Ph.D. Dissertation in Engineering

The Role of Digital Leadership and Organizational Capabilities for Innovation and Institutional Collaboration for Knowledge Creation:

-Towards Ethiopian Third Generation Universities

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The Role of Digital Leadership and Organizational Capabilities for Innovation and Institutional Collaboration for Knowledge Creation:

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Abstract

The Role of Digital Leadership and Organizational Capabilities for Innovation and Institutional Collaboration for Knowledge Creation:

-Towards Ethiopian Third Generation Universities.

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Higher Education Institutions (HEIs) are receiving pressure to focus on the “third mission” or contribution to society apart from teaching and research activities. In a broader sense, the third mission is a multidisciplinary, complex, evolving phenomenon. HEIs serve as both socio-economic and sociopolitical institutions in nations. Although Ethiopia has less than a century of HEI, both public and private institutions have played a vital role in contributing to the country’s national economic and social transformation by contributing to its human resource needs. However, HEIs face several challenges in achieving their strategic objectives due to their geographical location and governance mechanisms. Several problems related to this, including an expansion of student numbers, a decrease in research funding, a lack of state-of-the-art laboratory facilities, and inexperienced governance and leadership to achieve 21st-century HEIs third mission. To enhance the quality and accessibility of HEIs in Ethiopia, reforms were implemented. These reforms encompassed

measures such as regulating public HEI expansion. Among the revisions to the academic focus area mix is the attraction of expatriate faculty and leaders with international experience and expertise from developed countries such as Germany and Korea. Despite these initiatives, HEIs in developing countries, including Ethiopia, continue to face challenges such as the growing demand for knowledge exploitation and innovation. In addition, they face increased competition for top students and faculty members globally. The emergence of Digital Transformation has played a significant role in the development and contributions of HEIs, knowledge sources, and innovation.

This research explores the transition of Ethiopian public HEIs toward third generation universities through innovation using digital leadership and organizational capabilities and Institutional collaborations on joint knowledge creation of Ethiopian HEIs and NRIs. Specifically, it investigates HEI leaders' perceptions and lived experiences regarding leadership roles and organizational capabilities for innovation and institutional transition. Using joint knowledge generation to improve innovation performance in HEIs and collaboration between institutions, this research aims to improve innovation performance in HEIs and to promote collaboration between institutions. The study consists of two separate essays assessing innovation and education, and institutional collaboration on joint knowledge creation. In addition, the study assesses the roles academic leaders and researchers play in terms of leadership, innovation, and joint knowledge generation. After an exhaustive literature review, two essays were conducted to bring to the attention of researchers about the transition of HEIs in Ethiopia. The first essay explores the role of digital leadership and organizational capabilities in the transition to 3GU. A measure of institutional performance and transition was adopted based on selected theories from innovation in HEIs and strategic management. An online survey was administered to academic leaders, lecturers, and IT leaders at 11 Ethiopian

public higher education institutions. The data were properly coded and normalized using a Structural Equation Model (SEM). The tool was used for the PLS-SEM4.0.9.2 version. Second, we conducted an analysis based on spatial dimensions using SNA R-Program to analyze institutional collaborations of joint knowledge creation for innovation for quality research performance in the context of joint knowledge creation.

The first study's findings suggested conceptualizations of innovation and education for institutions' transition to the knowledge economy. A study was conducted on digital leadership's role in innovation. The results indicate that institutional transformations can expand their mission to third-mission activities. Organizational capabilities and digital leadership have a positive impact on HEI performance. Digitalization capabilities play a moderating role with subconstructs like data, IT infrastructure, and business processes. This has a significant impact on HEI innovation performance. The second essay uses social network analysis with spatial analysis to investigate the role of geographical locations in interdisciplinary and joint research collaborations. In this study, supra-affiliation outperforms intra-affiliation for institutional collaboration in quality research. Further, geographical distance has less impact on joint knowledge creation between institutions. This helps institutions create better-quality researchers for innovation, institutional transformation, and interdisciplinary research.

HEI innovation and innovation performance studies in Ethiopian HEIs are significant. The first essay discusses the roles HEI leadership should play from the leadership level to the lower level, showing how their efforts to link organizational capabilities and digital leadership improve innovation. This study contributes to academic/research/technology transfer and know-how commercialization in developing countries, including Ethiopia, for the first time. According to the results, the national innovation systems are not

coordinated among research and academic institutions. It is important to note that this study is limited by the fact that there are still few respondents from top-level HEI leaders compared to middle and lower-level Ethiopian HEI leaders. Research should focus on collaborations with industries and expand this research for national innovation systems using academic and firm patenting trends.

By extending the academic literature on innovation in higher education institutions and institutional collaborations, these essays contribute to the institutional transition of the university. Ethiopian HEIs need to work towards an institutional transition to third generation universities.

Keywords: Digital Leadership, HEIs Innovation Performance, Organizational Capabilities, Institutional Collaboration, Interdisciplinary Research, third generation university.

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Chapter 1: Overall Introduction

1.1 Background and Motivation

Higher Education Institutions (HEIs)' role in transforming communities' socioeconomic and sociotechnical capabilities of communities has been increasingly recognized over time (Wissema, 2009). Education missions are changing globally due to a third mission and universities' innovativeness of transitioning to third generation universities with efficiency and effectiveness due to high cost, low budget, and funding for high-tech laboratory facilities.

The current generation of universities faces challenges in terms of financial and social impacts, and governments demand universities to align their mission with technology-led economic growth and social development (Ghorbani et al., 2021; Kyrö & Mattila, 2012). This has led to the emergence of the concept of the "third generation university" (3GU) which emphasizes technological advancement, innovation in teaching and research, and active community participation(Etzkowitz, 2004; Wissema, 2009). The third mission of the universities is challenged nowadays as many countries are challenged in processing knowledge creation and dissemination, technology transfer, and innovations (Etzkowitz, 1983; Wu & Zhou, 2012).

The global digital transformation has greatly impacted HEIs (Etzkowitz et al., 2000). Digital transformations are ever-increasing their impact on academic institutions through the 4th industrial revolution. Although these digital technologies and platforms are reshaping the academic, research, and third missions, the universities fall behind the other sectors probably due to a lack of effective leadership and change in institutional culture (Rodríguez-Abitia & Bribiesca-Correa, 2021). It's important for universities to stick to digital transformations to achieve their

mission and relevance in the modern world through careful planning, investment, leadership, and collaboration among stakeholders (Alenezi, 2021).

Innovation is a crucial factor of competitiveness in the economy and a mechanism to increase organizational ability in the changing environment (Damanpour & Gopalakrishnan, 1998). Although HEIs do not tend to do business in innovation, they still need to maintain and improve their positions in the global education environment by scaling up research and innovative ideas. Education plays a vital role in sustaining the future, the need to work on HEIs innovations is vital. As a result of this, a study conducted by (Haelermans & De Witte, 2012)categorized education innovations into five categories: (1) profiling innovations, regarding curriculum changes; (2) pedagogical/didactic innovations which are mainly related to the content of the courses and the method of instruction; (3) process and organizational innovations; (4) teacher professionalization; and (5) innovation in the educational supply chain as a result of collaborations.

There is a perception that innovation in universities can be measured by the development of educational, research, and non-profit products and services. In addition, as part of the process, it includes improvements or changes that are intended to be made to the processes and organizational structures of HEIs as part of the process. HEIs prioritize innovation, and innovation performance in their third mission. These mission issues are tied to university engagement and collaboration with society and industries. They focus on knowledge/technology generation and dissemination becoming integral to universities and their primary missions (Pinheiro et al., 2015). There is vital literature that reveals the importance of innovation towards third mission and third generation universities.

The digital transformation efforts in HEIs, and reforms are also being implemented to improve digital literacy and infrastructure in schools. This

is to create a better teaching and learning environment for students to enhance their competitiveness and innovation skills (Laitsou et al., 2020). They classified public universities based on their establishment date and infrastructure level. Recent reforms that began in 2021 further categorized universities into research, science, technology, general, and applied categories(Tamrat & Teferra, 2018). These include curriculum development, public university autonomy, accreditation of programs and universities, investment in Techno-startups and Big IT capacity buildings, national digital strategies for HEI, and national telecom reforms to improve digital access. Furthermore, there have been reforms in university-industry-government collaboration, entrepreneurial and innovation activities, startup ecosystems, venture capital, and accreditation and autonomy of public universities (Shkabatur et al., 2021).

A successful transition to HEIs' organizational missions requires leadership. Digital leadership has emerged as a vital type of leadership in HEIs, particularly during the COVID-19 pandemic (Jameson et al., 2022). Digital leadership encompasses strategic planning, vision, and innovation in leveraging technology for teaching and research. Digital leaders must be able to manage change, foster an innovation culture, and promote collaboration and communication among stakeholders. They must also balance the needs of different departments, ensure efficient resource utilization, and prioritize reliable and secure digital infrastructure (Verhoef et al., 2021). Organizational capabilities of HEIs play a vital role in the transition to 3GU. This includes developing creative programs, integrating technology into the curriculum, building industry partnerships, and fostering an environment that promotes innovation and creativity. Flexibility, agility, and continuous learning are essential for HEIs to adapt to the changing needs of students and the workforce, attract and retain talent, and manage resources effectively (Altbach & Altbach, 2013).

HEIs should also focus on developing graduates with the competencies required for the fourth industrial revolution, including innovative thinking, social skills, personal skills, global citizenship, and ICT knowledge and skills, by integrating digital technologies into the learning environment (Bourn et al., 2017; Luna Scott, 2015). Studies also reveal that leaderships and innovativeness are consistent and leaders from highly skilled leaders transform their organizations (W. Li et al., 2018).

Institutional collaboration and Knowledge generations of HEIs and other industries and research Institutions striving to overcome the challenges in the quality of their outcomes and investing back to improve those outcomes. Researchers also suggest that institutional collaboration is imperative for knowledge generation and innovation. Velu (2015) argues that institutions are necessary to govern collaborative innovation and create markets to enable and sustain it. Santoro & Gopalakrishnan (2000) finds that trust facilitates knowledge transfer institutionalization between industrial firms and university research centers. As shown by Kruss (2006), knowledge networks are shaped by factors such as the level of expert knowledge in scientific and managerial fields, competitive dynamics in the industrial subsector, and government policy steering mechanisms. Using a knowledge spiral as a dynamic for the whole project, (Castiaux, 2007) examines knowledge flows and collaboration behaviors in university-industry collaborative research projects. Overall, the papers suggest that institutional collaboration is necessary for knowledge generation and innovation.

HEIs in Ethiopia (HEIs) are undergoing a series of reforms aimed at improving institutional innovation performance, with a focus on digital transformation (Tamrat & Teferra, 2018). However, these reforms are still at a low level of implementation (Tamrat & Teferra, 2018). The risk of reduced competitiveness and universality of HEIs has become a central issue in the

country's educational reforms. Despite limited resources, the Ethiopian government is heavily investing in digital transformation initiatives, such as establishing the Ethiopian Research and Education Network(EthERNet) for national and global sharing of educational and research resources (Bankole & Assefa, 2017). The government has also launched initiatives such as ICT parks, science parks, techno startups, and national data centers to further drive digital transformation.

Therefore, as the growing digital transformations lead to demand for highly skilled and innovative workforces for competitive HEIs, the study aims to investigate the HEIs' innovation performance empirically through assessing the role of digital leadership and organizational capabilities in Ethiopian HEI innovation performance. Furthermore, the institutional collaborations of Ethiopian research and National Research Institutes to measure their innovations and interdisciplinary research for the transition to the third generation university.

1.2 Research Problem Description

The changing nature of universities in the digital era, including the internal organizational work process, roles in society, and the increasing importance of digital leadership, innovation, and entrepreneurship, poses challenges for HEIs worldwide (B. R. Clark, 1998).

The nature of universities is changing from time to time due to digital disruptions and technological transformations both universities' internal organizational processes and their changing roles in society (B. R. Clark, 1998). The wider discussions on the future of universities opened long ago due to the changing missions of HEIs. The nature of those pressures in universities worldwide is initiated with the main aim of exploitation of the knowledge produced in the universities for value creation. The disruptions of digital technologies make digital capability and leadership capabilities equally important and a central focus of organizational competitiveness. Leaders are nowadays facing new challenges because of digital technology disruptions.

Researchers across the academic and business world are indicating the changes in organizational culture and business ecosystems due to digital transformations and the confrontation of the change makers and employees with traditional mindsets. As a result, leaders need to adapt or argue with new skills and mindsets to navigate the digital transformations in their organizations or institutions for competitive advantage.

It also has become is evident that the development of today's society and economy is closely linked to the university's mission, with entrepreneurship or and know-how exploitation playing an integral role. Dozens of researchers in the last decades studied the HEIs' role in socio-economic development and the sustainability of social development. Etzkowitz et al., (2000) developed a 'triple helix model' model based on

academic-industry-government links that form a spiral pattern of cooperation whereas (Goldstein, 2010) suggests a new model for understanding and metrics for traditional teaching and research missions, internal organizational changes that are more conducive to collaboration (both internal and external), new modes of governance and management, and new institutional capacities.

As they conflict with open science, strategies for advancing economic development, such as technological innovation, commercialization, and knowledge transfer, can make it difficult to promote entrepreneurship in universities. Considering the social barriers to entrepreneurship Kyrö & Mattila (2012) that the "entrepreneurial turn" has made visible in the university context. It is also evident that digital leadership recently emerged as an important role in higher education(Antonopoulou et al., 2020). Few studies have been conducted in higher education institutions that focus on digital leadership where the study of digital leadership is not yet explored, as areas change rapidly. Hall (2021) stated that higher education has become a center for innovation and entrepreneurship as HEIs focus on the third mission. As the role of digital leadership is undeniable, still there is also an unclear distinction between the term "digital leadership" , "leadership in the digital age" which can help institutional leadership strategically build the digital transformation processes that can be reflected in their respective academic institutions (Ehlers, 2020). Though Universities are the source of constant intellectual and scientific innovation for society, still leaders in the university tend not to accept changes in the university due to legacy systems.

HEIs in every corner of the world have distinct characteristics based on their geographical locations and the leadership styles that each of them employs (Vroom & Yetton, 1973). Due to the rapid advancement of technology, even large corporations cannot rely solely on their patents, and R and D departments. The processes by which organizations carry out their

activities are linked to organized human society. There was also little discussion of the third generation of universities in developing countries and institutional transitions to the knowledge-based economy.

Organizational leadership has long been practiced as part of business administration to achieve institutional goals. This research focuses primarily on digital leadership, which will be defined in the following sections as how higher education improves its innovative performances. Leadership is one the very important means by which organizational leaders mobilize and influence other people to achieve their desired goals, vision, and missions (Antonopoulou et al., 2021a; Khaw et al., 2022). According to (Connolly et al., 2019), leadership influences the relationships between the leader and followers who are willing and able to change and reflect the results of their common goals.

Studies have found that digital leadership, which includes dynamic capabilities and innovation management, is related to institutional success, strategic alliances, and leadership development as the key to facilitating innovation(Schoemaker et al., 2018; Schweitzer, 2014). Here in the case of higher education, organizational capabilities played an important role in digitalization capabilities, including research, cooperation, and joint work with local and foreign institutions to determine innovation and performance capabilities.

The theory of human capital explains how it focuses on the assumption that formal education is an instrument for improving the productivity of its population. Therefore, investment in human capital development to improve productivity is of great importance in educational institutions (Tamrat, 2021; Tamrat & Teferra, 2018). Because the innovation process has some distinct traits, innovation leadership differs from leadership in other corporate contexts (Y. Chen et al., 2014).

Innovation in this research context is defined as "intentional introduction and application within a role, group or organization of ideas, processes, products, or procedures, new to the relevant unit of adoption" (Akbari et al., 2021; West & Altink, 1996). Nowadays universities are not expected to be limited by knowledge creation but also to achieve society's social and economic objectives through knowledge creation (Fadeeva & Mochizuki, 2010).

Organizational capabilities in HEIs refer to the IT capabilities of HEI that refer to the abilities of institutions to effectively use and manage IT resources to achieve strategic goals. The capabilities are not limited to technical aspects but also include the organizational culture and policies that support the use of IT. It includes infrastructure, governance, information management, collaboration, and training and support of IT and IT systems (Bianchi & Sousa, 2016). Hence, today universities are expected to be efficient and globally competent to attract world-class personnel to innovate and exploit the know-how they generate through commercialization and technology transfer. Accordingly, universities are expected to focus on their third mission and beyond to include social innovations in their missions. For the sustainability of the universities, they need to go beyond the traditional function of education, research, and community outreach. Finally, some statements indicate the transitions to third generation universities of Ethiopian HEIs.

The disruptions of digital technologies and technological transformations are fundamentally changing the landscape of higher education institutions (HEIs) worldwide, impacting their internal organizational work processes and roles in society. Leaders in HEIs are facing difficult challenges due to the disruptions of digital technology(Cruz-Ros et al., 2021). There is a growing need for digital leadership skills and mindsets to navigate digital transformations for competitive advantage.

Moreover, entrepreneurship and knowledge exploitation have become integral to universities' mission in today's social and economic development. However, strategies to advance economic development, such as technological innovation and commercialization, can conflict with open science. This can make it difficult to promote entrepreneurial culture in universities. However, there is a lack of research on digital leadership in higher education. The unclear distinction between "digital leadership" and "leadership in the digital age" hinders academic institutions' strategic planning and implementation of digital transformation processes.

In Ethiopia, the digital transformation of HEIs has revealed systemic inequities, including a significant digital divide, limited resources, and insufficient digital literacy education. Despite the presence of digital technologies, universities have lagged behind other sectors due to ineffective leadership and resistance to institutional culture change, as identified by (Rodríguez-Abitia & Bribiesca-Correa, 2021). The emergence of the Covid-19 pandemic further exposed the limitations of HEIs in swiftly transitioning to online instruction systems. Challenges related to IT infrastructure, technological capabilities, and a lack of autonomy have posed significant hurdles.

The digitalization of education and the broader digital transformations profoundly impact the national economy and society. HEI leaders are confronted with new and complex challenges arising from digital technology disruptions. Consequently, leaders must adapt and acquire new skills and mindsets to navigate digital transformations within their organizations or institutions to gain a competitive advantage. The ability of HEI leaders to embrace digital technologies and foster a culture of innovation and adaptability is crucial in effectively responding to the changing landscape of higher education and maximizing the benefits of digitalization (Ghorbani et al., 2021).

Hence understanding the role of digital leadership in HEIs is crucial to improve innovative performance, facilitating institutional success, and achieving strategic goals. The organizational capabilities, including IT capabilities and the organizational culture and policies that support IT use, play a significant role in HEI digitalization capabilities thereby contributing to innovation and institutional transitions. Therefore, the research on digital leadership in HE is timely and relevant for addressing the challenges and opportunities posed by digital disruptions and technological transformations in universities worldwide, specifically in developing countries like Ethiopia.

1.3 Research Objectives and Questions

HEIs are the sources of knowledge and human resources that can play an important role in the nation's socioeconomic development. They are in many parts of the world transitioning due to technological transformations and digital disruptions. Hence, this study seeks to study the transitions of HEIs to third generation universities in Ethiopia by exploring the role of digital leadership and organizational capabilities toward innovation performance, and institutional collaboration toward joint knowledge creation. This section presents the general research objectives and questions that our study addresses in the following chapters with their specific objectives and research questions.

First Objective: Investigating the role of digital leadership and organizational capabilities in the innovation performance of Ethiopian HEIs. The identification of underlying factors, the role of leadership, and universities' level of innovativeness, the purpose of conducting this evolving leadership style is for the purpose of competitive advantage and globalization missions of the universities for transitions. Accordingly, the first study used an empirical analysis to answer the following three research questions:

RQ1: *What is the role of digital leadership on the innovation performance of Ethiopian HEIs?*

RQ2*: What are the roles of organizational capabilities in influencing the innovation performance of Ethiopian HEIs?*

RQ3: *How do the digitalization capabilities moderate between digital leadership and innovation performance of Ethiopian HEIs?*

The Second Objective: Investigate the institutional collaborations of Knowledge generation between researchers in the Ethiopian HEIs and research institutes. This study aims to explore institutional collaborations for generating quality research for commercialization to help institutional

transitions. This study uses the SNA approach for conducting institutional collaborations from Scopus-indexed publications with at least two authors affiliated with Ethiopian public academic and national research institutes. The study tries to investigate the following research questions.

RQ4: *Do the intra-affiliation and supra-affiliation collaborations on joint knowledge creation have a significant difference in Ethiopian HEIs and the NRIs?*

RQ5: *What is the impact of the distance between the institutions on the Joint Knowledge creation of Ethiopian HEIs and NRIs?*

This dissertation with two parts investigates important factors for institutional transitions of the Ethiopian HEIs through the study of the role of digital leadership and organizational capabilities, for innovation and institutional collaborations for joint knowledge creation for commercialization institutional transitions to third generation universities. The work tries to indicate directions for leadership and governance toward transforming universities into 3GU. Hence, this study explores the role of digital leadership, institutional collaboration on knowledge generation, and innovations in Ethiopian HEIs to achieve socioeconomic growth and development, social innovations, and university sustainability.

1.4 Research Philosophy and Methodology

Empiricism and pragmatism inspire this research. Empirical evidence assumptions are central to knowledge and institutional formation and transition. By adopting evidence-driven thinking, this study uses a philosophical and pragmatic approach. The study uses the theory of leadership and open innovation for institutional transition and joint knowledge generation. The dissertation has two studies interlinked to contribute to institutional innovation and the transition to 3GU.

The first study uses a deductive approach leveraging the existing theories of organizational leadership and open innovation using a cross-sectional survey study using a questionnaire survey adopted from works of literature from the respondents of leaders in public HEIs in Ethiopia to draw evidence-based conclusions. To collect data, a survey instrument was designed based on literature and validated with domain experts. After data preprocessing, the analysis tool Partial Least Square (PLS) and Covariance-based (CB) Structural Equation Modeling (SEM), SmartPLS version 4.0.9.2 for analyzing the hypothesis of the proposed research model. Accordingly, the results help to make evidence-driven analyses to gain insight into innovation and education in Ethiopian HEIs for institutional transitions.

The second study used social network anlalysis of institutional collaboration to create quality research for institutional transition. Based on the analysis result, supra-affiliation outperformed using Mann-Whitney-Malcoxon analysis. The impact of distance on researchers' collaboration Spearman's correction ranking was applied and better quality was obtained

from collaborations from various academic and research institutes.

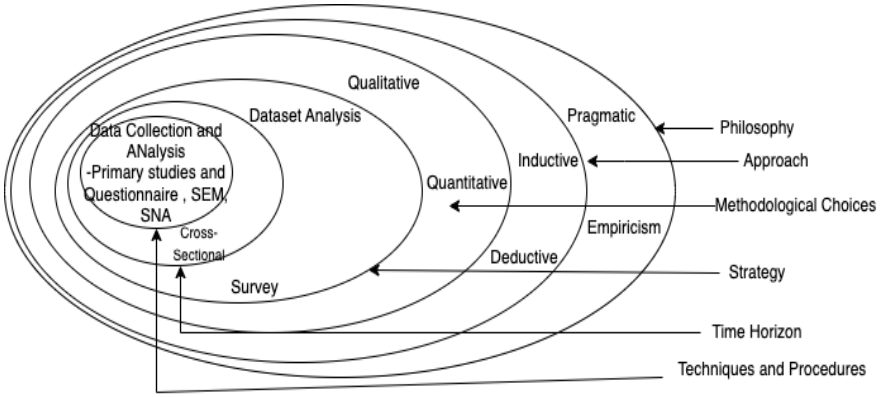


Figure 1: *Research Philosophy- Research Methodology*

The two studies show the practical views towards the institutional transitions focusing on innovation and Institutional collaborations of HEIs of Ethiopia. Figure 1 shows the philosophy and methodology used in this research work.

1.5 Research Contribution

Two studies are conducted to investigate innovation in HEIs and institutional collaboration on joint knowledge creation in Ethiopian HEIs. The first study was on the role of digital leadership and organizational capabilities for innovation using a cross-sectional survey using structural equation modeling (SEM). Analysis of the data collected showed digital leadership and organizational performance aligned with institutional missions. Previous studies conducted by (Antonopoulou et al., 2021a, 2021b; B. R. Clark, 1998; Gibb, 2012; Wissema, 2009) focused on a specific type of leadership in organizational performance. However, none have explored digital leadership and innovation in HEIs. Second, there are limited studies that have examined the combined impact of organizational capabilities and digital leadership on performance specifically in HEI. These studies highlight the unique role of these factors in shaping overall performance outcomes.

To begin with, this study extends the theory of leadership and organizational capabilities to include HEI digitalization capabilities as a means of improving innovation performance in HEIs as a means of enhancing leadership and organizational capabilities. Innovation performance research in HEIs is nowadays becoming vital due to the low level of digital transformation in HEIs compared to other sectors. Previous research focused on digital leadership at the Senate and secondary school levels during the Covid-19 reform era. It has been found that no empirical research has been conducted on the role of digital leadership and organizational capabilities in the transition to the knowledge economy. This is one of the main contributions of this study.

