the study phenomenon is therefore grounded in the IS discipline, where HEIs and IT systems are considered as social-technical systems. The interpretivist assumption was therefore important in guiding all the three research activities of this thesis (see Table 2, Section 3.3).

In Research Activity 1, the use of interpretivism allowed us to explore and understand the context of the higher education sector, within which emerging technologies are integrated to support service innovation in the university. In preliminary studies, based on the interpretivism assumption, we were able to investigate the state of ICT policies in the context of Rwandan higher education in terms of considering strategies for ICT capacity building as a method of technology and institutional alignment (*Paper 1*).

This philosophical assumption was then applied to explore the process and factors related to the adoption and use of IT systems in teaching, learning (*Papers 3 and 4*), research (*Paper 2*) and administration (*Paper*

5). The interpretivist assumption was also used to evaluate the model for IT-institutional alignment (*Paper 8*) using mainly qualitative approaches to data collection and analysis.

Positivist research, on the other hand, assumes that reality can be objectively known through predictions and measurable constructs that are independent of the researcher (Neuman, 2011). The process of research within this philosophical stance implies that knowledge is acquired by formulating hypotheses and statistical tests using quantitative variables (Klein & Myers, 1999; Yin, 2003). Based on the principle of causality, research using a positivist philosophy aims to understand a phenomenon and the relationship between dependent and independent variables. In this research, this philosophical assumption was applied to the statistical analysis and testing of hypotheses for the theoretical variables in Study 7 of Research Activity 2. More specifically, it enabled us to develop and test a model for IT-institutional alignment within the context of higher education.

In order to scientifically accomplish this research goal, it was important to first comprehend the real-world problem related to the integration and alignment of IT within universities. The identified problem was a misalignment between technology and the activities of the university, leading to low or no value addition from IT on the university service delivery. This problem was understood by acquiring knowledge from multiple realities and sources, using scientific methods of data collection and analysis.

In this research, the real-world setting was composed of the universities in Rwanda and similar contexts in developing countries. Several IT systems that were under implementation in the domains of teaching, learning, research and administration were also considered within this real-world context as reported in Figure 2.

The next phase of this research focused on using the knowledge acquired during the initial study phase to propose a framework for IT-institutional alignment practices. This framework then served as a scaffold for developing a complete IT-institutional alignment model for university performance. The proposed model was evaluated naturalistically, meaning that it was assessed within the real-world environment of the Rwandan higher education context.

The interpretivist and positivist assumptions were combined to guide this doctoral research due to its exploratory and confirmatory aspects. Consequently, both inductive and deductive research approaches were applied within the above two philosophical assumptions (Neuman, 2011; Saunders, Lewis, & Thornhill, 2012; Wilson, 2010). In this process, it was important to inductively explore how and to what extent IT has been integrated in universities in the real world. Similarly, the positivist assumption was important in deductively determining (Saunders et al., 2012; Wilson, 2010) the effect of the hypothesised IT-institutional alignment practices the university performance. Once again, the interpretivist assumption enabled us to evaluate the proposed model for IT-institutional alignment in a real-world environment.

As shown in Table 2, both qualitative and qualitative research approaches were applied. Qualitative research was mainly applied in the Studies 1, 5, 6 and 8, mostly using case studies (Creswell, 2014; Yin, 2014), while quantitative research, which involves the application of statistical data collection and analysis techniques (Straub, Gefen, & Boudreau, 2005), was employed in Studies 2, 3, 4, and 7.

Furthermore, since one of the objectives of this doctoral research was to develop a model in the form of an artefact, it was important to apply a design science research (DSR) approach (Hevner, March, Park, & Ram, 2004; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). DSR was selected since the development of an IT-institutional alignment model for a higher education context requires several preliminary studies to be first undertaken; we then proceeded to modelling the organisational practices related to alignment of IT with university services. DSR therefore allows us to undertake all phases of the study, from an exploration of the real-world problem to the development and evaluation of a specific model for IT-institutional alignment.

As a problem-solving paradigm (Hevner & Chatterjee, 2010; Simon, 1996) the DSR approach considers interactions between the technology (machines), people (staff and students), and organisations (universities) that must be aligned with the IT to add value via the achievement of high levels of institutional effectiveness and efficiency (institutional performance). DSR aims to develop and evaluate an artefact in the form of a model, framework, method or instantiation (Hevner & Chatterjee, 2010; Vaishnavi & Kuechler, 2015). The developed artefact is a tentative solution to a specific problem that is explored and acknowledged

in a particular context (in this case, universities in developing regions such as Rwanda).

As mentioned earlier, the general goal of this doctoral research is to develop an IT-institutional alignment model composed of a range of contextual practices related to the effective integration of IT within university services. These practices are performed from a social-technical system perspective in which people, computers, and organisations interact within a particular environment (Orlikowski & Iacono, 2001). Given the complexity of the social-technical perspective on IT-organisational alignment, the DSR methodology and its process steps (as shown in Figure 10) were found to be relevant in guiding this doctoral research.
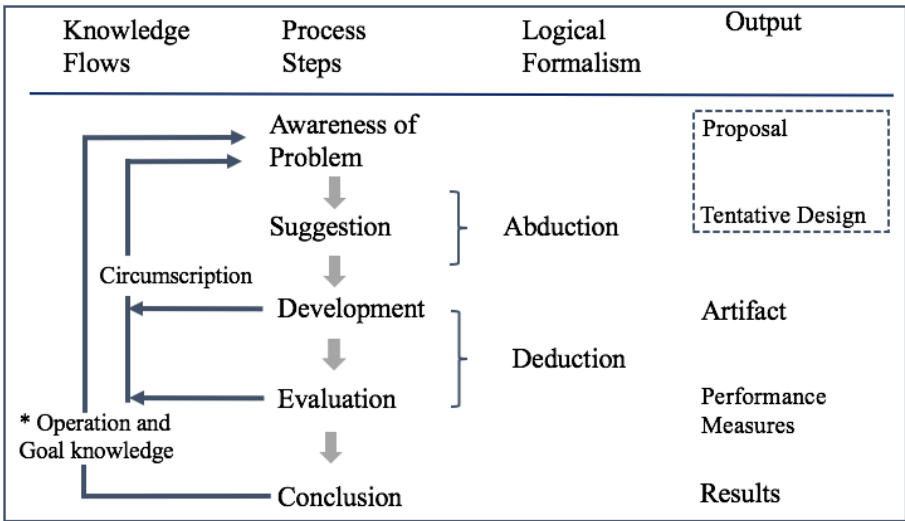
Figure 10. The design science research approach (from Hevner et al., 2004 and Vaishnavi & Kuechler, 2015)

The fundamental principle of DSR is that it is important to understand and acquire knowledge of the design problem and its tentative solution (Hevner et al., 2004; Johannesson & Perjons, 2012; Vaishnavi & Kuechler, 2015). This is followed by the development of an artefact and then evaluating it for its utility, quality, and fitness within a particular real-world environment. Finally, the DSR process ends with reflection and documentation of the results of evaluating the developed artefact. The process of applying the DSR in line with the research objectives and related outputs of this research is illustrated in Figure 11.

DSR Process Steps Research Objectives Output

Problem Awareness
(SRQ: 1,2,3,4, and 5)

Research Objective 1
To understand how and to what extent ICT is integrated in teaching, learning, research and administration services at University of Rwanda.

Knowledge and evidences on the state of IT integration in HEI's teaching, learning, research and administration
Sub-studies: 1,2,3,4, and 5

Suggestion
(SRQ:6)

Research Objective 2
To design and develop a contextual IT-institutional alignment model with relevant practices for effective technology implementation in Rwandan higher education.

• Identified IT-alignment practices and categories
• A framework with the practices of IT institutional alignment for HEIs context
Sub-study 6

Design & Development
(SRQ:7)

• Tested IT-institutional alignment practices
• A developed and tested IT-institutional alignment model for university performance (ITIAM Version 1)
Sub-study 7

Evaluation
(SRQ:8)

Research Objective 3
To evaluate a contextual IT-Institutional alignment model for higher education institutional performance in Rwanda.

• An outline of the model evaluation results
• An improved model after evaluation process (ITIAM Version 2)
Sub-study 8

Main RQ
How can information technology and institutional activities be holistically aligned to support the effective IT integration and performance improvement in Rwandan higher education institutions?

Conclusion
Compilation and publication of Research Results

ITIAM: IT-Institutional Alignment Model, *SRQ:* Sub research question, *RQ:* Research Question, *HEIs:* Higher Education Institutions

Figure 11. Design science research process steps, as applied in this thesis

Using the same approach, DSRM guidelines were followed in this research. These seven guidelines are: design as an artefact; problem relevance; design evaluation; research contributions; research rigor; design as a search process; and communication of research (Hevner & Chatterjee, 2010; Hevner et al., 2004; March & Smith, 1995). This enabled an understanding and knowledge of the design problem and allowed a tentative solution to be proposed. These guidelines ensured that the results of the study were applied in a relevant way to the case study organisations (HEIs) using clear and appropriate research methodologies. Details of how these DSR guidelines were followed are given in Section 3.2 below.

3.2. Aligning the Research with DSRM Guidelines

Within IS research, DSRM suggests a set of guidelines for high-quality DSR (Hevner & Chatterjee, 2010; Hevner et al., 2004; March & Smith, 1995). These DSR guidelines are used in this research to ensure its rigor, from the literature review to the development and evaluation of the IT-institutional alignment model, which is considered here as an artefact.

> *(1) Design as an Artefact:* DSR must produce a viable artefact in the form of a model, method, construct or instantiation. The aim of the current research is therefore to develop an ITIAM for

effective IT integration and institutional performance for the education sector. This model, in the form of an artefact, can be made available to policy makers, IT specialists and top managers within HEIs to serve as guidance for creating and assessing the alignment between IT and institutional services.

(2) *Problem Relevance:* DSR must develop a technology-based solution to a relevant organisational problem (March & Smith, 1995). Hence, this research addresses the problem of a lack of knowledge of the relevant and contextual IT-institutional alignment practices that could support effective IT integration in teaching, learning, research and administration in HEIs. It also attempts to understand how IT alignment practices influence the overall institutional performance within the context of Rwandan higher education.

(3) *Design as a Search Process:* According to Hevner et al. (2004), the search for an effective artefact suggests the utilisation of the available means to achieve the desired ends and to find an effective solution to the problem. The overall search process must also satisfy the laws of the problem environment. In this research, the literature on IT alignment and integration within HEIs serves as a knowledge base for collecting data and then later for the design and development of a contextual IT-institutional alignment model for the higher education sector. As a design search process, a typical model with the proposed IT alignment is also evaluated in terms of the expected users at university level, in the search for further recommendations for improvements to the model.

(4) *Research Rigor:* DSR involves the application of rigorous research methods when constructing and evaluating the design artefact. Hence, the design, development and evaluation of the model for IT-institutional alignment follows scientific principles and is based on a literature review of related theories. The current research also involves different categories of participants in data collection who are involved in the implementation of IT within teaching, learning, research and administration. Overall, the main output of this research is the model that is developed following the establishment of a research process and framework.

(5) Research Contributions: The contributions of DSR should be verifiable, clear and interesting in terms of the design artefact, the design foundations and the applied methodologies. Within the DSR paradigm, the developed artefact itself is a research contribution (Hevner et al., 2004). The evaluation of the proposed IT-institutional alignment model should indicate its usability and efficiency in guiding IT integration for institutional performance in the given context. This means that policy makers, university managers and IT specialists and researchers in the area of higher education should perceive the benefits of adopting and using the proposed model during the evaluation phase.

(6) Design Evaluation: The designed artefact must be demonstrated and evaluated rigorously in terms of its utility, quality and efficacy, using well-determined evaluation approaches (Hevner et al., 2004; March & Smith, 1995). In the current study, the evaluation phase of the IT-institutional alignment model in a real-world context is expected to determine the usability of the model within research and practice related to aligning IT with university services while ensuring institutional performance through the integration and use of IT.

(7) Communication of Research: The results of the design science research must be presented to researchers, and to technology- and management-oriented audiences (Vaishnavi & Kuechler, 2015; Hevner et al., 2004). For practical purposes, the developed model and a related detailed description of how to use it to guide the IT integration process must be communicated to university managers, IT specialists and other educational stakeholders. From an academic perspective, this research provides an example of how the DSR approach can be applied to improve IT alignment within HEIs while ensuring both the effective integration of IT into service delivery and institutional performance. Hence, this research findings are published in international online databases for further references by the academic community.

3.3. Research Process and Activities

This section discusses the process that was followed in carrying out this doctoral research. It provides an overview of the activities undertaken in line with the objectives of each research activity, the research questions and the related studies that were conducted. A summary is also given in Table 2. The results of each study undertaken in each research activity are also briefly presented.

Table 2. Research activities and their relationships with the research process

	Research Activity 1 ⟹	Research Activity 2 ⟹	Research Activity 3
Objectives	To understand how and to what extent ICT is integrated in Teaching, Learning, Research and Administration activities at University of Rwanda.	To design and develop a contextual IT-Institutional Alignment Model with relevant practices for effective technology implementation in Rwandan higher education.	To evaluate a contextual IT-Institutional Alignment Model for higher education institutional performance in Rwanda.
Research Questions	RQ1, RQ2, RQ3 RQ4, RQ5	RQ6, RQ7	RQ8
Papers	Paper I, Paper II, Paper III, Paper IV, Paper V	Paper VI, Paper VII	Paper VIII
Philosophical paradigm	Interpretive-Exploratory Studies (Qualitative & Quantitative)	• Interpretive (Exploratory Study) • Positivist (Test of Hypotheses) (Qualitative & Quantitative)	• Interpretive-Exploratory study (Quantitative & Qualitative)
Design Science Research Approach	• Problem awareness • Problem contextual status	• Tentative design of the model • Development of the model	• Demonstrate and evaluate the model • Reporting the evaluation results
Methods (Research Strategies)	• Single Case Study research • Survey Research	• Embedded Multiple Case Study • Survey research	Multiple Case Study Designs
Data Collection techniques	Document Survey / Survey Questionnaires / Unstructured and Semi-structured Interviews / Observations	Semi-structured Interviews/ Literature review/ Survey Questionnaires	Survey Questionnaires /In-depth interviews
Data analysis	• Critical Discourse Analysis • Exploratory Data Analysis (EDA) • Content/ Thematic Analysis • Use of Software Packages	• Exploratory Data Analysis • Thematic Analysis • Correlation and Regression Analysis • Use of Statistical Software	• Exploratory Data Analysis (Descriptive data analysis) • Use of Software Packages

3.3.1. Research Process

This research began by reviewing the literature on ICT capacity building and technology integration in the higher education sector in general. Observations were also made of several current IT implementation projects in several universities. More especially, the focus was on education institutions from developing regions and the Rwandan universities in particular.

In *Research Activity 1*, the goal was to understand how and to what extent technology is being integrated into research, teaching, learning and administration services. In this research activity, both the unified theory of acceptance and usage of technology (Venkatesh, Morris, Davis, & Davis, 2003) and the TAM (Davis, Bagozzi, & Warshaw,

1989) were applied in Studies 2 and 3 respectively. These two theories enabled us to understand the institutional acceptance, adoption and use of IT systems in university teaching, learning, and research.

Following this, the theory of innovation diffusion (Rogers, 2010) and complex adaptive systems theory (McCarthy, 2003) were combined in Study 5 in an effort to understand the complexity and diffusion level of IT to support the university's managerial processes. The focus was on exploring the challenges of IT-institutional alignment between the acquired new technologies and university activities.

Hence, the status of institutional practices related to aligning technology with university services was also studied by analysing current ICT-related policies that are in place to support the adoption and use of technology in teaching, learning, research and administration. Moreover, the students' familiarity with digital skills was also explored, since the effective integration of technology in higher education depends strongly on how easily students can use the available IT systems.

Overall, the preliminary results of Research Activity 1 created an awareness of the current status, issues and challenges related to IT integration within the case study institutions. This helped in an understanding of the contextual misalignment between technology and university services, and led us to plan for an intervention in the form of a model to improve and maintain effective IT-institutional alignment.

The goal of *Research Activity 2* was to identify the dimensions and practices of IT-institutional alignment within a higher education context and to propose a contextual framework for aligning technology with university services. In this phase, the aim was also to develop and test an ITIAM for the Rwandan higher education context. Within Research Activity 2, the social-technical system framework (Baxter & Sommerville, 2011) of Emery and Trist (1960) and the concept of IT alignment were combined in Study 6 to understand the relevant practices for effective IT-institutional alignment in the context of higher education. The same IT alignment theory was also applied in proposing and evaluating a model for IT alignment practices that can contribute to the overall performance of the university.

An extended review of the related literature and sampled data from two case study institutions in Rwanda and Mozambique allowed us to identify metrics and associated practices for optimising the alignment

between technology and university activities in the context of a developing country. These alignment practices were summarised in the IT-institutional alignment framework proposed in Study 6 of Research Activity 2.

The next step in this research activity was to design and develop a model that explained the effects of IT-institutional alignment on institutional performance within the context of Rwandan higher education or similar contexts. The ITIAM was developed through a study based on the use of correlation and regression analysis techniques on data collected from a selected sample of HEIs and public organisations in Rwanda.

Research Activity 3 involved evaluating the developed model using a selected number of participants from the case study institutions. The intention here was to understand the relevance of the ITIAM in regard to creating, improving and maintaining a fit between new technologies and institutional activities. At this stage of the research, the IS artefact evaluation approach (Prat, Comyn-Wattiau, & Akoka, 2014) was applied to evaluate the proposed ITIAM using a sample from case study institutions in Rwanda.

3.3.2. Research Activity 1: Real-World Problem Awareness

This activity was carried out using a multiple-stage process to cover all main areas of university services: teaching, learning, research and administration. In order to create an initial frame for this doctoral research, the researcher explored the literature on technology integration in the higher education sector and the alignment between IT and organisations. Preliminary visits were made to several universities within developing countries to observe how new IT systems were being integrated, adopted and used and the associated contextual challenges.

These studies of IT systems cases were preceded by an exploration of ICT-related policies in order to understand the statements about human and IT infrastructure capacity building at the policy level. In total, five studies were conducted under Research Activity 1 to acquire knowledge about contextual real-world problems related to technology integration in HEIs.

3.3.3. Research Activity 2: Design and Development of the Model for IT-Institutional Alignment

At this stage, the initial goal of this research activity was to understand the alignment practices that lead to institutional performance of HEIs through the use of IT systems. This was followed by the design and development of the model for IT-institutional alignment, which highlights the effect of alignment practices on institutional performance in the context of Rwandan higher education. Two studies were conducted in this phase of the research.

The first study responded to the sixth research question (SRQ6): *"What are the dimensions and practices for improving IT and institutional alignment in developing countries' higher education context?"* This study was conducted between May 2015 and May 2016 in order to understand the complexity of IT alignment practices in a real-world university setting. The research design for this study considered the metrics for IT alignment established earlier: communication, scope and architecture, governance, competence and value measurement, skills, and partnership (Luftman, 2004). These metrics were used as guidance in describing and categorising the identified IT-institutional alignment practices from the case study institutions by providing a holistic assessment of these alignment practices in line with the related literature. Hence, through an exploration and analysis of the related literature and existing practices, and the process related to IT implementation in the selected case study universities (Yin, 2003), a number of pertinent IT-institutional alignment practices were identified. These alignment practices were specifically related to the context of higher education in developing countries.

The second study carried out within this research activity 2 was in response to the seventh research question (SRQ7): *"How can a holistic and reliable instrument for creating and measuring IT-institutional alignment be developed in the context of HEI performance in Rwanda?"* The goal of this study (Study 7) was to investigate the effect of the identified IT-institutional alignment practices on the institutional performance of Rwandan universities. This goal was achieved by conducting a statistical test of the effect of the identified IT-alignment practices on the academic and managerial performance of universities.

Since the main aim was to obtain a tested and developed model highlighting the effects of IT alignment practices on institutional

performance, it was reasonable to hypothesise a correlation effect between these practices (independent variables) and the institutional performance (dependent variable). Accordingly, a theoretical research model with six hypotheses was developed, based on the identified IT-institutional alignment practice categories and a set of university performance indicators resulting from the adoption and use of IT.

A survey research method developed by Kothari (2004) was therefore applied in the collection of data from a sample of the universities and other ICT and education-related government institutions in Rwanda. This study was conducted between September 2017 and May 2018 and respondents were drawn from a sample of 12 universities, five other institutions, and the Rwandan Ministry of Education.

A detailed report of the results for Research Activity 2 can be found in Chapter 4, and more specifically in Papers 6 and 7 of this thesis.

3.3.4. Research Activity 3: Evaluation of the Proposed IT-Institutional Alignment Model

The study undertaken as part of Research Activity 3 aimed to evaluate the developed ITIAM for institutional performance. This evaluation was conducted based on an understanding of the perceptions of university stakeholders on the proposed ITIAM in terms of its understandability, usability, utility and completeness.

This evaluation aimed to provide rigorous feedback on the developed model vis-à-vis a real-world environment (Hevner et al., 2004; Vaishnavi & Kuechler, 2007). There are several different categories of evaluation methods (Hevner et al., 2004; Kushniruk, 2002). Methods for evaluation (i.e. the testing, analytical and experimentation of artefacts) (Kothari, 2004) can be either theoretical or practical. For each type of evaluation chosen, a researcher may opt to use qualitative or quantitative approaches, or a combination of both.

A theoretical evaluation method is more effective for evaluating texts and word-based information such as concepts, methodologies, models, frameworks and definitions. The aim of this evaluation method is to obtain insight and feedback on the research participants' interpretations and to gather further suggestions for improvements if concerns are identified by the reviewers. Due to the nature of this research and the time

limitations, a theoretical evaluation method was applied to the selected case study institutions to evaluate the proposed ITIAM with regard to a selected number of IT specialists and academic staff with managerial roles.

3.4. Research Strategies

Based on the type of research problem and the research context, two research strategies were chosen as methods for enquiry (Cohen, Manion, & Morrison, 2013; Myers, 2009). From a philosophical perspective, a methodology is a strategy for systematically conducting an inquiry and constructing scientific knowledge (Myers, 2009). Case studies and surveys were therefore used as research strategies (Creswell, 2014; Denscombe, 2014; Yin, 2003). Further details of how these research strategies were applied in this research are provided in each study undertaken, and these are summarised in Table 2.

3.4.1. Case Study Research

This research strategy is used mainly by interpretivist researchers to explore a contemporary phenomenon in depth within a real-life setting (Creswell, 2014). As it is principally used within qualitative research, this approach allows a researcher to use multiple sources of evidence (Cohen et al., 2013; Yin, 2003). It is an established research strategy in the IS discipline (Oates, 2006; Orlikowski & Baroudi, 1991), and recent scholars in this field have used case studies to explore the alignment between technology and organisations (Aversano et al., 2012; Dent, 2015; El-Mekawy et al., 2015; Vermerris et al., 2014).

Hence, in this research, case studies (HEIs and a range of IT systems) were used to understand the phenomenon of aligning new technologies with the university services of teaching, learning, research and administration. Due to the social-technical nature of this research, it was challenging to obtain an overall view of the state of IT implementation within the university's working environment in the context of Rwandan higher education. It was therefore essential to explore various sources of data (Stake, 1995) using different methods of data collection to gain an in-depth understanding of the alignment between the IT systems under implementation and the teaching, learning, research and administrative activities. Hence, in the case study strategy, both data sources

and method triangulation in data collection were applied in the preliminary explorative studies. A methodological triangulation is defined as a data collection technique whereby a researcher applies more than one method of data collection for the same research topic (Denzin, 1973); this author also describes data source triangulation as an approach that involves various categories of research respondents to get multiple perspectives in the findings and to facilitate the validation of data.