Second, the study further contributes to the literature through the integration of digital leadership and organizational capabilities toward the transition to 3GU. In this study, digital leadership was also found to act as a

moderator between leadership styles and innovation performance in terms of leadership styles. The empirical evidence was verified by evaluating the level of moderation, which shows whether it is strong or weak. This would also help researchers in similar areas in the future to consider studying the transition of HEIs towards 3GU using moderating factors and digital leadership.

Third, the study further contributes to the literature through the integration of theories from leadership, strategic management, dynamic capabilities, Knowledge-based view, and resource-centered views together for an effective and efficient transition of HEIs toward 3GU. In this way, the proposed research model can be developed by bringing together these different theories. By contributing theoretical lenses, this accelerates the transition to a knowledge-based economy.

Fourth, the study contributes to academic and research collaboration among Ethiopian universities and research institutes. This study contributes to the body of literature by extending research conducted from the perspective of spatial dimensions. There has been no research conducted on Ethiopian soil to investigate the contribution joint knowledge generation makes towards innovation and the national innovation system so far. This can serve as an initial step toward building a centralized innovation ecosystem in Ethiopia.

Fifth, practical contributions for policymakers and governments towards improving the digitalization capabilities, digital literacy, and innovation performance of the HEIs and national innovation systems. This will contribute to sociotechnical and socioeconomic transitions. For formulating national and institutional policies to improve innovation and innovation performance, this study provides recommendations based on an empirical study conducted by public higher education institutions.

Finally, the practical contributions to the need for institutional collaborations in joint knowledge/technology creation and dissemination with research institutes and industries. In addition, this research opens the door to further research on innovation and innovation performance in similar areas. This enables HEIs to establish regional innovation systems and transition to third-mission activities.

1.6 Research Outline

This thesis comprises five chapters, encompassing two separate studies. In Chapter 1, an introduction presents an overview and summary of the entire dissertation. Chapter 2 focuses on a literature review. This establishes a theoretical foundation for Organizational Capabilities, Digital Leadership, and Digital Transformations in the education sector. It also focuses on the transition to third-generation universities. It also explores the main theories used to investigate innovative HEIs and proposes hypotheses based on related works. Chapters 3 and 4 are structured as independent essays, designated study- 1 and study-2 respectively. They present the studies' findings along with their conclusions and policy implications. Finally, Chapter 5 encompasses a comprehensive discussion and conclusion of the entire dissertation. It also includes theoretical and practical implications and suggestions for future field research.

The scope of the research and the depth of the investigation are mapped in this part, which is the map for the entire work. Following are the steps involved in conducting this research.

1. Conducted a literature review to understand the state of the art in the research area and find the research gap and relevance for the study.
2. Design a conceptual research model for each essay to investigate the problems.
3. Evaluate and assess all the latent variables with the use of measurable models and make an appropriate analysis.
4. Conduct validation of the instrument measures with domain experts and practitioners (Study 1)
5. Check the reliability, validity, and multicollinearity of the data collected.

6. Apply SmartPLS 4.0.9.2 version to our model (Structural equation modeling) analysis to test our hypotheses (Study 1).
7. Perform a mediation assessment to understand the roles of digital leadership and innovation performance for transitions. (Study 1)
8. Perform a comparison of the analysis results using PLS-SEM and CB-SEM techniques.
9. Extract data for the Scopus database for the second Study
10. Data cleaning and processing spatial data of affiliations (Study 2)
11. Test the hypothesis and confirm the institutional collaborations for transitions of HEIs. (Study 2)
12. Report results and discuss implications and contributions of the research work.

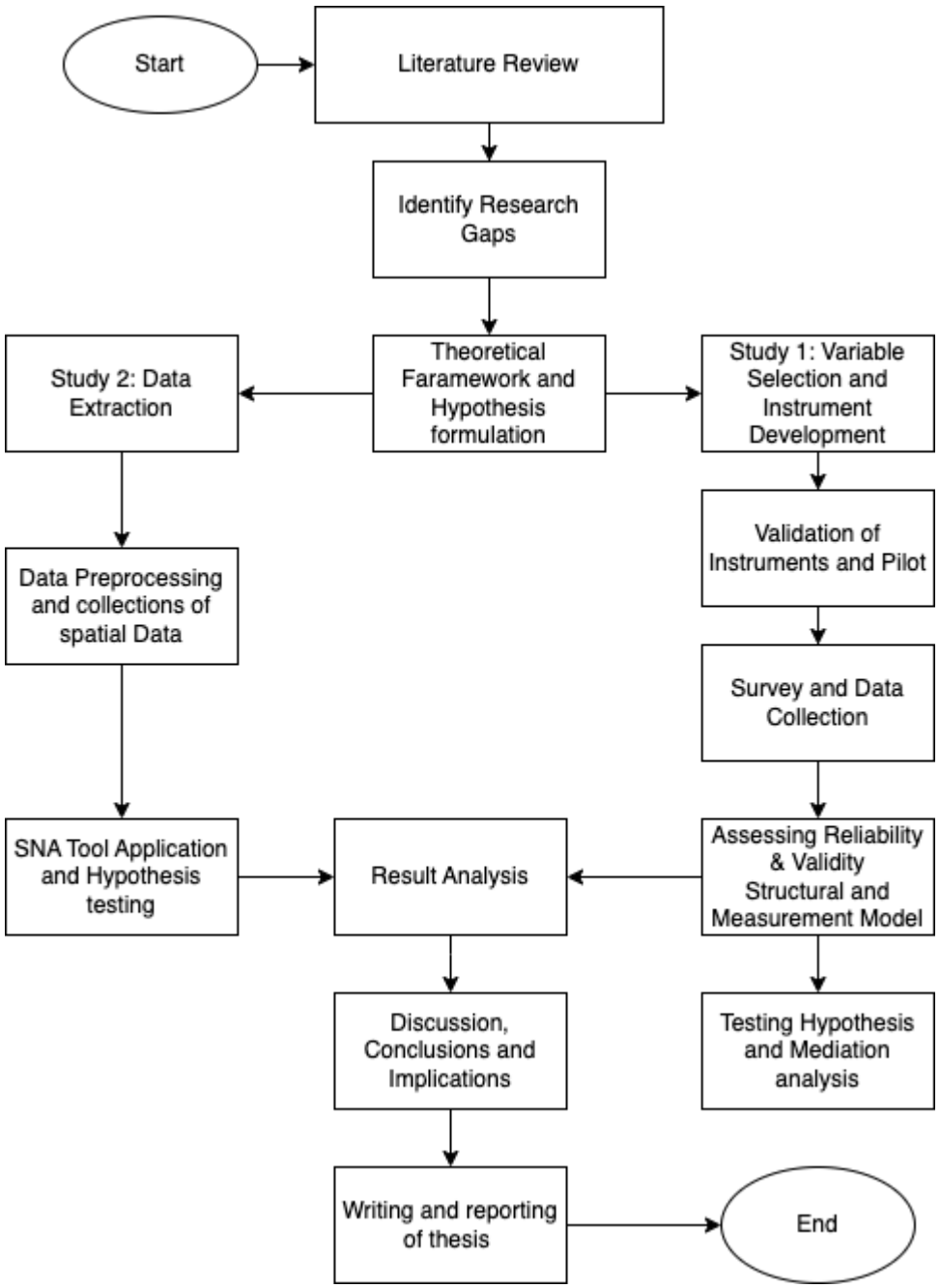


Figure 2: *Research design Map*

Chapter-2. Literature Review

2.1. Overview

Academia recognizes how the world changes rapidly. The new missions are in place due to digital transformation and the need to align the results and outputs with innovative work. Knowledge plays an important role in the economy (Guerrero et al., 2019). Globalization and fierce competition have rewarded creativity, innovation, and agility. HEIs are required to change their internal innovation cultures and work procedures to overcome challenges and cope with evolving missions.

The education sector is one of the sectors affected due to the knowledge economy pushing entrepreneurial approaches to the self-sufficiency of HEI. HEIs are moving towards competency-based education to produce more innovative graduates. Graduates of these HEIs have a huge impact on the future entrepreneurial labor market.

However, higher education systems in most countries face similar challenges despite significant differences in economic conditions, resource availability, cultural settings, social structures, and historical background despite a wide range of different factors, including combining elite with mass higher education, providing lifelong education, maintaining research capabilities, and providing society with a place where critical thinking, independent thinking, social identity, and values can be developed and maintained. Academics, governments, and policymakers around the world have begun to pay attention to this fact, especially during recessionary times when it becomes more relevant. These efforts have been particularly encouraged due to the fact that entrepreneurial universities are becoming key catalysts for the development of regions, economies, and societies (Guerrero & Urbano, 2019).

According to various researchers, third-generation universities are engines of socioeconomic development in their regions (Etzkowitz, 2004; Naderibeni et al., 2020), but the main question is how these engines work. The enabling environment for entrepreneurial universities is imperative to set up and strengthen the ecosystem (Salamzadeh, 2015). The capabilities that universities have over time are the crucial factor in their success. Universities need a clear understanding and vision of the agenda they set to establish entrepreneurial universities and follow them properly with leadership. This is to have well-defined and countable works to realize the entrepreneurial university. Here the speed of innovation is accelerating, and HEI leaders need to take steps in this direction to benefit their organizations. The digital landscape for digital transformation at HEIs is moving from a competency-based to a trust-based approach.

The current HEIs in developing countries are mostly education and research institutions that do not impact the national economic growth and development of the country (Etzkowitz et al., 2000). By moving toward third-generation universities, we need to redefine universities' roles so that they can play a significant role in economic and social development (Etzkowitz, 1983). In the following section, the literature explores the major concepts and constructs used in this study.

2.2. Generation Universities

The early universities in many countries are related to religion and played a pivotal role in transforming society's literacy. Universities in different regions and countries were established during different periods. Regarding the generations (Wissema, 2009), argue that the need for the exploitation of know-how is the central point of third-generation universities. The three phases of university transitions are not smooth, and there is know-

how-based commercialization in universities. The following section briefly summarizes the major focus areas of three generations of universities.

2.2.1. First-Generation Universities

First-generation universities refer to the earliest institutions of higher education established in various parts of the world. These universities typically date back several centuries and have played a crucial role in shaping modern education systems. Since their establishment, these universities laid the foundation for higher education and served as centers of intellectual growth and knowledge dissemination during their respective periods. They continue to maintain academic excellence and historical significance to this day. These universities are still playing a significant role in society and transforming from time to time. As universalities are still trying to cross this generational level in developing countries to move into a second or third generation of universities, they are still attempting to cross this generational level. It is shown in Table 1 below that the first-generation universities have been divided into several areas based on their significant characteristics.

2.2.2. Second-generation Universities

Second-generation universities refer to universities established after the first wave of universities in their respective countries. These universities were established in the mid-20th century and beyond. They are often called "post-independence" universities, as they were founded after their countries gained independence from colonial powers (B. R. Clark, 1998; Gibb, 2012; Wissema, 2009).

In developing countries, second-generation universities play a significant role in expanding access to higher education and supporting workforce development. These universities were often established to address

the socioeconomic needs of their countries by providing education and training in areas such as agriculture, medicine, engineering, and business (Guerrero & Urbano, 2019; Pinheiro et al., 2015; Rashedi et al., 2013).

Second-generation universities in developing countries typically face a range of challenges, including limited funding, inadequate infrastructure, and a shortage of qualified faculty and staff. However, despite these challenges, these universities have made significant contributions to the development of their countries. This is done by producing highly skilled graduates, conducting research on local and regional challenges, and promoting social and economic development.

To address the challenges faced by second-generation universities in developing countries, various initiatives have been launched to enhance their capacity and enhance their quality. These initiatives include increasing higher education funding, improving faculty and staff quality, strengthening research capacity, and promoting partnerships with other universities and institutions. By doing so, these universities can continue to play a vital role in driving economic growth, addressing social challenges, and improving the quality of life for people in their respective countries.

2.2.3. Third-Generation Universities

The concept of a “Third Generation University” is relatively new and evolving centered around the idea of the university as a social and economic actor in its community and beyond. Third Generation Universities, also known as “Engaged Universities” or “Civic Universities,” go beyond the traditional roles of teaching and research to become active participants in their communities and work to address societal challenges through their programs and activities.

It is important for an entrepreneurial university to emphasize innovation, commercialization, and engagement with industry partners to be competitive. It aims to create economic and social impact through research, education, and knowledge transfer. The entrepreneurial university model has emerged over the last few decades as a response to the changing demands of the knowledge economy. It also responds to the need for universities to be more responsive to industry and society's needs (Etzkowitz & Leydesdorff, 2000; Perkmann et al., 2013; Wissema, 2009).

The challenges faced by third-generation (entrepreneurial) universities include a) balancing academic excellence with commercialization and impact, b) ensuring that commercialization does not compromise academic integrity or independence, c) managing conflicts of interest and intellectual property issues, d)item Developing effective collaborations with industry partners, e) encouraging faculty and students to embrace entrepreneurship and innovation, f) Overcoming resistance to change and traditional academic norms, g) Securing funding and resources for entrepreneurial activities, and h) Measuring the impact and effectiveness of entrepreneurial activities. Entrepreneurial universities are institutions of higher education that are focused on developing entrepreneurship among students and faculty members and fostering innovation and economic growth. Such universities encourage entrepreneurship by creating an environment that is conducive to entrepreneurship, providing training and support to students and faculty members, and facilitating industry collaboration (Shane, 2004). The prospects of the entrepreneurial university model are promising, as it is seen as a key driver of economic growth and innovation. By nurturing entrepreneurship among students and faculty members, the entrepreneurial university model can create a pipeline of talent for the startup ecosystem and contribute to the development of new products, services, and technologies (Gibb, 2012).

Furthermore, the entrepreneurial university model can help bridge the gap between academia and industry, by facilitating collaboration and knowledge exchange between the two. This can lead to the development of new technologies, products, and services that can benefit society and the economy.

In addition, the entrepreneurial university model can create a culture of innovation and risk-taking, which is essential for entrepreneurship. This can help create a more dynamic and vibrant society that is better equipped to face the challenges of the future (B. R. Clark, 1998; Etzkowitz, 2004). These universities focus on the engagement of society. They also emphasize developing relationships with industry, government, and non-profit organizations to address community needs. This includes a focus on applied research driven by real-world problems and collaboration with external partners to find solutions to these difficulties.

In addition, Third Generation Universities place a strong emphasis on higher education institutions' social responsibility and aim to promote diversity, inclusion, and sustainability in all their activities. They also prioritize a global outlook through international partnerships and cross-cultural learning. The term Third Generation University was coined by Francisco Marmolejo, a former World Bank tertiary education specialist. The concept refers to universities characterized by their ability to adapt to changing social needs. It also responds to the challenges and opportunities of the global knowledge-based economy. However, some of the key aspects associated with third-generation universities are as follows:

Emphasis on interdisciplinary research: The third-generation universities often prioritize research that crosses traditional disciplinary boundaries, addresses complex real-world problems, and creates interdisciplinary knowledge with practical applications.

Entrepreneurial spirit: These universities often focus on entrepreneurship, innovation, and the commercialization of research. They may have robust technology transfer programs and incubators to support startups and spin off businesses.

Engagement with the wider community: 3rd generation universities are often deeply engaged with their local and global communities, collaborating with industry, government, and other stakeholders to address pressing societal challenges.

Emphasis on experiential and applied learning: These universities often offer experiential and applied learning opportunities that allow students to apply their knowledge and skills to real-world problems. Use of cutting-edge technologies and teaching methods: Third-generation universities often embrace cutting-edge technologies and innovative teaching methods, such as blended and online learning, competency-based education, and personalized learning. Third-generation universities focus on innovation, entrepreneurship, and participation in the wider world. Additionally, they are willing to embrace the latest technologies and teaching methods to better serve their students and society.

These universities prioritize innovation, interdisciplinary collaboration, and community participation in their teaching, research, and outreach activities. It is their goal to create a culture of lifelong learning, to prepare students for a world that is becoming increasingly complex, interconnected, and inherently uncertain, and to prepare them for the future. Every corner of the world is experiencing a socio-economic and socio-technical transition at the same time as universities are transitioning from one to another. HEIs in developing countries are also part of this phenomenon. The 3GU has the following characteristics (Wissema, 2009).

Table 1: *Summary of the Characteristics of the Three Generations Universities (Wissema, 2009).*

Aspects	1st Generation	2nd Generation	3rd Generation
Objective	Education	Education, Research	Education, Research, Know-how Exploitation
Role	Defending Truth	Discovering Nature	Creating of Values
Method	Scholastic	Modern Science, Mono-discipline	Modern Science, Interdisciplinary
Creating	Professional	Professional, Scientists	Professionals, Scientists, Entrepreneurs
Orientation	Universal	National	Global
Management	President	Part-time Scientist	Professional Management

- Exploitation of know-how becomes the third university objective as universities are seen as the cradle of new entrepreneurial activity in addition to traditional tasks of research and education.
- 3GU operates in a highly competitive global market. They actively compete for the most qualified academics, students, and research contracts in the industry.

- 3GUs are network universities, collaborating with individual research and development (R&D), financiers, professional services providers, and other universities via their knowledge carousel.
- Research is mostly interdisciplinary. 3GUs embrace the concept of consilience and creativity is a driving force like the national scientific method.
- 3GU's are multicultural organizations with a wide and diverse range of staff and students; in this respect, they are similar to medieval universities. As they also want to play a significant role, they create special facilities for the most talented and brightest students and academics.
- 3GU's are cosmopolitan; they operate internationally. They employ English for all courses as the new medium of instruction and office administration.
- 3GUs will become less dependent on state regulations.
- Taking the technology transfer approach involves knowledge exchange relationships. Here we should discuss the knowledge carousel.

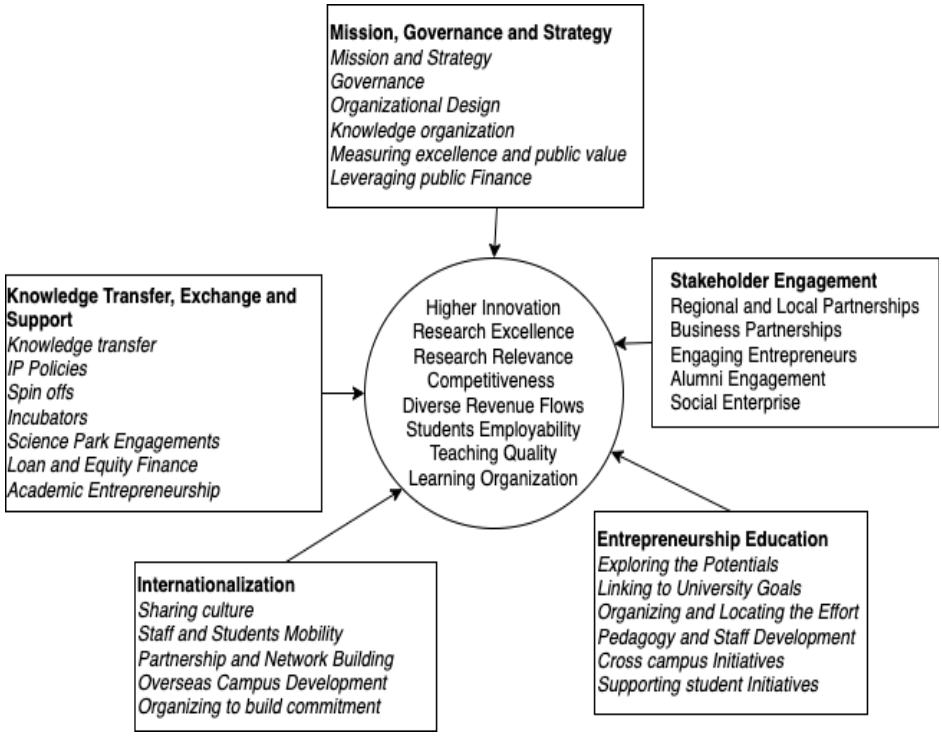


Figure 3:*The Potentials of Entrepreneurial University Review to Key Strategic Goals (Gibb, 2012)*

Entrepreneurial universities and third-generation universities have differences and similarities. Most literature suggests that there are few focus differences between the two focus on Knowledge Exploitation. Gibb (2012) suggested that entrepreneurship and enterprise creation are crucial to growth and competitiveness. Student aspirations to start companies may be improved by HEIs.

2.3. Initiatives of 3GU in Developing Countries

In terms of transitioning to third-generation universities, both developed and developing countries are working on it. Some developing countries are showing significant progresses in transitioning those HEIs in countries like Indonesia, Iran, and Ghana have made notable advancements. For instance, India's several universities have emerged as third-generation institutions, exemplified by the Indian Institute of Technology (IIT), and Korean Advanced Institutes of Science and Technology (KAIST). They

prioritize innovation and entrepreneurship, offering research and teaching programs that foster these qualities. Additionally, they are renowned for their partnerships with industry, providing students with internship opportunities and collaborative research projects alongside prominent companies.

Similarly, third-generation universities in developing countries, such as India, play a crucial role in advancing social and economic development. Their emphasis on interdisciplinary research, innovation, and collaboration with industry and government facilitates innovation and entrepreneurship. Moreover, these institutions nurture the next generation of leaders and researchers who will shape their country's future.

A study by (Godin, 2009) identified various organizational capabilities associated with innovation in Iranian higher education institutions (HEIs). These capabilities include a culture of risk-taking and experimentation, effective communication and collaboration, and a focus on strategic planning.

To transform their higher education institutions and to compete and survive in the market, developing countries are heavily investing in their scarce resources. There is a strong correlation between socioeconomic and sociotechnical transition because of this. In countries such as India, Indonesia, Iran, Mexico, and Ghana, a lot of effort is being put into improving the innovation capabilities of their higher education institutions. As a result, they will be able to produce innovative research and contribute to the industry.

Researchers also studied the factors affecting third-generation universities in Iran, India, Indonesia, Ghana, and other countries, including management's attention to entrepreneurship, and reforming the education and research system. Further, the researcher recommends that institutional innovation and research commercialization be supported with leadership and resource allocations. It is generally suggested that third-generation universities

are being established in different countries, which prioritize commercialization of research findings, entrepreneurship, and innovation as part of their mission statement. The following section discusses the types of leadership selected for this study and theories utilized from multiple domains.

2.4. Types and Theories of Leadership

In this subtopic, we explore the types of leadership and the main theories related to these types and styles of leadership. We also explore the most suitable factors and indicators. University leadership and governance became the core of universities' transition in the academic world. For university reform and transitions within and around the ecosystems in HEIs in Ethiopia, we examine the governance and leadership mechanisms and styles that suit university transitions. Various reforms were conducted in Ethiopian Higher Education Institutions to change the university transition according to (United Nations Educational & Organization (UNESCO), 2016) white paper. Various reforms were conducted to overcome the challenges and provide policy advice to the Education systems in Ethiopia.

Governance and leadership play a crucial role in HEIs making the transition to third-generation universities. Governance and leadership in HEIs and their focus areas are evolving from time to time. Scholars are working towards this transition. We discuss the important attributes and characteristics of universities in different generations.

The 3GU and/or entrepreneurial universities are used interchangeably in various literature. The emergence of third-generation universities in many advanced economies has lasted for decades. Academic institutions evolve from region to region depending on the socioeconomic and sociotechnical capabilities of the countries. Third-generation universities and entrepreneurial universities emphasize the use of know-how and innovations with wider activities and characteristics. The triple helix model of innovation is a university's entrepreneurial development that can be divided into three phases (Etzkowitz, 2013). During the initial phase of the university's entrepreneurial journey, the academic institution adopts a strategic approach to chart its course. It gains the capacity to establish

priorities by acquiring resources through donations, tuition fees, grants, or negotiations with resource providers. As it progresses to the second phase, the university becomes actively involved in commercializing intellectual property originating from its faculty, staff, and students. In the third phase, the educational institution takes on a proactive role in enhancing the effectiveness of its regional innovation environment, often collaborating with industry and government stakeholders. While these stages are typically followed in the mentioned order, they can also occur in varying sequences or even simultaneously. The university harnesses its intellectual resources to generate economic outcomes and fosters knowledge for both practical and intrinsic purposes.

Here, various literature suggests that 3GU is both inevitable and desirable. It is inevitable mainly because the following trends in the HEIs are destroying the 2GU that any country cannot ignore. Therefore due to pressure on the quality of education as a result of HEIs and Students massification since the early 2000s, the difficulty of managing Higher institutions due to student massification and governance issues, globalization affects for the international universities to compete, the rise of the interdisciplinary program and researches that result in frictions with faculties, increased costs of conducting research, the challenges posed by establishing campuses outside the main university, knowledge economy governance demands, issues of cooperating for research with industries and the rise of IT-driven startups and companies in the digital ecosystem. Therefore, our research aims to assess the challenges and prospects of third-generation universities in Ethiopia HEIs experiencing these inevitable realities.

- Due to the fast enrolment increase in Ethiopia HEIs and faculties over the last three decades which posed challenges to education. It also influences the Educational Quality of the HEIs and graduates. Universities are also working towards selecting the best-talented

students, faculties, and researchers that suit the academia and industries as their place of studying, working, and co-prosperity.

- ➢ An increase in the number of public and private higher education institutions created an imbalance in the development of human resource capacity and the required infrastructures. This coupled with institutional accreditation and autonomy of HEIs posed challenges to producing well-trained, skilled, and innovative graduates from their universities.
- ➢ A huge competition from the internationalization/ Global HEIs that led to the mobility of graduates and/or gig-economy workforce mobilization created.
- ➢ Governance and management structure of the third-generation university. Crisis on the funding of researchers and technology transfers in 3GU and managing the transitions to third-generation universities

The researcher selected the following prominent leadership types and styles that contribute to the appropriate leadership style for the purpose of this study.

2.4.1. Digital Leadership- Transnational Leadership

Transactional leadership is a leadership style that focuses on the exchange between the leader and followers. This is where the leader rewards and punishes followers based on performance. In higher education institutions (HEIs), transactional leadership can maintain the status quo and achieve short-term objectives. One of the key benefits of transactional leadership in HEIs is that it provides clear and specific direction for faculty and staff. By establishing clear expectations and providing rewards and punishments based on performance, transactional leaders can create order and structure. This can be particularly useful in the maintenance of

established procedures and protocols. Research has shown that transactional leadership can improve organizational outcomes in HEI. In a study conducted (Prayuda, 2019), the authors found that transactional leadership was positively related to employee satisfaction and organizational commitment in Indonesian universities. The authors suggested that transactional leaders can provide clear and specific direction to employees, leading to higher satisfaction and dedication. Similarly, a study by (S. B. Choi et al., 2016) found that transactional leadership was positively related to student satisfaction with faculty at South Korean universities. The author argued that transactional leaders can provide clear expectations and rewards for faculty members, which leads to improved student performance. However, transactional leadership has some limitations in HEIs. For example, it may not promote innovation, creativity, and long-term organizational change. Transactional leaders may focus too much on short-term goals and maintaining the status quo, which can limit the organization's ability to adapt to new challenges and new opportunities.

In conclusion, transactional leadership can be a useful leadership style in HEIs, particularly in maintaining the status quo and achieving short-term goals. However, it may not promote innovation, creativity, and long-term organizational change. Therefore, HEIs should strive to cultivate and develop leaders who can balance transactional leadership with other leadership styles, such as transformational leadership. This promotes both short-term and long-term organizational success.

2.4.2. Digital Leadership- Transformational Leadership

Transformational leadership is a leadership style that focuses on inspiring and motivating followers to achieve their full potential, rather than simply providing direction and guidance. In the context of HEIs,

transformational leadership can be particularly effective in creating a culture of innovation, excellence, and continuous improvement.

One of the key benefits of transformational leadership in HEIs is that it can inspire a sense of shared purpose and a commitment to excellence among faculty and staff. By emphasizing the importance of vision, innovation, and collaboration, transformational leaders can create a sense of excitement and participation among faculty and staff, leading to increased productivity and better results. Research has shown that transformational leadership can have a significant impact on organizational outcomes in HEI. In a study conducted (Kristiana & Tukiran, 2021), the authors found that transformational leadership was positively related to organizational commitment, job satisfaction, and organizational citizenship behavior among faculty members in Taiwanese universities. Similarly, a study by (Gong et al., 2009) found that transformational leadership was positively related to employee creativity and innovation in Iranian universities. The authors argued that transformational leaders can inspire and motivate employees to be more creative and innovative, which can lead to better organizational results. In addition, transformational leadership can also be effective in promoting organizational change and adaptation in HEI.

By emphasizing the importance of continuous improvement, collaboration, and learning, transformational leaders can create a culture of change and adaptation that enables the organization to respond to new challenges and opportunities. In conclusion, transformational leadership can be a powerful tool for promoting excellence, innovation, and continuous improvement in HEIs. It can inspire a sense of shared purpose and commitment among faculty and staff, leading to increased productivity and better outcomes. In addition, it can be effective in promoting organizational change and adaptation, enabling the organization to respond to new

challenges and opportunities. Therefore, HEIs should strive to cultivate and develop transformational leaders who can inspire and guide their organizations to achieve their goals and visions.

2.4.3. Digital Leadership- Authentic Leadership

Authentic leadership is a leadership style that emphasizes the importance of being true to yourself, acting with integrity, transparency, and honesty, and building strong relationships with followers. In the context of HEIs, authentic leadership can be particularly effective in creating a culture of trust, collaboration, and innovation.

One of the key benefits of authentic leadership in HEIs is that it can promote a sense of trust and credibility among faculty and staff. By being transparent, open, and honest, authentic leaders can build strong relationships with followers, which can lead to greater engagement, commitment, and motivation. Research has shown that authentic leadership can have a significant impact on organizational outcomes in HEI. In a study conducted by (Walumbwa et al., 2008), the authors found that authentic leadership was positively related to the satisfaction of the job of the faculty and the organizational commitment at Chinese, Kenyan, and US universities. The authors suggested that authentic leaders can create a positive work environment that enables faculty members to thrive and succeed.

Likewise, a study conducted by Jaiswal & Dhar (2016) discovered a positive correlation between authentic leadership and employee creativity and innovation in Indian universities. The authors posited that authentic leaders play a vital role in fostering an innovative culture by motivating employees to embrace creativity, take calculated risks, and view failures as opportunities for learning. Furthermore, authentic leadership can also be effective in promoting organizational change and adaptation in HEIs. By being open and transparent about the need for change, authentic leaders can

inspire and motivate faculty and staff to embrace new challenges and opportunities.

In conclusion, authentic leadership can be a powerful leadership style in HEIs, particularly in promoting trust, collaboration, and innovation. It can create a positive work environment that enables faculty members to thrive and succeed, promote a culture of innovation, and inspire and motivate employees to embrace change and adaptation. Therefore, HEIs should strive to cultivate and develop authentic leaders who can inspire and guide their organizations to achieve their goals and visions.

2.5. Selected Management and Psychological Theories

2.5.1. Social Cognitive Theory (SCT): this is a psychological theory that emphasizes the dynamic interaction between personal, behavioral, and environmental factors in shaping individuals' attitudes and behaviors. According to SCT, individuals learn by observing and modeling the behaviors of others, reflecting on their own experiences, and evaluating the outcomes of their actions.

In the context of HEIs, SCT can provide insight into how students develop their attitudes toward learning, career development, and academic success. For example, students can model the behaviors of successful peers or faculty members, develop self-efficacy beliefs based on their own experiences, and engage in self-reflection to evaluate their progress.

Research has demonstrated that SCT can wield a substantial influence on academic achievements in HEIs. For instance, Schunk & Pajares (2009)conducted a study that revealed a positive association between self-efficacy beliefs and academic performance among high school and college students in the United States. The authors suggested that students with heightened self-efficacy are more inclined to set ambitious goals, persist in the face of challenges, and attain academic excellence. Similarly, Tang et al, (2016) conducted a study focused on Chinese university students, which found a positive relationship between social support from peers, faculty members, and family and self-efficacy beliefs. The authors argued that social support has the potential to bolster students' self-efficacy, consequently leading to enhanced academic achievements.

By understanding the complex interaction between personal, behavioral, and environmental factors, HEIs can develop more effective interventions and support programs to help students achieve their academic goals and succeed in their future careers.

2.5.2. Upper Echelons Theory (UET): is a management theory that suggests that the characteristics of the top leaders in an organization can significantly impact the strategic decisions and performance of that organization. In the context of HEI, UET can be useful in understanding how the characteristics of top leaders can influence the culture, strategy, and results of the institution.

UET posits that top leaders, such as university presidents or chancellors, bring their own unique backgrounds, experiences, and cognitive frameworks to the decision-making process. These individual characteristics can shape the strategic priorities and decision-making processes of the organization.

In the context of HEIs, UET can be useful in understanding how the characteristics of university presidents or chancellors can impact the culture and outcomes of the institution. For example, research has shown that the gender and race of university presidents can impact the strategic priorities of the institution. A study Eagly (2007) found that female university presidents were more likely to prioritize issues related to diversity and equity in higher education compared to male presidents. Similarly, a study by (Milem et al., 2000) found that the racial background of university presidents was related to the diversity of the student body at the institution. Moreover, research has also suggested that the leadership style of top leaders can impact the culture and outcomes of the institution. A study by Clark & Lampert (1986) found that the leadership style of university presidents was related to the strategic orientation of the institution. For example, presidents who exhibited a more participatory leadership style were more likely to prioritize faculty development and academic quality compared to presidents who exhibited a more autocratic style.

Hence, the UET can be a useful theoretical framework for understanding how the characteristics of top leaders in HEIs can impact the

culture, strategy, and outcomes of the institution. By understanding the unique backgrounds and experiences of university presidents or chancellors, HEIs can develop more effective strategies and interventions to promote equity, diversity, and academic excellence in higher education.

2.5.3. Social Exchange Theory (SET): is a social psychological framework that elucidates the dynamics of relationship formation and maintenance through the exchange of resources, including social support, trust, and cooperation. When applied to the context of HEIs, SET becomes a valuable tool for comprehending how students, faculty, and staff forge and sustain relationships by exchanging various resources. SET suggests that individuals engage in relationships that are based on mutual benefit and the exchange of resources. Individuals evaluate the costs and benefits of their relationships and will continue to invest in relationships where the benefits outweigh the costs.

In the context of HEI, SET can be useful in understanding how students, faculty, and staff form relationships based on the exchange of resources, such as academic support, mentorship, and social connections. For example, students may form relationships with faculty members who provide academic support and mentorship, and faculty members may invest in relationships with students who demonstrate potential for academic success.

Research has shown that SET can have a significant impact on academic outcomes in HEIs. A study by Pascarella & Terenzini (2005) found that social integration, or the extent to which students form relationships with faculty members and peers, was positively related to academic achievement in US college students. The authors suggested that social integration can provide students with access to valuable resources, such as academic support, mentorship, and social connections, that can lead to better academic outcomes. Similarly, a study also found that social

support from faculty members and peers was positively related to academic achievement in Australian university students (Kember et al., 2001). The authors argued that social support can provide students with motivation, guidance, and resources that can help them overcome academic challenges and achieve their goals. Therefore, SET can be a useful theoretical framework to understand how individuals form and maintain relationships based on the exchange of resources in HEIs. By understanding the complex exchange of resources between students, faculty, and staff, HEIs can develop more effective interventions and support programs to help students achieve their academic goals and succeed in their future careers.

2.5.4. Social Identity Theory (SIT): is a social psychological theory that explains how individuals form and maintain their identities based on their membership in social groups, such as race, gender, and nationality. In the context of HEIs, SIT can be useful in understanding how students and faculty form and maintain their identities based on their membership in academic departments, student organizations, and other social groups within the institution.

SIT posits that individuals form their identities based on their membership in social groups and that this membership provides a sense of belonging and shared identity. Individuals may identify with multiple social groups and their sense of identity and belonging can change depending on the context and social situation.

In the context of HEIs, SIT can be useful in understanding how students and faculty form their identities based on their membership in academic departments, student organizations, and other social groups within the institution. For example, students may identify with their major or academic department, and faculty may identify with their research area or professional association. Research has shown that SIT can have a significant impact on the academic and social experiences of students and faculty in

HEIs. A study also found that students who identified with their academic major reported higher levels of academic engagement and satisfaction with their college experience (Hurtado et al., 1998). The authors argued that this sense of identity and belonging can provide students with motivation and a sense of purpose in their academic pursuits.

Similarly, a study (Rashedi et al., 2013) found that faculty members who identified with their professional associations reported higher levels of job satisfaction and engagement in their teaching and research activities. The authors suggested that this sense of identity and belonging can provide faculty with a sense of community and shared purpose, which can lead to improved outcomes for both the faculty members and the institution.

Therefore, SIT can be a useful theoretical framework for understanding how students and faculty form and maintain their identities based on their membership in social groups within HEIs. By understanding the complex social dynamics of identity and belonging in HEIs, institutions can develop more effective interventions and support programs to help students and faculty achieve their academic and professional goals.

2.5.5. Social Learning Theory (SLT): is a psychological theory that explains how individuals learn new behaviors and skills through observation, imitation, and modeling. In the context of higher education institutions (HEIs), SLT can be useful in understanding how students learn new behaviors and skills through interactions with peers, faculty, and other members of the academic community. SLT posits that people learn by observing the behavior of others and that this observational learning can lead to the development of new skills, attitudes, and behaviors. Individuals are more likely to mimic the behavior of role models who are perceived as competent and influential and who provide positive reinforcement for their actions.

In the context of HEI, SLT can be useful in understanding how students learn new behaviors and skills through interactions with peers, faculty, and other members of the academic community. For example, students can observe the behavior of successful peers or faculty members and mimic their study habits, time management skills, and other academic behaviors. Research has shown that SLT can have a significant impact on the academic outcomes of students in HEI. A study by Zajacova et al.,(2005) found that the academic performance of college students was influenced by the academic behaviors of their peers. The authors argued that students who observed their peers engaging in positive academic behaviors were more likely to imitate these behaviors and achieve higher levels of academic success.

Similarly, a study (Wolters & Hussain, 2015)found that self-efficacy, or the belief in one's ability to succeed in academic tasks, was positively related to academic achievement in college students. The authors suggested that students can develop self-efficacy by observing the behavior of successful peers or faculty members, and by receiving positive feedback and reinforcement for their academic efforts. Therefore, SLT can be a useful theoretical framework for understanding how students learn new behaviors and skills through inter- actions with peers, faculty, and other members of the academic community in HEIs. By understanding the role of observational learning in academic success, institutions can develop more effective interventions and support programs to help students achieve their academic goals and succeed in their future careers.

2.5.6. Theory of Leadership and Innovation

The theory of leadership and innovation in higher education institutions (HEI) posits that effective leadership can play a critical role in promoting and facilitating innovation in these institutions. HEIs are complex organizations that require innovative approaches to adapt to the changing

needs of students, faculty, and society. This theory suggests that leaders who are willing to take risks, foster creativity, and create a culture of innovation can help HEIs achieve their goals and fulfill their missions. The transformational leadership theory provides a valuable framework for comprehending the interplay between leadership and innovation in Higher Education Institutions (HEIs). This theory posits that effective leaders can inspire and motivate their followers to attain elevated levels of performance and creativity by instilling a sense of purpose, vision, and direction.

Leaders who exhibit transformational leadership behaviors, such as stimulating intellect, offering personalized consideration, and providing inspirational motivation, can foster a culture of innovation within HEIs by encouraging their followers to explore unconventional approaches and generate novel ideas. Empirical research has demonstrated the positive impact of transformational leadership on innovation in HEIs. For instance, a study conducted by (W. Li et al., 2018) revealed a positive correlation between transformational leadership behaviors and innovative work behavior among university faculty in China. The authors argued that transformational leaders cultivate a climate of autonomy, creativity, and collaboration among their followers, leading to the cultivation of new ideas and solutions.

Similarly, a study Kong & Thomson (2009) found that transformational leadership behaviors were positively related to innovation in Canadian HEI. The authors suggested that transformational leaders can create a climate of innovation by providing support, resources, and incentives for innovative projects and promoting a culture of risk-taking and experimentation. Therefore, the theory of leadership and innovation in HEI suggests that effective leadership can play a critical role in promoting and facilitating innovation in these institutions. Transformational leadership is a

framework that can be used to understand the relationship between leadership and innovation in HEI. By fostering a culture of innovation and creativity, leaders can help HEIs adapt to the changing needs of their stakeholders and achieve their missions.

2.6. Resource-Based View Theory

It constitutes a theoretical framework that underscores the significance of an organization's internal resources and capabilities in achieving enduring competitive advantage. Within the context of HEIs, the RBV perspective has been employed to explore how internal resources contribute to academic excellence, innovation, and strategic success. As per the RBV framework, an organization's resources and capabilities can be categorized into tangible and intangible assets. Tangible assets encompass physical resources such as buildings, equipment, and financial reserves, while intangible assets encompass intellectual property, human capital, and organizational culture. The RBV perspective posits that an organization's competitive advantage stems from the distinctive combination and strategic deployment of these resources and capabilities.

Several studies have explored the role of the RBV framework in understanding competitive advantage in HEI. For example, a study by Oplatka & Hemsley-Brown (2021) applied the RBV perspective to the context of Israeli HEI and found that human capital, intellectual capital, and research infrastructure were key resources to achieving academic excellence and competitive advantage. Similarly, a study by Santos et al.,(2021) applied the RBV framework to the context of Spanish HEIs and found that knowledge creation and dissemination, research infrastructure, and academic culture were key resources for promoting innovation and strategic success. Furthermore, a study by Tutko & others (2016) explored the role of the RBV framework in promoting quality management in Polish HEIs. The authors

found that the RBV perspective could be used to identify and leverage internal resources, such as human capital and organizational culture, to improve quality management and achieve strategic success.

Therefore, the RBV framework provides a useful lens for understanding the role of internal resources and capabilities in promoting competitive advantage and strategic success in HEI. By identifying and leveraging key resources, such as human capital, research infrastructure, and organizational culture, HEIs can enhance their ability to achieve academic excellence, promote innovation, and meet the changing needs of students, faculty, and society.

2.7. Knowledge-Based View Theory

The knowledge-based view (KBV) presents a theoretical framework that places a significant emphasis on an organization's knowledge and knowledge management practices as crucial factors for attaining sustained competitive advantage. This perspective of KBV has been particularly employed in the context of Higher Education Institutions (HEIs) to investigate the role of knowledge resources in fostering academic excellence, innovation, and overall strategic success.

According to the KBV framework, knowledge assets can be categorized into three distinct types: codified knowledge, tacit knowledge, and experiential knowledge. Codified knowledge pertains to explicit information that can be documented and stored, such as textbooks and research articles. On the other hand, tacit knowledge encompasses valuable insights, expertise, and skills that are challenging to articulate. Lastly, experiential knowledge refers to the wisdom and understanding gained through direct experiences, like on-the-job training and fieldwork.

Numerous studies have delved into the application of the KBV framework to comprehend and appreciate the competitive advantage

dynamics within HEIs. By examining the interplay of these knowledge categories, organizations can better leverage their knowledge assets to remain at the forefront t of academic success and innovation while maintaining a strategic edge.For example, a study by Yeravdekar & Tiwari (2014) applied the KBV perspective to Indian HEIs and found that knowledge resources, such as faculty expertise and research collaborations, were key drivers of academic excellence. Similarly, a study by (Hou et al., 2018) applied the KBV framework to the context of Chinese HEIs and found that knowledge management practices, such as knowledge sharing and collaboration, were key resources for promoting innovation and strategic success. Furthermore, a study by Abiwu &Martins (2022) explored the role of the KBV framework in promoting quality management in Iranian HEIs. The authors found that knowledge resources, such as faculty expertise and research capabilities, were critical to improving quality management and strategic success.

Therefore, the KBV framework provides an effective lens for understanding knowledge resources and knowledge management practices. This is useful for promoting competitive advantage and strategic success in HEIs. Using key knowledge assets, such as faculty expertise, research collaborations, and knowledge-sharing practices, HEIs can enhance their ability to achieve academic excellence. They can also promote innovation, and meet the changing needs of students, faculty, and society at large.

2.8. Digital Leadership

In this research, the concept of digital leadership encompasses a blend of leadership abilities that encompass innovative and disruptive approaches with a digital mindset, incorporating digital awareness and experience as described by (Roberts, 1999). Scholars within this field have put forth their own definitions of digital leadership and e-leadership. In the context of education, digital leadership involves the seamless integration of a diverse

range of technologies, tools, and instruments, including but not limited to the Internet of Things (IoT), e-platforms like webinars, social media, Artificial Intelligence, Big Data, and Machine Learning. This integration empowers educators to navigate and harness the potential of digital resources effectively.

Digital leadership and sustainable performance improvement are nowadays coined. Few researchers also conducted researchers like (Khaw et al., 2022) suggest that digital leadership has a positive impact on sustainable performance. The researcher conducted a systematic literature review and found that digital leadership is necessary for management development to ensure sustainable performance in an organization. Pham &Vu (2022) also discussed digital leadership positively moderates the relationship between digital servitization and sustainability-oriented organizational performance. Niu et al., (2022) discussed that digital leadership has a significant effect on ESG management and organizational innovation, which in turn plays an important role in organizational sustainability. digital leadership and sustainable innovation performance in higher education. A bibliometric study of global research trends in sustainable management of digital transformation in higher education was conducted by (Abad-Segura et al., 2020) and found that the growing concerns of digital transformations and innovations for institutional sustainability. Therefore, it's important to note that digital leadership is an important factor in achieving sustainable performance.

The papers suggest that governance structures play an important role in facilitating innovation and institutional collaboration in HEIs. Choi et al., (2016) suggests three models for governance structures that can facilitate collaboration between HEIs and science and technology parks. Meçe (2020) and Khouja (2018) both focus on information technology governance (ITG)

in HEIs, with Meçe finding an increasing number of publications on ITG usage in HEIs worldwide, and Khouja noting that there is no consensus on the IT Governance framework or standard to use in HEIs. Bianchi & Sousa (2016) argues that HEIs can play a role in building regional innovation systems (RIS), but that this role has been under-researched. The papers collectively suggest that governance structures, including ITG, play an important role in facilitating innovation and institutional collaboration in HEIs, but that there is no one-size-fits-all approach to governance structures and that further research is needed to fully understand the role of HEIs in building RIS.

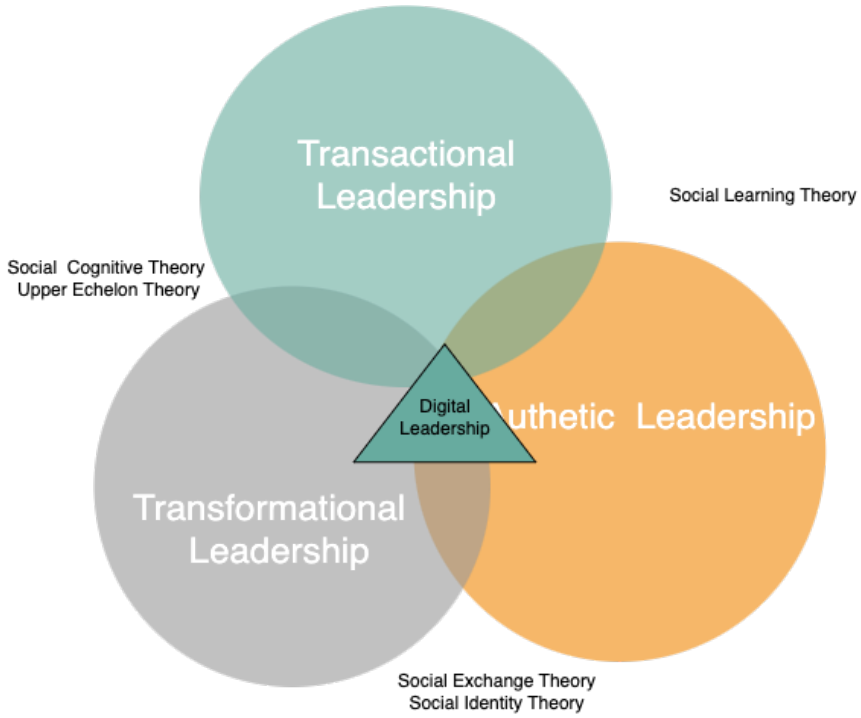


Figure 4: *Theories and Digital Leadership (Prince, 2018)*

2.9. Organizational Capabilities in HEIs

Organizational capabilities are the collective skills, knowledge, and resources that enable an organization to achieve its strategic goals and objectives. In higher education institutions (HEIs), organizational capabilities are critical to achieving academic excellence, promoting innovation, and meeting the changing needs of students, faculty, and society. This concept has gained increasing attention in the field of HEIs research and has been explored in various studies. One framework that can be used to understand organizational capabilities in HEIs is the dynamic capabilities perspective. This perspective suggests that organizational capabilities are not static but can be developed and enhanced over time through learning, adaptation, and innovation. HEIs that can develop and use their dynamic capabilities can be more agile and responsive to changing conditions and challenges.

Research has shown that HEIs can develop a range of organizational capabilities that are critical for success. For example, a study (J. B. Goddard & Chatterton, 2003) identified several key organizational capabilities that were associated with academic excellence in HEIs, including a strong culture of research and scholarship, effective resource allocation, and a focus on student learning and engagement.

O'Reilly et al., (2019) explored the role of dynamic capabilities in promoting innovation in Swedish HEIs and were able to develop and use their dynamic capabilities, such as knowledge creation and absorptive capacity, and were more likely to innovate and adapt to changing conditions. To achieve the purpose of the study, three dimensions of organizational capabilities namely organizational learning capabilities; knowledge

management capabilities; and IT capabilities, were chosen based on studies (Geels, 2005; Kabrilyants et al., 2021).