Accordingly, a case study strategy was used in Research Activity 1 in Studies 2, 3, and 5 (see Table 2) due to the exploratory nature of these three studies. It was also used in Research Activity 2 in Study 6, with the aim of exploring in more depth the contextual situation of IT alignment within specific HEIs and then proposing a framework with a set of practices for effective IT-institutional alignment.

The case study strategy was also applied in Research Activity 3 in Study 8, which aimed to evaluate the proposed ITIAM within the real contextual environment. A detailed description of the types of case studies applied in this doctoral research can be found in each paper in the overall thesis.

3.4.2. Survey Research

Unlike the case study strategy, survey research is widely used by positivist researchers as a systematic approach to exploring a sample of the study population with the possibility of generalising the results (Cohen et al., 2013; Creswell, 2014). Based on the assumption that truth can be known based on statistical measurable indicators (Straub et al., 2005), quantitative analytical techniques related to survey data are predominantly used in a survey research strategy (Yin, 2014).

This method can therefore also be employed to examine the correlation effect between a set of variables with the aim of providing confirmatory information. Hence, a survey research strategy was used in Research Activity 1, in Study 4, and in Research Activity 2, in Study 7. In the latter study in particular, the aim was to determine the correlation effect between the alignment practices of HEIs identified earlier and university performance. Hence, using a survey research strategy, data source triangulation (Cohen et al., 2013; Denzin, 1973) was employed to gather more perceptions from different categories of respondents and to validate the data related to the ITIAM model.

3.5. Data Collection Techniques

Based on the types of data to be collected in this research, a number of data collection techniques were used. To achieve this task, instruments for data collection and analysis were designed for each particular study, following certain guidelines for each selected study approach. These guidelines were: (i) to formulate the objectives of each study; (ii) to design appropriate techniques for data collection; (iii) to collect relevant data; (iv) to process and analyse the collected data; and (v) to report the results of the study (Kothari, 2004; Myers, 2009).

Hence, survey questionnaires, interviews, document surveys, and observations (Cohen et al., 2013; Creswell, 2009; Johannesson & Perjons, 2012; Myers, 2009; Yin, 2003) were used throughout this research. Each data collection technique was selected based on the objective of each study and the research question to be addressed over all three research activities.

3.5.1. Survey Questionnaires

Questionnaires are survey instruments that are mainly used for collecting structured numerical data (Kothari, 2004; Yin, 2003). In some cases, questionnaires can be administered to research participants and can be filled out without the presence of the researcher (Cohen et al., 2013). In this research, a survey questionnaire was employed in all three research activities, and particularly in Studies 2, 3, 4, 7 and 8.

3.5.2. Interviews

The interview technique, which is often used by researchers in educational research (Cohen et al., 2013), enables a researcher to obtain clearer views and ideas on a specific research topic in a particular real-world environment. Although several classifications of interviews have been put forward by different scholars, these are generally classified as unstructured, structured and semi-structured interviews (Yin, 2003).

In this research, semi-structured interviews were used in Studies 5 and 6, while unstructured interviews were used in Studies 2 and 3. At some points, this technique was triangulated (Denzin, 1973) with survey questionnaires, observations, and document surveys, with the purpose of collecting additional information to confirm and validate the quantitative findings of the above studies. More especially, in-depth

interviews (Cohen et al., 2013; Yin, 2003) were used in Study 8, under Research Activity 3 during the evaluation of the proposed IT-institutional alignment model.

3.5.3. Document Surveys

This data collection technique enables the collection of secondary data about the research environment (Cohen et al., 2013; Denscombe, 2014; Yin, 2003). Several types of documents, such as website pages, institutional letters and memos, policies, newspapers, magazines and government publications, can serve as secondary sources of data (Denscombe, 2014). Based on the type of research questions to address, a research study can identify which documents or other written sources of data to use. The choice of documents to be used also depends on the degree of accessibility (Denscombe, 2014).

Thus, in this research, and especially in Study 1 of Research Activity 1, a number of documents were collected for further analysis, such as scientific articles, reports, and policy documents related to ICT capacity building in HEIs. This literature survey enabled us to gather information about the real-world situation in regard to IT and university alignment, and particularly in developing regions. A document survey was also applied in other studies of this doctoral research to collect data related to IT alignment within organisations and IT integration within university services.

3.5.4. Observations

Observing people and the environment is a common and discrete way of collecting research data (Denscombe, 2014; Yin, 2003). This approach allows a researcher to collect on-site evidence from the real-world environment. For example, observations can be made while implementing a new innovation in an organisation to perceive what attempts are made to integrate it. As a naturalistic approach, activities observed within the system and related interactions are monitored and recorded for further analysis (Kushniruk, 2002). With this data collection approach, a researcher can observe the participants and note their different behaviours and feedback when using a particular IT system.

Hence, in this research, participant observation was used to understand how involved participants were in terms of adopting and using IT

systems in the university working environment. Observations were mostly carried out in Studies 2, 3 and 5 of Research Activity 1. The purpose of observation in these studies was to obtain insights related to barriers and issues regarding the integration of technology into teaching, learning, research and administration in the case study institutions. This technique was applied as the study participants were using IT tools during the research process.

A detailed description of how the above data collection techniques were used in each study of the overall research process can be found in each published paper, in the appendix to this thesis.

3.6. Data Analysis Approaches

The collected data needed to be systematically analysed in order to answer the research questions. To prepare for this task, a researcher needs to consider how data analysis is to be conducted (Cohen et al., 2013; Stillar, 1998). Based on the research strategies and data collection techniques adopted in this research, three types of data analysis approaches were used: exploratory data analysis, content analysis, and correlation and regression analysis.

3.6.1. Exploratory Data Analysis

Exploratory data analysis (EDA) is an approach whereby a researcher looks broadly at patterns, their categories and trends in the collected data in an attempt to obtain a picture of how these data can answer the research question (Tukey, 1977). EDA has been described as an approach to learning from the data in order to explore the world using a scientific process (L. V. Jones, 1986). For quantitative data, EDA can be done using computer-based statistical applications to gain a descriptive understanding of the characteristics of datasets (Morgenthaler, 2009). This analysis approach was applied in Research Activity 1, in Studies 2, 3, 4, and 5, to analyse the data collected using questionnaires. EDA was also used in Study 8 of Research Activity 3.

3.6.2. Content Analysis

This is a qualitative analysis approach that is used to determine patterns and structures from a set of texts (Creswell, 2014). This approach can be categorised into two types: conceptual and relational analysis

(Denzin & Lincoln, 2011; Krippendorff, 2004). A content analysis approach is used by researchers to quantify or qualify the presence, meaning, and relationships of identified words and concepts. In this approach, inferences can be made on the basis of information from textual data (Krippendorff, 2004; Stillar, 1998).

Having collected qualitative data in Study 1, conceptual content analysis was applied to analyse the set of policies and other scientific articles related to ICT and education. Critical discourse analysis was then used on the collected policy documents. Following this, the content analysis approach was also used in Study 5 of Research Activity 1, in Study 6 of Research Activity 2, and then in Study 8 of Research Activity 3. The purpose of using the content analysis approach was to gain an inductive understanding of the patterns and themes from interviews and document texts with reference to the applied theoretical concepts, and to be able to answer the research questions appropriately through each study.

3.6.3. Correlation and Regression Analysis

This approach to analysis allows a researcher to test and estimate causal relationships among two or several variables (Ross, 2014). This is a statistical approach that is used to test a hypothesis about the existence of a relationship between observable variables and the latent constructs in a scientific process (Straub et al., 2005). By using knowledge about a theory and previously derived empirical data, a researcher deduces the patterns and relationships *a priori* and then proceeds to statistical testing of hypotheses.

In this research, correlation and regression analysis techniques were applied in Study 7 of Research Activity 2, as reported in Table 2. The purpose of using correlation and regression analysis was twofold. Firstly, the aim was to test the relationships among the model constructs (alignment practices and institutional performance). A regression analysis was then conducted to determine the effect (influence) of the alignment practices (independent variables) on the degree of institutional performance (dependent variable) through effective IT integration in HEIs.

3.7. Ethical Consideration

In each research undertaking, especially when it involves human beings, ethical issues must be taken into consideration (Denscombe, 2014). By considering ethical principles in the research process, the integrity of the research participants can be given maximum consideration.

This research involved various categories of respondents. Hence, consent and confidentiality are the two main ethical issues in the social research process (Cohen et al., 2013), and these were highly respected during the collection and analysis of data. Before data were collected, informed consent was obtained from participants prior to obtaining official permission to conduct research from each institution involved. More particularly, participants were informed about the purpose of each study in which they were involved, and were informed that their participation is voluntary.

An assurance was given that the anonymity and confidentiality of participants would be maintained and information was provided to each participant. Likewise, participants were also assured that all the collected data were to be used only for the purposes of this doctoral research. To deal with data confidentiality, all the collected data for this research were kept in a safe and protected storage with a restricted access. Only the researcher was authorized to give access to the data collected during this doctoral research.

4. Results

This section presents a summary of the overall findings of this research. More detailed results can be found in each research paper (RP 1 to RP 8) as presented in the Appendix. The overall research had one main research question, which was addressed through the eight research sub-questions for each study. The findings were then synthesised under three research activities, as presented in Figure 12 below:
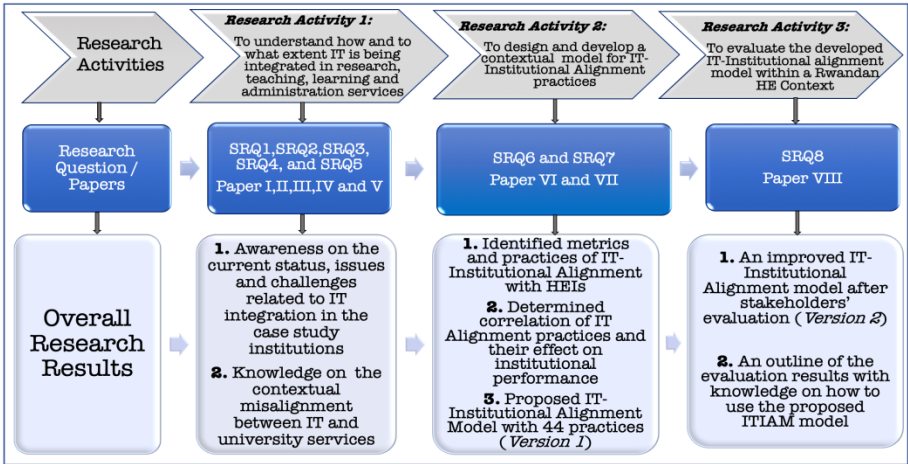
Figure 12. Relationships between the research activities and papers, and summary of the related findings

The results of this overall doctoral research are connected to each other via each research activity (Figure 12). Following the DSR approach, the development of the ITIAM was inspired by the awareness of the existing state of the art in regard to the integration of IT in the case study universities and the IT alignment practices within the higher education context, as identified earlier. This was also supported by the identified managerial and academic institutional performance indicators for universities. Detailed results for each paper are given in the following sub-sections.

4.1. Contextual Awareness of IT Integration in University Activities

At the outset of this research, five preliminary studies were conducted with the aim of understanding the contextual state of IT integration in university services. Here, the purpose was to understand the extent of the misalignment between IT and university activities, including the inhibitors and factors that may have contributed to the adoption, use and integration of IT in service delivery. The findings of each study within Research Activity 1 are discussed in the next section.

4.1.1. **Study 1:** Exploration of ICT Policies Related to the Higher Education Sector.

As stated above, this was an exploratory study (*Paper 1*) with the aim of understanding how ICT policies related to higher education can articulate strategies for ICT capacity building, from both technical and non-technical perspectives. It was conducted from April 2014 to July 2015, mainly in Rwanda, and guided by the following research questions:

- What strategies for ICT capacity building are asserted by Rwandan ICT policies related to higher education?
- To what extent are these strategies clearly emphasised in terms of effective guidance for implementing technology in the new, merged UR?

Since the main sources of data were documents, a qualitative approach was used on a sample of nine policy documents corrected from universities and government institutions in charge of ICT and education. Using critical discourse analysis, 11 policies from national and university levels were analysed to understand how they considered ICT capacity building for the effective integration of technology into university services.

Summary of Findings for Study 1

- **A lack of articulation of important ICT capacity-building strategies in institutional-level policies**

This study revealed that strategies for the effective adoption and use of online learning management systems are not articulated at all in the policies analysed.

The results of discourse analysis indicate that the investment cluster is the least claimed in terms of strategies to build ICT capacities for universities. This is confirmed by the fact that most of its statements related to capacity-building strategies scored a low degree of appreciation in the analysed policy documents. In addition, none of the institutional policy documents claims the creation of financial schemes for students and teachers to enable them to acquire ICT tools (ICT-CB18, ICT-CB19) or to increase the internet bandwidth reserved for educational data (ICT-CB24).

Under the institutional cluster, several relevant strategies for building ICT capacities are well articulated in the policy documents. However, no institutional policy has asserted the creation of awareness of the available ICT facilities (ICT-CB15).

Table 3. Matrix representing ICT capacity-building strategies from document policies

Table 3 shows the different ICT capacity strategies and the extent of their presence in the policies analysed here that are currently in place. In terms of the instructional cluster (teaching and learning), the findings indicate that some key important strategies, such as the students' access to online digital learning materials (ICT-CB4) and the development of

e-learning courses (ICT-CB4), are not strongly claimed by any policy in the sample. However, these two ICT capacity-building strategies are considered to be core elements for effective IT integration in teaching and learning activities (Nachmias, Mioduser, Cohen, & Tubin, 2004; Taylor, J. A., & Newton, 2013).

Overall, the results showed a lack of clear articulation of important strategies to support the integration of IT in the areas of teaching, learning, research and university administration. A lack of clear policies governing how ICT resources can be acquired, implemented, used and maintained at the institution is likely to hinder the overall process of IT integration into university services.

- **Inadequate translation of ICT strategies from national-level to institutional-level policies**

As highlighted by Kozma (2005), broad guidelines and objectives in national-level policies are contextualised by institutional-level policies to enable the operationalisation of national programmes regarding the adoption and use of IT in higher education. However, most of the institutional level policies analysed here did not consider this translation. Consequently, although national-level policies related to ICT integration in Rwandan higher education are well crafted, there were no clear relationships between institutional policies and these national-level policies. As it can be observed from the Table 3, several strategies for ICT capacity building set out in the policy documents from MINEDUC, RDB/IT and MYICT are not articulated in institutional-level policy documents from the universities considered as case studies in this research.

Lastly, the results indicate that the ICT policies and master plans in place at the time of this study could not effectively support the implementation of IT systems in the newly created UR, formed by merging all the former public universities and higher education institutes. As a conclusion to Study 1, a lack of clear policies for ICT capacity building at institutional level may have contributed to the high levels of failure in integrating technology in some Rwandan HEIs. This misalignment between national-level and institutional-level policies related to ICT is also claimed by different stakeholders and partners in the higher education sector.

The above findings formed the basis for further exploration of the real-world context to understand more about how and to what extent certain IT systems have been integrated into the areas of teaching, learning, research and administration. This led us to conduct a study of each area of technology intervention: teaching, learning, research and education management.

4.1.2. **Study 2**: IT Integration to Support the Research Process

In order to explore and obtain a further understanding of IT integration to support the research process, Study 2 (*Paper 2*) was carried out and one IT system for research process was used as a case study. This study aimed to answer the research question relating to teachers' and researchers' perceptions of the relevance of an online thesis management system for improving the research process at UR.

The system under implementation in this study was SciPro, an IT support system for the scientific thesis process. This system enables online thesis supervision by facilitating communication and resource sharing between students and research supervisors for both undergraduate and postgraduate programs (Aghaee, Hansson, Tedre, & Drougge, 2014).

It was selected as a system case for this study since it supports universities in the adoption and use of technology within the research process. In addition, during this study, SciPro was at an early stage of implementation at UR, offering an opportunity to consider it as a case study to understand how technology is being adopted to support research activities and the contextual related challenges of system adoption and usage.

Following the exposure of teachers to the SciPro system, the goal of Study 2 was to evaluate the perceptions of future users in regard to the relevance of the system in improving the thesis process at UR. As an explorative case study research, an embedded case study approach was used with multiple units of analysis (Denscombe, 2014; Yin, 2003). Respondents who had previously been invited from the five colleges of UR for the initial SciPro system test participated in this study. Data collection was done between June and October 2014, during the initial phases of testing and implementation of SciPro at UR's three campuses.

Participants in this study included teachers, e-learning coordinators and IT project managers and directors of research. They were selected via the Centre of Instructional Technology (CIT) of UR, which invited them to assess the introduction and testing of the SciPro system as a new technology for thesis supervision process and research improvement. Questionnaires were distributed to the participants after training and testing sessions of the introduced system. All completed questionnaires were returned for data analysis. Follow-up face-to-face interviews were conducted with some respondents to obtain their views and expectations of the SciPro system in terms of alignment with UR's research context. A summary of the results of Study 2 is given below.

Summary of Findings for Study 2

- **Perceptions of the SciPro system and its importance in supporting the research process**

During the pilot test of the SciPro System at UR, participants explored 13 features of the system, and were then asked to describe the level of importance of each feature.

As can be observed from Figure 13, features such as scheduling the final research seminar (89.4%), anti-plagiarism control (87.1%), the idea bank (77.40%), student-supervisor matching (74.2%) and automatic grading of reports (74.2%) were reported as being highly important in supporting the thesis-writing process. Moreover, the participants in this study reported a considerable degree of importance for the remaining features of the SciPro system.
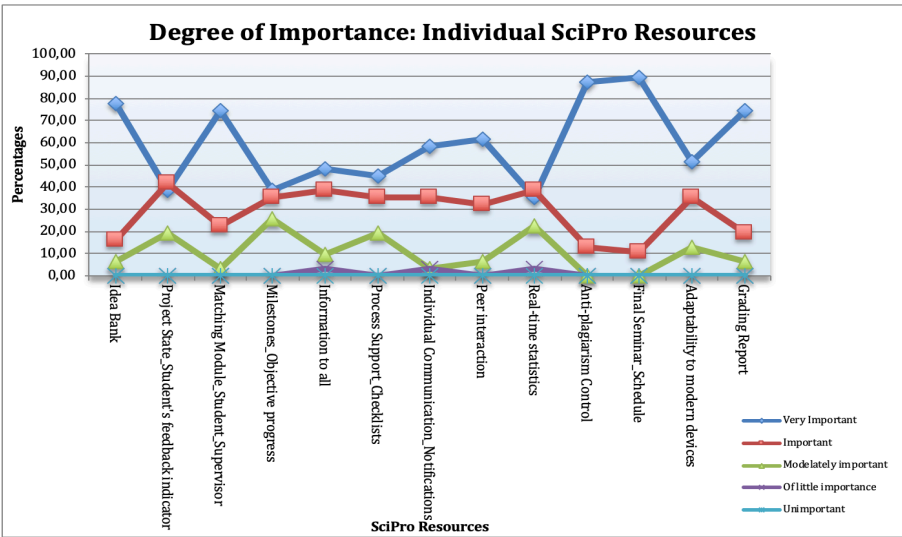
Figure 13. Perceptions of the degree of importance of SciPro resources

Furthermore, the results of quantitative analysis, as presented in Figure 14 below, show that the participants' behavioural intentions were high (90.78%) in regard to the future use of the SciPro system. Their degree of behavioural intention is a dependent variable of the system's features, which are determined by three main factors: performance expectancy (92.74%), effort expectancy (89.24%) and social influence (90.35%).
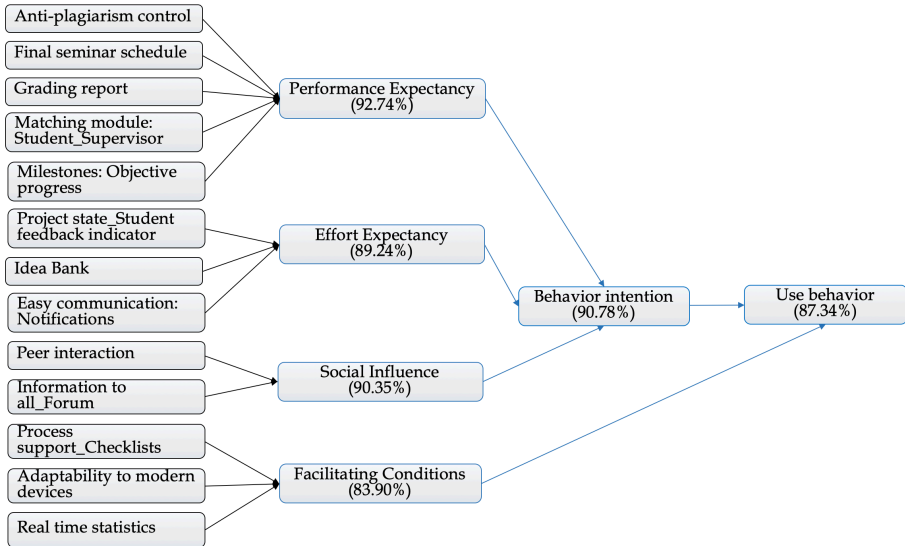
Figure 14. Supervisors' perceptions of SciPro system resources

From Figure 14, it can be observed that the participants in the SciPro test intend to use this system for thesis supervision at UR. This may be the case provided that other institutional, social and technical factors are addressed. However, this means that other factors external to the SciPro system must be taken into consideration to ensure the effective implementation and use of this system. The findings of this study indicate that there is a need for commitment and involvement from top university management throughout the entire SciPro integration process and a need for motivation for early system adopters (champions). In addition, the successful implementation of SciPro will depend on improved internet access, mainly for students and supervisors, and the customisation of the system to increase its level of adaptability and fitness in the context and practice of UR.

- **Unfavourable UR working conditions outside the SciPro system**

Although the SciPro system was attractive to the sample of participants in this study, some inhibitors to the integration of this tool at UR were also identified. These included: (i) a lack of a clear e-learning policy and research policy to recognise the SciPro system; (ii) inadequate ICT infrastructure in place (mainly internet bandwidth and computers for students and teachers); (iii) a lack of motivation for researchers to use the SciPro system; and (iv) a low level of involvement by university top management in the overall system integration process.

Study 2 concluded that, the above explained as the research findings can translate that there is still a lack of alignment between the technical and non-technical (institutional, individual and social) aspects which are likely to hinder the effective integration of the SciPro system at UR.

Hence, from an institutional dimension, policies on e-learning, research and mechanisms for motivating academic staff need to be put in place. The results from Study 2 enabled us to recommend continuous and appropriate training for end-users and system administrators, and an awareness of the availability of this SciPro system at UR. From a technical point of view, although the resources and functionalities of the SciPro system were perceived positively by participants in this study, some features of this system such as the online peer review process and anti-plagiarism control functionalities must be customised and adapted

to the current UR thesis and research process for both undergraduate and postgraduate programs.

Based on the results of Study 2, it was perceived that a particular technology such as the SciPro system cannot be useful and add value to service delivery without considering the principal individual and institutional factors. Thus, a clear framework for aligning technology with university research activities needs to be put in place to guide the integration of IT systems to enable an innovative research process at UR.

4.1.3. **Study 3:** The Integration of Information Technology in Teaching and Learning Activities

Another area of investigation for this doctoral research was the integration of technology into teaching and learning (*Paper 3*). In this first explorative phase, the aim of Study 3 was to obtain knowledge about how technology is integrated into teaching and learning as a core activity of HEIs. This study was motivated by the fact that the integration and use of e-learning systems were still problematic in several Rwandan HEIs, due to both institutional and individual constraints (Mukama, 2009). Criticisms have also been put forward of the huge financial investments made in ICT to support the Rwandan higher education sector, but which have added no value to service delivery.

In Study 3, an upgraded LMS based on Moodle was selected as a case study of an IT system currently used at UR. During this study, this e-learning system was undergoing implementation within all the colleges of UR. The aim of this study was to understand the adoption and use of this e-learning platform that was being integrated to support teaching and learning activities. We wanted to hear about teachers' perceptions of the usefulness, ease of use, trustworthiness of this system, and the facilitating conditions that were in place in this institution to support its implementation.