Organizational capabilities refer to specific knowledge, skills, and resources that enable an organization to function effectively and fulfill its mission. In this context, organizational capabilities in HEIs can be defined as the ability to align resources, people, and processes in a way that supports the institution's strategic direction and enhances its performance. Organizational capabilities are essential for HEIs to achieve their mission and remain competitive in the landscape of higher education. HEIs must develop and maintain these capabilities to ensure they are effective and efficient in providing high-quality education and research. Therefore, HEIs require various organizational capabilities, such as leadership, resource management, innovation and change management, governance, and compliance, teaching and learning, and research and development.

2.9.1. Organizational Learning Capabilities

Refer to an organization's ability to learn, adapt and innovate in response to changing business conditions and customer needs. It encompasses the processes, systems, and structures that enable an organization to acquire, assimilate, and apply knowledge to improve performance and achieve strategic objectives. Organizational learning capabilities are essential for achieving and maintaining competitive advantage in today's dynamic and complex business environment. The following are some key capabilities that organizations must develop to improve their learning capacity:

Knowledge management: This involves systematic creation, sharing, and utilization of knowledge within the organization. It includes processes and technologies for capturing, storing, and disseminating information and best practices, as well as promoting a culture of knowledge sharing and continuous learning.

Learning culture: Organizations with a strong learning culture encourage experimentation, risk-taking, and continuous improvement. They recognize the value of employee learning and development, provide opportunities for skill development and growth, and reward innovation and creativity.

Strategic alignment: Organizational learning should align with the strategic objectives of the company. This involves identifying the key areas where learning and innovation can create the most value and focusing efforts and resources accordingly.

Collaboration: Learning is often a collective endeavor, and collaboration among employees, teams, and business units is critical to sharing knowledge, generating new ideas, and solving complex problems.

Measurement and evaluation: Effective organizational learning requires a system to measure and evaluate performance and learning outcomes. This includes setting goals, tracking progress, and using data to identify areas for improvement and make informed decisions.

In summary, organizational learning capabilities are critical for achieving sustainable competitive advantage in today's rapidly changing business environment. Organizations that invest in knowledge management, foster a learning culture, align learning with strategic objectives, promote collaboration, and measure and evaluate their performance will be better positioned to adapt, innovate, and thrive in the long run.

Organizational learning capabilities refer to the ability of an organization to acquire, interpret, and apply knowledge and information to improve its performance and achieve its strategic goals. In the context of higher education institutions (HEIs), organizational learning capabilities play a crucial role in promoting innovation, improving teaching, and learning, and

driving institutional development. This essay examines the concept of organizational learning capabilities in HEIs and their impact on institutional performance.

The concept of organizational learning capabilities: encompass a range of activities and processes that facilitate the acquisition, sharing, and use of knowledge within an organization. These capabilities include:

- **Knowledge acquisition:** The ability of an organization to acquire new knowledge from various sources, such as research, training, and networking.
- **Knowledge interpretation:** The ability to analyze and interpret knowledge to understand its importance and relevance to the organization.
- **Knowledge dissemination:** The ability to share knowledge with relevant stakeholders within and outside the organization.
- **Knowledge application:** The ability to apply knowledge to improve organizational processes, products, and services.

Organizational learning capabilities have been widely studied in the literature and have been found to be positively associated with organizational performance, innovation, and competitive advantage (DiBella et al., 1996). Organizational learning capabilities in HEIs: HEIs are complex organizations that operate in a dynamic and rapidly changing environment. As such, they need to constantly adapt and innovate to meet the changing needs and expectations of their stakeholders. Organizational learning capabilities play a crucial role in enabling HEIs to achieve these objectives. HEIs with strong organizational learning capabilities are better able to:

- Adapt to changing circumstances: HEIs with strong organizational learning capabilities are better able to adapt to changes in the

external environment, such as changes in government policies, technological advances, and shifting student demographics.

- ➢ Improve teaching and learning: Organizational learning capabilities allow HEIs to improve teaching and learning quality by incorporating new pedagogical approaches and technologies.
- ➢ Enhance research and innovation: HEIs with strong organizational learning capabilities are better able to participate in research and in- novation, which is critical to advance knowledge and contribute to the development of society.
- ➢ Increase efficiency and effectiveness: Organizational learning capabilities enable HEIs to identify and implement more efficient and effective processes, which can lead to cost savings and improved performance.

2.9.2. Knowledge Management Capabilities

Knowledge management (KM) capabilities denote an organization's proficiency in efficiently handling its knowledge assets to generate value and attain strategic objectives. In the specific context of higher education institutions (HEIs), these KM capabilities assume a pivotal role in facilitating teaching and learning, research, and innovation endeavors. The present study delves into the notion of KM capabilities within HEIs and their profound influence on institutional performance.

The scope of KM capabilities encompasses a diverse array of activities and processes that empower an organization to create, capture, store, share, and effectively utilize knowledge to achieve its desired goals. These capabilities form the foundation of a well-rounded KM strategy and enable HEIs to foster a dynamic and knowledge-driven environment for continuous growth and improvement.

Knowledge creation: the ability to generate new knowledge through research, innovation, and collaboration.

Knowledge capture: The ability to identify, document and store knowledge in a structured and accessible manner.

Knowledge sharing: The ability to share knowledge between relevant stakeholders within and outside of the organization.

Knowledge application: The ability to apply knowledge to improve organizational processes, products, and services. KM capabilities have been widely studied in the literature and have been found to be positively associated with organizational performance, innovation, and competitive advantage (Alavi & Leidner, 2001; Gold et al., 2001; Nonaka et al., 1995) are knowledge-intensive organizations that rely on the effective management of knowledge to achieve their objectives. KM capabilities play a crucial role in enabling HEIs to create, capture, store, share, and use knowledge to improve teaching and learning, research, and innovation. HEIs with strong KM capabilities are better able to:

Facilitate teaching and learning: KM capabilities enable HEIs to capture and share knowledge about pedagogy, curriculum design, and assessment, which can lead to improved student learning outcomes.

Promote research and innovation: KM capabilities enable HEIs to capture and share knowledge about research methodologies, findings, and applications, which can lead to new discoveries and innovations.

Enhance institutional reputation: KM capabilities enable HEIs to create and share knowledge about their achievements, research excellence, and impact on society, which can enhance their reputation and attract new students, faculty, and funding.

Increase efficiency and effectiveness: KM capabilities enable HEIs to identify and apply best practices in various areas, such as administration, finance, and human resources, which can lead to cost savings and improved performance.

2.9.3. IT Capabilities in HEIs

IT capabilities encompass an organization's capacity to efficiently and effectively utilize IT resources to accomplish its strategic objectives. Within the realm of Higher Education Institutions (HEIs), these capabilities hold significant importance as they support various aspects like teaching, learning, research, and administration. This study investigates the concept of IT capabilities within HEIs and their influence on institutional performance. The scope of IT capabilities encompasses a diverse range of activities and processes that empower an organization to optimally harness IT resources to achieve its goals. These capabilities include:

IT infrastructure: The hardware, software, and networking resources required to support organizational processes and activities.

IT governance: The processes, policies, and procedures that enable effective management and control of IT resources.

IT innovation: The ability to use IT resources to create new products, services, and processes that drive institutional innovation and competitiveness.

IT-enabled processes: The use of IT resources to automate and streamline organizational processes to increase efficiency and effectiveness. IT capabilities have been widely studied in the literature and are positively associated with organizational performance, innovation, and competitive advantage (Barney & Hesterly, 2010; Bharadwaj, 2000; Brynjolfsson et al., 2002). HEIs are complex organizations that rely heavily on IT resources to support their core activities, including teaching and learning, research, and administration. IT capabilities play a crucial role in enabling HEIs to effectively leverage IT resources to achieve their objectives. HEIs with strong IT capabilities are better able to:

Enhance teaching and learning: IT capabilities enable HEIs to provide innovative and engaging educational experiences for students, such as online courses, multimedia resources, and mobile learning.

Facilitate research: IT capabilities enable HEIs to support complex research activities, such as data analysis, modeling, and simulation, and provide access to vast amounts of research data.

Improve administration: IT capabilities enable HEIs to automate and streamline administrative processes, such as student registration, financial management, and human resources.

Enhance institutional reputation: IT capabilities enable HEIs to leverage social media, digital marketing, and other online resources to improve their reputation, attract new students and faculty, and secure funding.

2.10. University Knowledge Creation

In the higher education sector, innovation holds a crucial role as institutions strive to stay competitive and adapt to the evolving demands of students and society. Exploring the concept of innovation within HEIs reveals its intricate and diverse nature, encompassing dimensions like technology, curriculum, pedagogy, research, and collaborations. This multifaceted approach to innovation enables HEIs to effectively address the challenges and opportunities of the modern educational landscape.

Several studies have explored the factors that promote innovation in HEIs. For example, a study by Carvalho & Winden (2017) identified several drivers of innovation in Finnish HEIs, including strong leadership, a culture of experimentation, and collaboration with external partners.

Similarly, a study by Deem et al., (2007) explored the role of academic entrepreneurship in promoting innovation in UK HEIs. The authors found that academic entrepreneurs, who can identify and exploit opportunities for innovation, play a critical role in promoting change and renewal within universities.

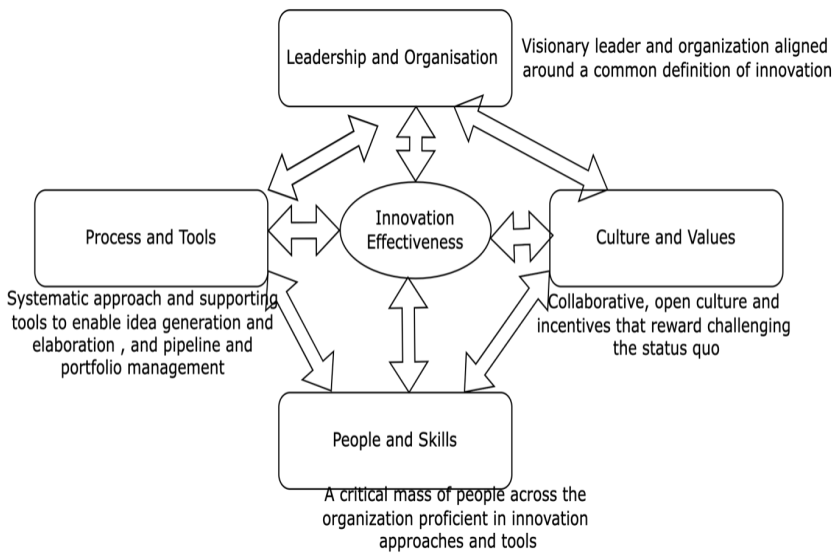


Figure 5: *A model of Innovation capability*

Innovation culture and organizational culture are very important to discuss in the context of this research. Most literature suggests that innovative cultures are those cultures that support the creation and dissemination of new ideas. Many researchers also argue that cultures must match the organizational context. According to Loewe & Dominiquini (2006), practical innovations depend on organizational culture and values, leadership behavior, management process, people, and skills. Internal competence is established for innovation as a continual process, not as a one-off, short-term effort, on the foundation of these domains. Please refer to Table 1 for the four keys to a discussion of systemic innovation capabilities.

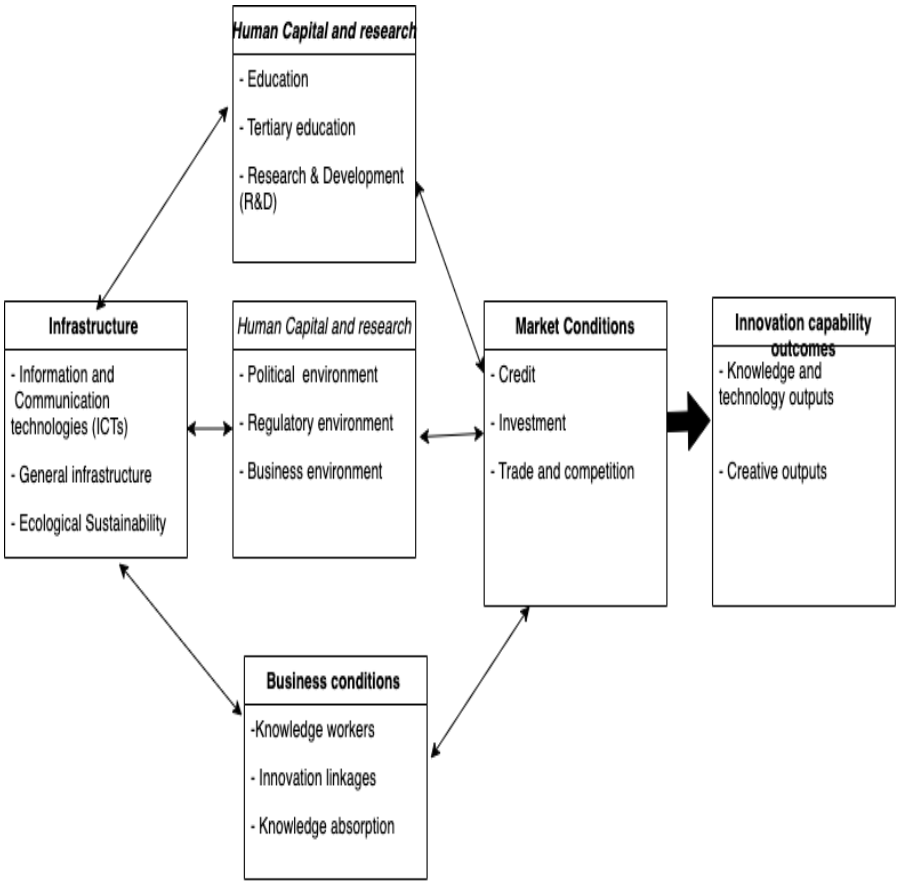


Figure 6: *Configuration of national innovation capability framework and Relationship between Factors Fakhimi and Miremadi 2022*

Table 2:*Determinants of HEIs Innovation Performance*

Digital Leadership	(Ahmad et al., 2021; Antonopoulou et al., 2020; Ehlers, 2020; Khaw et al., 2022; Prince, 2018; Promsri, 2019; Sheninger, 2019; Vidicki et al., 2023)
University Structure	(Abibo et al., 2023; Etzkowitz, 2013; Etzkowitz & Leydesdorff, 2000; Ghorbani et al., 2021; O'Reilly et al., 2019; Rashedi et al., 2013; Suryadi, 2007; Yeravdekar & Tiwari, 2014)
HEIs Innovation	(Abibo et al., 2023; Cai et al., 2020; Geels, 2005; Guerrero et al., 2019, 2019; Hall, 2021; Loewe & Dominiquini, 2006; Razavi et al., 2016)
Innovation in Research Activities	(Abad-Segura et al., 2020; Abramo et al., 2011; Castiaux, 2007; Y.-H. Choi et al., 2021; Etzkowitz & Leydesdorff, 2000; Ghorbani et al., 2021; Guerrero & Urbano, 2019)
Curriculum Innovation	(Antonopoulou et al., 2020; Cai et al., 2020; Guerrero & Urbano, 2019; Leydesdorff & Etzkowitz, 1998; Suryadi, 2007; Vidicki et al., 2023, 2023)
Innovation in third mission	(Ghorbani et al., 2021; Schoemaker et al., 2018; Vidicki et al., 2023; Wissema, 2009; Wu & Zhou, 2012), (Pinheiro et al., 2015)
Process Innovation	(Allen & Henn, 2007; Geels, 2005; Heaton et al., 2019; Hofer & Potter, 2010; Huda & Hussin, 2016; Roberts, 1999; Santos et al., 2021; Shkabatur et al., 2021)
Organizational	(Allen & Henn, 2007; Cui et al., 2022; DiBella et al., 1996;

Innovation	Gold et al., 2001; Hoonsopon & Ruenrom, 2012; Kasim & Noh, 2012; Lewrick et al., 2012; Niu et al., 2022; Sutanto, 2017)
Entrepreneurship Activities	(B. R. Clark, 1998; Etzkowitz et al., 2000; Ghorbani et al., 2021; Guerrero & Urbano, 2019; Hofer & Potter, 2010; Naderibeni et al., 2020; O'Reilly et al., 2019; Shane, 2004)
Knowledge creation	(Bergendahl & Magnusson, 2015; Castiaux, 2007, 2007; Gold et al., 2001; Kruss, 2006; Limoges et al., 1994, 1994; Reinold et al., 2013; Santos et al., 2021)
Organizational Capabilities	(DiBella et al., 1996; Hoonsopon & Ruenrom, 2012; Kabrilyants et al., 2021; Lawson & Samson, 2001; Lewrick et al., 2012; Wilden et al., 2013)
Digitalization capabilities	(Abad-Segura et al., 2020; Annarelli et al., 2021; Antonopoulou et al., 2021b; Laitsou et al., 2020; Rodríguez-Abitia & Bribiesca-Correa, 2021; Wei et al., 2022)

To foster entrepreneurial and innovative endeavors within universities, it is imperative for university leaders to strike a balance between management practices and transformative leadership styles. This harmonious approach propels the university towards progress and growth. Notably, all actions occur within the backdrop of institutional culture and leadership style, with the latter significantly influencing the former. As universities work towards their mission of contributing value to society and the economy, these functions play a pivotal role in propelling them towards their objectives.

2.11. Ethiopian HEIs: Case Study

This research focuses on Ethiopia, a country located in the Horn of Africa, boasting a substantial population of 120 million. Ethiopia has been chosen as the primary data collection site for this study. At present, the nation accommodates over 30 million students enrolled in schools, indicating a significant and growing educational demographic. However, the expansion of several higher education institutions (HEIs) is raising concerns about the potential impact on the quality of education. Ethiopia's higher education system is diverse, encompassing both public and private institutions, all striving for global competitiveness and driving sociotechnical transformation by producing skilled workers(Grillo & Stirrat, 2020; Mastoraki, 2020).

As of 2022, there are over 51 public and 370 private HEIs that have been reformed by the government, with a focus on research and academic activities (Sasmoko et al., 2019; Yigzaw et al., 2021). The transition towards a 3GU is necessary due to the significant increase in student enrollment and potential for growth (Tamrat & Teferra, 2018).

In Ethiopia, the reform of academic institutions is driven by their inefficiency in creating socioeconomic and socio-technical transitions. The Ministry of Education (MoE) has declared a proclamation on higher education that includes policies on institutional arrangement, personnel and financial administration, leadership selection procedures, and academic programs. The proclamation grants autonomy to university leadership to achieve institutional missions and visions. The academic administration is implementing changes through reform initiatives such as standardization and specialization of HEIs, the establishment of Centers of Excellence, categorizing HEIs based on international standards, improving the qualifications of HEI leaders, and introducing a standardized exit exam.

Ethiopia has made significant reforms in its higher education sector over the past decade. One of the most significant reforms has been the expansion

of the higher education system, resulting in a significant increase in student enrollment, particularly in STEM fields.

In addition to the expansion, there has been a focus on quality assurance through the establishment of the Higher Education Relevance and Quality Agency (HERQA) (Bishaw & Melesse, 2017; Tadesse, 2014). Curriculum reform has also been a priority, with a move toward competency-based education that focuses on the development of skills and abilities relevant to the job market. The government has also established a Women's Affairs Directorate in each university to promote gender equity and address issues such as sexual harassment. Finally, there has been a push to promote research and innovation through the establishment of research and innovation funds. Ethiopian higher education reforms have also aimed to promote access, equity, quality, relevance, and innovation, with a greater focus on research and development to create new knowledge that can address the country's development challenges.

HEIs are partnering with industry and other stakeholders to identify research priorities that align with the country's needs. HEIs are also establishing entrepreneurship and incubation centers to support students and faculty in establishing start-ups and developing innovative solutions. They partner with the industry to foster innovation and technology transfer and are developing policies and procedures to manage intellectual property created by their faculty and students. It also recently introduced the proclamations for autonomous universities to overcome the government-controlled policy towards the autonomies of the HEIs.

For public HEIs, academic leadership is responsible for setting program-level objectives and institutional visions and missions. To achieve their objectives and fulfill their institutional missions, these HEIs may change their leadership structures. Study participants include academic leaders and ICT leaders from HEIs that have demonstrated better performance.

Administration/support staff, student leadership, or other educational stakeholders are not considered. Ethiopian public university presidents/chancellors and heads of educational programs are targeted in the study. Institutional visions and missions are established by academic leadership for public HEIs.

Despite these reforms, Ethiopian HEIs still face challenges in promoting innovation and technology transfer. These challenges include limited funding for research and innovation, a lack of infrastructure and equipment necessary to support innovation and technology transfer, and a shortage of skilled personnel in areas such as research and development, entrepreneurship, and technology transfer. Therefore, implementing significant reforms to promote innovation and technology transfer, such as curriculum development and research, entrepreneurship and incubation centers, industry partnerships, and intellectual property management, is crucial.

There were no substantial transitions towards educational innovation or transitions of HEIs despite various phases of leadership and curriculum reforms. Due to the advent of ICT expansion and national innovation roadmaps from 2020-2025, HEIs are aligning their mission towards the third mission. This is to exploit know-how and create innovative ecosystems to competitive advantages at the national and global levels. Hence, this study explored Ethiopian HEIs' innovation performances and institutional collaborations for improving their competitiveness.

Chapter 3: The Role of Digital Leadership and Organizational Capabilities in Transformation of Higher Education Toward 3GU: A Case of Ethiopian HEIs

3.1. Introduction

We are, nowadays, living in challenging eras of rapid technological advancement, innovation of business models, and ever-changing consumer habits and expectations of companies (Verhoef et al., 2021). The rise of the use of Information Communication Technology(ICT) and the availability of the global active internet for users reached nearly 63.1% of the global population (Bhutoria & Aljabri, 2022; *Tech Trends 2023*, n.d.). Although the benefits associated with the digital world are highly increasing across the globe, universities are where knowledge and skills for consuming such technology are processed and generated using their leadership. There has been a renewed focus on ICT in education according to a recent report by the World Bank. It states that the pandemic has shifted education technology's objective from disrupting the status quo to inclusion and reducing inequity.

The ever-increasing demand for digitalization in organizational settings, in turn, initiated the demand for managers who need to equip themselves with the necessary competence, including skills and knowledge. HEIs are where leaders train and gain the necessary skills and knowledge to serve their respective industries. Various works of literature suggest the HEIs themselves need to be explored in terms of their leadership and digital transformation processes. Research on digital leadership and innovation performance has increased in recent years, especially due to developments in digital transformation and the emergence of the COVID-19 pandemic. In this

regard, some notable researchers like (Yuting et al., 2022) conducted a study on the relationship between technology leadership and ICT competency in higher education. The development of Information Communication Technology (ICT) in higher-level education, especially universities linked with innovation, is crucial along with the opportunities these technologies equip with. The availability of these skills to manage these resources is important for institutions. In the era of digital transformation, IT governance, and digital leadership become important areas of study for researchers (Antonopoulou et al., 2021a).

Digital leadership or sometimes referred to as e-leadership is a blended leadership style showing huge importance during this turbulent era. The demand for such leadership is growing rapidly in most parts of the world, in both public and private companies and economies, to foster digital transformations. The need to prepare digitally skilled and competent leaders in public higher education to overcome leadership challenges is increasing nowadays for the realization of competitive advantages. The prevalence of covid-19 from early 2020 also created the need to respond to the upcoming challenges through digital engagements in public institutions. Digital leadership places a strong emphasis on customer orientation, requiring a deep understanding of both technology and human interface dynamics (Schneider & Kokshagina, 2021). To succeed in this domain, leaders must motivate and reshape the organizational culture and workforce talents to embrace novel approaches in thinking, collaboration, and connection. Digital Leaders exhibit distinct thinking, actions, and responses compared to traditional leaders (Antonopoulou et al., 2021b; Petrucci & Rivera, 2018).

This study by Sheninger (2019) defined Digital leadership as ”creating direction, influencing others, beginning sustainable change through access to knowledge, and establishing relationships to foresee developments that will

be crucial to schools' performance in the future" about digitalization in schools.

As to Schneider & Kokshagina (2021), there are seven (7) digital leadership pillars in education. The digital transformation of higher education institutions relies on seven key areas of digital leadership: 1) vision, 2) collaboration, 3) leadership, 4) management skills, 5) adaptability, 6) innovation, and 7) digital literacy. These areas form the foundational pillars for digital leadership within the higher education sector. When integrated into the organizational culture, these pillars enhance the utilization of available digital platforms, especially social networks, enabling leaders to seize opportunities and drive sustainable institutional changes. The adoption and implementation of these pillars empower educational institutions to embrace the digital era effectively and leverage its full potential.

Applying digital technologies to learners in the university environment allows them to have comprehensive and better opportunities. HEIs are the source of Knowledge creation institutions and are assessed by their digital transformation activities mainly in their education programs, students, training services, and governance. In a recent study by UNESCO reveals that the competencies of HEI graduates are those adapting to the Industrial Revolution 4.0 with six competencies such as innovative and creative thinking, social skills, personal skills, and global citizenship. ICT knowledge and the governance and leadership of HEIs are also impacted by the emergence of COVID-19, which requires a robust leadership style. Digital leadership is defined by different scholars in the following table, and we will define our own way later for the purpose of research work comprising transformational leadership, transnational leadership, and authentic leadership styles (Giang & Dung, 2021).

However, most of the research was conducted in developed countries where there is insufficient research in the field of digital leadership and innovation performance in the case of higher education institutions in developing countries. Therefore, it is necessary to investigate digital leadership and innovation performance to nurture HEI leaders for the transition to third-generation universities in developing countries.

RQ1: *What is the role of digital leadership on the innovation performance of Ethiopian HEIs?*

RQ2: *What are the roles of organizational capabilities in influencing the Innovation Performance of Ethiopian HEIs?*

RQ3: *How are the digitalization capabilities moderate between digital leadership and innovation Performance of Ethiopian HEIs?*

The research used survey data collected from 146 academic and ICT leaders who held leadership positions for at least two years in 11 public higher education institutions in Ethiopia. The objective was to investigate how these leaders contributed to the performance of academic innovation in the transition to 3GU.

3.2. Literature Review

3.2.1. Role of Leadership and HEIs

While there has been some interest in digital leadership and innovation performance in academic literature in the 21st century, there have been few efforts in higher education institutions to focus on digital leadership and innovation performance in third-world countries in the last decades. In recent times, the field of digital leadership and innovation in higher education has witnessed notable advancements in both theoretical understanding and practical applications. This chapter examines the significant practices that have emerged in recent years, along with the current challenges, open questions, and intense debates within this domain.

The ongoing discussion regarding the future of universities primarily revolves around their position within the present and forthcoming social structure. As pointed out by Pomorski (2019) this discourse delves into the intricate relationships between the education system, society, and education policy. Moreover, it explores the potential for reconstructing and transforming social relations in the context of higher education.

A new university model is necessary to help us navigate the network society and innovative economy, where knowledge is a fundamental asset and effective management of big data is essential. The authors propose that universities have a crucial role to play in ensuring sustainable economic and social growth at a global level. However, to be considered research universities and to adapt to the new circumstances and become entrepreneurial universities, they must meet certain criteria.

The modern knowledge-based economy needs frequent and flexible changing qualifications of graduates with the ability to adapt to lifelong

learning. Leadership in HEIs is necessitated to facilitate the transformation of those institutions into better innovative and entrepreneurial institutions. According to various authors (Antonopoulou et al., 2020; Ehlers, 2020; Ghorbani et al., 2021; Pomorski, 2019; Wissema, 2009) Leadership was defined as a mechanism or tool to influence others to achieve organizational missions by transforming the working culture and behaviors of employees.

3.2.2. Digital Leadership and Digital Transformation

The significance of digital leadership cannot be overstated, especially given the impact of the internet and social media on various aspects of our lives, including how businesses and public organizations are run. To stay ahead in this rapidly evolving landscape, organizations must have skilled leaders overseeing their digital operations (Petkovics, 2018). Failure to do so could result in falling behind, with competitors likely to adopt new trends that are quickly becoming an integral part of daily life.

Forbes highlights that successful digital transformation relies heavily on competent digital leadership. A digital leader's role extends beyond just discovering innovative replacements for outdated systems; they should also possess an open-minded approach to problem-solving and display a strong inquisitiveness in their job, inspiring teams to unleash their creative potential through their efforts.

In this era of disruption, it's essential for individuals from all backgrounds, experiences, roles, and functions to adopt digital leadership. A personal and business-oriented framework is a useful approach for leaders to remain current in this rapidly changing landscape. Digital leaders exhibit fearlessness by challenging the status quo and presenting alternative solutions to obsolete systems. Without embracing digital tools, transformation goals may remain out of reach, and attracting top talent in a

world of rapid technological advancement may become increasingly challenging.

3.2.3. Digital Leadership Competency

In the past, the Digital Leadership (DL) competency model, frequently utilized by human resource professionals, comprised six competencies: authenticity, leadership courage, empathy utilization, inclusive communication, relationship building, and culture shaping. However, a more comprehensive framework, proposed by (Ahlquist, 2014), expands on this model by incorporating concepts of digital literacy, citizenship, and the social change model values. The revised framework outlines ten essential competencies of a digital leader as follows:

a) Awareness of Emerging Technology Tools and Platforms b) Digital Content Analysis, Distinguishing Accuracy and Quality from False or Misinterpreted Information c) Online Self-Awareness and Reflection of Digital Profile (Consciousness of Self) d) Establishing Personal Virtual Boundaries, Including Privacy, Time Management, and Overall Wellness (Congruence) e) Cultivating Professional, Strategic, and Career-Oriented Online Branding (Commitment) f) Building a Personal Learning Network (Collaboration) g) Integration of Digital Technologies into Leadership Presence (Common Purpose) h) Cyber Conflict Resolution and Mediation (Controversy with Society) i) Digital Decision-Making Strategies based on Positive, Authentic, and Constructive Activity (Citizenship) j) Utilizing Social Media for Social Good (Citizenship).

These competencies encompass the various skills and attributes essential for a digital leader to excel in the rapidly evolving landscape of technology and digital communication.

3.2.4. Digitalization Capabilities in HEIs

It is a key aspect for HEIs to equip themselves with digital technologies and make sure that they possess the capabilities to exploit the opportunities and manage their resources efficiently. In most cases, the capabilities are systematically and strategically applied, deploying, renewing, extending, modifying, and changing resources of the organizations and individuals to optimize the organization's effectiveness and competitiveness.

A study by Galliers & Leidner (2014) explored the role of IT infrastructure integration in promoting innovation in HEIs. The authors found that the integration of IT infrastructure across the institution, including systems for teaching, learning, and research, was critical to fostering innovation in HEIs. The authors noted that an integrated IT infrastructure enabled greater collaboration among faculty, staff, and students, and facilitated the sharing of knowledge and resources, which in turn led to more innovative practices.

Another study by Bruijl (2018) examined the relationship between business process integration and innovations. The authors found that an integrated business process environment, where information flows seamlessly across different functions and units, was associated with higher levels of innovation in HEIs. The authors noted that an integrated business process environment enabled HEIs to be more flexible and responsive to changing circumstances and allowed them to experiment with new approaches to teaching, learning, and research and governance issues.

According to a study conducted by Limani (2019), there has been a significant shift in the interest and adoption of digital technologies within higher education institutions (HEIs). However, when compared to other

industries, the field of education, particularly HEIs, has been slower to embrace these changes due to its loyalty to traditional methods and practices.

In Kane et al.'s , (2015) discussion, they emphasized that digital transformation goes beyond technology; it revolves around strategy. Their findings indicated that while the education sector's innovation rates surpass other industries, product and service innovation remain below average, while technology innovation aligns with the average. Successful digital transformation necessitates a clear digital strategy and a leadership culture that embraces change and fosters innovation. A noteworthy aspect of digital transformation is the growing acceptance of risk-taking as digitally advanced companies seek new competitive advantages. Additionally, employees of all age groups prefer working for businesses deeply committed to technological progress. Company leaders must bear this in mind to attract and retain top-tier talent. These insights resonate with previous technology evolutions, but they underscore the unique aspects of digital transformation in today's dynamic landscape.

Nevertheless, digital technologies and online resources are now being widely used in teaching and learning across all fields, and they are promoting in- novation in pedagogy and teacher training. The rapid pace of technological advancement is transforming HEIs and other levels of education, and this transformation is enabling higher education to enter a new era where it can help students achieve better learning outcomes.

Overall, these studies suggest that the integration of IT infrastructure, business processes, and data is critical to improving the innovation performance of HEIs. Institutions that can effectively integrate these different elements are more likely to foster a culture of innovation, promote collaboration and knowledge-sharing, and be better equipped to respond to changing circumstances.

3.2.5. Innovation and Innovation Performance in HEIs

Over the last few decades, there have been longstanding efforts in the private sector to develop innovation indicators for several sectors. R&D's innovation survey and specific indicators are examples of collective efforts. However, measuring innovation and innovation performance in public institutions and specifically higher education institutions is still at an early stage. Input, output, outcome, impact, and framework conditions indicators are identified as relevant indicators for identifying and measuring business innovation processes (Vidicki et al., 2023). It has been argued by Suryadi (2007) that there are three key factors that should be considered when evaluating the performance of higher education institutions: the quality of academics (teaching-learning), the quality of research, and the quality of community services (commercialization).

The concept of innovation is dynamic, evolving over time and influenced by the specific context of the field. Within the domain of higher education (HE) literature, the term "innovation" has often been employed without a precise definition. It generally conveys significant alterations or reforms across multiple dimensions of higher education, including academic endeavors, curriculum development, teaching methodologies, learning processes, and technological integration, among others.

To illustrate, researchers like (Hannan et al., 2000; Loewe & Dominiquini, 2006; Parry et al., 2012; Pascarella & Terenzini, 2005; Zhu & Engels, 2014) have delved into the intricacies of innovation within higher education. Conversely, there exist various studies in the realm of higher education (e.g(B. R. Clark, 1998; Slaughter et al., 2004; Slaughter & Leslie, 1997) that tackle issues related to innovation without explicitly utilizing the term itself. These investigations primarily center on how universities adjust to evolving circumstances in their surroundings.

Nevertheless, Goddard and Vallance (2013, p. 49)have voiced criticism, noting that a majority of higher education researchers tend to focus exclusively on external factors such as funding and regulatory frameworks, often neglecting the broader societal context within which universities function (Cai et al., 2020).

On the other hand, many researchers define the term “innovation” by linking it to creativity, novelty, and implementation, while others also associate it with entrepreneurship (Hofer & Potter, 2010). For instance, scholars and other observers of higher education have emphasized the need for universities to promote an entrepreneurial culture to thrive in a globalized marketplace and support research that can have a positive impact on society (B. R. Clark, 1998). However, entrepreneurial goals differ from innovative production. As we will explain later in this chapter, a more comprehensive understanding of the relationship between innovation and entrepreneurship can result in greater clarity about when marketization is suitable for a university’s research or degree programs. Additionally, as we discuss the dimensions of innovation, we will demonstrate that a sole focus on financial profit does not always encourage an innovative climate.

The significance of innovation and its critical role in the future of HEIs, it is essential to acknowledge that diverse career competencies are essential for success in a knowledge-based society of the 21st century (Tierney & Lanford, 2016). Consequently, universities will need to adopt innovative approaches to equip individuals with valuable skills, particularly considering decreasing state funding. Ambitious institutions will also require innovative thinking that considers regional demands. Although not every institution aims to become world-class, each one should encourage innovative research, organizational structures, and pedagogical approaches that can benefit people beyond the academic sphere. Innovation performance measures an

organization's success at creating and implementing new ideas, products, services, and processes (Tierney & Lanford, 2016). It is typically measured by the number of new products and services launched, the number of patents filed, the number of new processes implemented, and the amount of revenue generated from new products and services. Innovation performance can also be measured by customer feedback, employee engagement, and the amount of time and resources invested in innovation initiatives.

Whether the forthcoming wave of innovations predominantly leans towards sustainability or takes a more disruptive route, change is undoubtedly looming on the horizon for higher education. This chapter presents a conceptual framework that can be finessed as upcoming research delves into innovation within diverse higher education landscapes. Through this ongoing exploration, institutions will be better prepared to devise and execute pioneering research that holds the potential to make positive societal contributions and propel human knowledge forward.

The Rise of the Knowledge-Intensive Economy: Owing to the surge in technological advancements and shifts in dynamics in recent times, traditional economies centered around cross-border transactions and labor-intensive practices have undergone significant transformations. In the contemporary landscape of knowledge-based economies, workers are not merely expected to apply their skills; they are also anticipated to exhibit creativity, collaborate within teams, and adeptly adjust to swiftly evolving technologies and innovative concepts.

Heightened Demand for a Creative and Innovative Workforce: The perpetual increase in the need for highly skilled workers has resulted in the delegation of technologically sophisticated tasks to external parties.

Issues of Massification versus World-class Aspiration: The increased demand for Higher education and the increase in the number of students in

HEIs challenged both creativity and innovation. These put the HEIs under pressure to focus on Massification rather than innovation. HEIs in Africa where the number of students is still increasing there is pressure on the quality of education and innovation.

Decrease in Funding and Resources in HEIs: HEIs are under massive pressure due to the decrease in resources including financial resources. Both Central government and regional governments are primarily focusing on investing in General school levels that HEIs.

Hence, HEIs Innovation performance can be viewed from the following perspectives: Curriculum innovation, Innovations in research, innovation in the third mission (number of projects with public bodies, number of newly reported technical solutions, number of newly applied patents, number of spin-offs and startup companies, number of training and seminars provided to public bodies, process innovation, and organizational innovations). The purpose of this research work was to collect responses about perceptions and lived experiences regarding these five areas, in relation to their respective Higher Education Institutions, in the form of a survey.

3.2.6. Dynamic Capability in HEIs

Dynamic capabilities (DCs) hold a pivotal position within the realm of strategic management practices. They encapsulate an organization's capacity to discern and capitalize on opportunities, to adapt and overhaul its internal configuration, and play a particularly critical role in swiftly evolving industries. Consequently, DCs serve as the driving force behind value generation and the cultivation of competitive edges (Heaton et al., 2019; Teece, 2018; Wilden et al., 2013).

These dynamic capabilities empower various entities, including HEIs, to consistently uphold exceptional performance standards across time. In the

context of HEIs, augmenting their innovative prowess becomes achievable by evaluating strategic efficacy and harnessing the potential of sensing, seizing, and reconfiguring capabilities. Sensing capabilities empower HEIs to remain attuned to the currents of research trends and emerging fields of study. On the other hand, seizing capabilities empower these institutions to capitalize on opportunities and translate their research into commercial success. The aptitude for reconfiguring facilitates HEIs in pivoting their research focus and cultivating novel domains that harmonize with evolving market requisites.

Researchers conducted similar research around dynamic capability and intellectual capital, which are key factors in HEI innovation performance. Sahami et al., (2021) discussed in their work that intellectual capital and dynamic capability directly affect innovative performance. Wu & Zhou (2012) also suggested that dynamic capabilities have a direct effect on innovative performance and enhance the positive effect of relationship capital on innovative performance. Lawson & Samson (2001) proposed in their work a conceptual model of the firm as an innovation engine, with innovation capability as the primary engine for wealth creation.

Furthermore, Tjahjadi et al., (2022) also discussed that intellectual capital readiness fully mediates the influence of global market orientation strategy on HEIs' performances, while open innovation does not mediate the effect of global market orientation strategy on HEIs' performances. The findings of this research work suggest that HEIs should invest in and cultivate their dynamic capabilities and intellectual capital to improve innovation performance. According to Dobni (2006), suggested the importance of the senior management to encourage the innovations and knowledge transfer capabilities for universities to succeed in transitions.

Hence, the following table 3 summarizes the related works and the relevance of the current study.

Table 3: *Summary of related works and research gap*

Author	Lack of Effective Leadership				Organizational and Digital Capabilities			Insufficient degree of innovation		Country	Methodology used	Research Focus
	Authentic leadership	Transactional Leadership	Transformational Leadership	Digital leadership	OL Capabilities	KM Capabilities	IT Capabilities	Digitalization capabilities	HEIs Innovation			
Antonopoulou et al., 2020;	✓	✓	✓	✓	✗	✗	✗	✓	✓	Greece	Qualitative	Study of the HEIs Senate Members on Digital Leadership

Antonopoulou et al., 2021b	✓	✓	✓	✗	✓	✗	✗	✓	✗	Greece	Quantitative	Leadership and responses to covid-19
Ahmad et al., 2021	✗	✓	✓	✗	✓	✗	✗	✓	✗	Jordan	Conceptual View	Digital Transformation Metrics
Ehlers, 2020;	✗	✗	✓	✗	✓	✗	✗	✓	✓	Germany	SLR	Develop unique HE leading culture
Khaw et al.	✓	✓	✓	✗	✓	✗	✗	✗	✗	NA	SLR	Digital Leadership and sustainable performance

Promsri, 2019;	✓	✓	✓	✓	✓	✗	✗	✗	✗	Thailand	SLR	Digital leadership and Digital Transformation
Sheninger, 2019	✓	✓	✓	✓	✓	✗	✗	✗	✓	NA	Book	The changing paradigm of changing time
(Vidicki et al., 2023)	✓	✓	✗	✗	✓	✗	✗	✗	✓	Serbia	Quantitative	Metrics for HEI innovation Performance
Guerrero et al., 2019	✓	✓	✗	✗	✗	✗	✓	✓	✗	NA	SLR	Building universities intrapreneurial capabilities

(Taleb & Pheniqi, 2022)	✓	✓	✗	✗	✓	✗	✓	✗	✗	Morocco	Quantitative	IT agility and HEI's Innovation Performance
Hall, 2021	✓	✓	✗	✗	✗	✓	✗	✓	✗	USA	Quantitative	Students as partner in entrepreneurship and innovation in universities
(Wissema, 2009)	✗	✗	✓	✓	✓	✓	✓	✓	✓	Netherlands	Qualitative	Managing the university transitions
Loewe & Dominiquini, 2006	✗	✗	✗	✗	✓	✓	✓	✓	✓	USA	Quantitative	Overcoming the barriers of innovation

Razavi et al., 2016	✗	✗	✗	✓	✓	✓	✓	✓	✓	Iran	Qualitative	ICT firms' innovation capabilities
Etzkowitz & Leydesdorff, 2000	✗	✗	✓	✓	✗	✗	✗	✗	✓	Brazil	Quantitative	Triple-Helix and Innovation
Guerrero & Urbano, 2019)	✓	✓	✗	✓	✓	✓	✗	✓	✓	NA	SLR	The role of Entrepreneurial university and innovation
Clark, 1998;	✗	✗	✗	✗	✓	✓	✓	✓	✓	EU(4Count)	Qualitative	Organizational pathway transformations of universities

Rodríguez-Abitia & Bribiesca-Correa, 2021;	✗	✗	✗	✓	✓	✗	✗	✓	✓	Mexico	Quantitative	Digital transformations in universities
Hoonsopon & Ruenrom, 2012	✗	✗	✗	✓	✓	✓	✗	✗	✓	Thailand	Quantitative	Organizational capability and innovation
O'Reilly et al., 2019	✗	✗	✗	✓	✓	✓	✓	✓	✓	UK & Ireland	Quantitative	Knowledge management capabilities and Universities
(Dobni, 2006)	✗	✗	✗	✗	✗	✗	✓	✓	✓	Latin American	Quantitative	The innovation blueprint

Shane, 2004	✗	✗	✗	✓	✓	✓	✓	✗	✗	USA	Book	University spinoff
(Huda & Hussin, 2016)	✗	✗	✗	✗	✗	✓	✓	✓	✓	Indonesia	Quantitative	Evaluation model IT innovation
Current Study	✓	✓	✓	✓	✓	✓	✓	✓	✓	Ethiopia	Quantitative	Role of Digital Leadership for Innovative HEIs

Note: ✓= refers to the paper covers, ✗=Refers to the paper does to cover the topic, NA= Not Specified

Based on the results of Table 3, the researchers concentrated on innovation, leadership, digital transformation, and organizational innovation cultures in their study. Accordingly, the purpose of the current study is to explore the relationship between digital leadership and organizational capabilities for innovation performance in Ethiopian higher education institutions.

3.3. Methodology

This section explains the methodological approach adopted for the study to understand the hypothesis presented in the related works and gap section of the research. The following steps were taken to conduct the empirical study:

a) Conducted an in-depth literature review on digital leadership, organization performance, and innovation performance. b) research gaps were identified from the literature. c) Developed research models and latent variable instruments based on those theories and models. d) Validated the instruments with selected domain experts from Ethiopian HEIs and Leadership, prepared a Google survey, and sent it to the selected HEIs for their participation. e) Requested all leadership to distribute the survey to their university leadership to ensure adequate responses and participation. f) Conducted data pre-processing and analysis using the Partial Least Square Structural Equation Modeling (PLS-SEM) SmartPLS4 tool. g) Analysis using covariance-based (CB-SEM). Mediation and Moderation analysis were conducted using bootstrapping and path coefficients of SEM.

Analysis result from structural path analysis was conducted, and findings were discussed with their implications. The following section presents the steps on the theoretical development of the research model and results with discussions and conclusions.

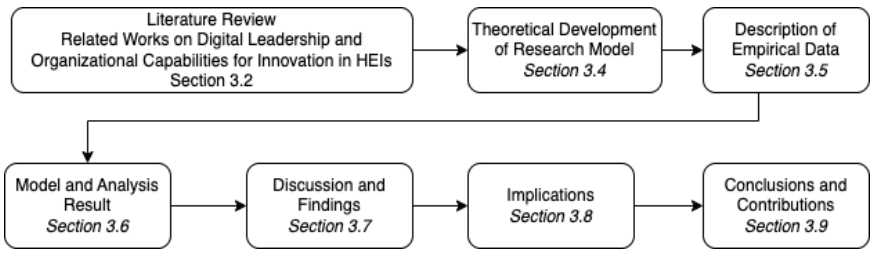


Figure 7:*The overall steps followed for this study.*

3.4. Theoretical Development of Research Model

3.4.1. Underlying Theories

3.4.1.1. The three Selected Leadership Theories

Authentic, transactional, and transformational leadership theories are utilized in this study for HEIs to enhance performance and foster positive organizational outcomes and transitions. The following three theories are described in short:

Authentic Leadership Theory: focuses on leaders' genuine and transparent behavior. In HEIs, authentic leaders can promote a positive work environment and increase performance first by Demonstrating ethical behavior and integrity (Walumbwa et al., 2008): Authentic leaders serve as role models by adhering to high ethical standards and displaying integrity in their actions, which cultivates trust and credibility among faculty, staff, and students. Secondly, by *building relationships based on trust:* It's to foster open and honest communication, actively listen to others' perspectives, and provides support and guidance. This fosters a culture of trust and collaboration within the institution. Lastly, by *encouraging personal growth and development*: Authentic leaders promote individuals' growth and development within the institution, providing opportunities for learning, feedback, and professional advancement (Covelli & Mason, 2017) .

Transactional Leadership Theory: focuses on exchanges between leaders and followers, emphasizing rewards and punishments to motivate performance. In HEIs, transactional leadership can enhance performance first by *clearly communicating expectations and goals:* Transactional leaders set clear expectations for faculty and staff, defining performance criteria, and providing feedback on progress towards goals. Second by *rewarding desired performance:* Transactional leaders use incentives such as recognition,

promotions, or monetary rewards to motivate individuals and teams to achieve their targets. Thirdly by *addressing performance issues:* Transactional leaders identify and address performance gaps through corrective actions, providing guidance, and implementing consequences for poor performance (Basham, 2012).

Transformational Leadership Theory: Transformational leadership focuses on inspiring and motivating followers to achieve exceptional performance outcomes. In HEIs, transformational leadership can improve institutional performance by *inspiring a shared vision:* Transformational leaders articulate a compelling vision for the institution, aligning faculty, staff, and students towards a common purpose, which fosters motivation and commitment. Second by *Providing intellectual stimulation:* Transformational leaders encourage creativity, critical thinking, and innovation within the institution, stimulating intellectual growth and pushing the boundaries of knowledge. Third, *by developing and empowering others:* Here leaders invest in the development of faculty and staff, providing mentorship, and training opportunities, and delegating meaningful responsibilities, which enhances motivation and performance (Howell & Avolio, 1993).

It's imperative to note that effective leadership in HEIs often involves a combination of these three theories, as leaders adapt their approach to different situations and individuals (Howell & Avolio, 1993). A comprehensive leadership strategy that integrates authentic, transactional, and transformational elements can contribute to performance improvement and create a positive organizational culture in HEIs.

3.4.1.2. Theory of Open Innovation

The Theory of Open Innovation, introduced by Henry Chesbrough, suggests that innovation can be enhanced by leveraging external knowledge and resources through collaboration and partnerships (Gassmann et al., 2010). When it comes to Higher Education Institutions (HEIs), incorporating open

innovation principles can significantly contribute to innovation performance, particularly when viewed from a leadership perspective. Here's how leadership can facilitate open innovation and drive innovation performance.

Creating a culture of openness: Leaders in HEIs can foster a culture that encourages openness to external ideas, collaboration, and knowledge sharing. This involves promoting an environment where faculty, staff, and students are encouraged to engage with external stakeholders, industry partners, and other institutions. This is to exchange ideas and co-create knowledge.

Building strategic partnerships: Leaders can play a pivotal role in establishing and nurturing strategic partnerships with external organizations, industry leaders, and research institutes. Leaders can create opportunities for joint research projects, technology transfer, and knowledge exchange by actively seeking and forming collaborations. This can spur innovation within the institution.

Facilitating networking and collaboration: Leaders can facilitate networking opportunities and platforms where different stakeholders, both internal and external, can come together to exchange ideas, share best practices, and collaborate on innovative initiatives. This can involve organizing conferences, workshops, seminars, and industry-academic forums to foster collaboration and cross-pollination of ideas (Huizingh, 2011).