The study was carried out in 2015, and an adapted six-construct conceptual research model related to technology adoption and acceptance (Venkatesh et al., 2003) was used in the design of a research questionnaire and interviews. The study involved only those teachers who participated in at least one of the training sessions organised by the CIT at UR. Using a purposive sampling technique (Denscombe, 2014), 87

participants completed the questionnaire successfully and 16 interviews were conducted with respondents from the same sample.

Summary of Findings for Study 3

- **The upgraded e-learning system is useful, easy to use and trustworthy.**

In regard to the system's usefulness, ease of use and trustworthiness, the findings indicate a high degree of acceptance of these constructs. An analysis of the data showed that participants found the system useful, easy and trustworthy. This is supported by the fact that all of the 26 related items used for these three constructs scored a high degree of agreement from the study participants. A detailed report of these results, indicating high percentages on the scales of agreement from 5, 6, and 7 can be found in Table 3 on page 7 of Paper 3. Therefore, as an example, participants expressed that they found the platform useful in their academic endeavours (*Perceived usefulness: PU12$\rightarrow$97.7%)* and easy to use in managing their online course content (*Perceived ease of use: PEOU10$\rightarrow$96.55%*). They also felt that only authorised users could view and access course materials uploaded to the system (*Perceived trust: PT3$\rightarrow$96.55%*).

- **Low intention of teachers to use the system in the future**

Contrary to the above findings, however, the same study revealed that the degree of intention to use the system in the future was very low. This can be observed from Figure 15, which shows the means of the items used in the research conceptual model to understand the participants' perceptions of the adoption and use of the UR e-learning platform. In addition, the results in Figure 15 reveal that the degree of intention towards the e-learning platform (*Intention to use the platform*: ITUP1$\rightarrow$ ITUP4) was low compared to other items used in the research conceptual model.
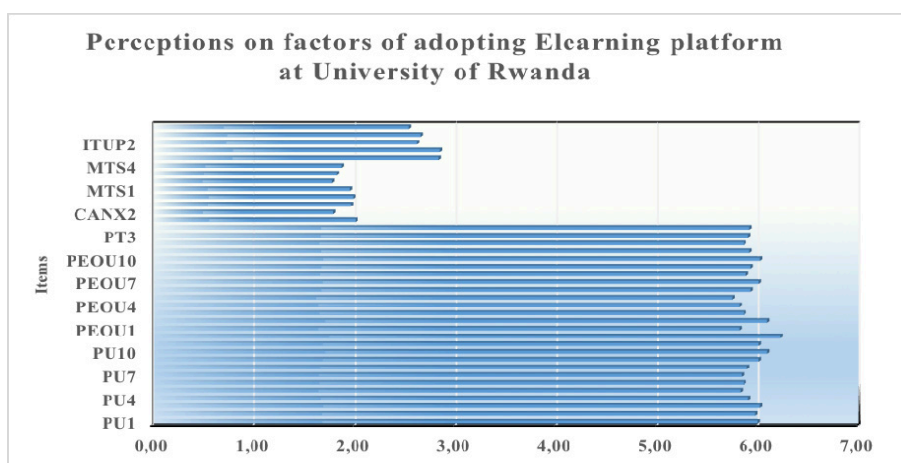
Figure 15. Perceptions of the adoption and intention to use an e-learning platform at the University of Rwanda

By comparing the means of the items shown in Figure 15 above, it can also be seen that the teachers' intention to use this platform would be negatively affected by *managerial and technical support* (MTS), since the platform itself is useful, trustworthy, and easy to use from the participants' perspective.

Findings from the interviews coincided with the quantitative results, and the following factors were identified as hindering the adoption and use of the UR e-learning platform:

- Gaps in policy synergy (a lack of a specific e-learning policy with links to other existing UR policies)
- Lack of incentives (related to considering the adoption of IT in staff performance evaluations)
- Inadequate basic ICT infrastructure
- Inadequate technical support for faculty staff
- Low involvement of senior management in the IT implementation process
- Poor internet connection across campuses
- Lack of awareness of the existing e-learning platform

These are the key bottlenecks recognised from the real-world setting at UR that contribute negatively to the low degree of the teachers' intention to use the upgraded e-learning platform at this university.

In summary, the results of Study 3 conveyed that although the e-learning platform based on Moodle was being integrated into teaching and

learning at UR, there was still a misalignment between the human, institutional and technical aspects. Furthermore, even if this platform were upgraded to a higher level and perceived positively by teachers, this would not necessarily guarantee its adoption and use in the future to improve performance by modernising the teaching and learning activities at this university. The platform needs to be aligned with the context of the UR by addressing the bottlenecks reported above, which have also affected the integration of other previous versions of UR e-learning systems.

4.1.4. **Study 4:** Students' Familiarity with Technology

In order to explore the perspective of students on the integration of technology, a study was conducted to understand the extent to which new incoming students at UR were able to use the range of new technologies available in their online learning environment. Based on the assumption that a particular level of familiarity of students with new technologies for education and research has a big impact on their adoption and use (Kennedy, Judd, Churchward, Gray, & Krause, 2008), Study 4 focused on the learners' perspective on the use of the current IT systems at the university. This study therefore aimed to understand the degree of familiarity with technology of first-year students at UR. The following research questions guided the researchers:

(i) To what extent do first-year university students own, access and use a range of digital tools?
(ii) What activities do these students perform with these digital tools?
(iii) Have these students had any previous computer-based training?
(iv) What is their self-reported level of confidence in using a range of digital tools?

The degree of the students' familiarity with technology was therefore explored in terms of factors such as accessibility, ownership, usage and previous computer-based training, as conceptualised in the framework as factors determining the familiarity of students with new technologies (Beetham & Sharpe, 2013; Ferrari, 2012).

This Study 4 was conducted between the autumn semester of 2015 and the spring semester of 2016. Prior to data collection, authorisation for conducting this study was obtained from the Directorate of Research and Postgraduate Studies at UR. The survey questionnaire was

administered to the participants both online and face-to-face during the admission and registration period. Participants in the study were directed to the questionnaire link after the registration process was completed, via the UR IEMIS. The population for this study was composed of incoming first-year students at UR for the academic year 2015–2016. In total, a random sample of 576 students successfully completed the survey questionnaire, 286 of which used the online questionnaire and 290 used a paper-based version.

Due to the types of data that needed to be collected, survey research was used as a strategy (Denscombe, 2010) for gathering factual, descriptive information from students, in terms of their familiarity with new technologies. The questionnaire used in the study was adapted from the survey instruments used by Kennedy et al. (2008) and Thinyane (2010) to measure students' familiarity with technology in contexts other than the Rwandan higher education system.

Summary of Findings for Study 5

- **Low familiarity with technologies**

The degree of familiarity with technology was explored with reference to the students' accessibility, ownership and usage of a range of digital tools and the internet.

The results presented in Figure 18 below indicate that the degree of access to both digital tools and the Internet was relatively low, at least for the sample of students who participated in this study. This is explained by the fact that the majority of respondents had limited access (54%) or no access (32.7%) to desktop computers. The same trend was observed for the accessibility of laptop computers, where 45% of respondents had limited access and 32.1% had no access at all.

Figure 16 title: *Access to technology (tools and the nternet)*

	Desktop	Laptop	Tablet	Smart phone	Digital camera	PDA	Audio Recorder	Wireless_Intern et	Modem_Interne t	Cable_Internet
■ Unlimited access	13,4	22,9	7,1	37,5	9,4	4,3	12,2	16,8	16,1	12,3
■ Limited access	35,4	27,8	12,0	14,1	17,4	10,1	12,3	31,3	24,5	20,3
■ Very limited access	18,6	17,2	13,0	12,2	14,8	8,0	11,1	13,4	15,5	15,5
■ No access	17,2	17,5	39,6	19,4	31,4	44,4	33,7	24,5	27,6	32,5
■ Not sure	15,5	14,6	28,3	16,8	27,1	33,2	30,7	14,1	16,3	19,4

Figure 16. Students' access to technological tools and the internet

The findings presented in Figure 16 for the students' accessibility to digital tools indicate that a high proportion of students had limited or no access to tablets, digital cameras, smartphones, audio recorders, and personal digital assistants (PDAs).

A similar trend can be observed for the data regarding the students' access to the internet. While 44.7% of respondents had limited access to wireless networks and 38.6% had no access at all, only 16.8% of the sample reported having unlimited access. In addition, only 12.3% of students reported having access to cable internet, while the rest of the sample had either limited (35.8%) or no access (51.9%) at all to WiFi internet. The majority of the sample had very restricted (39.8%) or no access (43.92%) to the modem internet. In this section, the statistics reported in Figure 16 indicate a significant heterogeneity in the respondents' access to technology and show that a substantial number of students have limited or no access to digital tools and the internet.

Regarding the ownership of digital tools and gadgets by the incoming students at UR, participants in this study were asked to report which digital tools they owned before registering with UR. A summary of the findings on the ownership of digital tools is presented in Figure 17 below.
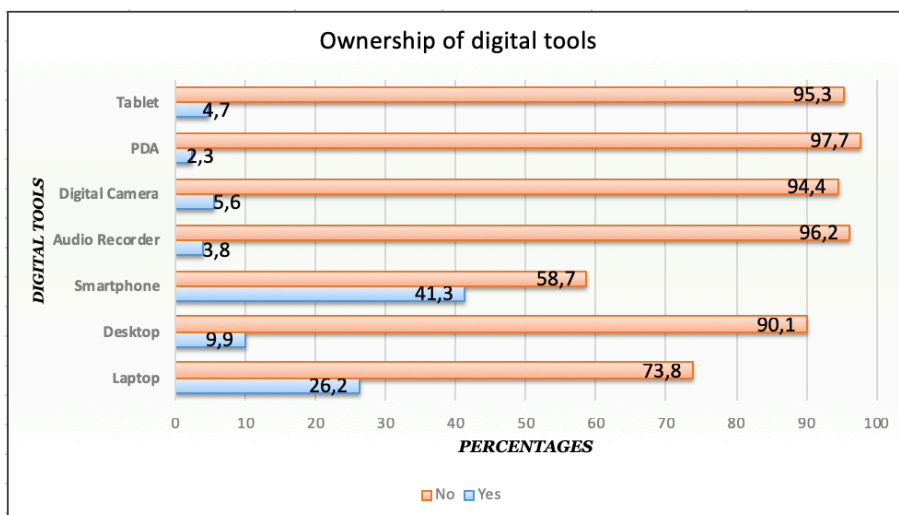
Figure 17. Ownership of digital tools by students

As can be observed from Figure 17, although smartphones were the most widely owned digital tools (41.32% of respondents), a large proportion of the sample did not own one (58.7%). In addition, only 26.2% of respondents had their own laptops, and the remaining six digital tools were owned by less than 10% of the incoming students at UR, who participated in this study.

Based on the assumption that access to and ownership of digital tools and the internet do not necessarily translate into an increased degree of familiarity with technology, if they are not used, this study was equally interested in understanding the frequency of use of different digital tools by the incoming students. The findings in relation to the frequency of use of digital tools and the internet are reported in Figure 18 below.

	Desktop	Laptop	Tablet	Smart phone	Digital camera	PDA	Audio recorder
Always	10,8	17,7	6,6	35,4	7,3	4,0	9,5
Sometimes	22,6	23,8	4,9	13,5	10,8	5,0	8,3
Often	12,8	13,4	4,5	5,4	8,9	4,2	5,2
Rarely	26,0	17,5	10,4	9,4	14,4	5,6	10,8
Never	27,8	27,6	73,6	36,3	58,7	81,3	66,2

Percentages
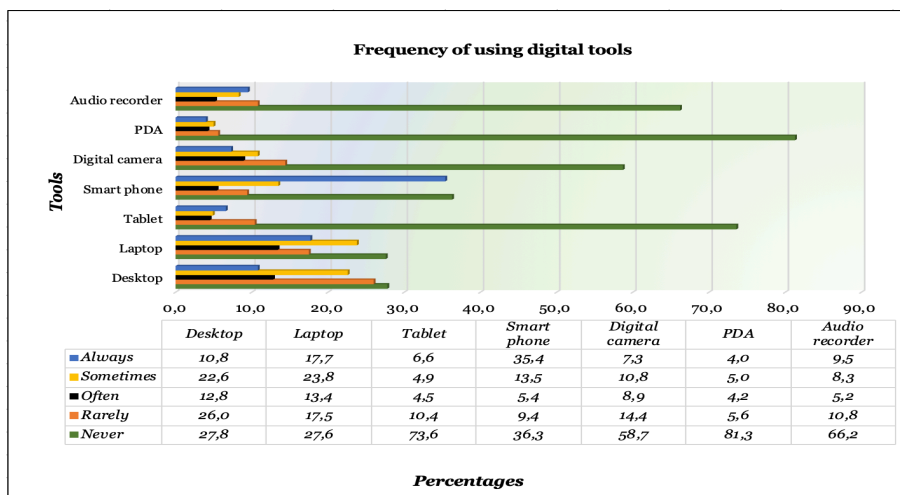
Figure 18. Respondents' frequency of use of digital tools

As can be observed from the figure above, the proportion of first-year students who rarely or never used computers, smartphones or other proposed digital tools was significantly greater than those who moderately or often used these IT tools. For example, this study revealed that only a small number of first-year students frequently used desktops (10.8%) and laptops (17.7%). The same trend was observed for digital cameras, PDAs and audio recorders (Figure 18).

Since prior computer and other IT-related training can contribute to the students' degree of familiarity with technology, Study 4 aimed to gather information on previous computer-based training as self-reported by the first-year students participating in this study.
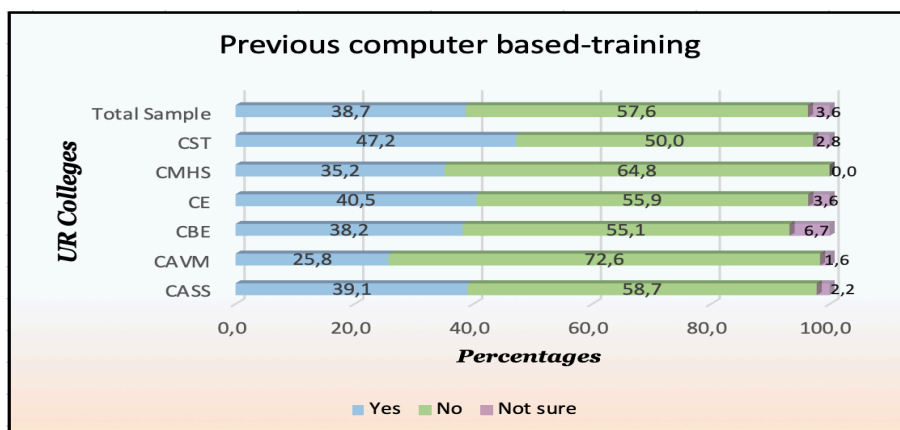
Figure 19. Students' previous computer-based training

The results presented in Figure 19 above indicate that 57.6% of the students in this study had never had any IT-related training before registering at UR. In addition, the statistics in Figure 19 also show that more than 50% of the first-year students registering at each college of UR had never had prior training on computer applications. This is even more alarming, as the figures related to a lack of prior computer-based training were substantially higher for the College of Agriculture and Veterinary Medicine (72.6%) and the College of Medicine and Health Sciences (64.8%).

The results related to computer-based training allowed us to realise that a considerable number of first-year students at UR are not equipped with adequate, relevant digital skills and competencies to cope with the current university's online learning environment. Hence, to achieve effective alignment between the new university students and today's online learning environment, strategies for enabling ICT-related refresher courses on basic and advanced digital skills must be established by the university at the start of the first semester for these new incoming students.

In this study, we were also interested in assessing the first-year students' previous experience with the e-learning systems that they are expected to use at UR. The results related to this aspect are presented in Figure 20 below.

	Not specified	Very difficult	Difficult	Neutral	Easy	Very easy	Never used it
Uncategorised	25,0	0,0	0,0	12,5	12,5	0,0	50,0
Non STEM	8,2	4,7	9,9	15,5	7,7	3,0	51,1
STEM	5,9	4,9	7,7	13,2	9,1	5,2	54,0
TVET	3,6	3,6	14,3	21,4	17,9	14,3	25,0
Education	5,0	0,0	10,0	10,0	5,0	0,0	70,0
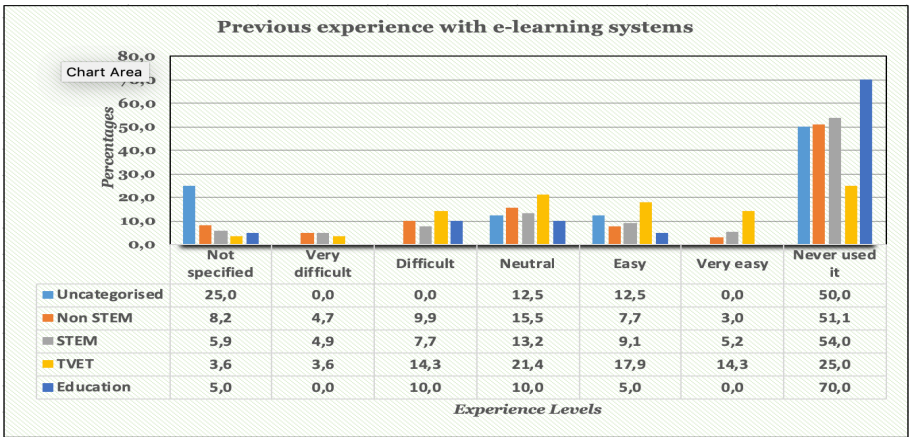
Figure 20. Students' prior experience with e-learning systems

It can be observed from the figure above that the majority of students (more than 50%) had never used any online platform for education purposes. Accordingly, of the very few who had had earlier exposure to e-

learning systems, many expressed that they still had difficulties in using a range of online LMSs such as the Moodle platform currently being used at UR.

This lack of exposure to computer-based tools in the surveyed sample indicates that the degree of use of the available online learning resources at UR by first-year students is likely to be low. Hence, this may also have a negative impact on IT integration in teaching and learning events at this university.

General Conclusions of Study 5

A substantial number of first-year students have had limited or no access to a number of digital tools such as desktops, laptops, tablets and smartphones. Their degree of digital skills is therefore problematic, and this is likely to affect their adoption and use of the technological tools available at UR. More specifically, due to their low degree of accessibility, ownership, usage and previous experience with technology (as indicated by the results of the study), it may be difficult for them to use a range of digital tools for learning purposes.

Overall, the results of Study 4 indicated that the majority of the first-year students coming to UR are not familiar with technology, and their previous exposure to e-learning systems is very low. This study contrasts with the works of Jones et al. (2010), Kennedy et al. (2008) and Thinyane (2010), since a low proportion of their samples had not used technology in substantial way, while in the current study, the majority of first-year students had rarely or never used technology. As a recommendation from this Study 5, UR must therefore develop mechanisms and practices for bridging the gap with students in terms of access, ownership, and use of digital tools.

In addition, the study revealed that the majority of incoming first-year students at UR are not tech-savvy, and are at different levels of technological readiness. This means that only very few incoming students at UR can search for and retrieve digital information, evaluate and synthesise soft data, and share and collaborate within the digital learning environment of the current higher education context.

The findings of Study 5 therefore provided an early warning to teachers, university senior management and educational planners in Rwandan

tertiary education to revisit the institutional curriculum in order to accommodate these students' needs in terms of acquiring the digital skills necessary to cope with the current online learning environment. More specifically, course design and increased access to and use of digital technologies should be aligned with this heterogeneity in the students' familiarity with technology, in order to effectively accommodate the first-year students' digital divide and the differences between them.

As UR continues to shift the majority of courses and modules from a traditional learning environment to an online version, this study can serve as a reference for addressing this technological shift. Finally, in order for these first-year students to cope within the current university's digital learning environment, the university faces a significant challenge in bridging the gap by increasing access to computer labs and the internet on campus.

4.1.5. **Study 5:** Integration of Information Technology to Support the University Administration Process

This was also an exploratory study (*Paper 4*) with the aim of gaining further knowledge about the real-world setting using the case of an IT system that was being integrated into the administrative functions at UR. The technological tool considered in this study was an IEMIS that was acquired to automate services such as online student registration, budgeting and finance, human resource management, management assets, procurement, processing students' marks, and providing institutional data to the university management. The objective of Study 5 was to investigate the complexity of the IEMIS and its stage of diffusion at UR under the guidance of the following two research questions:

- How complex is the integrated business management information system being implemented at UR?
- At what stage of integration is this system for supporting the university's administrative processes?

The study was carried out between January and November 2016, only three years after all of the public universities had been merged to form a single university. This was a qualitative research in which words, observations, visual images and diagrams were analysed to answer the research questions (Denscombe, 2014). In addition to a desk-based research method for data collection, 12 interviews were also conducted with six teachers and six administrative staff who were involved in the IEMIS implementation process. The purpose of these interviews was to

gain a deeper understanding of the contextual problems related to IE-MIS implementation.

Summary of Findings for Study 5

- **Complexity of the implementation of the IEMIS system**

Initially, to explore the complexity of the IEMIS system at UR, themes were identified from the data sources that were grouped into extracted categories (codes) and sub-categories (main subsystems). The identified themes, categories and sub-categories can be seen in Figure 21.
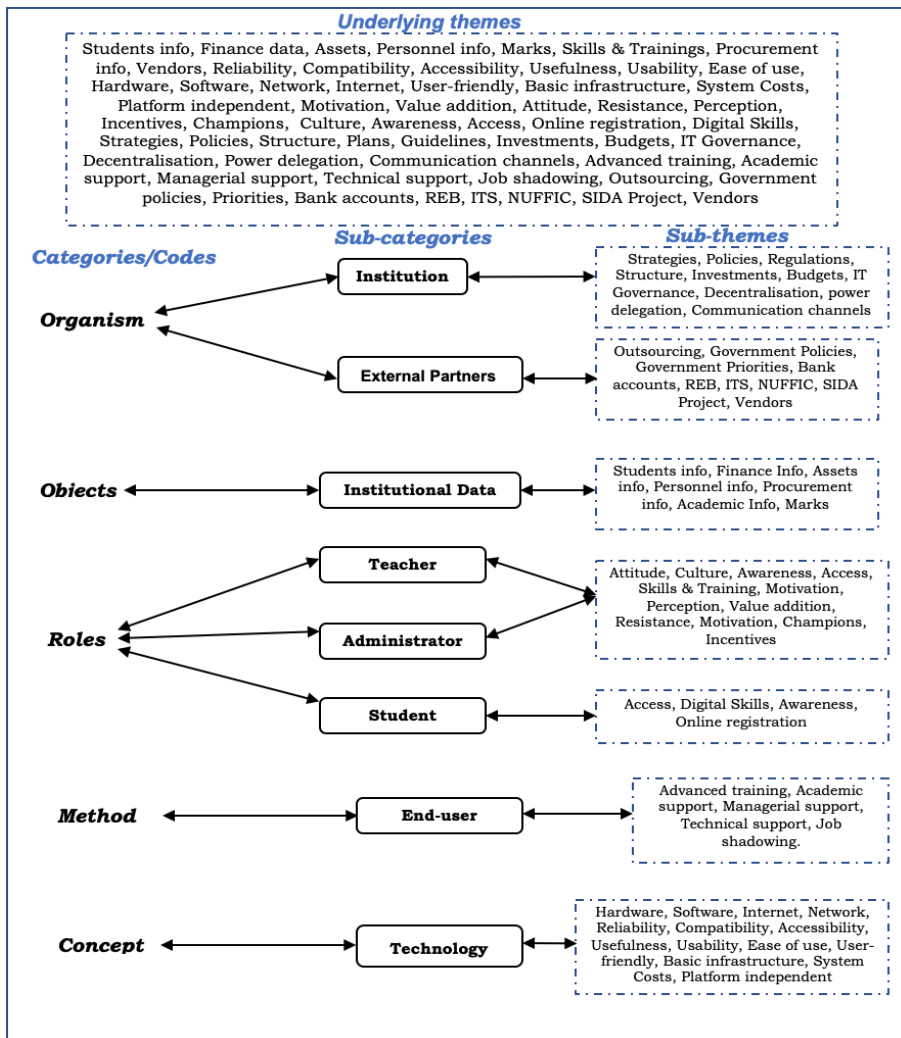
Figure 21. Themes, categories and sub-categories of the IEMIS

The main categories to emerge during data analysis were (i) roles (*teacher, student, administrator*); (ii) methods (*end-user support*); (iii) concepts (*technology*); (iv) objects (*institutional data*); and (v) organisms (*institution, external partners*). In total, 67 themes were identified from the interview manuscripts and the secondary documents. The technology subsystem contained the most themes (14), followed by the teacher, administrator and institutional data with 12 themes. The institution subsystem contained 10 themes, while the external partners contained nine. The remaining subsystems, end-user support and students, contained five themes each.

The identified subsystems and their associated categories in terms of an educational management information system framework serve as a basis for (i) exploring the complexity of the IEMIS system, and (ii) understanding its stage of integration (diffusion) as an innovative tool that support the administration services at UR.

In order to understand the level of complexity of the IEMIS, this study applied the theory of complex adaptive systems (Miller & Page, 2009), considering IEMIS as an innovative artefact (technology) integrated within an organisation, in this case the UR. The data analysis considered four features of a complex adaptive system (Cleveland, 1994):
- ✓ *Complexity:* A system is composed of subsystems that interact non-linearly with one another.
- ✓ *Self-organisation:* A system can re-organise itself to find an appropriate fit within the environment without external forces.
- ✓ *Co-evolution:* Subsystems can constantly adapt over time to each other and to the overall system
- ✓ *Connectivity:* A system is composed of several interrelated subsystems, making up a holistic system.
- ✓ *Emergence:* A complex system is based on an agency whereby each subsystem acts alongside other networked agents in an environment that is produced by its interactions.

The findings indicate that the IEMIS is composed of *eight distinct subsystems*. As can be seen from Figure 22, each of these subsystems interact with each other for the common goal of improving the administrative service delivery across the university. Moreover, the findings from Study 5 indicate that all the identified IEMIS subsystems have been emerging, interacting, co-evolving, adapting and self-organising in a nonlinear way (in a negative or positive direction) within the

disruptive environment of merging several institutions into a single multi-campus university.
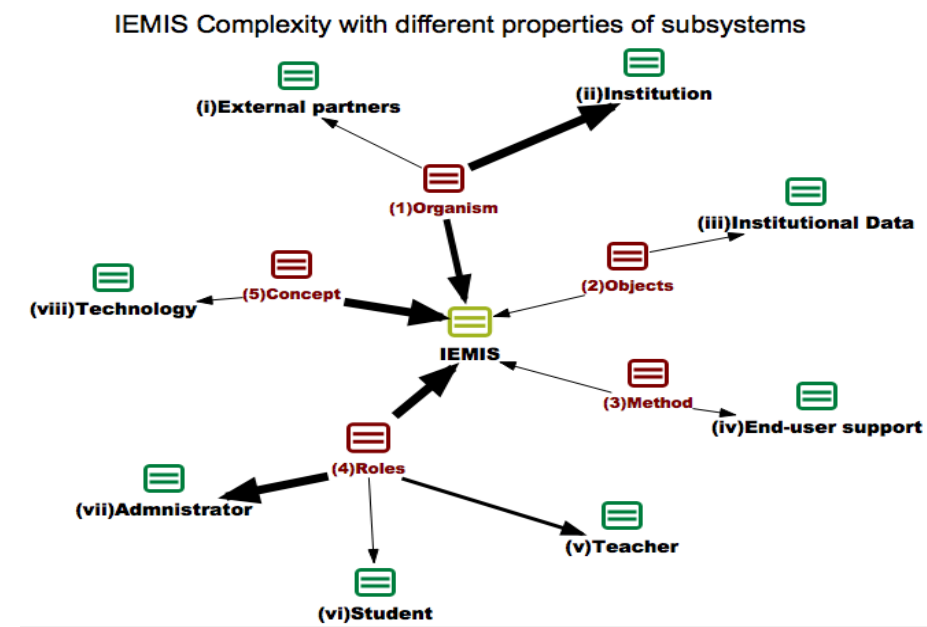
Figure 22. Complexity of IEMIS in terms of the different properties of the subsystems

The complexity of the system is also explained by the fact that these eight subsystems are categorised into five distinct properties: organism, objects, concept, roles, and method. Hence for this study, the complexity of the IEMIS at UR can also be seen in Table 4 above.

Table 4. Complexity of the IEMIS in terms of the analysed data

From the data sources used for this study (interviews, and reports related to this system), the frequencies of coded text segments were extracted for all subsystems of IEMIS. The nodes representing the frequency of observation for each subsystem indicate that "institution" and "technology" are the core components of the IEMIS subsystems that should be primarily considered when dealing with the system

complexity to ensure its effective implementation and innovation within the university services.

- **Implementation of the IEMIS system is at a lower level**

To answer the second research question, the innovation diffusion theory (Rogers, 2010) was applied. In particular, the levels of innovation diffusion in the organisation identified in this theory (abstraction, knowledge, persuasion, decision, implementation and confirmation) enabled us to categorise the level of integration of IEMIS as per the analysed data. A visualisation of the diffusion levels of IEMIS across the administrative services at UR was obtained by computing the symbol size of all the coded segments from the interview manuscripts, using the code matrix browser tool of MaxQDA software.

Table 5. Visualisation of IEMIS diffusion levels at the University of Rwanda
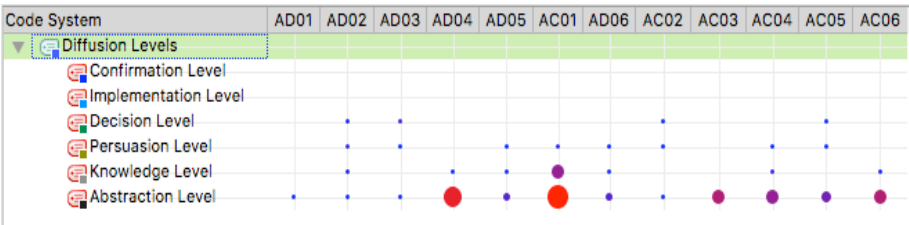
As shown in Table 5, the findings indicate that the integration of the IEMIS into university service is still at a lower level. Notably, the adoption and usage of the IEMIS fall below the expected level. As per the interviews analysed, most respondents reported this to be at abstraction level, and very few reported it to be at knowledge and decision level (See the nodes in Table 5). More specifically, respondents AC01, AD04, AC06, and AC04 argued strongly that the IEMIS system was still at abstraction level. This level of IEMIS diffusion at UR is affirmed by the increased number of occurrences in the analysed text segments of the interview data, as shown in Table 5 above.

Based on the identified degree of IEMIS complexity, the findings of Paper 5 clearly showed that where initiatives and attempts were being made to align the technical, institutional, and individual aspects of IEMIS, the degree of diffusion had reached the implementation and confirmation levels in terms of the university's administrative services that it was intended to innovatively support.

Thereafter, respondents to Study 5 identified the following as key factors in the low level of diffusion of the IEMIS at UR:

- The IEMIS is not a user-friendly platform
- It is not compatible with existing ICT infrastructure
- Existing ICT policies do not clearly inform IEMIS implementers
- There is a lack of awareness of the IEMIS for many staff
- There is a lack of clear motivational mechanisms for the end-users to use the IEMIS
- The communication channels between the top management and the system end-users (academic and administrative staff) are ineffective.

The most important elements that were suggested by respondents to be put in place to ensure a successful integration of the IEMIS within a multi-campus institution such as UR were: (i) *clear institutional policies, strategies, and guidelines*; (ii) *involvement of top management (leadership)*; (iii) *clearly established institutional structures*; and (iv) a *clear and strategic IT governance structure for the university*. The factors of *adequate hardware, software, accessibility and maintenance of the IEMIS* and *existing infrastructure* were also given high priority by respondents in relation to the effective adoption and use of the IEMIS.

4.2. Design and Development of the IT-Institutional Alignment Model

After obtaining an awareness of the problem of the real-world context, the second research activity was dedicated to developing a tentative solution in the form of an artefact. The problems identified in Research Activity 1 were related to the challenges and constraints of integrating IT into university services (*Papers 1 to 5*). More particularly, Research Activity 1 revealed that there is a misalignment between the IT systems that are in place and university activities such as teaching, learning, research and administration. Moreover, the primary cause of these problems is a lack of a clear related model for creating effective IT-institutional alignment for university performance through the use of IT. All of the prior studies undertaken as part of this doctoral research reveal that this failure in IT integration, at least for the systems examined in each study, can be seen from both the technical and non-technical

dimensions, as it is grounded in human (social), structure and infra-structure perspectives.

As a continuation of this doctoral research, the objective of Research Activity 2 was therefore to design and develop a contextual technology and institutional alignment model for the higher education sector and the University of Rwanda in particular. The following research question was addressed: **(SRQ7)** How can a holistic and reliable instrument for creating and measuring IT-institutional alignment be developed in the context of HEI performance in Rwanda? The findings of Research Activity 2 are presented in the following sections.

4.2.1. **Study 6:** Dimensions and Practices of IT-Institutional Alignment in the Context of Higher Education in Developing Countries

The aim of Study 6 was to identify and propose appropriate practices of IT-institutional alignment in the context of higher education in developing countries. This was achieved by responding to the research question regarding the dimensions and practices for improving IT and institutional alignment in the context of higher education in developing countries **(SRQ6)**. The identified alignment practices are expected to serve as a reference allowing universities to address the identified problem of failure in IT integration in a real-world context by effectively aligning IT with teaching, learning, research, and university administration.

The preliminary steps of this study involved conducting an extensive literature review of IT alignment in organisations, and more particularly IT integration in HEIs. The research approach adopted in Study 6 was an embedded multiple case study strategy using the two largest academic institutions in the region, namely UR and Eduardo Mondlane University in Mozambique. The data collection methods included the document surveys and interviews conducted to a selected sample of respondents from senior management, IT specialists and the faculty staff with the managerial responsibility.

The study was conducted between May 2015 to May 2016. Face-to-face semi-structured interviews were conducted using an interview protocol containing metrics for creating and assessing IT-organisational alignment, adopted from Luftman (2003). Using a thematic analysis

approach, the selected literature and interview manuscripts were analysed to identify patterns related to alignment practices.

Summary of Findings for Study 6

- **A framework with IT-institutional alignment practices**

This study identified IT-alignment practices within the context of HEIs that were categorised under the six metrics of IT-organisational alignment (Luftman, 2003): (i) communication (CP1-CP7); (ii) structure/governance (SGP1-SGP11); (iii) partnership (PP1-PP6); (iv) competence/value measurement (CVMP1-CMVP7); (v) technology scope (TSP1-TSP6); and (vi) skills (SP1-SP8). The details of these alignment practices are presented in Table 6 below.

Table 6. Identified IT-institutional alignment practices, categorised under six metrics

Metric	Code of Practice	Practice	Interviews-Institution1	Interviews-Institution2
Communication	CP1	Awareness on objectives, strategies, and rules for technology use	DTLE, DITG, RAO, PPTL, ITSA	DDIC, HITIC, DCAD, HITIC, DCDL, FL
	CP2	New IT systems demos and FAQs developed and communicated	DRIPGS, RAO, PPTL, ITSA,	HITIC
	CP3	Enabling institutional learning environment and effective communication channels	DRIPGS, ELS, RAO, PPTL, ITSA	DVC, DCAD, CDPF, DDIC, HITIC, FL
	CP4	IT-Management-Pedagogical liaison staff and Centres	DRIPGS, ELS, PPTL, ITSA	DVC, DDIC, HITIC, DCAD, FL
	CP5	Understanding and ownership of university business by IT staff	DITG, RAO, PPTL, ITSA	HITIC, DCDL
	CP6	Understanding and ownership of IT by administrators	DITG, RAO, PPTL, ITSA	DDIC, HITIC, DCAD, DCDL
	CP7	Enabling easy access to students online learning materials	DTLE, PPTL, ELS	DVC, CDPF

Structure / Governance	SGP1	*Developing and validating a University aligned ICT Master Plan*	DRIPGS, ELS, RAO, ITSA	HITIC, DCAD, FL
	SGP2	*Developing and enforcing policies for technical and non-technical domains*	DRIPGS, DITG, ELS, PPTL, ITSA	DVC, DDIC, HITIC, DCAD, DCDL, FL, CDPF
	SGP3	*Regular follow up on using technology after training*	DTLE, ELS, RAO, PPTL, ITSA	DCAD, DCDL, FL
	SGP4	*Developing motivation mechanisms and strategies for innovative IT champions*	DTLE, ELS, RAO, PPTL, ITSA	DDIC, HITIC, DCAD, DCDL, FL, CDPF
	SGP5	*Top management involvement and supporting IT implementation*	DTLE, DRIPGS, DITG, ELS, RAO, PPTL, ITSA	DVC, HITIC, DCDL, FL
	SGP6	*Enabling strategies, rules and procedures for IT procurement and use*	DTLE, DRIPGS, DITG, ELS, RAO, ITSA	DDIC, HITIC, FL
	SGP7	*Rational IT budgeting in the overall university's financial planning*	DTLE, RAO, PPTL, ITSA	HITIC, DCAD, DCDL, FL, CDPF
	SGP8	*Ensure relationship with IT infrastructure governance and university governance*	DITG, ELS, RAO, ITSA	DVC, DDIC, HITIC, DCAD, DCDL, FL, CDPF
	SGP9	*Establishing Senior-level IT steering committees*	DITG, RAO, PPTL, ITSA	HITIC
	SGP10	*Decentralization and empowering middle and lower level managers*	DITG, ELS, RAO, PPTL	DDIC, HITIC
	SGP11	*Developing digital teaching materials and other resources*	DTLE, DRIPGS, ELS	DVC, HITIC, DCAD, DCDL, CDPF
Partnership	PP1	*Creating external partnership for IT investments and funding*	DRIPGS, ELS, PPTL, ITSA	DVC, DDIC, HITIC, DCDL, FL, CDPF
	PP2	*Developing other universities' partnership for IT knowledge exchange*	ELS, RAO, ITSA	DVC, DDIC, HITIC, DCAD, DCDL, FL
	PP3	*Developing external partnership with IT service providers and outsourcing*	ELS, RAO, PPTL, ITSA	DVC, DDIC, HITIC, DCAD, DCDL, FL, CDPF
	PP4	*Securing Government support for IT implementation*	DRIPGS, ELS, RAO, PPTL, ITSA	DDIC, FL, CDPF
	PP5	*Managing IT Solutions-University activities relationship internally*	DRIPGS, DITG, RAO, ITSA	DVC, HITIC, DCAD, DCAD, DCDL, FL, CDPF
	PP6	*Managing and aligning external partners' interests with university IT needs*	DITG, RAO, PPTL, ITSA	DCDL
Competence /value Measurement	CVMP1	*Develop metrics for evaluating university IT expenditure and cost-benefit*	DITG, ELS, PPTL, ITSA	HITIC, FL, CDPF, DDIC, CDPF
	CVMP2	*Regular monitoring and evaluation of staff IT training*	DTLE, ELS, RAO, PPTL, ITSA	DVC, HITIC, DCDL, FL, CDPF
	CVMP3	*Regular measurement of People, Structure and IT infrastructure linkage*	DITG, RAO, ITSA	HITIC, DDIC, DCDL, CDPF, DCAD
	CVMP4	*Regularly measuring and monitoring Student per computer ratio*	DITG, RAO,	DDIC, HITIC, FL, CDPF
	CVMP5	*Develop clear procedures and metrics for regular IT value-addition measurement*	DITG, ELS, RAO, ITSA	DDIC, HITIC, FL, CDPF, DCAD
	CVMP6	*Assessing IT related policies enforcement regularly*	DITG, RAO, PPTL, ITSA	HITIC
	CVMP7	*Evaluating IT skills and the implementation of training programs*	DITG, ELS, RAO, PPTL,	DCAD, CDPF

Technology Scope	TSP1	Providing relevant and timely technical support up to the lower unit	DTLE, ELS, RAO, PPTL, ITSA	DVC, DDIC, HITIC, DCAD, DCDL, FL, CDPF
	TSP2	Ensuring primary and standard IT systems in place across campuses	DTLE, DRIPGS, DITG, ELS, RAO, ITSA	DVC, DDIC, DCAD, HITIC, DCDL, FL, CDPF
	TSP3	Providing improved and stable connectivity and internet bandwidth	DTLE, DRIPGS, ELS, RAO, PPTL, ITSA	DVC, DDIC, HITIC, DCDL, FL, CDPF
	TSP4	Providing easy access to internet and IT systems features for staff and students	DTLE, DRIPGS, RAO, PPTL, ITSA	DVC, DDIC, HITIC, DCAD, DCDL, FL
	TSP5	Ensuring high level IT system security standards and maintenance operations	DITG, ELS, RAO, ITSA	DVC, DDIC, DCAD, CDPF
	TSP6	Providing integrated technology architecture and user-friendly platforms	DITG, ELS, RAO, PPTL, ITSA	DVC, HITIC, DCDL, CDPF
Skills	SP1	Adequate Teacher's IT training to reduce resistance to technology	DTLE, DRIPGS, ELS, RAO, PPTL, ITSA	DVC, DDIC, HITIC, DCAD, DCDL, FL, CDPF
	SP2	Adequate IT support staff and End-users training provided regularly	DRIPGS, DITG, ELS, RAO, PPTL, ITSA	DVC, HITIC, DCAD, DCDL, FL, CDPF
	SP3	Align IT training plans to job description /responsibilities	DTLE, ELS, RAO, PPTL, ITSA	HITIC, DCAD
	SP4	Enabling social interaction for digital knowledge sharing among staff	DRIPGS, RAO, ITSA	HITIC, DCAD, CDPF
	SP5	Right people at the right place: Staff placement	DITG, ELS, PPTL, ITSA	CDPF
	SP6	Establishing clear IT professionals' recruitment processes	DITG, RAO, ITSA	FL, CDPF
	SP7	Establish IT talent attraction and retention strategies	DITG, ELS, RAO, PPTR, ITSA	DDIC, CDPF
	SP8	Career and IT skills development in line with university priorities	DITG, ELS, RAO, PPTL, ITSA	DDIC, HITIC, DCAD, DCDL, FL, CDPF

An extensive, in-depth analysis of the interview manuscripts and a follow-up discussion with stakeholders in ICT in education enabled us to harmonise the identified IT alignment practices within a social-technical system perspective. Following this, a framework containing the identified practices for aligning IT with research, teaching, learning and the administrative functions of the university was proposed, as shown in Figure 23 below.
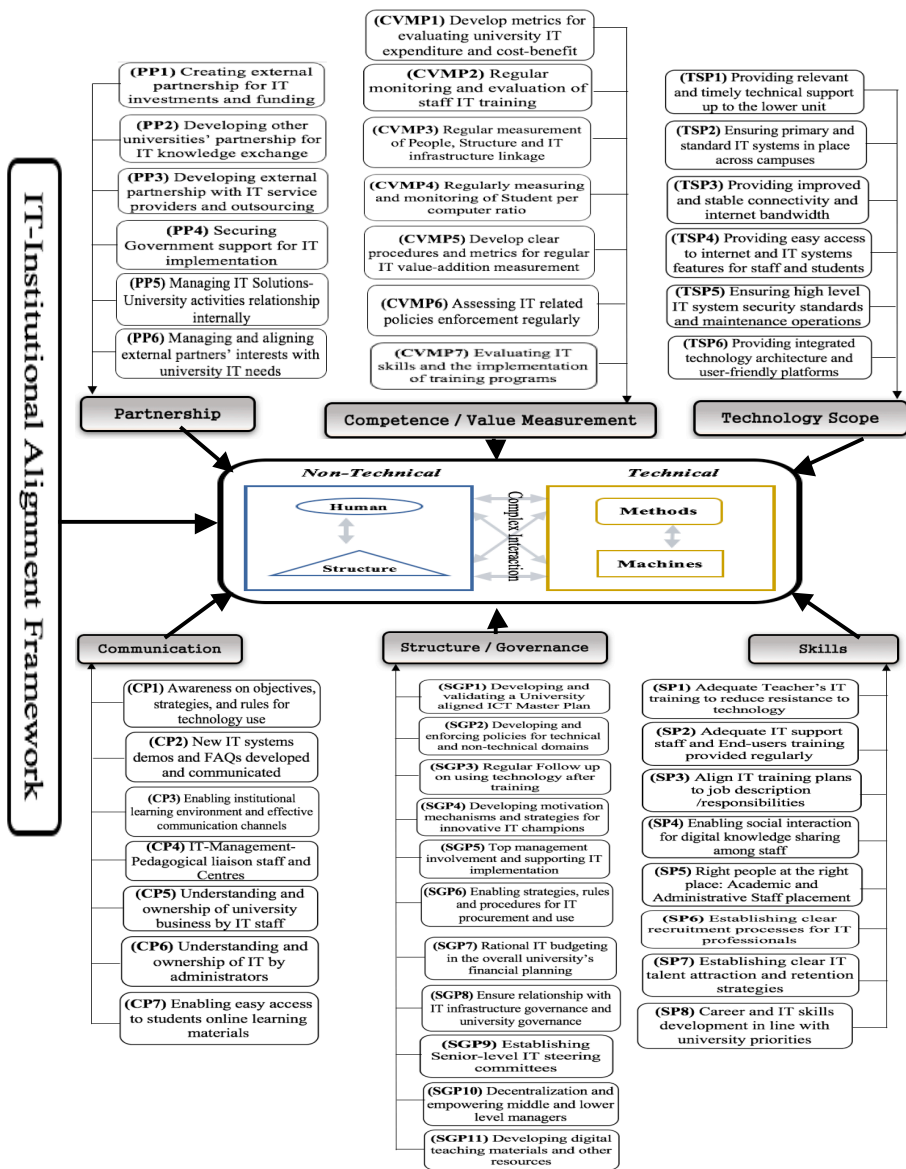
Figure 23. A framework for IT-institutional alignment practices within a higher education context

The above framework can be considered the main findings and contribution of Study 6. The proposed framework contains 45 practices of IT-institutional alignment in the context of higher education, and these are categorised under six dimensions. The findings show that 18 of the practices identified here are similar to those proposed in Luftman's method of IT-organisational alignment; however, a small amount of rewording was necessary to improve their understanding from a higher

education viewpoint. The remaining 27 alignment practices reflect the specific higher education context of teaching, learning, administration and research. Of these newly identified alignment practices, six fall into the category of *Structure/Governance* (SGP2, SGP3, SGP5, SGP6, SGP10, and SGP11). The two categories of *Partnership* (PP1, PP2, PP3, PP4 and PP6) and *Competence/Value Measurement* (CVMP1, CVMP2, CVMP4, CVMP6, and CVMP7) each contain five new alignment practices that are purely related to the education sector.

In particular, the *Partnership* category contains new alignment practices related to the external collaboration of the university with other partners such as the government, IT vendors and other universities for the outsourcing, knowledge exchange and funding of IT. The other two remaining categories of *Technology Scope* (TSP1, TSP3, TSP4 and TSP5) and *Skills* (SP1, SP3, SP5 and SP6) contain four new distinct alignment practices each, as compared to Luftman's (2003) model. The *Communication* category also contains three new alignment practices (CP1, CP2 and CP7), as shown in Figure 23.