Allocating resources and support: Leadership plays a critical role in resource allocation, ensuring that sufficient resources, both financial and human, are dedicated to fostering open innovation. This may involve investing in research and development facilities, providing funding for collaborative projects, and supporting initiatives that encourage experimentation and entrepreneurial activities.

Encouraging risk-taking and experimentation: Open innovation often requires taking risks and experimenting with novel ideas. Leaders in HEIs can create an environment that supports risk-taking, tolerates failure as a learning

opportunity, and rewards innovative efforts. Encouraging an experimentation mindset, leaders can inspire faculty, staff, and students to explore creative approaches and push the boundaries of knowledge and innovation.

Emphasizing knowledge transfer and commercialization: Leaders can promote research commercialization and facilitate knowledge transfer from academia to industry. This can involve establishing technology transfer offices, supporting patent applications, and providing guidance on intellectual property management and commercialization strategies.

By embracing open innovation principles and incorporating them into their leadership practices, HEI leaders can stimulate a dynamic innovation ecosystem (Kumari et al., 2019). This fosters collaboration and drive innovation performance in HEIs. Through effective leadership for creating an environment that encourages openness, collaboration, and knowledge exchange. In addition, it provides the necessary resources and support for innovative initiatives to thrive.

3.4.1.3. Theory of Interorganizational Relations

The theory of inter-organizational relations, also known as inter-organizational collaboration or partnership theory, focuses on interactions and relationships between organizations. In the context of Higher Education Institutions (HEIs), utilizing this theory can be beneficial for various purposes such as research collaborations, knowledge sharing, resource pooling, and joint initiatives (Gassmann et al., 2010). Here are some ways HEIs can apply inter-organizational relations theory:

Research Collaborations: HEIs can form research collaborations with other institutions, research centers, or industry partners to undertake joint research projects. This allows for the sharing of resources, expertise, and data, fostering innovation and advancing knowledge in specific domains. Collaborative research efforts can also lead to increased funding opportunities and broader research impact.

Knowledge Exchange and Transfer: Interorganizational relations provide opportunities for HEIs to share knowledge. This can include hosting workshops, seminars, or conferences where experts from different organizations come together to exchange ideas, present research findings, and discuss emerging trends. HEIs can also participate in consortiums or networks focused on specific areas of knowledge to facilitate knowledge transfer and collective learning.

Resource Pooling: Collaboration among HEIs can involve pooling resources such as laboratory facilities, equipment, and research infrastructure. By sharing resources, institutions can overcome financial constraints and leverage economies of scale. This results in cost efficiencies and enhanced capabilities for research and innovation.

Joint Initiatives and Programs: HEIs can engage in collaborative initiatives with other organizations to develop programs or initiatives that address common challenges or promote specific goals. This can include collaborative academic programs, joint degree programs, or joint research centers. Such partnerships enable institutions to combine their strengths and expertise, creating synergies and delivering more comprehensive educational and research outcomes.

Policy Advocacy and Influence: HEIs can leverage interorganizational relations to collectively advocate for policies and reforms that impact the higher education sector. Collaborating with other institutions, industry bodies, or professional associations can amplify HEI voices in policy discussions. This will enable them to shape decisions and contribute to the development of favorable policies for the sector.

Community Engagement and Outreach: HEIs can establish partnerships with local communities, non-profit organizations, or government agencies to address societal challenges and contribute to community development. Such collaborations enable HEIs to apply their expertise and resources to real-world

problems, fostering social impact and reinforcing their role as active contributors to society.

It's imperative to note that successful interorganizational relations in HEIs require effective leadership, clear communication channels, mutual trust, and shared goals (Vanhaverbeke & Cloodt, 2014). HEIs should establish formal agreements, governance structures, and mechanisms for monitoring and evaluating collaboration effectiveness. By strategically applying the theory of interorganizational relations, HEIs can enhance their capabilities, expand their networks, and leverage synergies. This will enable them to achieve their educational and research missions more effectively.

3.4.2. Factors Description

The following section describes the factors selected for the proposed research mode based on the works of literature consulted.

3.4.2.1. Lack of Effective Leadership

Leadership plays a critical role in leading and managing transitions within HEIs (Avolio, 1999). Leading the way are policymakers and academics involved in implementing policies and initiatives to make institutions more sustainable. Due to institutional externalities for creating and delivering values for their customers. Transitions may involve changes in institutional strategies, structures, policies, or practices to adapt to evolving educational landscapes or external factors. Effective leadership that emphasizes innovation can facilitate smooth transitions by encouraging the exploration of creative approaches, fostering adaptability, and managing resistance to change. Innovation-oriented leadership provides the vision, direction, and motivation needed to navigate transitions and guide the institution toward new opportunities and improved performance.

Hence, leadership that promotes innovation and performance can also support institutional transitions by fostering a culture of continuous improvement (Jaskyte, 2004). This is done by embracing emerging technologies and pedagogical advancements and encouraging interdisciplinary collaborations. These efforts contribute to the institution's capacity to adapt, innovate, and stay relevant in a rapidly changing higher education landscape. Based on this, the most common leadership styles, Authentic, Transactional, and Transformational, were selected for contributing to digital leadership and leadership styles, as well as promoting innovation in Ethiopian HEIs.

3.4.2.2. Lack of Digitally Aware Leadership

Digital leaders understand the potential of digital technologies, promote digital literacy, and foster a culture of innovation and digital adoption within the organization. The lack of digitally aware leadership in HEIs refers to a situation where leaders within these institutions do not possess a sufficient understanding or awareness of digital technologies and their potential impact on teaching, learning, research, and administrative processes. This factor can significantly affect the institution's ability to effectively navigate and leverage digital advancements in the education sector. Among others, the aspect of digital leadership is inadequate strategic planning that incorporates technology-enabled initiatives, limited resource allocation for digitalization and digital literacy programs, missed opportunities for innovation using tools and digital business processes, ineffective digital integration for seamless institutional operations, and overcoming the resistance of digital culture with exemplary use and encouraging of the emerging innovative systems.

3.4.2.3. Organizational and Digital Capabilities

Organizational capabilities provide the foundation for fostering an innovative culture, supporting risk-taking, and encouraging creativity and collaboration. These capabilities include leadership support, effective communication channels, supportive policies, resource allocation mechanisms, and a conducive work environment. Digitalization focuses on leveraging digital technologies to drive innovation within HEIs. Organizational capabilities and digitalization capabilities are not static; they evolve together. As HEIs embrace digitalization, their organizational capabilities need to adapt to the changing technological landscape (Wissema, 2009). This involves developing enhanced skills, updating policies and practices, fostering a digital mindset, and cultivating a culture of continuous learning and innovation.

Digitalization capabilities can influence the organizational capabilities of institutions, creating a symbiotic relationship among themselves through moderation. Furthermore, the organizational capabilities have Organizational Learning capabilities, Knowledge Management Capabilities, and IT capabilities of the HEIs whereas the Digitalization capabilities consist of IT infrastructure Integration, Data Integration, and Business Process Integration as a subconstruct for the study of organizational capabilities and digitalization capabilities respectively (Geels, 2005; Kabrilyants et al., 2021).

3.4.2.4. Insufficient Degree of Innovation

Innovation Performance represents the ability of Higher Education Institutions (HEIs) to generate and implement innovative ideas, practices, and solutions (Kumari et al., 2019). It encompasses the development and adoption of effective teaching methods, curriculum design, research advancements, partnerships, and entrepreneurial

initiatives within the educational context. Innovation performance is the dependent variable in your study. It reflects the outcome or result of the interplay between the independent variables (organizational capabilities, authentic leadership, transactional leadership, transformational leadership) mediated by digital leadership and moderated by digitalization capabilities.

Innovation in HEIs emerged as a critical aspect to overcome sustainability and competitiveness problems. This is due to the strategic priorities, the less emphasis on innovation and entrepreneurship, less partnership and collaborations of the institutions, and less investment in the professional development of leaders for properly managing the innovation ecosystems.

Therefore, by leveraging the lack of innovation as a factor for improvement, HEIs can initiate actions and strategies that foster a more innovative and dynamic environment. This can lead to enhanced educational experiences, increased research productivity, improved institutional performance, and better alignment with students' evolving needs and expectations.

3.4.2.5. Leaders' Institutional Transitions Awareness

HEI leaders' digital leadership level of awareness is vital for institutional transitions as it enables them to navigate digital transformations, make informed decisions, drive change, allocate resources effectively, build digital capacity, and mitigate risks. Their awareness ensures that the institution is well-positioned to leverage digital opportunities, adapt to the evolving higher education landscape,

and deliver value to students, faculty, and other stakeholders. Especially in this changing digital landscape, the role of leadership awareness toward making strategic decisions makings for institutional transitions is crucial. To enhance institutional competitiveness and value creation, HEIs should adopt digital tools and practices that align with their strategic goals.

3.4.3. Relationships of Variables

3.4.3.1. Organizational Capabilities for Innovation Performance

Organizations are developing different capabilities for improving their organizational performances. Organizational capabilities were long studied in different strategic management research and are still used in institutional performance including HEIs. The relationship between organizational capabilities and innovation performance in universities is examined based on knowledge-based companies in Iranian. The findings suggest that capabilities such as technology management, human resource management, and strategic planning have a positive impact on innovation performance (Akbari et al., 2021). Etzkowitz & Leydesdorff (2000) on his "triple helix" model of innovation, which emphasizes the importance of collaboration between universities, industries, and governments. The authors argue that universities can enhance their innovation performance by developing organizational capabilities that facilitate these collaborations. The impact of organizational capability is also studied and found that organizational capabilities have a vital impact on the development of radical and incremental product innovation performances (Hoonsopon & Ruenrom, 2012).

Hypothesis 1: *Organizational Capabilities impact the innovation performance of the University.*

3.4.3.2. Digital Leadership and Innovation Performance

Effective leadership and governance are crucial factors in driving organizational performance in HEIs. Numerous studies have indicated a direct correlation between digital leadership and innovative performance in HEIs. The focus of institutional leadership lies in upholding the values and objectives of professional education management and promoting the practices of the faculty in achieving excellence in teaching, research, and consulting services. The faculty members are at the heart of the institution's success and its pursuit of excellence (B. R. Clark, 1998).

A study by Iqbal and Piwowar-Sulej (Iqbal & Piwowar-Sulej, 2022) found that digital leadership positively influences innovation performance in HEIs through its impact on organizational culture and the development of digital competencies among staff and students. Similarly, a study by (Cai et al., 2020) found that digital leadership positively impacts innovation performance by enhancing the use of digital technologies in teaching and learning. Digital leadership can also impact innovation performance in HEIs by fostering collaboration and knowledge sharing among faculty and staff. This is particularly important in the context of the COVID-19 pandemic, which has accelerated the adoption of digital technologies in HEIs and highlighted the need for effective digital leadership. A study by Wati et at., (2022) found that digital leadership positively influences innovation performance in HEIs by promoting collaboration and knowledge sharing among faculty and staff. Furthermore, digital leadership can also impact innovation performance in HEIs by enhancing the use of data analytics and other digital tools to support decision-making and improve institutional performance. Hence, we hypothesize the following:

Hypothesis 2: *Digital Leadership positively influences the innovation performance of HEIs.*

3.4.3.3. The Mediating Role of Digital Leadership between Transformational Leadership and HEIs Innovation Performance.

The mediating role of digital leadership in the relationship between transformational leadership and innovation performance found that digital leadership positively mediates the relationship between transformational leadership and innovation performance in organizations. The results suggest that leaders who adopt digital technologies and practices can better facilitate innovation within their organizations. A survey-based empirical study was undertaken to explore two key relationships: whether transformational leadership yields a positive impact on digital leadership and whether digital leadership, in turn, influences innovation performance positively. Moreover, the study revealed a significant discovery: digital leadership acts as a mediator between transformational leadership and innovation performance. This suggests that digital leadership holds a critical role in fostering innovation within organizational contexts.

Similarly, numerous researchers have also suggested the mediating role of digital leadership between transformational leadership and innovation performance, particularly in the higher education sector. For instance, Hooi & Chan (2022) conducted research indicating that an innovative culture serves as a mediating factor between transformational leadership and the digitization of workplaces. In a similar vein, Chen et al., (2014) uncovered that corporate entrepreneurship operates as a mediator between CEOs' transformational leadership and the performance of product innovation.

Adding to this perspective, Raj & Srivastava (2016) highlighted the mediation of organizational learning in the relationship between transformational leadership and innovation. Further contributing to this discourse, Owusu-Agyeman (2021) delved into the enhancement of the

participative process through engagement, motivation, communication flow, communication utilization, and decision-making. These elements were identified as crucial for driving innovation among administrative staff within higher education institutions.

Hypothesis 3a: *Transformational Leadership positively influences innovation performance in HEIs.*

In Korean Higher Education Institutions (HEIs), the linkage between transactional leadership and innovation performance is mediated by digital transformation, as evidenced by (Y.-H. Choi et al., 2021). Similarly, in Chinese HEIs, Cui et al., (2022) also identified digital transformation as a mediating factor between transactional leadership and innovation performance. In the context of Bangladesh HEIs, Ali et al., (2020) demonstrated that transactional leadership yields a positive impact on digital innovation.

Within this framework, Owusu-Agyeman (2021) conducted a study emphasizing that engagement, motivation, communication flow, communication utilization, and decision-making significantly bolster the participative process. This, in turn, plays a pivotal role in fostering innovation among administrative staff within HEIs, particularly in the context of the relationship between transactional leadership and innovation performance.

Examining the direct impact, Thahira et al., (2020) established that transactional leadership directly and positively influences an organization's innovativeness. However, Wahab & Tyasari (2020) took a different angle by focusing on entrepreneurial leadership. They discovered that managerial competency and learning orientation exhibit positive associations with job performance, and entrepreneurial leadership functions as a mediating factor between managerial competency, learning orientation, and job performance.

Hypothesis 3b: *Transactions Leadership positively influences the innovation performance of HEIs.*

Hypothesis 3c: *Authentic Leadership positively influences the innovation performance of HEIs.*

3.4.3.4. Moderating Effect of Data, Business Process, and IT Infrastructure Integration Between Digital Leadership and Innovation Performance

IT infrastructure integration plays a crucial role in the innovation performance of HEIs. The integration of IT infrastructure can enhance the efficiency of the research process, facilitate communication among researchers, and enable collaboration among multiple stakeholders. This, in turn, can lead to better research output, an increase in funding opportunities, and a higher degree of innovation performance.

Research has shown that IT infrastructure integration is positively associated with the innovation performance of HEIs. For instance, a study conducted by (Xiong et al., 2022) on Chinese HEIs found that the integration of IT infrastructure positively affects innovation performance in these institutions. The study also found that the use of cloud computing, Big Data, and other IT tools was associated with a higher degree of innovation performance in HEIs. Similarly, another study by (M. Chen et al., 2018) on Chinese HEIs found that the integration of IT infrastructure, including the use of mobile devices, cloud computing, and other digital tools, significantly influenced the innovation performance of these institutions.

Moreover, the integration of IT infrastructure in HEIs has also been found to improve the effectiveness of teaching and learning processes. For example, the integration of e-learning tools and virtual classroom technology has enabled HEIs to deliver more flexible and personalized

education, leading to better academic performance. In conclusion, the integration of IT infrastructure plays a vital role in the innovation performance of HEIs. HEIs that successfully integrate IT infrastructure and digital tools are more likely to have better research output, improved teaching and learning processes, and better funding opportunities, leading to a higher degree of innovation performance.

Hypothesis 4a: *IT infrastructure integration moderates the relationship be- tween organizational capabilities and innovation performance.*

Hypothesis 4b: *Business process integration moderates the relationship be- tween organizational capabilities and innovation performance.*

Hypothesis 4c: *Data integration moderates the relationship between organizational capabilities and innovation performance.*

3.4.3.5. Moderating Role of Digitalization Capabilities between Organizational Capabilities and Innovation Performance in HEIs

Enabling efficient digital leadership and facilitating innovation performance processes within Higher Education Institutions (HEIs) necessitates the digitalization of these institutions. Scholarly literature has underscored the moderating role played by digitalization capabilities in the connection between organizational capabilities and innovation performance within HEIs.

Wang (2022) explored the significant impact of digital knowledge capability and innovation capability on the performance of innovative organizations. This relationship is further nuanced by the moderating influence of employees' resistance to innovation on the connection between digital knowledge competence and innovation capability. Taleb & Pheniqi

(2022) discovered a positive link between IT agility and innovation performances in HEIs, albeit with IT ambidexterity exerting a negative moderating effect.

Presenting a conceptual framework, Hoffmann (2018) posited that organizational design strategies can lead to either favorable or adverse outcomes in terms of digital innovation performance. Moreover, Hoffmann emphasized that various configurations of strategies could be equally effective within the same context.

Wei et al., (2022) delved into the positive impact of IT capability on enhancing knowledge breadth and depth, consequently driving digital innovation. The study also highlighted the moderating role of institutional environments in shaping the relationship between IT capability and the knowledge base.

Given these insights, a consensus emerges among researchers that digitalization capabilities hold a pivotal role in driving innovation performance within HEIs. Moreover, the intricate relationship between organizational capabilities and innovation performance is mediated by diverse factors such as employee resistance, IT ambidexterity, and institutional contexts. It is within this context that we formulate our hypothesis, suggesting a connection between organizational capability and HEIs' innovation performance, moderated by digitalization capabilities, as follows:

Hypothesis 5: *Digitization Capability moderates the relationship between organizational Capability and Innovation Performance.*

3.4.3.6. Moderating Role of Digitalization Capabilities between Digital Leadership and Innovation Performance

Digital orientation and digital capabilities are essential in today's digital world. Individuals who are digitally oriented and possess strong digital capabilities are better equipped to navigate the changing landscape. They can also benefit from its opportunities. They are also better prepared to adapt to the latest technologies as they emerge and stay up to date with the latest trends in the digital age.

Digital leadership is crucial in guiding digital technologies integration into HEI operations. There is growing evidence that it is positively related to innovation performance. However, digital leadership's effectiveness in promoting innovation is likely to be influenced by HEIs' digitalization capability. This refers to their ability to effectively use digital technologies. Several studies have investigated the relationship between digital leadership, digitalization capability, and innovation performance in HEIs. For example, a study by Khaw et al., (2022) found that digital leadership had a significant positive effect on innovation performance in Taiwanese universities. However, the relationship was stronger when universities had higher digitalization capabilities. Similarly, a study by Jafari-Sadeghi et al., (2023) found that digital leadership was positively related to innovation performance in Portuguese universities. However, universities' digitalization capability moderated the relationship. Specifically, the positive relationship was stronger for universities with higher digitalization capability levels.

A study by Annarelli et al., (2021) also examined the relationship between digital leadership, digitalization capability, and innovation performance in Chinese universities. The study found that digital leadership had a significant positive effect on innovation performance. They also find that the

relationship was stronger for universities with higher digitalization capability levels.

Hypothesis 6: *Digitalization Capability moderates the positive relationship between Digital Leadership and Innovation Performance in HEIs*

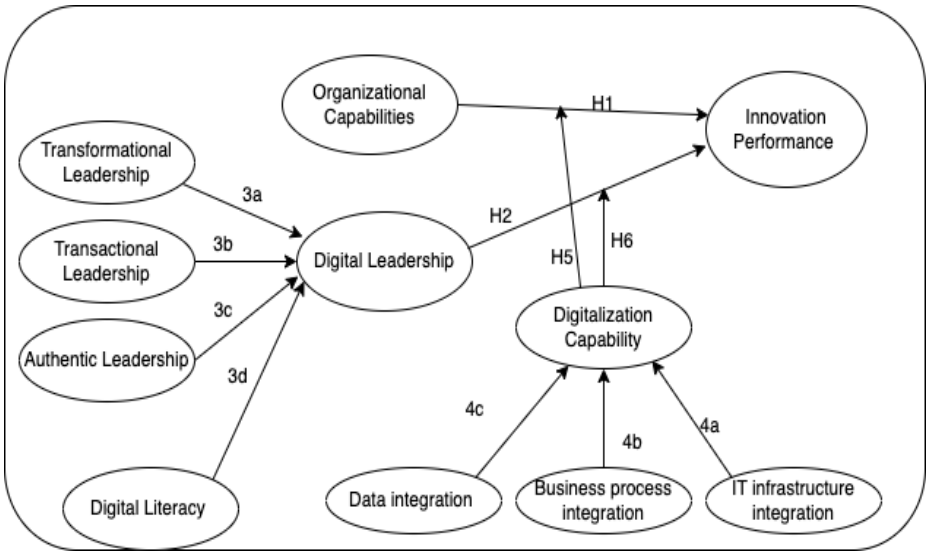


Figure 8: *Proposed Research Model*

Hence, the proposed model is mainly based on the growing leadership frameworks of (Annarelli et al., 2021; Antonopoulou et al., 2021b; Heaton et al., 2019; Khaw et al., 2022; Prince, 2018; Vidicki et al., 2023; Wissema, 2009) and the dynamic capabilities of strategic management for organizational and digitalization capabilities.

3.5. Description of Empirical Data

3.5.1. Measurement Instrument

The measurement of constructs of digital leadership and organizational capabilities that play a crucial role in driving innovation performance during the transition HEIs is adapted from literature based on the model developed for the Ethiopian HEI transition. The theoretical model was developed by incorporating organizational capabilities of strategic management and digital leadership maturity models adopted from a combination of well-known leadership models. The understanding of this definition of factors and interrelationships helps to contribute to the comprehensive analysis of the relationship between organizational performance. Five-Likert scale ranging from **(Not at all)** to **(Frequently, if not always)**. The detailed measurement instruments along with the sources used are presented in **Appendix (1).**

Authentic leadership: Authentic leadership questions are asked to the Ethiopian HEIs leaders for measuring their lived experiences and perceptions towards their self-awareness of leadership, transparency during leadership, integrity, and having sufficient viewpoints about decisions. HEIs and ICT leadership leaders are assessed by using four items called AUL1-AUL4 of the Authentic Leadership Inventory (Avolio, 1999; Promsri, 2019) that assess their perceptions and experiences.

Transactional leadership: Transactional leadership measurement items were adopted to explore the perception and lived experience of Ethiopian HEI leaders from lower to Higher levels to explore transactional leadership factors such as misunderstanding, complaints, rules, and obligations, taking actions after failing, and intervening after things become serious. Generally, transactional items were used to measure the

transactional behavior of the leaders and followers for Innovation performances. Transactional leadership with seven items was adopted and used to assess TRC1-TRC7 (Avolio, 1999; Promsri, 2019; Wan Omar & Hussin, 2013).

Transformational leadership: Leaders in Ethiopian HEIs are measured by transformational leadership measurement items pertaining to their collective and individual transformative institutional missions. It is also used to guide institutional and individual performance to create innovation and better performance. Transformational Leadership with Ten items for leaders labeled TRF1-TRF10 (Avolio, 1999; Promsri, 2019; Wan Omar & Hussin, 2013).

Organizational capabilities: Organizational Capabilities measurement items were used to evaluate the organizational effectiveness, resource management capabilities, innovation, and change management capabilities, learning capabilities governance, and compliance capabilities, and research management capabilities of Ethiopian HEI Leaders. The organizational capabilities variable is measured using six (6) items were adopted from (Gold et al., 2001; Goldstein, 2010; Hoonsopon & Ruenrom, 2012; Lewrick et al., 2012) and labeled them using OCA1-OCA6.

Digital leadership: Digital leadership measurement items are designed to evaluate the HEI Leaders' perceptions and lived experiences of understanding the changing digital environment, digital transformation (DT), clear vision and purpose of DT, communication within an organization through a digital mechanism, the effectiveness of the DT, create a conducive environment for DT, Collaborate for innovation, take advantage of ICT, application of digitized tools and competencies and partnering digitally for research and innovation. And also, the DL uses 16 items adopted from (Claassen et al., 2021; Promsri, 2019; Sasmoko et al.,

2019) and(DasGupta, 2011; Whitehurst, 2015) and is designed to measure the ability to navigate and lead in the digital era including characteristics of digital leadership including the practices, skills, and competencies at the university leadership level from top to lower management members. Ten (10) measurement items were used to measure the construct labeled DLD1-DLD10.

Digitalization capabilities: Digitalization capabilities measurement items were adopted from used to measure lived experience and perceptions of the Ethiopian HEI in terms of automation effectiveness and efficiency. In addition, they measured capabilities in course delivery, student assessment, and support in university management. Digitalization Capabilities adopted from (Ahmad et al., 2021; Promsri, 2019; Schneider & Kokshagina, 2021) and measures the digitalization capabilities of the HEIs through infrastructure, data, and business process integrations. Digital capabilities are measured using four (4) items Labeled from DCA1-DCA4.

Data Integration: is used to measure and is also measured in 2 items. Business Process Integration of digital capabilities is measured using 3 items based on organizational capacities. IT infrastructure Integration is used to measure the IT infrastructure integration and digitalization capabilities to conduct digitalized services spontaneously and adopted (Ahmad et al., 2021; Promsri, 2019) measured using three (3) items from DDI1-DDI3.

Business Process integration: Measurement items were adopted from (Ahmad et al., 2021; Promsri, 2019) 's internal working procedures, along with instantaneous data and information sharing within institutions. Business process integration uses four items labeled DBP1-DB4.

IT Infrastructure Integration: We used measurement items to measure the lives and perceptions of HEI leaders regarding IT infrastructure

availability, usability, and contributions. Four (4) items were adopted from (Ahmad et al., 2021; Promsri, 2019; Schneider & Kokshagina, 2021) and labeled DIT1-DIT4 for IT Infrastructure integration.

Innovation performance of HEIs: Innovation Performance items were adopted from (Antonopoulou et al., 2021b; Claassen et al., 2021; Tierney & Lanford, 2016; Vidicki et al., 2023): is used to measure the innovation performance of HEIs measured using nine (9) items were used to measure the innovation performance of the HEIs using survey items adopted and modified from innovation surveys and areas like curriculum innovation, process innovation, organizational innovation, and third mission innovation activities.

Digital Literacy is employed in the following ways: a) Ensuring that all members of the direct report team possess the essential technical skills required for the effective execution of our digital strategy. b) Actively pursuing external resources such as insights from thought leaders, collaborative research initiatives, partnerships, and executive education to continually nurture the organization's digital capabilities. c) Equipping the entire leadership team with a comprehensive understanding of the strategic and operational advantages stemming from our digital technologies.

To determine whether these control variables affect the dependent variable, the age of the university, the university community size, the IT investment, and the type of institution were collected. Due to the nature of the study, control variables were not used to analyze the results.

Demographic information of the respondents was gathered in relation to their participation in leadership, academic background, years of experience, educational attainment, and length of service in leadership roles. The classification options for these variables were based on established standards, which can be found in ***Appendix 1***.

3.5.2. Data Sample and Procedure

Data was collected from selected Ethiopian public HEIs through a Google form survey questionnaire. The target respondents are leaders of the academic units, Senior Lecturers, and ICT staff who are working/had worked previously as academic leaders for at least two (2) years in the HEIs. The data collected for this research is collected on a questionnaire developed based on the existing literature, current standards, best practices, feedback, and market research for digital leadership. This study is based on a cross-sectional study conducted at eleven (11) public universities in Ethiopian higher education institutions.

In total, 146 respondents were obtained from eleven (11) public HEIs in which full-time academic and ICT leaders work or have previously worked. This sample represents a fairly typical sector of HEIs; however, it is still not representative of all tertiary institutions in Ethiopia. The choice of these universities was based on proximity and ease of data collection. However, four were rejected because of missing values, leaving them for analysis.

According to the "ten times thumbs rule" recommended by (Hair et al., 2011) and (Barclay et al., 1995) for PLS-SEM, the sample size should be at least ten times larger than the number of variables in the model. However, this rule assumes that each variable is measured without error and is unidimensional, which may not always be the case in practice. Variables may be multidimensional and contain measurement errors, which can impact the accuracy of the estimates (Hair Jr et al., 2017).

After the model was prepared, instrument validation was conducted before data collection was launched. Ten (10) academic and Leadership domain experts were used to validate for improving the readability and

understanding of the survey questions. Google form was used to prepare the questions and distributed via email to all universities through their emails. A total of 146 valid responses were collected through a survey, with 139 responses from males and 7 from females. This sample size exceeded the minimum requirement.

3.5.3. Demographic Analysis of Respondents

Table 4 presents the demographic data of the respondents, including their sex, age, and education level. Among the respondents, 139 (95.2% of the leadership positions are held by men, while only 7(4.8% of the respondents are female. The majority of the respondent participants or 87(59.6%) are between the ages of 30 and 40, with master's degree holders accounting for 91(62.3%) and followed by Ph.D. degrees and higher education levels. Participants were contacted by email to request their participation. Regarding 4.1, of the 146 respondents from Ethiopian public HEIs, Adama Science and Technology University, Arsi University, and Bahir Dar University had the highest participation rates at 20%, 16%, and 14%, respectively.

***Table 4**: Demographic characteristics of the sample*

Sex	Freq.	Age gr	Freq.	Edu Level	Freq.
Male	139 (95.2%)	Less than 30	12 (8.2%)	Ph. D. and Above	51 (34.9%)
Female	7 (4.8%)	30-40	87(59.6%)	Master's degree	91 (62.3%)
		41-50	38(26%)	Bachelor's degree	4(2.7%)
		51-60	8(5.5%)		
		Greater than 60	1(0.7%)		

The respondents were all leaders in their respective institutions and regular reminders were sent to encourage them to complete the survey. Table 5 summarizes the characteristics of the participants according to their academic field and years of service in HEI. Most of the survey participants served at the university for 11 to 20 years (66%), followed by less than six to ten years of service in HEIs. Regarding their leadership level, most participants held middle management positions such as Dean or Director, followed by lower management/leadership positions. The Engineering and Natural Sciences academic field accounted for 61% of participants, followed by Business and Commerce, which accounted for 29%.

***Table 5**: Leadership Characteristics of Sample*

Service Year in HEIs	Freq.	Educational Field	Freq.
0-5	10 (6.8%)	Commerce and Business	10 (6.8%)
06-Oct	44(30.1%	Engineering and Natural Sciences	105 (71.9%)
Nov-20	84 (57.7%)	Medicine and Health Sciences	11 (7.5%)
More than 20	8(5.5%)	Social Sciences and Humanities	20 (13.7%)

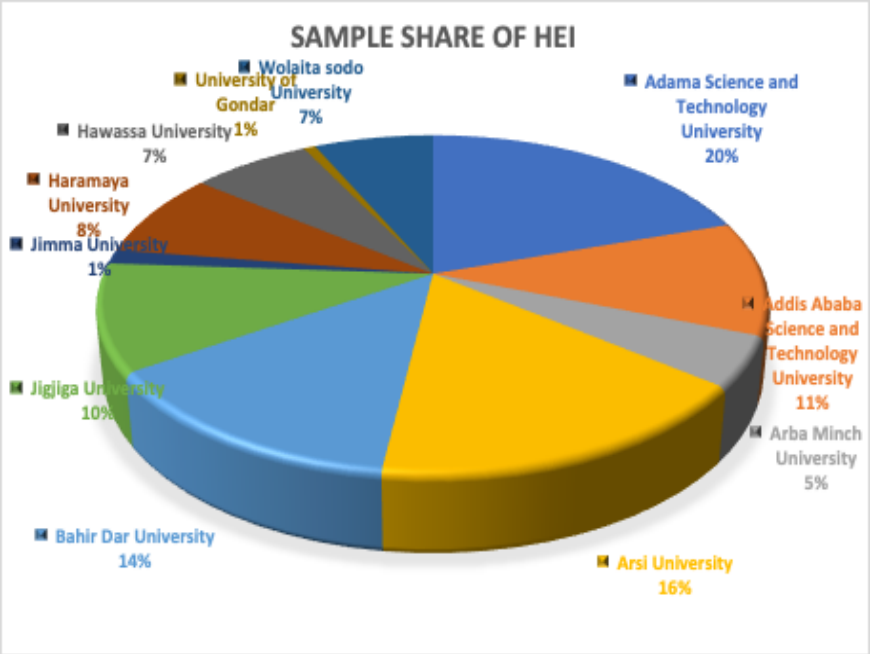


Figure 9: Percentage of Ethiopian HEI respondents

In Table 6, a summary is provided on the leadership level and years of experience of the respondents in Higher Education Institutions (HEIs). The information reveals that the majority of respondents, constituting 47.9% or 70 leaders, are in middle-level management/leadership roles, such as deans or directors of their colleges and central administration of the respective universities. Lower-level management/leadership roles represent 23.3% of the respondents, while only 6.8% represent higher-level management/leadership, including the presidents and vice presidents of HEI. Table 4 shows the service years of the respondents in HEI of which the majority (84) or 57.7% of the participants served from 11 to 20 years. Staff who served 6 to 10 years account for 30% of the survey participants.

A mere 6.8% of the participants have served for more than 20 years, and only 5.5% have more than 20 years of experience. Furthermore, around 16% of the respondents are current lecturers who have taken leadership positions for at least one term or up to two years in most universities.

***Table 6**: HEIs Leadership Level and Years of Service of Participants*

Leadership Level	Freq.	Years of Service in Leadership Position	Freq.
Top Management	10 (6.8%)	Up-to 5 Years	90 (61.6%)
Middle Management	70 (47.9%)	6- 10 years	47(32.2%)
Lower Management	34 (23.3 %)	11-20 Years	8 (5.5%)
Lecturers	23 (15.8 %)	More than 20 years	1 (0.7%)
IT Staff	9 (6.2%)		

The survey also includes ICT leaders, ranging from directors to team leaders in their respective work units, who play a vital role in the HEIs digitizing Processes. It should be noted that most of the participants belong to the young leadership group, with less than 10 years of experience.

3.6. Model Analysis and Results

To test the hypotheses, the study used structural equation modeling (SEM), a technique that, like multiple regression, examines relationships between variables. However, unlike multiple regression, SEM can evaluate multiple levels of dependence relationships within the same analysis, including both subsequent relationships between dependent and independent variables, as well as relationships among dependent variables (Shook et al., 2004).

SEM is a robust quantitative data analysis technique that allows the estimation and testing of theoretical relationships between observed and latent constructs. It combines the strengths of factor analysis and regression to handle multiple relationships and path analysis methods are used to assess relationships from the exploratory factor analysis (EFA) to confirmatory factor analysis (CFA) (Hair et al., 2011).

Previous research studies have successfully employed SEM to investigate various leadership constructs, including authentic leadership and predictive validity (Walumbwa et al., 2008), transactional leadership and chronic stress (Rowold & Schlotz, 2009), and transformational leadership and job satisfaction (Wan Omar & Hussin, 2013). Given its demonstrated effectiveness in prior research, SEM is a suitable tool for testing the Digital Leadership Research Model.

3.6.1. Descriptive Statistics

Table 7 shows the descriptive statistics analysis results for the factors and measurement items. A sample's mean and standard deviation (SD) provide important insights into the sample's range and distribution. It shows how the sample is shaped and distributed based on the mean and standard

deviation. In the sample data, the mean ranges from 4.256 for transactional leadership to 0.445 for digital literacy, while the standard deviation varies from 1.24 for transactional leadership to 0.498 for digital literacy, indicating spares in the mean.

Table 7: *Factors and Their Descriptive Statistics*

Role	Factor	Number of Items	Mean	Std Deviation
Independent	Authentic Leadership (AUL)	4	4.256	0.761
	Transactional Leadership (TRC)	4	2.821	1.244
	Transformational Leadership (TRF)	4	4.203	0.818
	Digital Literacy (DIL)	1	0.445	0.498
	Digital Leadership (DLD)	9	3.780	0.995
	Organizational Capabilities (OCA)	4	3.554	1.106
Dependent	Innovation Performance (IPF)	9	3.214	1.056
Moderating	Digitalization Capabilities (DCA)	2	2.489	1.095
	Business Process Integration (DBP)	3	2.996	1.017
	IT Integration (DIT)	2	3.668	1.024
	Data Integration (DDI)	2	2.729	1.044

3.6.2. Measurement Model

The purpose of measurement models is to evaluate the accuracy and soundness of the measures used in the study. Specifically, these models measure the convergence and divergence of the measures, which are evaluated by examining factor loadings, average variance extracted (AVE), and composite reliability (CR). Additionally, the models assess the consistency and stability of the measures, which are evaluated by examining CR and Cronbach's alpha coefficient.

Reliability and Validity

The evaluation of the measurement model encompassed assessments of reliability, convergent validity, and discriminant validity. In general, items with outer loadings are anticipated to surpass the threshold of >0.7, or they can range from 0.40 to 0.70. Items falling within this range could be considered for removal only if their exclusion leads to an increase in composite reliability (CR) or average variance extracted (AVE), as recommended by (Hair Jr et al., 2017). While there are two items displaying low loadings, the overall reliability and validity indicators stand strong and dependable.

Table 8 illustrates that all latent variables exhibit reliability, as indicated by both Cronbach's alpha and composite validity scores. These scores exceed the established threshold of 0.7, as proposed by (Henseler et al., 2012).To gauge convergent validity, the calculated average variance extracted (AVE) should surpass 0.5, as outlined by (Henseler et al., 2016). Consequently, we utilized all factors for assessing factor loading, composite reliability (CR), and average extracted variance (AVE). The loadings signify the correlation among items within factors, with each item's loading expected to meet or exceed 0.7 for acceptance. Thus, the establishment of convergent validity is affirmed.

Table 8: *Measurement Model Evaluation Summary*

Factor	Indicators	Loading	C.R	AVE	Cronbach's
Authentic Leadership (AUL)	AUL1	0.713	0.866	0.620	0.805
	AUL2	0.742			
	AUL3	0.841			
	AUL4	0.845			
Transactional Leadership (TRC)	TRC1	0.698	0.802	0.505	0.691
	TRC2	0.801			
	TRC3	0.726			
	TRC4	0.603			
Transformational Leadership (TRF)	TRF1	0.808	0.860	0.505	0.782
	TRF2	0.836			
	TRF3	0.748			
	TRF4	0.717			
Digital Literacy (DIL)	DIL	1.000			
Digital Leadership (DLD)	DLD10	0.824	0.929	0.595	0.915
	DLD11	0.798			
	DLD12	0.828			
	DLD13	0.736			

	DLD3	0.715			
	DLD4	0.705			
	DLD7	0.706			
	DLD8	0.820			
	DLD9	0.797			
Organizational Capabilities (OCA)	OCA1	0.832	0.889	0.668	0.834
	OCA2	0.835			
	OCA5	0.773			
	OCA6	0.829			
Business Process Integration (DBP)	DBP2	0.924	0.927	0.863	0.842
	DBP4	0.934			
Digitalization Capabilities (DCA)	DCA2	0.936	0.934	0.877	0.859
	DCA3	0.937			
IT Integration (DIT)	DIT1	0.778	0.889	0.727	0.816
	DIP2	0.890			
	DIT4	0.887			
Data Integration (DDI)	DDI2	0.929	0.932	0.872	0.854
	DDI3	0.939			
Innovation Performance (IPF)	IPF10	0.770	0.931	0.602	0.917

IPF11	0.793
IPF12	0.782
IPF13	0.809
IPF2	0.733
IPF5	0.755
IPF7	0.809
IPF8	0.782
IPF9	0.745

Reliable: If all factor loadings are equal to or exceed 0.7, it signifies the reliability of indicators. Similarly, if all Average Variance Extracted (AVE) values are greater than or equal to 0.5, it indicates the reliability of convergence. When all composite reliability (CR) scores are equal to or exceed 0.7, it suggests strong internal consistency. Furthermore, if Cronbach's alpha is greater than 0.7, it implies both indicator reliability and consistency.

Discriminant Validity

The tables 9 and 10 refer to the concept of discriminant validity, which is the ability of measures used in a study to differentiate between various constructs. This is evaluated by analyzing cross-loadings, which indicates the extent to which a measure aligns with its intended construct as opposed to other constructs, and by calculating the average variance extracted (AVE), which measures the amount of variance captured by a construct relative to measurement error. The Fornell-Larcker criterion is also used to assess discriminant validity, which stipulates that the AVE of each construct must exceed the highest squared correlation between that construct and any other construct in rows and columns.

To establish discriminant validity, the HTMT ratios were calculated, which demonstrated that the AVE of each construct exceeded its squared correlations with other constructs and that all cross-loadings were lower than

the loadings on their intended construct. HTMT values were also below the threshold of 0.90. Furthermore, the Fornell-Larcker criterion was applied to test the degree to which the correlations between latent factors and measured variables in the model were higher than the correlations between the latent factors themselves (Henseler et al., 2009). All the Fornell-Larcker criteria were satisfied. Therefore, both the Fornell-Larcker criterion and the HTMT supported the adequacy of discriminants for the latent variables, elements, and indicators, indicating that the validity of the discriminant was established.

Table 9: *Discriminant Validity-Heterotrait-Monotrait (HTMT) ratio*

	AUL	TRC	TRF	DIL	DLD	OCA	DIT	DBP	DDI	DCA	IPF
AUL											
TRC	0.175										
TRF	0.738	0.269									
DIL	0.225	0.086	0.236								
DLD	0.211	0.296	0.411	0.205							
OCA	0.104	0.143	0.160	0.218	0.445						
DIT	0.129	0.103	0.136	0.170	0.414	0.680					
DBP	0.106	0.275	0.138	0.205	0.422	0.733	0.761				
DDI	0.107	0.256	0.083	0.158	0.437	0.666	0.575	0.836			
DCA	0.154	0.220	0.104	0.060	0.341	0.525	0.569	0.700	0.895		
IPF	0.136	0.169	0.218	0.141	0.452	0.797	0.633	0.699	0.743	0.656	

Table 10: *Discriminant Validity (Fornell-Larcker Criterion)*

	AUL	TRC	TRF	DIL	DLD	OCA	DIT	DBP	DDI	DCA	IPF
AUL	0.787										
TRC	0.116	0.711									
TRF	0.594	0.23	0.779								
DIL	0.196	-0.003	0.21	1.000							
DLD	0.209	0.252	0.365	0.204	0.772						
OCA	0.05	-0.041	0.117	0.201	0.399	0.817					
DIT	0.098	0.051	0.041	0.158	0.364	0.562	0.853				
DBP	0.047	0.193	0.113	0.188	0.372	0.616	0.642	0.929			
DDI	-0.049	0.173	0.024	0.145	0.381	0.569	0.503	0.707	0.934		
DCA	-0.119	0.115	0.009	0.056	0.297	0.448	0.498	0.596	0.768	0.936	
IPF	0.041	0.116	0.165	0.14	0.422	0.71	0.562	0.619	0.665	0.585	0.776

Note: *Sig <0.005; **Sig <0.01, AUL= Authentic Leadership, TRC= Trans- actional Leadership, TRF=Transformational Leadership, DIL= Digital Literacy, OCA=Organizational Capabilities, DIT= IT integration, DBP= Business Process Integration, DDI=Data Integration, and IPF= Innovation Performance

3.6.3. Structural Model

The results obtained were analyzed to assess the structural model of the proposed research framework. Partial Least Squares Structural Equation Modeling (PLS-SEM) is a statistical technique used to analyze relationships between latent variables in a structural model. PLS-SEM is a non-parametric approach that is particularly suitable for small sample sizes and models with many variables or constructs (Hair Jr et al., 2017). Barclay et al., (1995) argued that the ten-time rule is not an absolute requirement but rather a

general guideline that depends on several factors, including the complexity of the model, the quality of the measures, the degree of inter-correlation between variables, and the research context. They suggested that researchers consider alternative methods such as PLS-SEM for models with small sample sizes of variables.

Collinearity Assessment

Identifying the collinearity of the constructs is the first step in the evaluation of the structural model. It reveals the Common Method Bais (CBM) measure by VIF which measures the data is not made by one person or a machine (Kock et al., 2021). When using PLS-SEM, the initial step is to examine collinearity statistics using Variance Inflation Factor (VIF) values, which are presented in Table 11 and range from 1.000 to 2.510. All VIF values are below 3, which indicates that collinearity does not impact the estimates of the structural model (Hair Jr et al., 2021).

Table 11: *Inner Collinearity Statistics (Using VIF)*

	AUL	TRC	TRF	DIL	DLD	OCA	DIT	DBP	DDI	DCA	IPF
AUL					1.558						
TRC					1.059						
TRF					1.636						
DIL					1.058						
DLD											1.313
OCA											1.683
DIT									1.715		
DBP									2.559		
DDI									2.015		
DCA											1.485

IPF	
DCA x 06.OCA	1.922
DCA x 05.DLD	1.685

Note: PLS-SEM stands for Partial least square Structural equation modeling, RMSE is for root mean square error, LM for Linear regression Model.

Structural Model Path Coefficients

The next task after the measurement model is the evaluation of structural path coefficients (relationships among study constructs) and their statistical relevance.

Hypothesis 1(H1): determines whether digital leadership capabilities influence HEI Innovation Performance. The evaluated results reveal that digital leadership capabilities have a significant positive influence on HEI organizational innovation performance. The hypothesis shows that digital leadership (DLD) plays a positive role in the innovation performance of HEIs with (βDLD→IPF =0.141, t-value=2.157, $p<0.05$). Therefore, H1 was supported as shown in Table 12 and the structural model presented in 10.

Hypothesis 2(H2a): determines whether transformational leadership influences digital leadership capabilities for higher education. The result evaluated reveals that Transformational have significance in the Digital leadership capabilities to influence the organizational innovation performance of the HEIs. The structural path coefficient between Transnational Leadership (TRF) and Digital Leadership (DLD) has statistical significance (βTRF → DLD=0.329, t- value=2.517, $p<0.05$). Hence, H2a was supported as shown in Table 12 and the structural model presented in figure 10.

Table 12: *Hypothesis Testing Results (Note: PT = Path coefficient(β), S.D = Standard Deviation)*

Hypothesis	R/Ships	Path Coefficient	S. D	T-Statistics	P values	Findings
H1	DLD -> IPF	0.142	0.065	2.171	0.030	Accepted
H2a	TRF -> DLD	0.304	0.133	2.287	0.022	Accepted
H2b	TRC -> DLD	0.185	0.083	2.230	0.026	Accepted
H2c	AUL -> DLD	-0.021	0.117	0.182	0.856	Not Accepted
H2d	DIL -> DLD	0.296	0.150	1.972	0.049	Accepted
H3	OCA -> IPF	0.513	0.070	7.328	0.000	Accepted

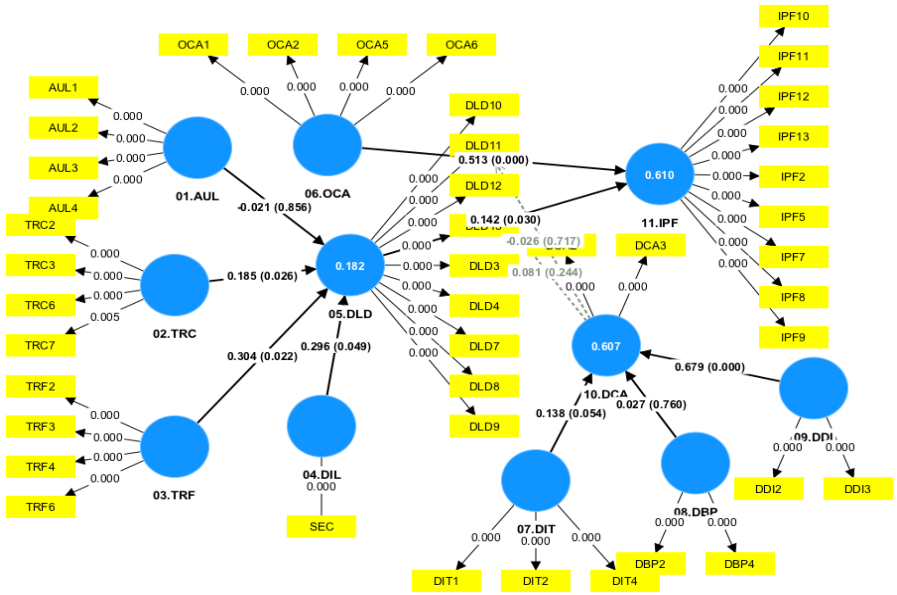


Figure 10: *Structural Path Analysis Using Bootstrapping-β (t − value)*

Hypothesis 3(2b): determines whether Transactional leadership influences the Digital Leadership of HEI. The evaluated result reveals that Digital leader- ship capabilities significantly positively influence the organizational innovation performance of HEIs. The hypothesis reveals that digital leadership (DLD) plays a positive role in the innovation performance of the HEIs with (βTRC →DLD=0.176, t-value=2.114, p<0.05). Hence, H2b was supported as shown in Table 12 and the structural model presented in Figure 10.

Hypothesis 4 (2c): determines whether Authentic Leadership styles of the Ethiopian HEIs leaders influences the Digital Leadership in the universities. The evaluated result reveals that Authentic Leadership does not have a significant impact on the digital leadership of HEIs leaders. The hypothesis reveals that authentic leadership (AUL) does not have statistical significance in playing a role in the Digital Leadership of the HEIs with (βAUL→ DLD=-0.004, t-value=0.037, p<0.970). Therefore, H2c was not supported as depicted in Table 12 and the structural model presented in Figure 10.

Hypothesis 5 (2d): determines whether digital literacy (DIL) influences the innovation performance of HEIs. The evaluated result reveals that digital literacy has statistically significantly positively influenced the innovation performance of HEIs. Hypothesis reveals that digital leadership (DIL) plays a positive role in the innovation performance of the HEIs with (βDIL → IPF =0.101, t-value=2.575, p<0.05). Therefore, H2d was supported as depicted in Table 12 and the structural model presented in figure 10.

Hypothesis 6(H3): determines whether the organizational capabilities influence the innovation performance of HEI. The evaluated results reveal that organizational capabilities have a significant positive influence on the organizational innovation performance of HEIs. The hypothesis shows that digital leadership (OCA) plays a positive role in the innovation performance of

HEIs with (βOCA →IPF =0.513, t-value=7.338, p<0.05). Therefore, H3 was supported as shown in Table 12 and the structural model presented in 10.