From a social-technical point of view, this study revealed that the identified alignment practices for IT-institutional alignment include both non-technical and technical aspects (see Figure 23). Thus, the concept of a social-technical system put forward by Fred Emery and Eric Trist in 1960 (Baxter & Sommerville, 2011) enabled us to highlight, for example, that in the social dimension, there are several alignment practices that are required to improve the individual culture (SP1, SP4, CP5, CP6, SGP3, SGP4) or organisational structure, management style and governance (SGP5, SGP6, SGP7, SGP8, SGP9, SGP10, PP5, CVMP1, CVMP6, CP4) for effective integration of IT in HEI activities. In the technical dimension of this concept, alignment practices such as TSP1, TSP2, TSP3, TSP4, TSP5, TSP6, SP1, SP2 and CP2 were also identified as being related to methods and machines (software and hardware). As result, HEIs should use this social-technical concept to ensure that the overall IT-institutional alignment process considers a social-technical perspective for an effective fit between IT and the university's activities.

General Conclusion of Study 6

In summary, if statistically tested, this IT-institutional alignment framework can be used to create and assess alignment between IT and

institutional activities in the two case study institutions, or in similar contexts. The proposed framework of IT-alignment practices constitutes a focused knowledge base that can be used as a starting point for empirical studies related to IT alignment in HEIs.

In addition, this framework can also serve as a reference for the design of policies and strategies related to the improvement of ICT integration in HEIs such as UR or similar settings. It can also enable an understanding of what should be done by universities to enable effective technology integration for innovation in teaching, learning, research and administrative services.

4.2.2. **Study 7:** Development and Testing of the IT-Institutional Alignment Model

The aim of this study was to design and develop a model that would appropriately enable HEIs to create, assess, and maintain alignment between IT and institutional service processes for improving institutional performance. The initial design of the research model was based on the earlier identified alignment practices in the Study 6. In achieving this objective, the following research question guided the researcher:

- How can a holistic and reliable instrument for creating and measuring IT-institutional alignment be developed in the context of HEI performance in Rwanda? **(SRQ7)**

The assumption that IT alignment practices can have an effect on university performance has never been statistically tested and confirmed before, at least in the context of Rwandan higher education. Six hypotheses were therefore put forward, as indicated in the research model below (Figure 24). The model included these hypotheses (independent variables), and these were statistically tested to determine first their correlation and then their effect on institutional performance within a higher education context. Hence, the research conceptual model also included the institutional performance as a dependent variable.
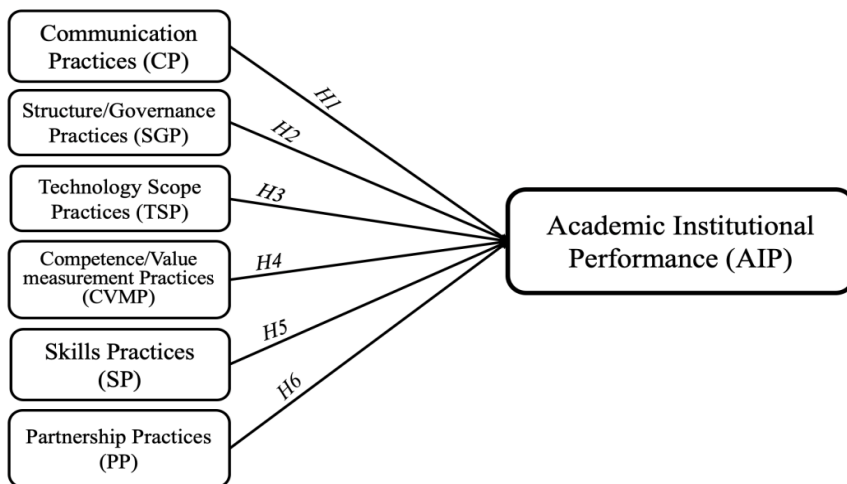
Figure 24. Research model for the relationship between IT alignment practices and institutional performance

A quantitative empirical survey research strategy (Ross, 2014) was applied. A survey questionnaire including the IT-institutional alignment practices and the performance indicators for universities was developed and distributed to the identified sample of participants.

A stratified random sampling technique (Denscombe, 2010; Urbach & Ahlemann, 2010) was applied to select the sample, which had three strata: (i) public universities and colleges; (ii) private universities and higher learning institutes in Rwanda; and (iii) high-level government institutions in charge of education and ICT. The sample included a range of IT specialists, IT managers, project managers, education managers, and academic staff with managerial roles.

In total, 207 participants were identified and asked to respond to the survey questionnaire. The survey questionnaire included a five-point Likert scale for hypothesis testing where 5 indicated 'strongly agree', 4 'agree', 3 'not sure', 2 'disagree' and 1 'strongly disagree'. Respondents were asked to report the extent of their agreement with the influence of 44 practices of IT-institutional alignment (IV) on academic institutional performance (DV) based on eight measurement items (indicators).

In this study, data were collected during a period from January 2017 to May 2018. The data collection process was preceded by testing the survey questionnaire on a small sample of IT specialists and educational

managers to ensure content validity. In total, 166 paper-based and online survey questionnaires (with a response rate 80.19 %) were successfully completed and returned. Of these, 39.76% were completed by academic staff, 33.13% by administrative and managerial staff, and 27.11% by IT specialists.

The measurement model was first tested for convergence validity through the internal consistency of the model constructs (Fowler, 2002). This pilot test showed that estimates of the reliability and validity of construct measurement, namely Cronbach's alpha, average variance extracted (AVE) and composite reliability, were all above the minimum requirements, with values of 0.7, 0.5 and 0.5 respectively (Fornel & Larcker, 1981; Fowler, 2002). The same measurement tests for the internal consistency were also conducted for the complete data sample, and the test results are presented in Figure 25.

The measurement model was then tested for discriminant validity. This was performed based on the criterion that the square root of AVE for each model construct must exceed the associated intercorrelation coefficients for the constructs (Fornel & Larcker, 1981; Hair, Hult, Ringle, & Sarstedt, 2014).

Table 7. Discriminant validity for the model constructs

Constructs	CP	SGP	CVMP	TSP	PP	SP	AIP
CP	(0.721)						
SGP	0.684	(0.721)					
CVMP	0.376	0.428	(0.735)				
TSP	0.411	0.399	0.440	(0.755)			
PP	0.422	0.461	0.429	0.352	(0.707)		
SP	0.443	0.535	0.495	0.470	0.446	(0.742)	
AIP	0.446	0.521	0.396	0.376	0.366	0.494	(0.728)

As can be seen from Table 7, the results of the discriminant validity test indicated that the square root of AVE for each construct (in bold-italic numbers) is greater than the corresponding inter-correlation coefficients, thus confirming that all measurement items met the criterion for discriminant validity for this study.

Summary of Results for Study 7

- **Significant correlation between the IT-institutional alignment practices and institutional performance**

As shown in Table 8, the results indicated a significant positive correlation between the six categories of IT-institutional alignment practices and academic institutional performance.

Although all of the alignment practices were positively and significantly correlated with the institutional performance, the most highly correlated alignment practices with a higher positive degree on institutional performance were those related to the *Structure/Governance* practices (.521**), *Skills* (.494**) and *Communication* (.446**) metrics. This explains the importance of these alignment practices in terms of university performance from the effective integration of IT within service delivery. However, the other constructs used in this study also showed a substantial positive and significant correlation with the institutional performance. These were *Competence/Value* (.396**), *Technology Scope* (.376**), and *Partnership* (.366**).

Table 8. Testing of hypotheses: correlation matrix for the model constructs

Constructs	CP	SGP	CVMP	TSP	PP	SP	AIP
CP	1.000						
SGP	.684**	1.000					
CVMP	.376**	.428**	1.000				
TSP	.411**	.399**	.440**	1.000			
PP	.422**	.461**	.429**	.352**	1.000		
SP	.443**	.535**	.495**	.470**	.446**	1.000	
AIP	.446**	.521**	.396**	.376**	.366**	.494**	1.000

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

The results from the construct correlation analysis shown in Table 8 enable us to postulate that the greater the improvement in the IT-institutional alignment practices related to the above six independent variables (SGP, SP, CP, CVMP, TSP, and PP) at UR, the greater the improvement in institutional performance and the higher the perceived IT value addition in line with the university's innovation in service delivery.

- **IT-institutional alignment practices have a positive influence on university performance**

A multiple regression analysis (Chatterjee & Hadi, 2013) was then conducted to test the six hypotheses of the research model. This test was conducted to assess the degree of variability in the institutional performance (AIP) due to the IT-institutional alignment practices (CP, SGP, CVMP, TSP, TSP and PP).

The results of this regression analysis indicate that the structural model for this study explains *.362 R-square* of variance in the institutional performance that can be predicted by the six categories of the IT-institutional alignment practices used in this study. This degree of variability in the outcome variable is also statistically significant at (Sig. = .000) level. Therefore, as shown in Figure 25, the six practices of IT-institutional alignment used in Study 7 can influence up to 36.2% of the degree of variance in the institutional performance (AIP).
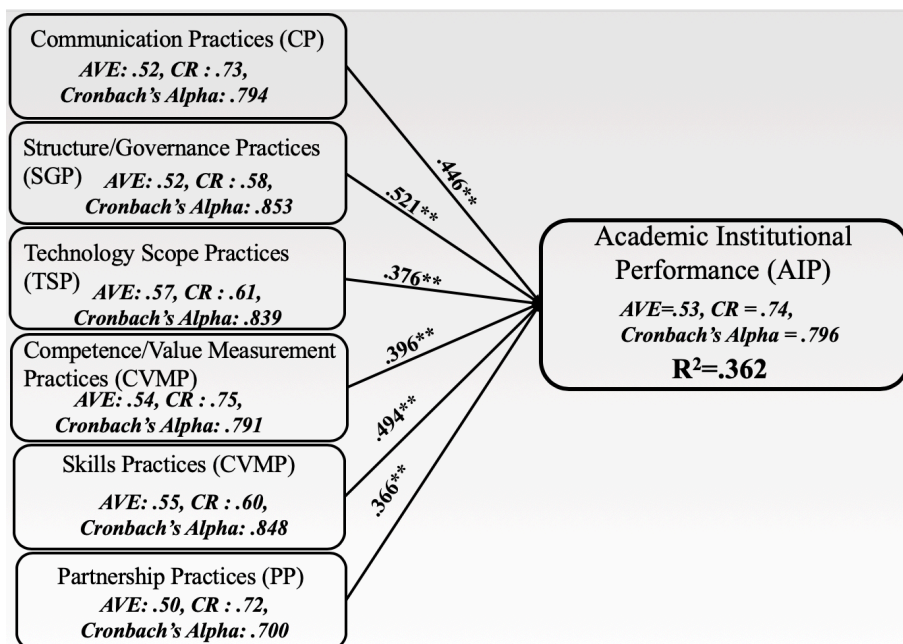
Figure 25. Statistical correlation and influence of IT alignment practices on institutional performance

The results from the regression analysis also indicated positive standardised Beta coefficients for all the model constructs, as shown in Table

9. These results therefore convey an explanation of a positive contribution of each alignment practice on the institutional performance.

Table 9. Results of regression analysis for hypotheses testing

Constructs	B	Std. Error	Beta	t	Sig.
		Structural Model			
CP	.089	.087	.092	1.027	.306
SGP	.209	.079	.249	2.634	.009
CVMP	.091	.077	.093	1.185	.238
TSP	.126	.120	.080	1.049	.296
PP	.057	.090	.048	.631	.529
SP	.180	.070	.214	2.562	.011

a. Dependent Variable: AIP

From Table 9 above, it can be understood that the effects of alignment practices related to *Structure/Governance* (Beta = .249) on institutional performance are greater than the other independent model constructs. The alignment practices under the skills category follow, with a substantial influence (Beta = .214) on the outcome variable. The remaining alignment practices under the *Competence/Value measurement, Communication, Technology Scope* and *Partnership* categories are found to contribute positively to the degree of institutional performance, though with moderate and small standardised coefficient values of Beta = .093, .092, .080, and .048, respectively.

Based on the above findings of the Study 7, the IT-Institutional Alignment Model (ITIAM) for university performance (Figure 26) through the effective integration of information technologies was proposed with 44 alignment practices. Each alignment practice in the ITIAM is reported as highly, moderately, and slightly influencing positively on the institutional performance. The scales for the alignments were determined from the item loadings for each practice, where high (*H= .70 to .100*), moderate (*M= .60 to .69*), and slight (*S= .50 to .59*). The following is a brief description of the alignment practices with high influence on institutional performance, as identified in Study 7:

(1) Structure/Governance Category (SGP)

The findings show that the following alignment practices under the SGP category have high influence on the effective integration of IT in university services: "*Developing motivation mechanisms and strategies for innovative IT champions (SGP3=.761)*", "*Regular follow-up on the use of technology after training (SGP2=.756)*", "*Top management*

involvement and supporting IT implementation (SGP4=.753)" and, "Ensure relationship with IT infrastructure governance, university governance and reforms (SGP7=.712)".

The other alignment practices under the SGP category were attributed as having a moderate to slight influence on institutional performance, meaning that these practices can contribute to a lesser extent to the effective alignment of IT with university services to ensure its performance through innovation in service delivery.

(2) Skills Category (SP)

This category was the second most important, with a positive significant effect on institutional performance, and in particular alignment practices such as: *"Adequate Teacher's IT training to reduce resistance to technology (SP1=.767), "Establish IT talent attraction and retention strategies (SP7=.763)", Right people at the right place: IT, Administrative and Academic Staff placement (SP5=.732)", "Align IT training plans with job description /responsibilities (SP3=.713)" and, "Establishing clear IT professionals' recruitment processes (SP6= .701).*

(3) Communication Category (CP)

Under the *Communication* category of alignment practices, the following contribute strongly to the effective alignment of IT with institutional services: *"Understanding and ownership of IT by administrators (CP6 = .744)", "Awareness on objectives, strategies, and rules for technology use (CP1=.731)"and, "Enabling institutional learning environment and effective communication channels (CP3=.726)".*

(4) Competence/Value Measurement Category (CVMP)

The findings also indicate that four alignment practices under the CVMP metric have a strong impact on effective IT integration and institutional performance in the context of Rwandan higher education: *"Regular monitoring and evaluation of staff IT training (CVMP2=.769)", "Develop clear procedures and metrics for regular IT value-addition measurement (CVMP5= .737)", "Regular measurement of People, Structure and IT infrastructure linkage (CVMP3= .727)" and, "Develop metrics for evaluating university IT expenditure and cost-benefit (CVMP1= .717)".*

(5) Technology Scope Category (TSP)

In this category, only one alignment practice, *"Providing integrated technology architecture and user-friendly platforms (TSP6 = .656)"*, was considered to be moderately important. The other five alignment practices in the model were found to be highly important in improving university performance through effective IT integration: *"Ensuring primary and standard IT systems in place across campuses (TSP2= .800)"*, *"Providing improved and stable connectivity and internet bandwidth (TSP2= .798"*, *"Ensuring high level IT system security standards and maintenance operations (TSP5= .782)"*, *"Providing easy access to internet and IT systems features for staff and students (TSP4= .738) and, "Providing relevant and timely technical support up to the lower unit (TSP1= .716).*

(6) Partnership Category (PP)

The last category of the IT-alignment model contains partnership-related alignment practices. As can be seen from Figure 26, the alignment practice of *"Developing other universities' partnership for IT knowledge exchange (PP2= .753)"* is considered to be highly important in ensuring improved IT integration and university performance.

However, the remaining other alignment practices in this category are also significant, as they are reported as being moderately and slightly important when aligning IT with teaching, learning, research and administration.

Alignment Practices

Codes
(CP1-H) Develop a culture of understanding and ownership of IT by administrators and university managers

(CP2-H) Awareness on objectives, strategies, and rules for technology use

(CP3-H) Enabling cultural and institutional learning environments and effective communication channels

(CP4-M) New IT systems demos and FAQs developed and communicated

(CP5-M) Enabling easy access to students online learning materials

(CP6-S) Develop a culture of understanding and ownership of university business by IT staff

(CP7-S) IT-Management-Pedagogical liaison staff and Centres

Codes
(SGP1-H) Developing motivation mechanisms and strategies for innovative IT champions
(SGP2-H) Regular Follow up on using technology after training
(SGP3-H) Top management involvement and supporting IT implementation
(SGP4-H) Ensure relationship with IT infrastructure governance, university governance and reforms
(SGP5-M) Decentralization and empowering middle and lower level managers
(SGP6-M) Developing digital teaching materials and other E-library resources
(SGP7-M) Establishing Senior-level IT steering committees
(SGP8-S) Developing enabling strategies, rules and procedures for IT procurement and use
(SGP9-S) Developing and enforcing the University ICT Master Plan and related policies
(SGP10-S) Rational IT budgeting in the overall university's financial planning

Codes
(CVMP1-H) Regular monitoring and evaluation of staff IT training

(CVMP2-H) Develop clear procedures and metrics for regular IT value-addition measurement

(CVMP3-H) Regular measurement of People, Structure and IT infrastructure linkage

(CVMP4-H) Develop metrics for evaluating university IT expenditures

(CVMP5-M) Assessing IT related policies enforcement regularly

(CVMP4-S) Regularly measuring and monitoring of Student per computer ratio

(CVMP7-S) Evaluating IT skills and the implementation of planned training programs

Practice Categories

Communication (CP) ↔ Structure / Governance (SGP) ↔ Competence/Value measurement (CVMP)

Technology Scope (TSP) ↔ Skills (SP) ↔ Partnership (PP)

Codes
(TSP1-H) Ensuring primary and standard IT systems in place across campuses
(TSP2-H) Providing improved and stable connectivity and internet bandwidth

(TSP3-H) Ensuring high level IT system security standards and maintenance operations

(TSP4-H) Providing easy access to internet and IT systems features for staff and students

(TSP5-H) Providing relevant and timely technical support up to the lower unit

(TSP6-M) Providing integrated technology architecture and user-friendly platforms

Codes
(SP1-H) Adequate Teacher's IT training to reduce a culture of resistance to technology
(SP2-H) Establishing clear IT talent attraction and retention strategies
(SP3-H) Right people at the right place: Staff placement
(SP4-H) Align IT training plans with job description-staff responsibilities
(SP5-H) Establishing clear recruitment processes for IT professionals
(SP6-M) Regular provision of adequate training for IT support staff and End-users
(SP7-M) Enabling the culture of social interaction for digital knowledge sharing among staff
(SP8-S) Career and IT skills development in line with university priorities

Codes
(PP1-H) Developing other universities' partnership for IT knowledge exchange

(PP2-M) Developing external partnership with IT service providers and outsourcing

(PP3-M) Creating external partnership for IT investments and funding

(PP4-S) Securing Government support for IT implementation projects

(PP5-S) Managing IT Solutions-University activities relationship within an effective internal partnership

(PP6-S) Managing and aligning external partners' interests with university IT needs

Alignment practices influence positively on institutional performance

"H" = High test score for alignment practice, based on items loadings **(between 0.70 – 1.00)**

"M" = Moderate test score for alignment practice, based on items loadings **(between 0.60 – 0.69)**

"S" = Slight test score for alignment practice, based on items loadings **(between 0.50 – 0.59)**

Academic Institutional Performance (**AIP**)

Codes
(AIP1-H) Established, highly accessible and used computer-based teaching and research facilities
(AIP2-H) Highly promoted IT applications for teaching learning, research and management processes
(AIP3-M) Established highly and innovative quality administrative service process
(AIP4-M) Provided excellent and modern teaching quality in online learning environment
(AIP5-M) High quality and quantity of staff trained and familiar with computer-based technologies
(AIP6-M) Cost-effective use of IT investments and high technology value addition at university
(AIP7-S) Increased students, customers, and other university partners' satisfaction
(AIP8-S) Overall increased institutional positive reputation to the general public through research publications

Figure 26. IT-institutional alignment model within a higher education context, Version 1

General Conclusions of Study 7

Overall, the findings for Study 7 indicated a positive influence of the proposed IT-institutional alignment practices on the institutional performance for HEIs in Rwanda (.362 R^2). The ITIAM developed and

tested here (Figure 26) can be used at both strategic and operational levels of the university to respond to the main problems of IT misalignment with teaching, learning, research and university administration. This model can also serve as a tool for reference to improve IT integration and value addition in terms of institutional innovation in service delivery.

Although all of these alignment practices have a positive influence on institutional performance, as suggested by the developed model, universities in Rwanda or similar settings should primarily consider these alignment practices with a high and a moderate degree of significance when embarking on the process of integrating IT into teaching, learning, administration and research activities.

4.3. Evaluating the Artefact: The IT-Institutional Alignment Model

The third research activity, which is the last of the current work, concerns the evaluation of the developed artefact. The last phase of DSR is defined as the process of determining how well a particular artefact performs (March & Smith, 1995; Prat et al., 2014; Vaishnavi & Kuechler, 2015; Venable, Pries-Heje, & Baskerville, 2012).

Hence, the evaluation of a design artefact is an important activity in DSR in order to ensure research rigour and provide real-time feedback for further improvements to the model (Hevner et al., 2004; Venable et al., 2012). Depending on the evaluation approach adopted, this feedback can be received from real-world or simulated environments.

The evaluation feedback may relate to evaluation criteria that are set *a priori*. According to the above authors, the evaluation criteria may include the utility and quality of the artefact in terms of its consistency, efficacy, clarity, completeness and its capability to evolve alongside others.

In this phase of the research activity, a study is therefore conducted from a naturalistic evaluation perspective in order to understand how the ITIAM can assist Rwandan HEIs in improving IT integration in teaching, learning, research and educational management. A

naturalistic evaluation assesses the performance of the artefact as an innovative technology in a real-world environment (Venable et al., 2012).

4.3.1. **Study 8:** Evaluation of the Artefact (ITIAM)

The aim of this study was to evaluate the ITIAM that was tested and developed in Study 7. The research question addressed in this study was: What are the perceptions of the university's IT implementation stakeholders on the proposed IT-institutional alignment model?

This evaluation aimed to obtain feedback from the expected future users regarding the developed model. The evaluation of the ITIAM was based on the criteria of contextual utility, efficacy and quality (Hevner et al., 2004; Vaishnavi & Kuechler, 2007). The model is also evaluated for its consistency, completeness, clarity, and its capability to evolve and fit with the real-world environment (Hevner et al., 2004; Prat et al., 2014), i.e. HEIs in Rwanda.

There are several different categories of evaluation methods (Hevner et al., 2004; Kushniruk, 2002). Methods for the evaluation of artefacts via testing, analysis and experimentation can be either theoretical or practical (Kothari, 2004). Furthermore, for any selected type of evaluation, a researcher may opt to use qualitative or quantitative approaches or a combination of both.

A theoretical evaluation method is more effective for evaluating texts and word-based information such as concepts, methodologies, models, frameworks and definitions (Hevner & Chatterjee, 2010; Kothari, 2004). The aim is to obtain insights and feedback regarding the interpretation of the research participants and further suggestions for improving the artefact. Due to the type of research and the time limitation, a theoretical evaluation method was used to evaluate the proposed ITIAM from the perspective of Rwandan higher education, which forms the real-world environment for this study.

A case study approach (Denscombe, 2014), which is an empirical investigation that studies a phenomenon within its real-world setting, was adopted to collect data for the evaluation of the ITIAM. Case studies allow a researcher to collect relevant data from multiple sources of evidence (Denscombe, 2014; Myers, 2009; Yin, 2014). Open survey questionnaires giving options for the participants to provide comments and

opinions were used in this study. In addition, in-depth semi-structured interviews were then conducted with a selected group of participants to gain more insights and opinions about the suggested ITIAM. Both the questionnaires and the interview protocol were designed based on a framework of evaluation criteria for IS (Prat et al., 2014).

The case study institutions were randomly selected from the universities and public organisations in Rwanda that were involved in Study 7 (Byungura & Hansson, 2019). Of these institutions, seven were HEIs while four were public organisations in charge of ICT, educational planning and implementation at the national level.

A five-point Likert scale was used in the questionnaires to rank each evaluation criterion for the model and to understand the degree of relevance to the model, where 5 indicated 'strongly agree', 4 'agree', 3 'not sure', 2 'disagree' and 1 'strongly disagree' (Kothari, 2004). Respondents were asked to report the extent to which they agreed with each criterion for evaluation of the model. The evaluation dimensions adopted in this study were the environment and structure (Hevner et al., 2004; March & Smith, 1995; Prat et al., 2014). The environment dimension consisted of criteria such as usefulness, ease of use, understandability, capability to be implemented, and fitness with the organisation (Hevner et al., 2004), while the structure dimension focused mainly on the clarity and completeness of the model (March & Smith, 1995).

In total, 56 respondents successfully completed the survey questionnaire for this study. Of these, 39.29% were IT specialists, 32.14% managerial and administrative staff, and 28.57% academic staff. Following this, eight respondents agreed to participate in more in-depth follow-up interviews, including two academic staff, four IT specialists and two managerial staff. Data were collected between October 2018 and February 2019.

The collected data were then carefully processed and analysed to answer the research question. Descriptive data analysis was performed on the collected quantitative data using Microsoft Excel. This analysis aimed to understand the respondents' perceptions of the ITIAM in terms of its quality, as per the applied evaluation criteria. The same analysis was then performed to understand the overall degree of acceptability of the model. A comparative analysis of the degree of the fitness of the model was also performed taking into consideration the proposed

evaluation criteria and the groups of respondents. Following this, an exploratory data analysis was undertaken to understand the areas of possible improvement in the model based on the respondents' views. The findings of this analysis assisted in adjusting the design of the ITIAM to improve its acceptability and fitness within the context of higher education in Rwanda.

Summary of Results for Study 8

The following is a summary of the findings of the evaluation of the proposed ITIAM.

Perceptions of the quality of the ITIAM per evaluation criteria

As shown in Figure 27, the findings of Study 8 indicated that the respondents perceived the model to meet all seven evaluation criteria used in this research, to a high level. For all evaluation criteria, the respondents agreed that the model was acceptable, with high ratings of between 83.93% and 96.43% for the degree of agreement.

Respondents' perceptions about the model							
	Clarity	Understandab ility	Completeness	Ease of use	Usefullness	Focus on Higher Education	Capability to be implemented
Strongly Agree	50,00	30,36	28,57	42,86	73,21	82,14	39,29
Agree	37,50	53,57	55,36	44,64	21,43	14,29	46,43
Undecided	12,50	16,07	10,71	10,71	5,36	3,57	14,29
Disagree	0,00	0,00	5,36	1,79	0,00	0,00	0,00
Strongly Disagree	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Figure 27. Respondents' perceptions of the ITIAM

The model was perceived to have a focus on higher education, the context that it was designed to support, with the highest level of agreement of 96.43%. Similarly, the evaluated model was perceived by respondents as a useful tool for aligning IT with university services, with 94.64% agreement.

However, perceptions related to the model's clarity, understandability, completeness, ease of use, and capability to be implemented indicated

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that some improvements could be made to the relevance of the model, at least in the case study institutions. For these five evaluation criteria, a considerable number of respondents were undecided or disagreed with these criteria for the proposed model.
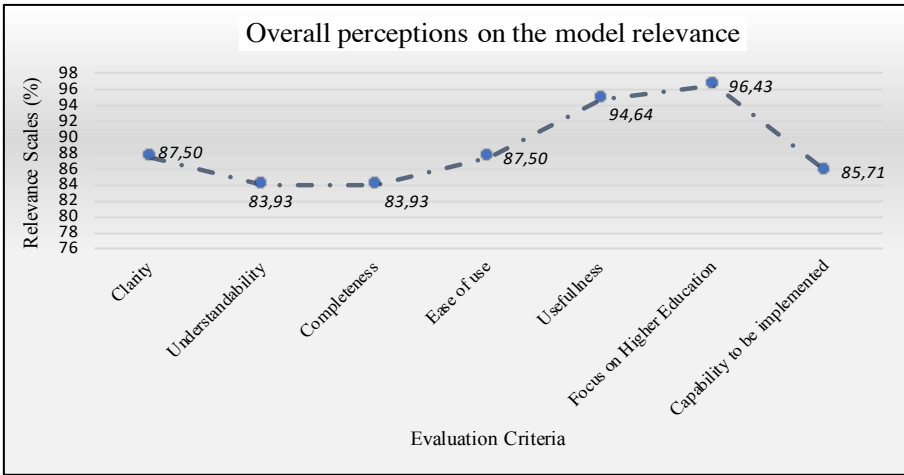
Figure 28. Respondents' perceptions of the overall relevance of the ITIAM

In terms of the relevance of the model, the findings show that those criteria rated at less than 90% (see Figure 28) indicate that the ITIAM needs to be improved to some extent. Proposals for improvement of the model that were extracted from the interview data were mainly related to the five evaluation criteria that scored less than 90%, as presented in Figure 28. This information and the interview data enabled us to fine-tune the ITIAM, which then resulted in Version 2 of the model (Figure 30) after this evaluation.

Comparison of the relevance of the model per respondents' categories

In Study 8, a comparative analysis of the relevance of the model to the three categories of respondents, namely IT specialists, administrative & managerial staff, and academic staff, was conducted. The results of this analysis are presented below. Likewise, the results for this comparative analysis are also summarised in Figure 29.

Model relevance per evaluation criteria

Variations in the degree of model relevance per staff category

	Clarity	Understandability	Completeness	Ease of use	Usefullness	Focus on Higher Education	Capability to be implemented
Academic Staff	72,7	77,3	77,3	72,7	90,9	90,9	90,9
Managerial & Administrative Staff	94,4	100,0	94,4	94,4	100	100	83,3
IT Specialists	100	75,0	81,3	100	100	100	81,3

Figure 29. Comparison of the model relevance among staff categories

Clarity of the model: The findings of the comparative analysis indicated a relatively low variation of around 5.6% between managerial & administrative staff and IT specialists in terms of their agreement on the clarity of the ITIAM model. There was a substantial variation in the degree of agreement (27.3%) by the academic staff on the clarity of the ITIAM model compared to the other categories of respondents. The detailed variation of the scales of agreement for each category of respondents is shown in Figure 29. Concerns related to the clarity of the model were also addressed when redesigning Version 2 of the ITIAM.

Understandability of the model: In order for the model to be relevant within the context it intends to support, the users need to be able to understand it easily. The findings showed that the degree of understandability of the ITIAM was not at a preferred level for IT specialists (75%) and academic staff (77.3%), with a small variation in the ratings (2.3%) between these two categories. This implies that the ITIAM is seen similarly by both IT specialists and academic staff in terms of its

understandability. In addition, strategies for increasing the degree of understanding of the proposed model need to be established in order to improve its value in guiding IT integration within university services. On the other hand, the administrative & managerial staff agreed that the ITIAM was highly understandable (100%), with a significant level of variation compared to IT specialists (25%) and academic staff (22.7%). These results imply that respondents from managerial & administrative staff have a very good understanding of the alignment practices proposed in the ITIAM model, compared to respondents from other categories as reported in Figure 29.

Completeness of the model: The findings indicated a small variation in the level of agreement on the completeness of the ITIAM between IT specialists and academic staff. This variation in the ratings related to the model completeness was 4% between the two categories. It was also noticeable that for IT specialists and managerial & administrative staff, this variation increased significantly to 13.1%. The same trend was also observed between managerial & administrative staff and academic staff, with an even larger degree of variation of 17.1%. These facts suggest that respondents from the managerial & administrative category expressed a high degree of agreement on the completeness of the model in terms of its proposed alignment practices, compared to respondents from academic and IT departments.

Ease of use of the model: Ideally, to offer value to the institution, a model must be easily used by staff across the organisation. The variation in the degree of ease of use of the ITIAM was relatively small (5.6%) between respondents from IT positions and from the administrative and managerial staff. Both of these categories of staff reported that the model was easy to use, with a high degree of agreement. The variation in the degree of agreement increased to 27.3% and 21.7% for IT specialists and managerial and administrative staff, with respect to the academic staff. These findings suggest that IT specialists, managers and administrative staff at the university are more confident than faculty staff with regard to the ease of use of the proposed ITIAM.

Usefulness of the model: The findings related to this evaluation criteria showed that there was a fairly small variation of 9.1% between respondents from the academic staff and the other categories in relation to the usefulness of the ITIAM in supporting the integration of IT into university services. No variation was noticed between IT specialists,

administrators and managerial staff. Overall, these three categories strongly agreed that the proposed ITIAM was useful, with a degree of agreement of more than 90%. This suggests that once it is well understood and is clear to users, the ITIAM can be useful to universities in Rwanda as a tool for guiding the integration and use of IT. Figure 29 illustrates the variations in the relevance of the model in relation to its usefulness.

Focus on higher education: In a similar way to the usefulness of the model, the findings indicate a variability of 9.1% for academic staff, IT specialists and managerial & administrative staff. Since the agreement in the ratings from all respondents for the model's focus on higher education was higher than 90%, this suggests that respondents strongly agreed that the alignment practices proposed in the ITIAM have a strong focus on HEIs. This is an indication of the quality and relevance of the ITIAM in terms of serving as a reference for improving IT integration in teaching, learning, research, and university administration.

Capability to be implemented: This evaluation criterion scored the lowest ratings of the ITIAM compared to the other evaluation criteria, and a substantial level of agreement was shown. There were relatively small variations (9.7%, 7.5% and 2.1%) among the scores given by the three categories of respondents in relation to the capability of the ITIAM model to be implemented in Rwandan universities. Respondents from the academic staff strongly believed that universities could implement the ITIAM model and use its alignment practices, compared with the other categories of respondents.

All the variations in the degree of agreement on the relevance of the model with respect to the evaluation criteria are shown in Figure 29. In summary, the evaluation of the model showed that the degree of acceptability of the quality and relevance of the ITIAM was higher for its usefulness and focus on higher education than for the other evaluation criteria. This was observed for all categories of respondents. Moreover, this study revealed that the variations in the degree of agreement on the model's clarity, understandability, completeness and ease of use were higher between the academic staff and the other two categories of respondents.

The variation was also low for the usefulness of the model, the focus on higher education, and its capability to be implemented in all categories

of respondents. This means that for these three evaluation criteria, respondents were at a similar level of agreement on the relevance of the ITIAM.

Overall, the results from this analysis showed that even if the ITIAM was rated highly on all the evaluation criteria, with slight to moderate variations among respondents, some of the feedback from the open-ended questions and interviews suggested some concerns about the model that should not be overlooked. Further improvements to the ITIAM were therefore recommended based on this feedback, in order to meet institutional needs related to the effective integration of IT in service delivery and the overall institutional performance.

Proposals for improvement to the ITIAM

As part of the process of evaluation of the ITIAM, in-depth interviews and open-ended questions were used to collect opinions on what need to be improved to ensure the high quality and relevance of the model within the context of higher education in Rwanda. The findings from this qualitative data analysis indicated that, in general, the ITIAM is useful in supporting the integration of IT into university service delivery. Some example extracts from the feedback from respondents as part of this evaluation are provided in Table 10.

Table 10. Examples of respondents' opinions of the ITIAM

Respondent	Feedback and Opinions
Lecturer	This is a very nice model for IT integration in HEIs.
IT Campus Officer	The model is very useful, and can assist in creating alignment when the proposed practices are followed.
Admission Officer	The model is useful in promoting ICT integration in Higher Education systems and can improve the quality of education and research produced.
IT Officer	This model is definitely useful for universities aiming to deliver high-quality education and research through the integration of IT.
Senior Technologist, Capacity and Skills Development	The model is very important for universities in Rwanda seeking to improve IT integration and to add value to service delivery.
Director and Senior Lecturer	It could be very useful when implementing IT systems at UR.

However, the opinions from the respondents suggested several ways of improving the quality and relevance of the model in line with the evaluation criteria used in this Study 8. Table 11 below presents these

suggestions for improvement in terms of each evaluation criterion. While some of the suggestions are related directly to the model itself and to some of the proposed alignment practices, others concern the institutional and individual requirements for the ITIAM and its alignment practices in achieving a high degree of relevance in supporting the process of integrating IT in teaching, learning, research and administration.

Table 11. A summary of proposals for improvement from the evaluation of the ITIAM

Evaluation Criteria	Proposals for improvement	Improvements in ITIAM Model
Clarity	• Some key terms used in the model to be described more • Provide more description and rewording of the alignment practices • Ordering alignment practices by degree of importance • Reshaping the model to improve its visibility and readability	• Codes for each alignment practice described in detail • Some alignment practices are narratively rephrased • All alignment practices rearranged by order of priority & importance • The model is redesigned and now more readable
Understandability	• More workshops and seminars with IT implementation stakeholders • Creating awareness to increase the understanding of the model • Develop guidelines on model implementation and who is responsible for each practice to support its implementation	• Planned workshops and research seminars for creating the model awareness • Guidelines and manuals on how to use the model will be developed
Ease of Use	• Provide training on how to use the model • Provide further guidelines on how to use the model • More improvement to make it a user-friendly tool for all staff categories • Pilot testing of the model on a real IT system implementation process	• Planned training on how to use the model • Sharing the guidelines on how to use the model • Simplifying the mode and redesigning it for Academic, Managerial and Administrative staff to use it easily. • Plan to conduct a pilot test on a real IT system implementation
Completeness	• Culture issue not addressed in the proposed alignment practices • Model adaptation to other education levels • Add other practices to increase individual trust • More practices needed on communication and Structure & Governance categories	• Some alignment practices rephrased to reflect the culture and trust related to the adoption and use of IT tools • Plan to identify other possible alignment practices after practical model evaluation on a real-time IT system implementation
Usefulness	• None	• None
Focus on Higher Education	• None	• None
Capability to be implemented	• A collaborative approach for all stakeholders in higher education to implement the model • Avail policy, dedicated people and budget for the model to be implemented • To have a conducive atmosphere at universities to use available ICT tools • Top managers involvement and make IT implementation a top concern • Lack of enough IT facilities at campuses • After training and awareness, there is need for enforcement mechanisms to use the model	• Strategies and mechanisms to be established by universities for adopting and implementing the model • Avail IT facilities and IT support in place for effective implementation of the model • Ensure Top management commitment in the adoption and use of the model

The incorporation of respondents' proposals for improvements to the model resulted in a redesign of the ITIAM to make it fit within the context of Rwandan higher education more effectively. Figure 30 shows Version 2 of the ITIAM after evaluation with a sample of participants from the case study institutions in Rwanda.
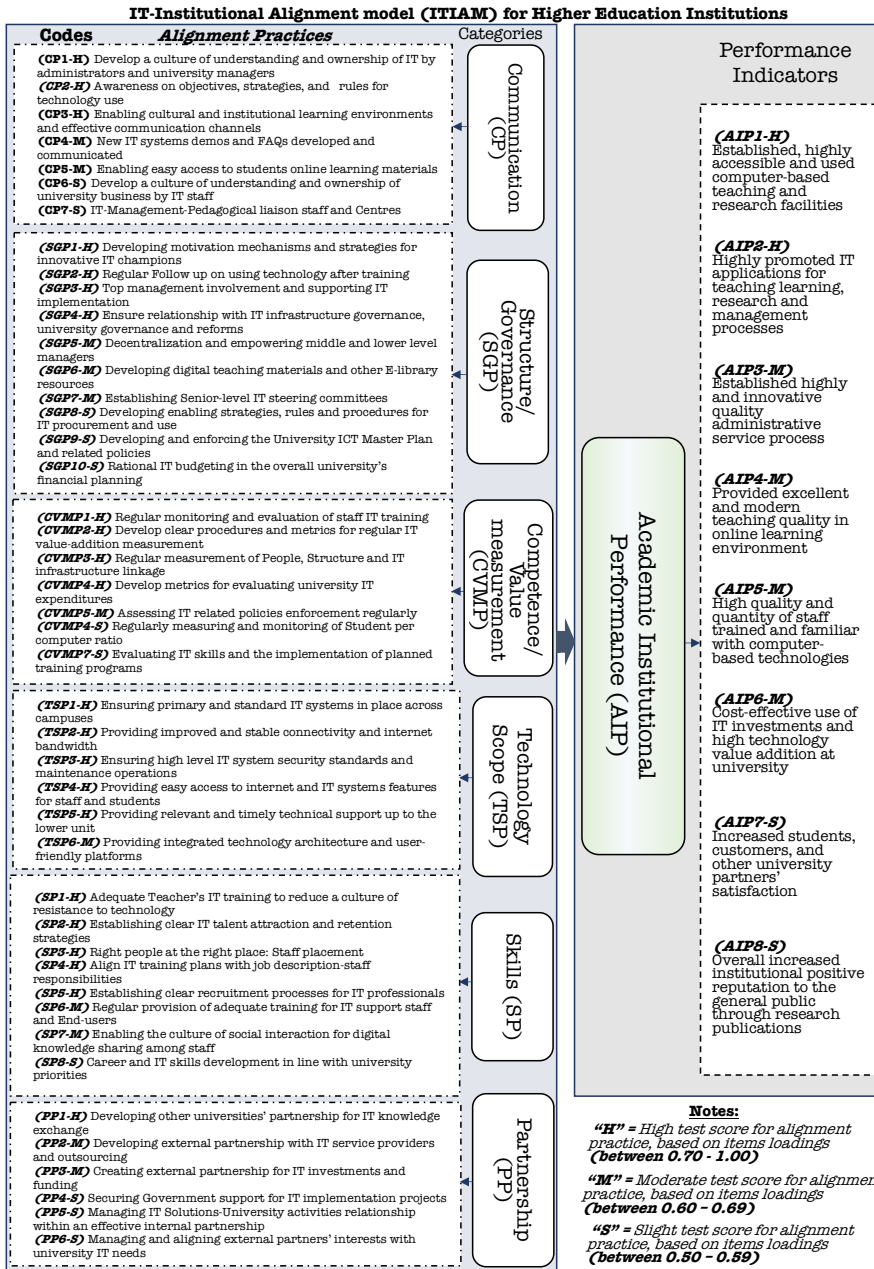
IT-Institutional Alignment model (ITIAM) for Higher Education Institutions

Codes	Alignment Practices	Categories

(CP1-H) Develop a culture of understanding and ownership of IT by administrators and university managers
(CP2-H) Awareness on objectives, strategies, and rules for technology use
(CP3-H) Enabling cultural and institutional learning environments and effective communication channels
(CP4-M) New IT systems demos and FAQs developed and communicated
(CP5-M) Enabling easy access to students online learning materials
(CP6-S) Develop a culture of understanding and ownership of university business by IT staff
(CP7-S) IT-Management-Pedagogical liaison staff and Centres

Communication (CP)

(SGP1-H) Developing motivation mechanisms and strategies for innovative IT champions
(SGP2-H) Regular Follow up on using technology after training
(SGP3-H) Top management involvement and supporting IT implementation
(SGP4-H) Ensure relationship with IT infrastructure governance, university governance and reforms
(SGP5-M) Decentralization and empowering middle and lower level managers
(SGP6-M) Developing digital teaching materials and other E-library resources
(SGP7-M) Establishing Senior-level IT steering committees
(SGP8-S) Developing enabling strategies, rules and procedures for IT procurement and use
(SGP9-S) Developing and enforcing the University ICT Master Plan and related policies
(SGP10-S) Rational IT budgeting in the overall university's financial planning

Structure/ Governance (SGP)

(CVMP1-H) Regular monitoring and evaluation of staff IT training
(CVMP2-H) Develop clear procedures and metrics for regular IT value-addition measurement
(CVMP3-H) Regular measurement of People, Structure and IT infrastructure linkage
(CVMP4-H) Develop metrics for evaluating university IT expenditures
(CVMP5-M) Assessing IT related policies enforcement regularly
(CVMP4-S) Regularly measuring and monitoring of Student per computer ratio
(CVMP7-S) Evaluating IT skills and the implementation of planned training programs

Competence/ Value measurement (CVMP)

(TSP1-H) Ensuring primary and standard IT systems in place across campuses
(TSP2-H) Providing improved and stable connectivity and internet bandwidth
(TSP3-H) Ensuring high level IT system security standards and maintenance operations
(TSP4-H) Providing easy access to internet and IT systems features for staff and students
(TSP5-H) Providing relevant and timely technical support up to the lower unit
(TSP6-M) Providing integrated technology architecture and user-friendly platforms

Technology Scope (TSP)

(SP1-H) Adequate Teacher's IT training to reduce a culture of resistance to technology
(SP2-H) Establishing clear IT talent attraction and retention strategies
(SP5-H) Right people at the right place: Staff placement
(SP4-H) Align IT training plans with job description-staff responsibilities
(SP5-H) Establishing clear recruitment processes for IT professionals
(SP6-M) Regular provision of adequate training for IT support staff and End-users
(SP7-M) Enabling the culture of social interaction for digital knowledge sharing among staff
(SP8-S) Career and IT skills development in line with university priorities

Skills (SP)

(PP1-H) Developing other universities' partnership for IT knowledge exchange
(PP2-M) Developing external partnership with IT service providers and outsourcing
(PP3-M) Creating external partnership for IT investments and funding
(PP4-S) Securing Government support for IT implementation projects
(PP5-S) Managing IT Solutions-University activities relationship within an effective internal partnership
(PP6-S) Managing and aligning external partners' interests with university IT needs

Partnership (PP)

Performance Indicators

Academic Institutional Performance (AIP)

(AIP1-H) Established, highly accessible and used computer-based teaching and research facilities

(AIP2-H) Highly promoted IT applications for teaching learning, research and management processes

(AIP3-M) Established highly and innovative quality administrative service process

(AIP4-M) Provided excellent and modern teaching quality in online learning environment

(AIP5-M) High quality and quantity of staff trained and familiar with computer-based technologies

(AIP6-M) Cost-effective use of IT investments and high technology value addition at university

(AIP7-S) Increased students, customers, and other university partners' satisfaction

(AIP8-S) Overall increased institutional positive reputation to the general public through research publications

Notes:
"H" = High test score for alignment practice, based on items loadings (between 0.70 - 1.00)

"M" = Moderate test score for alignment practice, based on items loadings (between 0.60 - 0.69)

"S" = Slight test score for alignment practice, based on items loadings (between 0.50 - 0.59)

Figure 30. IT-institutional alignment model within a higher education context, Version 2

In terms of the discussion presented above of the evaluation of the ITIAM, the results of this study showed that this model is highly acknowledged by respondents as a relevant tool that can guide the process of aligning IT with university activities. Furthermore, they indicate

that once adopted and adapted to the institutional context, the ITIAM has the potential to assist in supporting the integration of IT into teaching, learning, research and administration.

To allow this model to be successfully implemented, related guidelines need to be developed. These guidelines will include the phases of implementation of the model: (i) Getting familiar with the model; (ii) Implementation of the ITIAM within a real-time IT system that is being integrated into university services; and (iii) Evaluating how the model has been implemented in terms of the IT system in use.

We therefore recommend that in further studies, a practical evaluation of the ITIAM should be conducted by attempting to implement this model when a particular IT system is being integrated into one of the university services. For example, since the UR is currently undergoing various institutional restructuring processes, various IT systems need to be adapted to the new institutional structures. Hence, a practical evaluation of the ITIAM model should be carried out when the university redesigns some of its IT systems to fit with the new institutional structure and processes.

5. Main Research Contributions

This section discusses the main research contributions in both the scientific and practical dimensions. The literature suggests that practical problems can be addressed by proposing artefacts (Johannesson & Perjons, 2012) and by the use of the design science approach. Artefacts are developed through theoretical and scientific investigations with the aim of providing solutions to practical problems. This research was carried out following the DSR methodology and thus offers both scientific and practical contributions.

The theoretical or scientific contribution can be understood as new knowledge generated in the design research process, which can serve as the base for building an artefact in the form of a model, method, framework or a software (Gregor & Hevner, 2013). It can also be considered in terms of the lessons learned and documented (knowledge contribution) during the implementation and evaluation of an artefact. On the other hand, the practical research contribution refers to a set of solutions to practical problems offered by the proposed artefacts (Johannesson & Perjons, 2012). The contributions of this research can be therefore reported with reference to the above two types of DSR contributions.

5.1. Scientific Contributions

This research makes an empirical contribution to the scientific knowledge base in the domain of computer and systems sciences. More particularly, it delivers important directions for further research in the area of IT alignment in organisations and technology adoption in HEIs. It also contributes to the existing body of knowledge related to institutional performance through the effective integration of IT in service delivery from a social-technical perspective.

Accordingly, IT alignment is currently one of the highest concerns for managers when improving the adoption and use of IT in organisations.

Hence, this research extends the existing body of knowledge on alignment practices that can support the effective fit of IT with university services through the development of the ITIAM, which encompasses a set of alignment practices for HEI performance.

This model can serve as a reference for IT managers within universities in Rwanda to address the problem of misalignment between IT and institutional services. The proposed model is in accordance with the main research question, which guided the overall process of the sub-studies undertaken here, in terms of applying DSR as a scientific method.

Thus, the main theoretical research contributions of this work can be summarised with respect to the three research activities undertaken:

i. Initially, this research explored, identified, and created an awareness of the real-world context of the integration and alignment of IT within HEIs, from the perspective of a developing region. In this phase, we examined policies related to ICT in education and a number of IT systems that were under implementation in Rwandan higher education. Overall, the five studies conducted in this phase demonstrated a strong misalignment between the available IT systems and the structure, policies and activities of the university (Papers 1, 2, 3 and 5). This misalignment was expressed in terms of a failure to integrate, adopt and use IT systems in teaching, learning, research and administration in the case study institution. Study 4 also revealed a low level of familiarity with technology and a low degree of digital skills. This is likely to affect the adoption and use of IT systems available at UR. Similarly, the literature reviews demonstrated that there was a gap in the existing research related to IT and organisational alignment within a higher education context, and a lack of a clear model for IT alignment within universities. Overall, the sub-studies undertaken in Research Activity 1 contributed new knowledge by clarifying research that had been conducted earlier on IT-organisational alignment and related research gaps.

ii. The findings from Research Activity 2 led to the identification and suggestion of contextual practices for effective IT-institutional alignment (Study 6). At this stage, a framework encompassing a set

of alignment practices for effective IT integration in HEIs was proposed. Following this, through the DSR process cycle and guidelines, a contextual ITIAM for institutional performance was designed and developed in the form of an artefact (Study 7). This model was proposed as a solution to the contextual problems identified earlier related to the misalignment between IT systems and the educational activities at the university. The findings from Study 7 indicated a significant positive relationship among all categories of alignment practices, which were significantly and positively correlated with the institutional performance. This enabled us to confirm that the greater the improvement in the IT-institutional alignment practices proposed in the model, the more likely it is that the performance and innovation of the university will improve in terms of its service delivery through the integration of IT. Moreover, the findings also indicate that there is a significant positive influence from all six proposed alignment practices on the variance in the academic institutional performance.

iii. At this stage of the research, the proposed model was evaluated in a real-world context. The results of the evaluation of the ITIAM allowed us to redesign it and to come up with an updated version that would contribute to the body of knowledge on IT alignment within organisations. The new knowledge gained from Study 8 may assist universities in Rwanda or in similar settings to meet institutional needs by improving the adoption and use of IT resources, adding value to service delivery and contributing to the overall institutional performance. This performance can be attained through the effective integration of IT with reference to the alignment practices proposed in version 2 of the ITIAM.

5.2. Practical Contributions

From a practical point of view, this research informs various stakeholders in the area of ICT integration with education in Rwanda and similar contexts about the current state of adoption and use of IT systems and the associated challenges. Furthermore, the proposed framework for aligning IT with university activities can serve as a reference for

practitioners to assess and maintain a consistent fit between new IT systems and university activities. More particularly, the model for IT-institutional alignment that is developed, tested and evaluated here can serve as a managerial tool for CIOs, IT managers, IT governance specialists and faculty members with managerial responsibilities, allowing them to effectively plan, coordinate and evaluate the integration of IT into institutional services.

Furthermore, the overall research findings indicate that the implementation of new IT systems and the acquisition of hardware and software infrastructure should be preceded by the establishment of a clear institutional structure and governance framework. Similarly, adequate, relevant digital skills and competencies should be acquired and retained across the departments of the university to ensure improved and sustainable integration of IT into service delivery. In general, the university management, through the set of proposed alignment practices in the ITIAM, should establish an environment that is conducive to the effective adoption and use of the acquired IT.

Likewise, this research postulates that effective IT-institutional alignment practices are developed based on both the social and technical dimensions, whereby the acquired hardware and software should be contextualised within a particular institutional setting, and that priority should be placed on alignment practices related to social factors (Byungura & Hansson, 2019).

The latter include the development of relevant IT-related policies, the involvement of top management, the establishment of a clear IT governance structure, the development and maintenance of relevant IT skills, establishment of proper communication channels, and regular measurement of IT-driven value at the institution, among others. A failure to manage this IT-institutional alignment process effectively may result in poor and negative academic institutional performance and negative returns on IT investments.

Furthermore, this research suggested a set of effective alignment practices for practitioners and education managers to address the problems of misalignment between IT and institutional activities such as teaching, learning, research and educational management.

Accordingly, this research represents a step forward in the future direction of IT alignment within HEIs, and particular in the context of developing regions. In this new research direction, academicians, researchers and education managers can continuously develop new knowledge to address the problem of misalignment with new technologies that are implemented to support universities within developing countries.

6. Research Quality and Trustworthiness

The criteria of validity, reliability, and transferability are advocated in ensuring the quality and trustworthiness of research (Lincoln & Guba, 1985). These scholars also posited that the research results are not generalisable but are instead transferable from one study context to another.

The above criteria for judging the quality of the research were highly considered at each phase of this study, i.e. the research design, data collection and analysis processes.

6.1.   Research Reliability and Validity

Reliability was established in order to ensure that the measurement instruments that were used were consistent over time, and were used under the same conditions with the same subjects (Lincoln & Guba, 1985; Yin, 2003). Validity-related criteria were also used to guarantee the trustworthiness of this research. The latter can be approximated as true by ensuring that the adopted measurement instruments can measure or evaluate what is supposed to be measured (Creswell, 2014; Yin, 2003).

Since both the case study and survey research approaches were used in the research activities in this study, the validity and reliability were considered when choosing the appropriate qualitative and quantitative methods. As an empirical social research study (Yin, 2003), the reliability and the internal, external, construct, and content validity were taken into consideration throughout the eight studies to ensure the quality of these research results.

Construct validity: The construct validity refers to the degree to which a test measures what it is supposed to measure (Hair, Black, Babin, Anderson, & Tatham, 2006; Yin, 2003). To ensure excellent construct validity in quantitative research, both convergent and discriminant validity must be considered (Hair et al., 2006).

As proposed by Yin (2003), there are three main strategies that can be used to increase the construct validity when conducting a case study research. These include the use of multiple sources of evidence, a review of the case study reports by the key informants and the application of the chain of evidence. Similar to the triangulation in data collection and analysis, the construct validity was ensured in Studies 1, 3 and 5 during Research Activity 1 for the case study research. This was done by using multiple sources of data such as interviews, questionnaires and observations on the field site.

For example, where appropriate, open-ended questions were used to provide the opportunity for respondents' reflections, suggestions and social objections (Cohen et al., 2013) as a way of increasing the validity of data collection. Experts in the areas of ICT and education were consulted during the development of research instruments to incorporate their expertise in the research area. Draft papers were also sent to key informants from the case study institutions for review before submission of the manuscripts to the journals and conferences.

Construct validity was also guaranteed during the survey research in Study 7 under Research Activity 2. Both convergent and discriminant validity measures were tested (Fornel & Larcker, 1981; Hair et al., 2006). The statistical construct validity test was important, as this research activity aimed to understand the correlation between the IT alignment practices and their effects on institutional performance in higher education.

Internal validity: This type of validity test is associated with the credibility of the research, and checks whether the research findings reflect reality. It is also concerned with the internal design of the research, and involves a researcher applying certain methods that ensure that the research measures what is supposed to be measured. This type of validity helps to measure whether the research sounds right. Some of the methods proposed by Merriam (1998), such as triangulation of data collection and analysis techniques, peer examination, member checks, avoidance of researcher bias and sample selection (Creswell, 2014), were used in Studies 1 to 6 and in Study 8 to ensure that this research had a high degree of credibility.

External validity: This refers to the degree to which the research findings can be applied to the real world (Yin, 2003). The external validity

is high when the research findings can be replicated in other similar settings; otherwise, this validity is low. In this research, the external validity was based on case study research for Studies 1 to 3 and 5 (undertaken within Research Activity 1) and Study 6 (within Research Activity 2). The external validity was also increased in Studies 7 and 8 by involving well-established institutions, both universities and public organisations, that are in charge of ICT in education. The involvement of a significant number of participants in case study and survey research-based studies was another approach that was used to increase the external validity of this research. Study 7 was a survey research study for which the statistical findings could be generalised to the entire population, in this case the context of Rwandan higher education. The generalisability of these findings concurs with the assumption of statistical generalisability from a research sample to the entire population (Lee & Baskerville, 2003; Yin, 2003). Otherwise, the overall research findings of this thesis cannot be generalised to contexts other than the case study institutions involved.

6.2.   Research Transferability

This refers to checking whether the findings of this study are relevant to other contexts with similar settings (Lincoln & Guba, 1985). Since the main goal of this overall research was to propose a model (artefact) for IT-institutional alignment within the context of higher education, it was not possible to cover the entire research area.

This work also could not explore the entire population, due to limitations on the time allowed for doctoral research. Consequently, this research was limited to Rwanda's higher education system as an example of a developing country. A small number of universities were considered from Rwanda and three IT systems from one public university were considered.

As described by Hevner et al. (2004) and Vaishnavi and Kuechler (2015), an artefact, in this case the proposed ITIAM, may not fit well with other environments of the higher education. One reason for this may be that universities from one country to another tend to have different, policies, assumptions, and processes.

Hence, the findings presented in this research may only be replicated in higher education environments that share similar assumptions and settings with the Rwandan HEIs that participated in this research. Otherwise, it may be necessary to revisit and alter the proposed ITIAM for contextual fit with a particular organisational setting.

7. Concluding Remarks

7.1. Conclusion

The main aim of this research project was to develop a model of relevant practices for IT-institutional alignment within a higher education context, based on empirical investigation. The research aim was achieved by undertaking eight studies, each with own sub-research question. The results of each research study are presented in Section 4 of this thesis, and a summary of these findings is given for each of the three research activities in Table 12.

Overall, this doctoral research was guided by the following main research question:

"*How can information technology and institutional activities be holistically aligned to support the effective IT integration and performance improvement in Rwandan Higher Education Institutions?*"

The above research question has been answered via the empirical development and testing of a model for IT-institutional alignment containing 44 alignment practices (Figure 30). The identified alignment practices were clustered under six types: (1) Communication, (2) Structure/Governance, (3) Technology Scope, (4) Competence/Value Measurement, (5) Skills, and (6) Partnership. The proposed IT-Institutional Alignment Model (ITIAM) can assist universities in Rwanda or similar contexts to effectively integrate IT into teaching, learning, research and administration. The results of model testing indicate that the proposed alignment practices can positively contribute to improvements in institutional performance through the effective adoption and use of the available IT systems in service delivery.

Guided by the DSR approach, the real-world context was explored in order to understand the state of misalignment between IT and university activities and processes (Papers 1 to 5). This was followed by an

investigation of practices related to aligning IT with university services. At this stage of the research, a framework of IT-institutional alignment containing a set of 45 alignment practices was proposed (Paper 6). At this phase, the research was in line with a tentative design of a contextual model for IT-institutional alignment for university performance. A social-technical perspective by Emery and Trist, (1960) was considered for understanding the alignment practices within a higher education context. The purpose of considering a social-technical framework in this research was to ensure that IT is in harmony with the institutional activities to improve the university performance through an effective integration of IT in teaching, learning, research, and administration.

Within the DSR guidelines, the identified alignment practices were tested in order to understand the extent to which they could influence institutional performance within a higher education setting (Paper 7). This process resulted in developing and proposing a model for IT-institutional alignment with 44 practices, categorised using six metrics (Figure 26, ITIAM Version 1). All of the suggested alignment practices in the ITIAM were found to have a positive influence on improving university performance within the case study institutions in Rwanda.

Using a set of evaluation criteria adopted from Prat et al. (2014), the proposed ITIAM was then theoretically evaluated in Study 8. In this phase, an improved ITIAM model (Version 2) was developed based on its evaluation in the case study institutions.

Following the DSR process cycle, especially for the communication of research, the findings from all of the studies under this overall research have been discussed during research seminars with experts in the area of ICT in education, and computer and systems sciences. Later on, the same findings were reported and published in peer-reviewed journals and conference proceedings in area of education and information technology.

The proposed ITIAM is an attempt to bridge the gap left by the current models in the literature related to IT-organisational alignment. Since there is no clear model in the literature that can highlight the practices that create and maintain alignment between IT and HEIs, the ITIAM responds to this gap by providing a contextual set of alignment practices that contribute to institutional performance through the effective integration, adoption, and use of IT. The proposed model can therefore

serve as a frame of reference during the implementation of an IT system in teaching, learning, research and educational management, and more particularly in Rwanda.

7.2. Reflection

Since my first day of embarking on my academic career, I was enthusiastic to see how ICT could change the way people learn, teach and do research. At that time, in 2009, a number of policies and strategies were in place to support the integration of ICT in higher education systems. One of the leading national-level policies was the Rwanda Vision 2020. In this policy document, it is clearly articulated that innovation in education services should be supported by the integration and use of ICT. Prior to starting my academic pursuits, I had worked in the IT domain as a public servant, supporting end users in how to use ICT tools. My experience gave rise to another way of thinking about how people, institutional structure, and infrastructure might be effectively aligned to ensure innovation in service delivery.

Later on, I came to realise that regardless of the sophisticated IT tools that are in place to support universities, without the desire, enthusiasm, motivation and willingness of people to adopt and use IT tools, the performance of universities cannot be improved. My initial research endeavours as part of my master's thesis enabled me to understand that the misalignment between technical and non-technical (social and intellectual) dimensions (Henderson & Venkatraman, 1999; Lee et al., 2008; Reich & Benbasat, 2000) of IT integration in service delivery has significantly contributed to the failure in developing IT value addition and competitive advantage for a number of HEIs (Sife et al., 2007; Tarus, Gichoya, & Muumbo, 2015), mostly in developing countries including Rwanda (Byungura et al., 2015; Mukama, 2009).

The opportunity to undertake research at doctoral level enabled me to continue researching about the alignment between IT and HEIs. This was very attractive to me, as I aspired to contribute to creating, assessing and maintaining a reasonable degree of alignment between IT and university services from a research perspective, which could offer both practical and scientific contributions in this research area. At the start of my five-year doctoral program, several questions related to how best IT can be aligned with organisations were uppermost in my mind,

and these could be summarised into the main research question that guided this doctoral research. This question was *"How can IT and institutional activities be holistically aligned to support the effective integration of IT and performance improvement in Rwandan higher education institutions?"*

In an attempt to provide an answer to this research question, eight studies were undertaken as part of this doctoral research, and the related findings are presented in this thesis.

Has the main research question been answered by this doctoral research?

Following scientific principles and methodologies based on the steps of DSR, the data collected in each study of the overall research process enabled us to answer the above research question. As one outcome of this research, a framework of IT-institutional alignment practices is put forward. This framework contains 45 alignment practices divided into six categories. After testing these alignment practices, this research resulted in the proposal of an ITIAM with 44 alignment practices that if carried out by universities in Rwanda are expected to have a positive influence on institutional performance through the integration and use of IT. Additionally, the assumption is that universities that have participated in this research, and particularly in the development of the ITIAM, could benefit from using it when implementing IT systems in teaching, learning, research, and administration.

Although the proposed model was not evaluated within the real-time implementation process of an IT system, recommendations were put forward to improve the model's role as a form of guidance for aligning IT with university services.

Finally, in terms of the value addition from this research from a practical perspective, UR, my current employer has been involving me in several activities related to improving IT integration in teaching, learning, and research activities for overall institutional performance, based on the expertise I acquired during this PhD research journey. In addition, some of my research publications completed as part of this thesis have been also taken into consideration when deciding to involve me in some of the following activities.

While I was still carrying out research for this PhD, UR invited me to participate in the design and development of guidelines for plagiarism control and the integration of Turnitin, an online text matching tool for controlling plagiarism in academic writing. In addition, I was involved in the validation of the first version of the UR ICT master plan, whereby all stakeholders were invited to provide their opinions on this policy document. I was also invited to engage in providing training on the use of the UR e-learning platform and Turnitin software for academic staff. Similarly, based on the expertise acquired during this PhD research, I was invited to participate in evaluating the UR e-learning platform for the instructional technology subprogram of the UR-Sweden programme.

Last but not least, I was invited to deliver various lectures, workshops and seminars related to the integration of ICT in teaching, learning, and research at UR. Currently, with the expertise acquired during this PhD research, I have also been appointed as a member of the committee on digital education at University of Rwanda.

All of these activities mentioned above have impacted to some extent on the adoption and use of IT tools at UR while also improving institutional performance in teaching, learning and research.

7.3. Research Limitations

Like any other research, this work is not without limitations in terms of its scope and operationalisation. The research presented in this thesis is intended to fill the gap relating to the practice of IT-organisational alignment for university performance as a result of the effective integration of IT in service delivery.

Hence, from the perspective of the existing literature, this research falls into the category of IT alignment within HEIs. Moreover, this work was limited to exploring the state of the art in terms of the implementation, adoption and use of ICT in teaching, learning, research and administration, with a focus on the context of higher education in developing regions. In particular, due to time constraints, this research considered only three IT systems that were undergoing the process of integration at UR. The involvement of private universities, which are also part of the Rwandan higher education system, was also very limited.

Furthermore, within the same real-world setting, this research was also interested only in the influence of IT-institutional alignment practices on university performance. More particularly, Version 2 of the proposed ITIAM has certain limitations related to its degree of completeness and its capability to be implemented. These limitations could be addressed in further research work on the proposed ITIAM as applied to the real-time design, development and implementation of IT systems in universities.

7.4.   Directions for Future Research

The explorative phase of this research was carried out in public universities, which are different from private HEIs in terms of their ICT policies, technology uptake, ICT funding strategies and resources. Future research should therefore be undertaken in private institutions in Rwanda or similar settings in developing countries to explore the corresponding forms of IT misalignment. Further empirical studies are also recommended to test and evaluate the developed ITIAM in private institutions, which may result in improving this model and increasing its degree of generalisability to different Higher Education Institutional settings.

Due to the limited time allotted for this research, the developed ITIAM was evaluated only theoretically. In the future, a further practical evaluation is recommended in order to demonstrate its consistency and relevance within a specific practical setting, in which the ITIAM can be used to measure and maintain the alignment of an IT system during its implementation in a particular case study university. This type of practical evaluation can expand the knowledge base of IT-institutional alignment, giving a more practical and operational understanding of a specific set of personnel, IT system and real-world context.

Likewise, both theoretical and practical evaluations of the proposed ITIAM should be carried out in different research environments in order to generalise the findings from this research.

References

Aghaee, N., Hansson, H., Tedre, M., & Drougge, U. (2014). Learners' Perceptions on the structure and usefulness of e-resources for the thesis courses. *European Journal of Open, Distance and E-learning*, *17*(1), 154–171.

Alaceva, C., & Rusu, L. (2015). Barriers in achieving business/IT alignment in a large Swedish company: What we have learned? *Computers in Human Behavior*, *51*, 715–728.

Alexander, F. K. (2000). The changing face of accountability: Monitoring and assessing institutional performance in higher education. *The Journal of Higher Education*, *71*(4), 411–431.

Ali, S., & Green, P. (2012). Effective information technology (IT) governance mechanisms: An IT outsourcing perspective. *Information Systems Frontiers*, *14*(2), 179–193.

Ankem, K. (2004). Adoption of Internet resource-based value-added processes by faculty in LIS education. *Library & information science research*, *26*(4), 482–500.

Aversano, L., Grasso, C., & Tortorella, M. (2012). A literature review of Business/IT Alignment Strategies. *Procedia Technology*, *5*, 462–474.

Bates, A. W. (2000). *Managing Technological Change: Strategies for College and University Leaders. The Jossey-Bass Higher and Adult Education Series*. San Francisco, CA: Jossey-Bass Publishers.

Bates, A. W., Bates, T., & Sangra, A. (2011). *Managing technology in higher education: Strategies for transforming teaching and learning*. John Wiley & Sons.

Baxter, G., & Sommerville, I. (2011). Socio-technical systems: From design methods to systems engineering. *Interacting with computers*, *23*(1), 4–17.

Beetham, H., & Sharpe, R. (2013). *Rethinking pedagogy for a digital age: Designing for 21st century learning*. Routledge.

Bingimlas, K. A. (2009). Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A Review of the Literature. *Eurasia Journal of Mathematics, Science & Technology Education*, *5*(3), 235–245.

De Boer, H. F., Ender, J., & Leisyte, L. (2007). Public Sector Reform In Dutch Higher Education: The Organizational Transformation of the University. *Public Administration*, *85*(1), 27–46.

Bowen, P. L., Cheung, M. Y. D., & Rohde, F. H. (2007). Enhancing IT

governance practices: A model and case study of an organization's efforts. *International Journal of Accounting Information Systems*, *8*(3), 191–221.

Brown, I., & Motjolopane, I. (2005). Strategic business-IT alignment, and factors of influence: a case study in a public tertiary education institution: reviewed article. *South African Computer Journal*, *2005*(35), 20–28.

Buabeng-Andoh, C. (2012). Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature. *International Journal of Education and Development using Information and Communication Technology*, *8*(1), 136–155.

Buchanan, T., Sainter, P., & Saunders, G. (2013). Factors affecting faculty use of learning technologies: Implications for models of technology adoption. *Journal of Computing in Higher education*, *25*(1), 1–11.

Byrd, T. A., Lewis, B. ., & Bryan, R. . (2006). The leveraging influence of strategic alignment on IT investment: An empirical examination. *Information & Management*, *43*(3), 308–321.

Byungura, J. C., & Hansson, H. (2019). Development and validation of a holistic IT-institutional alignment model for higher education institutional performance. *Society for Information Technology & Teacher Education International Conference* (pp. 1279–1290). Las Vegas, Nevada: Association for the Advancement of Computing in Education (AACE).

Byungura, J. C., Hansson, H., & Thashmee, K. (2015). User Perceptions on Relevance of a Learning Management System: An Evaluation of Behavioural Intention and Usage of SciPro System at University of Rwanda. In T. António Moreira, S. András, & M. Ildikó (Eds.), *European Distance and E-Learning Network 2015 Annual Conference* (pp. 582–562). Barcelona, Spain.

Castillo-Merino, D., & Serradell-López, E. (2014). An analysis of the determinants of students' performance in e-learning. *Computers in Human Behavior*, *30*, 476–484.

Chan, Y. E. (2002). Why Haven't we Mastered Alignment?: The importance of the informal organization structure. *MIS Quarterly Executive*, *1*(2), 97–112.

Chan, Y. E., & Reich, B. H. (2007). IT alignment: what have we learned? *Journal of Information technology*, *22*(4), 297–315.

Chan, Y. E., Sabherwal, R., & Thatcher, J. B. (2006). Antecedents and Outcomes of Strategic IS Alignment: An Empirical Investigation. *IEEE Transactions on Engineering Management*, *53*(1), 27–47.

Chatterjee, S., & Hadi, A. S. (2013). *Regression analysis by example*. New York: John Wiley & Sons.

Chen, L. (2010). Business-IT alignment maturity of companies in China. *Information and Management*, *47*(1), 9–16.

Chen, W., & Hirschheim, R. (2004). A paradigmatic and methodological examination of information sytems research from 1991 to 2001. *Information Systems Journal, 14*(3), 197–235.

Cleveland, J. (1994). Complexity Theory Basic Concepts. *Slideshare.* Retrieved July 27, 2017, from https://www.slideshare.net/johncleveland/complexity-theory-basic-concepts

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education*. London: Routledge.

Cohen, L., Manion, L., & Morrison, K. (2013). *Research methods in education* (6th ed.). New York: Routledge.

Cragg, P., King, M., & Hussin, H. (2002). IT alignment and firm performance in small manufacturing firms. *The Journal of Strategic Information Systems*, *12*(2), 109–132.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches.* (3rd ed.). London, UK: Sage publications.

Creswell, J. W. (2013). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (3rd ed.). Tousand Oaks, California: SAGE Publications.

Creswell, J. W. (2014). *Research design : Qualitative, quantitative, and mixed methods approaches* (4th ed.). LA: SAGE Publications.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology a comparison of two theoretical models. *Management Science*, *35*(8), 982–1003.

Denscombe, M. (2010). *The Good Research Guide: for small-scale social research.* London: McGraw Hill.

Denscombe, M. (2014). *The good research guide: for small-scale social research projects*. McGraw-Hill Education, (UK).

Dent, A. (2015). Aligning IT and business strategy: an Australian university case study. *Journal of Higher Education Policy and Management*, *37*(5), 519–533.

Denzin, N. K. (1973). *The research act: A theoretical introduction to sociological methods.* New Jersey: Transaction Publishers.

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2011). *The Sage handbook of qualitative research*. London: Sage.

Edmunds, R., Thorpe, M., & Conole, G. (2012). Student attitudes towards and use of ICT in course study, work and social activity: A technology acceptance model approach. *British Journal of Educational Technology*, *43*(1), 71–84.

El-Mekawy, M., Rusu, L., & Perjons, E. (2015). An evaluation framework for comparing business-IT alignment models: A tool for supporting collaborative learning in organizations. *Computers in Human Behavior*, *51*, 1229–1247.

Farrell, G. (2007). *ICT in Education in Rwanda:Survey of ICD and Education in Africa: Rwanda Country Report.*

Ferrari, A. (2012). *Digital Competence in practice: An analysis of frameworks*. Sevilla: JRC IPTS.

Fornel, C., & Larcker, D. F. (1981). Structural equations models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, *18*, 39–50.

Fowler, F. J. (2002). *Survey Research Methods* (3rd ed.). Thousand Oaks, CA: Sage.

Franklin, C. (2007). Factors that influence elementary teachers use of computers. *Journal of Technology and Teacher Education*, *15*(2), 267–293.

Gefen, D. and, & Straub, D. W. (1997). Gender differences in the perception and use of e-mail: An extension to the technology acceptance model. *MIS quarterly*, *21*(4), 389–400.

GoR. (2008). *ICT in Education Policy*. Kigali, Rwanda.

GoR. (2013). Low no 71/2013 of 10/09/2013 establishing the University of Rwanda and determining its mission, powers, organization and functioning. *Official Gazette no 38 of 23/09/2013*, 34–54. Kigali.

Graham, C. R., Woodfield, W., & Harrison, J. B. (2013). A framework for institutional adoption and implementation of blended learning in higher education. *Internet and higher education, 18*(4–14).

Gregor, S., & Hevner, A. R. (2013). Positioning and presenting design science research for maximum impact. *MIS quarterly*, *37*(2), 337–355.

van Grembergen, W., & De Haes, S. (2008a). Strategies and models for IT governance. In W. van Grembergen & S. De Haes (Eds.), *Implementing Information Technology Governance: Models, Practices and Cases* (pp. 1–75). IGI Global.

van Grembergen, W., & De Haes, S. (2008b). *Implementing Information Technology Governance: Models, Practices, and Cases*. Hershey, PA, USA: IGI Publishing.

Gutierrez, A., & Serrano, A. (2008). Assessing Strategic, Tactical, and Operational Alignment Factors for SMEs: Alignment Across the Organisation's Value Chain. *International Journal of Value Chain Management*, *2*(1), 33–56.

De Haes, S., & van Grembergen, W. (2008). Analysing the relationship between IT governance and business/IT alignment maturity. *41st Hawaii International Conference on System Sciences* (pp. 428–428). IEEE.

De Haes, S., & van Grembergen, W. (2015). Enterprise Governance of Information Technology. In S. De Haes & W. Van Grembergen (Eds.), *Enterprise Governance of Information Technology. Management for Professionals.* (2nd ed., pp. 11–43). Cham: Springer.

Hair, J., Black, W., Babin, B., Anderson, R., & Tatham, R. (2006). *Multivariate Data Analysis*. Upper Saddle River, NJ: Prentice-Hall.

Hair, J., Hult, G., Ringle, C., & Sarstedt, M. (2014). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Los Angeles: Sage Publications.

Hammond, T. C., & Manfra, M. M. (2009). Giving, prompting, making: Aligning technology and pedagogy within TPACK for social studies instruction. *Contemporary issues in technology and teacher education*, *9*(2), 160–185.

Harris, M. (2000). Virtual learning and the network society. *Information, Communication and Society*, *3*(4), 580–596.

Henderson, J. C., & Venkatraman, H. (1999). Strategic alignment: Leveraging information technology for transforming organizations. *IBM systems journal*, *38*(2.3), 472–484.

Hevner, A. R., & Chatterjee, S. (2010). *Design research in information systems: Theory and practice*. New York, USA: Springer Science & Business Media.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*, *28*(1), 75–105.

Hirschheim, R. (1992). Information Systems Epistemology: an historical perspective. In R. Galliers (Ed.), *Information Systems Research: issues, methods and practical guidelines*. Henley-on-Thames: Alfred Waller Ltd.

Hölttä, S. (1998). The funding of universities in Finland: Towards goal-oriented government steering. *European Journal of Education*, *33*(1), 55–63.

Jimoyiannis, A. (2010). Designing and implementing an integrated technological pedagogical science knowledge framework for science teachers professional development. *Computers & Education*, *55*(3), 1259–1269.

Johannesson, P., & Perjons, E. (2012). *A Design Science Primer* (1st ed.). CreateSpace Independent Publishing Platform.

Johnson, A. M., & Lederer, A. L. (2010). CEO/CIO mutual understanding, strategic alignment, and the contribution of IS to the organization. *Information & Management*, *47*(3), 138–149.

Jones, C., Ramanau, R., Cross, S., & Healing, G. (2010). Net generation or digital natives: Is there a distinct new generation entering university? *Computers & Education*, *54*(3), 722–732.

Jones, L. V. (1986). *The Collected Works of John W. Tukey: Philosophy and Principles of Data Analysis 1949-1964*. CRC Press.

Kappos, A., & Rivard, S. (2008). A three-perspective model of culture, information systems, and their development and use. *MIS Quarterly*, *32*(3), 601–634.

Kashorda, M., & Waema, T. M. (2011). ICT indicators in higher education: Towards an e-readiness assessment model. *Proceeding and report of the 4th UbuntuNet Alliance annual conference* (pp. 57–76). Lilongwe: UbuntuNet Alliance.

Kearns, G. S., & Sabherwal, R. (2006). Strategic Alignment Between Business and Information Technology: A Knowledge-Based View of Behaviors, Outcome, and Consequences. *Journal of management*

information systems, *23*(3), 129–162.

Kennedy, G. E., Judd, T. S., Churchward, A., Gray, K., & Krause, K.-L. (2008). First year students' experiences with technology: Are they really digital natives? *Australasian Journal of Educational Technology*, *24*(1), 108–122.

Khan, M., Hossain, S., Hasan, M., & Clement, C. K. (2012). Barriers to the introduction of ICT into education in developing countries: The example of Bangladesh. *International Journal of Instruction*, *5*(1), 61–80.

Kirkup, G., & Kirkwood, A. (2005). Information and communications technologies (ICT) in higher education teaching—a tale of gradualism rather than revolution. *Learning, Media and Technology*, *30*(2), 185–199.

Klein, H., & Myers, M. (1999). A Set of Principles for Conducting Conducting and Evaluating Interpretive Field Studies in Information Systems. *MIS Quarterly*, *23*(1), 67–96.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary issues in technology and teacher education*, *9*(1), 60–70.

Kothari, C. R. (2004). *Research Methodology: Methods and techniques* (2nd ed.). New Delhi: New Age Publication.

Kozma, R. B. (2005). National policies that connect ICT-based education reform to economic and social development. *Human Technology: In an interdisciplinary journal on humans in ICT environments*, *1*(2), 117–156.

Krippendorff, K. (2004). *Analysis: An Introduction to its Methodology* (2nd ed.). Thousand Oaks CA: Sage.

Kushniruk, A. (2002). Evaluation in the design of health information systems: application of approaches emerging from usability engineering. *Computers in biology and medicine*, *32*(3), 141–149.

Lee, A. S., & Baskerville, R. L. (2003). Generalizing generalizability in information systems research. *Information Systems Research*, *14*(3), 221–243.

Lee, S. M., Kim, K., Paulson, P., & Park, H. (2008). Developing a socio-technical framework for business-IT alignment. *Industrial Management & Data Systems*, *108*(9), 1167–1181.

Lee, Y. C. (2006). An empirical investigation into factors influencing the adoption of an e-learning system. *Online information review*, *30*(5), 517–541.

Leidner, D. E., & Kayworth, T. (2006). A review of culture in information systems research: Toward a theory of information technology culture conflict. *MIS quarterly*, *30*(2), 357–399.

Leonard, J., & Seddon, P. (2012). A Meta-model of Alignment. *Communications of the Association for Information Systems*, *31*(1), 230–259.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Thousand Oaks:

CA: Sage Publications.

Lincoln, Y. S., Lynham, S. A., & Guba, E. G. (2011). Pradigmatic controversies, contradictions, and emerging confluences. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (4th ed., pp. 97–128). Tousand Oaks, CA: Sage.

Lindsay, A. W. (1982). Institutional Performance in Higher Education: The Efficiency Dimension. *Review of Educational Research*, *52*(2), 175–199.

Luftman, J. N. (2000). Assessing Business-IT Alignment Maturity. *Communications of AIS*, *4*(14), 1–49.

Luftman, J. N. (2003). Assessing IT / business alignment. *Information Systems Management*, *20*(4), 9–15.

Luftman, J. N. (2004). *Managing the Information Technology Resources*. New Jersey: Pearson Prentice Hall.

Luftman, J. N., Ben-Zvi, T., Dwivedi, R., & Rigoni, E. H. (2012). IT Governance: An alignment maturity perspective. *Business Strategy and Applications in Enterprise IT Governance*, 87–101.

Machado, C. (2007). Developing an e-readiness model for higher education institutions: Results of a focus group study. *British journal of educational technology*, *38*(1), 72–82.

March, S. T., & Smith, G. F. (1995). Design and natural science research on information technology. *Decision Support Systems*, *15*(4), 251–266.

Marshall, G., & Ruohonen, M. (Eds.). (1998). *Capacity Building for IT in Education in Developing Countries: IFIP TC3 WG3. 1, 3.4 & 3.5 Working Conference on Capacity Building for IT in Education in Developing Countries 19–25 August 1997, Harare, Zimbabwe*. Springer Science & Business Media.

Marshall, S. (2010). Change, technology and higher education: are universities capable of organisational change? *Research in Learning Technology*, *18*(3).

Martin, N., Gregor, S., & Hart, D. (2005). The social dimension of business and IS/IT alignment: Case studies of six public-sector organisations. *Australian Accounting Review*, *15*(3), 28–38.

McCarthy, I. P. (2003). Technology management-a complex adaptive systems approach. *International Journal of Technology Management*, *25*(8), 728–745.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco, CA: Jossey-Bass Publishers.

Miller, J. H., & Page, S. E. (2009). *Complex adaptive systems: An introduction to computational models of social life*. Princeton university press.

MINECOFIN. (2000). Rwanda Vision 2020. Retrieved November 16, 2018, from http://www.minecofin.gov.rw/fileadmin/General/Vision_2020/Vision-2020.pdf

Morgenthaler, S. (2009). Exploratory data analysis. *Wiley Interdisciplinary*

Reviews: Computational Statistics, *1*(1), 33–44.

Motiwalla, L. F. (2007). Mobile learning: A framework and evaluation. *Computers & education*, *49*(3), 581–596.

Mtebe, J. S., & Raisamo, R. (2014). Investigating perceived barriers to the use of open educational resources in higher education in Tanzania. *The International Review of Research in Open and Distributed Learning*, *15*(2), 43–66.

Muianga, X., Byungura, J. C., Hansson, H., Colombage, R. P., & Mutimucuio, I. (2016). Blended learning systems in tertiary education: A comparative analysis of two universities from Rwanda and Mozambique. *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 1006–1015). Washington DC: Association for the Advancement of Computing in Education (AACE).

Mukama, E. (2009). The interplay between learning and the use of ICT in Rwandan student teachers' everyday practice. *Journal of Computer Assisted Learning*, *25*(6), 539–548.

Myers, M. D. (2009). *Qualitative Research in Business & Management*. London: Sage Publications.

Nachmias, R., Mioduser, D., Cohen, A., & Tubin, D. (2004). Factors Involved in the Implementation of Pedagogical Innovations Using Technology. *Education and Information Technologies*, *9*(3), 291–308.

Neuman, W. L. (2011). *Social Research Methods: Qualitative and Quantitative Approaches* (7th ed.). USA: Allyn and Bacon.

Nfuka, E. N., & Rusu, L. (2011). The effect of critical success factors on IT governance performance. *Industrial Management & Data Systems*, *111*(9), 1418–1448.

Niess, M. L. (2011). Investigating TPACK: Knowledge growth in teaching with technology. *Journal of educational computing research*, *44*(3), 299–317.

Oates, B. J. (2006). *Researching information systems and computing*. London: Sage Publications.

Orlikowski, W. J., & Baroudi, J. J. (1991). Studying information technology in organizations: Research approaches and assumptions. *Information Systems Research*, *2*(1), 1–28.

Orlikowski, W. J., & Iacono, C. S. (2001). Theorizing the IT Artifact. *Information Systems Research*, *12*(2), 121–134.

Park, N., Lee, K. M., & Cheong, P. H. (2007). University instructors' acceptance of electronic courseware: An application of the technology acceptance model. *Journal of Computer-Mediated Communication*, *13*(1), 163–186.

Pedraza, N., Guerrero, M., & Lavín, J. (2011). Alignment of E-Business with SMEs' strategies in Northeast of Mexico. *Journal of Technology Management & Innovation*, *6*(4), 205–224.

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems

Research. *Journal of Management Information Systems*, *24*(3), 45–78.

Perry, R. (2006). Diffusion theories. In Edgar F. & B. and R. J. V. Montgomery (Eds.), *Encyclopedia of Sociology* (2nd ed., pp. 674–681). New York: Macmillan Reference USA: Macmillan Reference USA.

Persico, D., Manca, S., & Pozzi, F. (2014). Adapting the Technology Acceptance Model to evaluate the innovative potential of e-learning systems. *Computers in Human Behavior*, *30*, 614–622.

Peterson, R. R. (2003). Information Strategies and Tactics for Information Technology Governance. In W. van Grembergen (Ed.), *Strategies for Information Technology Governance*. Hershey, PA: Idea Group Publishing.

Prat, N., Comyn-Wattiau, I., & Akoka, J. (2014). Artifact Evaluation in Information Systems Design-Science Research-a Holistic View. *Pacific Asia Conference on Information Systems (PACIS)*. AIS Electronic Library.

Preston, D. S., & Karahanna, E. (2009). Antecedents of IS Strategic Alignment: A Nomological Network. *Information Systems Research*, *20*(2), 159–179.

Reich, B. H., & Benbasat, I. (2000). Factors that influence the social dimension of alignment between business and information technology objectives. *MIS quarterly*, *24*(1), 81–113.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Rogers, E. M. (2010). *Diffusion of innovations* (4th ed.). New York: Simon and Schuster.

Ross, S. M. (2014). *Introduction to Probability and Statistics for Engineers and Scientists* (5th ed.). Amsterdam: Academic Press, Elsevier.

Sabherwal, R., & Kirs, P. (1994). The alignment between organizational critical success factors and information technology capability in academic institutions. *Decision Sciences*, *25*(2), 301–330.

Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *The Turkish Online Journal of Educational Technology – TOJET*, *5*(2), 14–23.

Sampath Kumar, B. T., & Manjunath, G. (2013). Internet use and its impact on the academic performance of university teachers and researchers: A comparative study. *Higher Education, Skills and Work-based Learning*, *3*(3), 219–238.

Sandholtz, J. H., & Reilly, B. (2004). Teachers, not technicians: Rethinking technical expectations for teachers. *Teachers College Record*, *106*(3), 487–512.

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students* (5th ed.). London: Prentice Hall.

Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research Methods for Business Students* (6th ed.). Edinburgh Gate, Harlow: Pearson Education

Limited.

Schoonenboom, J. (2014). Using an adapted, task-level technology acceptance model to explain why instructors in higher education intend to use some learning management system tools more than others. *Computers & Education*, *71*, 247–256.

Selim, H. M. (2003). An empirical investigation of student acceptance of course websites. *Computers & Education*, *40*(4), 343–360.

Sife, A., Lwoga, E., & Sanga, C. (2007). New technologies for teaching and learning: Challenges for higher learning institutions in developing countries. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, *3*(2), 57–67.

Simon, H. (1996). *The Science of Artificial* (3rd ed.). Cambridge, MA: MIT Press.

Simonsson, M., & Johnson, P. (2006). Defining IT governance-A consolidation of literature. *The 18th conference on advanced information systems engineering (CAISE 2006)*. Luxembourg.

Snyder, I., Marginson, S., & Lewis, T. (2007). 'An alignment of the planets': mapping the intersections between pedagogy, technology and management in Australian universities. *Journal of Higher Education Policy and Management*, *29*(2), 187–202.

Stake, R. (1995). *The art of case research*. Thousand Oaks, CA: Sage Publications.

Stillar, G. F. (1998). *Analysing Everyday Texts: Discourses, Rhetoric, and Social Perspectives*. London: Sage.

Straub, D. W., Gefen, D., & Boudreau, M. (2005). Quantitative Research. In D. Avison & J. Pries-Heje (Eds.), *Research in Information Systems: A Handbook for Research Supervisors and Their Students* (Ed.). Amsterdam: Elsevier.

Tabata, L. N., & Johnsrud, L. K. (2008). The impact of faculty attitudes toward technology, distance education, and innovation. *Research in Higher Education*, *49*(7), 625.

Tarus, J. K., Gichoya, D., & Muumbo, A. (2015). Challenges of implementing e-learning in Kenya: A case of Kenyan public universities. *The International Review of Research in Open and Distributed Learning*, *16*(1), 120–141.

Taylor, J. A., & Newton, D. (2013). Beyond blended learning: A case study of institutional change at an Australian regional university. *The Internet and Higher Education*, *18*, 54–60.

Tedla, B. A. (2012). Understanding the Importance, Impacts and Barriers of ICT on Teaching and Learning in East African Countries. *International Journal for e-Learning Security*, *2*(3/4), 199–207.

Teo, T. S., & Ang, J. S. (1999). Critical success factors in the alignment of IS plans with business plans. *International journal of information management*, *19*(2), 173–185.

Thinyane, H. (2010). Are digital natives a world-wide phenomenon? An

investigation into South African first year students' use and experience with technology. *Computers & Education*, *55*(1), 406–414.

Tukey, J. W. (1977). *Exploratory Data Analysis*. New York: Addison-Wesley.

United Nations. (2015). Sustainable development goals. Retrieved October 19, 2017, from https://www.un.org/sustainabledevelopment/sustainable-development-goals/

UR. (2014). UR Vision and Mission. Retrieved July 16, 2016, from https://ur.ac.rw/?Vision-and-Mission

Urbach, N., & Ahlemann, F. (2010). Structural Equation Modeling in Information Systems Research Using Partial Least Squares. *ITTA: Journal of Information Technology Theory and Application*, *11*(2), 5–39.

Usluel, Y. K., Askar, P., & Bas, T. (2008). A structural equation model for ICT usage in higher education. *Educational Technology & Society*, *11*(2), 262–273.

Vaira, M. (2004). Globalization and higher education organizational change: A framework for analysis. *Higher Education*, *48*(4), 483–510.

Vaishnavi, V. K., & Kuechler, W. (2007). *Design Science Research Methods and Patterns: Improving and Innovating Information & Communication Technology.* (2nd ed.). USA: Auerbach Publications.

Vaishnavi, V. K., & Kuechler, W. (2015). *Design Science Research methods and patterns: Innovating Information and Communication Technology.* New York: CRC Press, Taylor & Francis Group.

Venable, J., Pries-Heje, J., & Baskerville, R. (2012). A comprehensive framework for evaluation in design science research. *International Conference on Design Science Research in Information Systems* (pp. 423–438). Berlin, Heidelberg: Springer.

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating perceived behavioral control, computer anxiety and enjoyment into the technology acceptance model. *Information systems research*, *11*(4), 342–365.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478.

Vermerris, A., Mocker, M., & Van Heck, E. (2014). No time to waste: the role of timing and complementarity of alignment practices in creating business value in IT projects. *European Journal of Information Systems*, *23*(6), 629–654.

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge–a review of the literature. *Journal of Computer Assisted Learning*, *29*(2), 109–121.

Wagner, D., Day, R., James, T., Kozma, R., Miller, J., & Unwin, T. (2005).

Monitoring and Evaluation of ICT in Education Projects A Handbook for Developing Countries. Washington DC: World Bank.

Wang, E. T., & Tai, J. C. (2003). Factors affecting information systems planning effectiveness: organizational contexts and planning systems dimensions. *Information & Management*, *40*(4), 287–303.

Wang, X., Mol, N. P., & Jongbloed, B. (2010). *Performance measurement in universities*. University of Twente.

Wang, Y., Han, X., & Yang, J. (2015). Revisiting the Blended Learning Literature: Using a Complex Adaptive Systems. *Educational Technology & Society*, *18*(2), 380–393.

Weill, P., & Ross, J. W. (2004). *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results*. Harvard Business School Press.

West, L. H. T., Hore, T., & Boon, P. K. (1980). Publication rates and research productivity. *Vestes*, *23*(2), 25–37.

Wilson, J. (2010). *Essentials of Business Research: A Guide to Doing Your Research Project* (1st ed.). Thousand Oaks, California: SAGE Publications.

Wu, S. P. J., Straub, D. W., & Liang, T. P. (2015). How information technology governance mechanisms and strategic alignment influence organizational performance: Insights from a matched survey of business and IT managers. *MIS Quarterly*, *32*(2), 497–518.

Yayla, A. A., & Hu, Q. (2009). Antecedents and Drivers of It-Business Strategic Alignment: Empirical Validation of a Theoretical Model. *Ecis* (pp. 2858-2869 ST-Analyzing community contributions).

Yayla, A. A., & Hu, Q. (2012). The impact of IT-business strategic alignment on firm performance in a developing country setting: exploring moderating roles of environmental uncertainty and strategic orientation. *European Journal of Information Systems*, *21*(4), 373–387.

Yin, R. K. (1994). *Case Study Research: Design and Method* (2nd ed.). London: SAGE Publications.

Yin, R. K. (2003). *Case Study Research. Design and Methods* (3rd ed.). California: Sage Publications.

Yin, R. K. (2009). *Case study research:Design and method* (4th ed.). Tousand Oaks, CA: Sage.

Yin, R. K. (2014). *Case study research: Design and methods* (5th ed.). Thousand Oaks, CA: Sage Publications.

Zainally, H. P. (2008). Administration of faculties by information and communication technology and its obstacles. *International journal of education and information technologies.*, *2*(1), 24–30.