Model Explanatory Power

The explanatory capability of a model pertains to its capacity in elucidating the variance or fluctuations observed in the dependent variable, grounded in the variances present in the independent variables integrated within the model. To gauge this, the coefficient of determination (R^2) is employed. This coefficient showcases the proportion of variance within the dependent variable that can be accounted for by the independent variables integrated into the model. Its values range from 0 to 1, with higher values signifying a more accurate alignment of the model with the data (Henseler et al., 2015; Shmueli et al., 2019). The outcomes of the R-square coefficient of determination are displayed in Table 13 below.

Model Predictive Relevance

Q^2 is used to measure predictive relevance, which indicates how well the model predicts the dependent variable based on the independent variables included in the model, ranging from -∞ to 1, with values greater than 0 indicating that the model has predictive power (Hair et al., 2019; Henseler et al., 2015).Table 13 below depicts the Q2 results as 0.606,0.737,0.033 and 0.006 for IPF, DCA, DLD, and DIL respectively, demonstrating the predictive relevance of the PLS-SEM path model (Hair Jr et al., 2017).

Table 13: Structural Model-Quality Criteria R^2and Q^2

	R^2	S. D	T-Statistics	P-Value	Q^2
DIL	0.017	1.003	2.664	P<0.005	0.006
DLD	0.182	0.988	2.156	P<0.005	0.023
DCA	0.607	0.651	5.128	P<0.005	0.587
IPF	0.610	0.668	7.420	P<0.005	0.561

Note: R-Square is for Coefficient of determination Q-square is a measure of model predictive relevance, S.D is for Standard deviation, and P-Value * Relationship is significant at P<0.005.

Model Predictive Power/Validity

The model's R square prediction explains the sample within the model, but it cannot accurately predict models outside the sample using current prediction techniques (Shmueli et al., 2016, 2019). To overcome this limitation, the predictive capability of the PLSPredict model is used. Through the analysis, Table 14 shows that the model has high predictive power, as indicated by the RMSE values for all indicators (DLD, DCA, and IPF), with the PLS-SEM analysis outperforming the LM benchmark model (Shmueli et al., 2019).

Table 14: Model Predictive Power Assessment

Key Endogenous Indicators	$PLS-SEM_{RMSE}$	LM_{RMSE}	**Comparison Results**
DIL	0.501	0.585	$PLS-SEM_{RMSE} < LM_{RMSE}$
DLD10	1.029	1.103	$PLS-SEM_{RMSE} < LM_{RMSE}$
DLD11	0.882	0.960	$PLS-SEM_{RMSE} < LM_{RMSE}$

DLD12	1.052	1.173	$PLS-SEM_{RMSE} < LM_{RMSE}$
DLD8	0.948	0.998	$PLS-SEM_{RMSE} < LM_{RMSE}$
DLD9	1.064	1.190	$PLS-SEM_{RMSE} < LM_{RMSE}$
DCA1	0.580	0.633	$PLS-SEM_{RMSE} < LM_{RMSE}$
DCA2	0.669	0.771	$PLS-SEM_{RMSE} < LM_{RMSE}$
DCA3	0.707	0.799	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF10	0.809	0.938	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF11	0.934	1.062	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF12	0.873	0.936	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF13	0.776	0.858	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF14	0.903	0.993	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF2	0.800	0.878	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF3	0.747	0.934	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF4	0.750	0.883	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF5	0.784	0.885	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF6	0.729	0.816	$PLS-SEM_{RMSE} < LM_{RMSE}$
IPF7	0.778	0.872	$PLS-SEM_{RMSE} < LM_{RMSE}$

Note: PLS-SEM= Partial Least square structural equation Modeling, RMSE= Root means square error, LM=Linear Regression

3.6.4. Mediation Analysis

Using smartPLS4, mediation analysis was performed to examine the mediation role of digital leadership (DLD), organizational capabilities (OCA) and digitalization capabilities (DCA) on the innovation performance of HEI. H7 is proposed to examine the mediation effect of TRF on IPF. Accordingly, we analyzed mediation analysis to determine the role of DLD and OCA in mediation between TRF and IPF. Table 15 reveals the statistical significance of the indirect effect of TRF on IPF through DLD and OCA (Beta =0.061, t=2.057, P <0.005), BCa. The total impact of the TRF on IPF.

Table 15: Mediation Analysis

Hypothesis	Relationships	Path Coefficient	S. D	T-Stat	P-Value	Findings
H7	TRF->DLD->OCA-IPF	0.061	0.030	2.057	0.040	Accepted
H8	DLD->OCA->IPF	0.207	0.051	4.047	0.000	Accepted
H9	DDI->DCA->IPF	0.141	0.065	2.157	0.031	Accepted
H10	TRC->DLD->DCA->IPF	0.038	0.020	1.933	0.053	Partial Accepted

Using our model, we formulate hypotheses for mediation analysis. Based on this, Table 14 demonstrates the hypothesis that there are relationships between the constricts analyzed. A Mediation Analysis explores the role of digital leadership and organizational capabilities as mediators between transformational leadership and innovation performance. Follow these steps:

Examine the correlation between transformational leadership (independent variable) and digital leadership (mediator variable) through regression analysis using either bootstrapping or structural equation modeling (SEM). Bootstrapping is a prevalent method to estimate the indirect effect and establish its significance. Furthermore, the study assessed the impact of transformational leadership on organizational capabilities by employing regression analysis, treating transformational leadership and organizational capabilities as independent and mediator variables, respectively. Notably, this assessment yielded significant results.

The study then proceeded to evaluate the influence of digital leadership on innovation performance. This was accomplished by conducting regression analysis to explore the relationship between digital leadership (mediator variable) and innovation performance (dependent variable), while adjusting for pertinent covariates. The objective was to confirm the substantive nature of this relationship.

Similarly, a regression analysis was employed to investigate the impact of organizational capabilities (mediator variable) on innovation performance (dependent variable), controlling for relevant covariates. This analysis aimed to ascertain the significance of this relationship.

The next step encompassed the assessment of the indirect effect of transformational leadership on innovation performance, mediated through digital leadership and organizational capabilities. This was achieved either through bootstrapping or SEM, with bootstrapping commonly applied to estimate indirect effects and determine confidence intervals.

If the indirect effect proves significant, it implies that digital leadership and organizational capabilities mediate the link between transformational leadership and innovation performance. The study then calculated the total

effect of transformational leadership on innovation performance by summing the direct and indirect impacts. The interpretation of the significance and magnitude of this total effect highlighted the intermediary roles played by digital leadership and organizational capabilities.

Consequently, the study underscores the substantive direct influence of transformational leadership on innovation performance. Furthermore, it delves into the mediating roles of digital leadership and organizational capabilities, elucidating the connection between transformational leadership and innovation performance. The notable indirect effects emphasize that digital leadership and organizational capabilities are pivotal mediators, nurturing innovation performance within the organization. The study underscores the importance of cultivating digital leadership and organizational capabilities to enhance the outcomes of innovation within the organizational context.

3.6.5. Moderation Analysis

Leaders with high digital leadership awareness effectively guide and influence digital transformation initiatives, fostering innovation and collaboration among stakeholders in HEIs. However, digital leadership's impact on innovation performance depends on the institution's digitalization capability. HEIs with strong digitalization capabilities integrate digital technologies effectively, enhancing teaching, research, administration, and student services. In contrast, HEIs with low digitalization capability struggle to realize digital leadership benefits, limiting their capacity to leverage digital tools and drive innovation. Understanding the moderating role of digitalization capability is crucial for HEI leaders and policymakers to invest in digital infrastructure, skills development, and organizational processes. This will position their institutions for enhanced competitiveness in the digital age. Because of the importance of these factors, HEIs' digital leadership and

innovation performance are moderated and enhanced by digitalization capabilities along with data, IT infrastructure, and business process integration.

Table 16: *Moderation Analysis*

Hypothesis	R/Ships	Path Coefficient	S. D	T-Statistics	P values	Findings
H4	DCA -> IPF	0.312	0.062	5.041	0.000	Accepted
H5a	DIT -> DCA	0.138	0.072	1.928	0.054	Not Accepted
H5b	DBP -> DCA	0.027	0.089	0.306	0.760	Not Accepted
H5c	DDI -> DCA	0.679	0.060	11.257	0.000	Accepted

Hypothesis 7(H4): determines whether the digitalization capabilities moderate the innovation performance of HEI. The evaluated results reveal that Digitalization capabilities have a significant positive influence on the innovation performance of HEIs. The hypothesis shows that digital leadership (DCA) plays a positive role in moderating between digital leadership and innovation performance of HEIs with (βDCA → IPF =0.313,

t-value=5.045, p<0.05). Therefore, H4 was supported as shown in Table 16 and the structural model presented in in figure 10.

Hypothesis 8(H5a): determines whether the integration capabilities of the IT infrastructure moderate the performance of the HEI Innovation. The evaluated results reveal that the integration capabilities of the IT infrastructure do have a significant influence on HEI innovation performance of HEIs. The hypothesis shows that IT Infrastructure (DIT) plays a positive role in the innovation performance of HEIs with (βDIT→DCA=0.138, t-value=1.928, p<0.054). Therefore, H5a was not supported as shown in Table 16 and the structural model presented in figure 10.

Hypothesis 9(H5b): determines whether Business Process Integration capabilities of digitalization capabilities of Ethiopian HEIs moderates HEI Innovation Performance. The evaluated results reveal that Business Process Integration capabilities have no significant moderation influence on HEI innovation performance. The hypothesis shows that digital leadership (DBP) does not plays a role in the innovation performance of HEIs with (βDBP →DCA=0.27, t-value=0.306, p<0.760). Therefore, H5b was not supported as shown in Table 16 and the structural model presented in figure 10.

Hypothesis 10(H5c): determines whether Data Integration capabilities of digitalization capabilities moderates the relationship between digital leadership and HEI Innovation Performance. The evaluated results reveal that Data Integration capabilities significantly positively influence HEI innovation performance. The hypothesis shows that Data Integration capabilities (DDI) play a positive role in the innovation performance of HEIs with (βDDT →DCA=0.679, t-value=11.257, p<0.05). Therefore, the hypothesis H5c was supported as shown in Table 16 and the structural model presented in figure 10.

3.6.6. Comparison of PLS-SEM versus CB-SEM

Figure 10 and Figure 11 show the comparison of structural path analysis using PLS-SEM bootstrapping and CB-SME analysis. Based on the literature related to Digital leadership and other leadership styles for HEI Innovation performance, hypothesis testing outperformed PLS-SEM. For instance, the result for transformation and Digital leadership on Innovation performance was not supported by CB-SEM while it was supported by PLS-SEM, while other results resemble each other which indicates the hypothesis testing instruments are consistent.

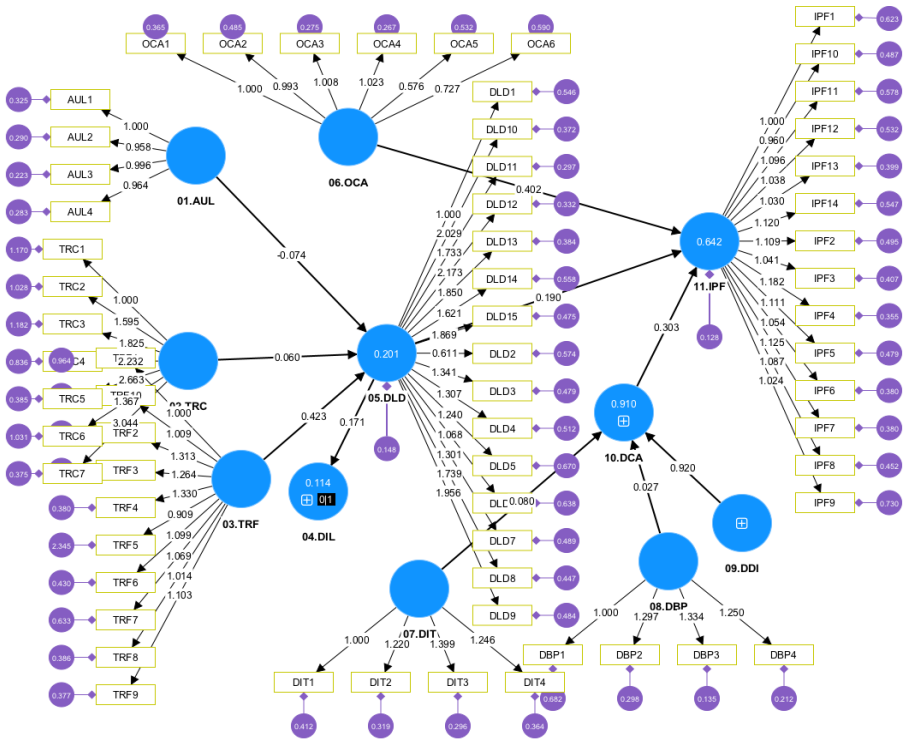


***Figure 11**: Structural path analysis CB-SEM*

Table 17: *Hypothesis testing results (CB-SEM)*

Hypothesis	R/Ships	Path Coefficient	S. D	T-Statistic	P values	Findings
H1	DLD -> 11.IPF	0.190	0.101	1.888	0.061	Not Accepted
H2a	TRF -> 05.DLD	0.423	0.154	2.749	0.007	Accepted
H2b	TRC -> 05.DLD	0.060	0.112	0.536	0.593	Not Accepted
H2c	AUL -> 05.DLD	-0.074	0.093	0.801	0.424	Not Accepted
H2d	DLD -> 04.DIL	0.171	0.070	2.456	0.015	Accepted
H3	OCA -> 11.IPF	0.402	0.064	6.316	0.000	Accepted
H4	DCA -> IPF	0.303	0.056	5.378	0.000	Accepted
H5a	DIT -> DCA	0.080	0.083	0.957	0.340	Not Accepted
H5b	DBP -> DCA	0.027	0.092	0.294	0.769	Not Accepted
H5c	DDI -> DCA	0.920	0.086	10.640	0.000	Accepted

Furthermore, the latent structures of the Leadership style PLS-SEM and CB-SEM models show slight differences in comparison. The PLS-SEM supports leadership styles associated with innovation performance for transformational and transactional leadership and digital leadership, while the CB-SEM is insignificant and does not support the hypothesis. Digitalization

capabilities sub-constructs have no statistical significance in CB-SEM, while digital leadership and organizational capabilities show statistical significance.

When faced with the choice between covariance-based structural equation modeling (CB-SEM) and variance-based partial least squares (PLS-SEM), determining the appropriate approach can pose a challenge. In this paper, a direct comparison is made by applying identical theoretical measurements, structural models, and datasets. The outcomes of this comparison shed light on key differences between the two methods.

The findings demonstrate that when employing CB-SEM, a considerable number of indicators need to be excluded to attain an acceptable level of goodness-of-fit in comparison to PLS-SEM. Moreover, PLS-SEM generally yields higher composite reliability and convergent validity, while other metrics like discriminant validity and beta coefficients display a comparable performance. Notably, PLS-SEM outperforms CB-SEM substantially in terms of the variance explained in the dependent variable indicators.

This study offers updated guidelines to assist researchers in determining whether CB-SEM or PLS-SEM is the more suitable method to employ. A fundamental distinction between these two approaches lies in their theoretical underpinnings. CB-SEM operates based on the common factor model, assuming that the analysis should be grounded solely in the shared variance within the dataset. Consequently, the analysis begins by calculating the covariance between variables, utilizing only the common variance for subsequent analysis (Hair et al., 2019).

3.7. Discussion

This study aims to expand our understanding of the factors that impact HEI transition to the third generation. This is done by thoroughly examining the role of digital leadership and organizational capabilities in innovation. Building on the theoretical lens of leadership and dynamic capabilities using Leadership theories, Open Innovation, RBV, and KBV, the proposed theoretical model breaks down the concepts of Innovation Performance. The study uses a cross-sectional survey approach to understand how digital leadership, organizational capabilities, and digitalization capabilities affect HEI innovation in Ethiopia. Data were collected from leaders from Ethiopian public HEIs for their perceptions and lived experience of innovation, commercialization of research outputs, and the role of leadership in the respective HEIs.

In this study the digital leadership system is a blend of Authentic, Transactional, and Transformational leadership styles that transform organizations through digital change. Digital leadership and organizational capabilities play an important role in innovation as key drivers of organizational strategic competitiveness(Ghorbani et al., 2021). This study used quantitative cross-sectional survey approaches that allow a better understanding of specific factors that influence leadership and organizational capabilities toward innovative HEI.

The results of the hypothesis using PLS-SEM using bootstrapping (Beta Path coefficient) are shown in the following sections: Moving towards a knowledge economy and society is urgent and inevitable in developing countries such as Ethiopia. The role of universities as sources of knowledge that can transform socioeconomic and sociotechnical transitions increases the demand for universities to transition to 3GUs. The transition of HEIs toward innovative institutions was analyzed using the digital leadership and

organizational capabilities of Ethiopian HEIs to explore the transitions of universities. This helps the HEIs contribute to the transition from a traditional resource-based economy to a knowledge-based economy.

It is becoming essential to create organizational changes in HEIs to contribute to the transition. HEIs can drive organizational changes by contributing to graduates' knowledge and skills. As a result, HEIs are improving and collaborating with other institutions. The governance of HEIs and the leadership of the organization play a vital role in implementing digital transformations in HEIs.

This study supports the positive impact of digital leadership and organizational capabilities on innovation performance. This is within the context of digitalization capabilities as a moderating variable. The results indicate that digital leadership and organizational capabilities significantly contribute to enhancing innovation performance in organizations. This supports the notion that effective leadership and strong organizational capabilities are crucial for fostering innovation in the digitized landscape.

Regarding the relationship between digital leadership and innovation performance, our results align with previous research that highlights the importance of leadership in driving innovation outcomes. The acceptance of this hypothesis suggests that organizations with digital leaders who effectively leverage digital technologies and guide their teams toward innovation are more likely to achieve better innovation performance. Digital leaders play a crucial role in shaping organizational culture, facilitating knowledge sharing, and promoting collaboration, which is essential for fostering innovation.

Similarly, the acceptance of the hypothesis related to organizational capabilities underscores their significance in driving innovation performance.

Organizational capabilities encompass various factors such as resource allocation, knowledge management, and strategic alignment. Our findings indicate that organizations that invest in developing and nurturing these capabilities are more likely to exhibit higher innovation performance levels. Such organizations are better equipped to respond to digital disruptions, adapt to changing market conditions, and leverage internal resources effectively to drive innovation initiatives.

Moreover, the moderating impact of digitalization capabilities on the interplay between digital leadership, organizational capabilities, and innovation performance underscores the pivotal role of technological preparedness in amplifying innovation outcomes. The endorsement of this hypothesis underscores that organizations equipped with robust digitalization capabilities encompassing technological infrastructure, digital skills, and data analytics proficiencies are better poised to harness the affirmative effects of digital leadership and organizational capabilities. These digitalization capabilities empower organizations to proficiently harness digital resources and tools, leverage insights derived from data, and adeptly respond to evolving market demands. This synergy augments the influence of digital leadership and organizational capabilities on innovation performance.

This alignment is also corroborated by other researchers, who likewise propose that organizational capabilities, encompassing learning capacity, creativity, and innovative acumen, exert a positive impact on innovation performance within university contexts. Sutanto (2017) discovered that organizational learning capability and creativity significantly influenced organizational innovation within Indonesian universities. Kasim & Noh (2012) posited that organizational innovation potentially influences university performance, constructing a framework to test this conjecture within Malaysian private universities. Lawson & Samsom (2001) conceptualized innovation

management as a facet of organizational capability and developed a model illustrating the firm's function as an innovation engine. In a review, Li et al. (2020) identified factors influencing university-enterprise cooperative innovation, including the structure of cooperative networks, geographical distribution, and social considerations, all contributing to innovation performance. Collectively, these studies suggest that universities can heighten innovation performance through investments in and cultivation of organizational capabilities. Hence this study substantiates its claim through empirical evidence that underscores the affirmative impact of digital leadership and organizational capabilities on innovation performance.

Overall, this study provides empirical evidence of the positive influence of digital leadership and organizational capabilities on innovation performance. Digitalization capabilities act as a significant moderator. These findings underscore the importance of cultivating effective digital leadership, strengthening organizational capabilities, and investing in digitalization capabilities. This will foster innovation in organizations. The results have practical implications for organizations seeking to enhance innovation performance in the digital age. They emphasize the need for a holistic approach that integrates leadership, organizational capabilities, and digital readiness.

3.7.1. The Mediating Role of Digital Leadership on Leadership Styles and Innovation Performance of HEIs

In this empirical study, the first conclusion that can be drawn is that there is a role of leadership styles that contribute to the public digital transformations of higher education institutions. A survey of the respondents was conducted to learn how HEIs were performing in terms of innovation performance, digitalization capabilities, and organization capabilities and how they were helping them make the transition. Regarding the question of

whether digital leadership plays an important role in transforming university and regional innovation in the future, I think that there is no doubt that it does. As a result, third-generation universities are better prepared for the future.

This study supports the mediating role of digital leadership between authentic, transactional, and transformational leadership and innovation performance in Higher Education Institutions (HEIs). These findings contribute to our understanding of the complex relationship between leadership styles and innovation outcomes in digitalization.

Firstly, the positive relationship between authentic leadership and innovation performance is consistent with previous research. This emphasizes the importance of leaders' genuine and transparent behavior in fostering a climate of trust, openness, and collaboration. Authentic leaders create an environment where individuals feel empowered to express their ideas and take risks, which are crucial factors for innovation. However, this study extends beyond the direct effect of authentic leadership by demonstrating that its impact on innovation performance is mediated by digital leadership.

Digital leadership plays a critical role as a mediator between authentic leadership and innovation performance in HEIs. This finding suggests that in the digital age, leaders need to effectively leverage digital technologies and create a digital vision to drive innovation initiatives. Digital leaders possess the knowledge and skills to harness digital tools and platforms. They facilitate communication and knowledge sharing and foster a digital culture within their organizations. By doing so, they enable the implementation of innovative practices and the integration of digital technologies into educational processes. Furthermore, our study reveals that both transactional and transformational leadership styles have indirect effects on innovation

performance through digital leadership. Transactional leaders, who focus on setting clear expectations, rewarding achievements, and providing resources, contribute to innovation performance by establishing a structured environment that supports digital initiatives. They create incentives and reward systems that motivate employees to engage in innovative behaviors and embrace digitalization.

On the other hand, transformational leaders, with their visionary and charismatic qualities, inspire and motivate followers to look beyond their own self-interests and strive for higher performance. Transformational leaders play a crucial role in creating a shared vision for digitalization and instilling a sense of purpose and excitement among employees. By doing so, they foster a culture of innovation and encourage individuals to embrace digital transformation efforts, leading to improved innovation performance.

The mediation of digital leadership highlights the importance of leaders' digital competencies in leveraging digital technologies' potential for innovation in HEIs. As digitalization reshapes the higher education landscape, leaders must adapt their leadership styles to effectively harness digital tools and platforms. This study emphasizes the need for leadership development programs that focus on building digital leadership capabilities to enhance innovation performance in HEIs.

The finding provides valuable insights into the role of leadership styles and digital leadership in driving innovation performance in HEIs. By understanding and leveraging digital leadership's mediating role, organizations can enhance their innovation capabilities. In addition, they can navigate the challenges and opportunities presented by digital transformation in the higher education sector.

The impact of the HEI's leadership and digitalization capabilities on establishing conducive innovation ecosystems and national innovation systems that guide institutional transitions. This will incubate more startups and entrepreneurs. Collaboration between universities and industries to generate commercialized joint knowledge. University leadership is unaware of techno-startups and innovation ecosystems that benefit academia and industry. The empirical study suggests that digital leadership has an impact on institutions' innovation performance with emphasis given to digitalization capabilities and working on innovative curricula.

Authentic leadership theory emphasizes leaders being genuine, transparent, and true to themselves. It suggests that true leaders can foster trust, openness, and collaboration within their organizations, which are essential for innovation. Transactional leadership theory focuses on the exchange of rewards and punishments between leaders and followers. Transactional leaders set clear expectations, reward meeting objectives, and ensure resources are available to accomplish tasks. In the context of innovation, transactional leaders can create a structured environment that supports digital initiatives and motivates employees to engage in innovative behaviors. Transformational leadership theory emphasizes leaders' role in inspiring and motivating followers to achieve extraordinary outcomes.

Transformational leaders have visionary qualities, set high expectations, and stimulate intellectual stimulation and individual consideration. In the context of innovation, transformational leaders can create a shared vision for digitalization and instill a sense of purpose and excitement among employees. This fosters an innovation culture. Digital leadership refers to leaders' ability to leverage digital technologies and create a digital vision to drive innovation and transformation. It involves the knowledge, skills, and competencies required to harness digital tools and platforms. It facilitates communication

and collaboration and fosters a digital culture within organizations. Hence the moderating role of digitalization capabilities explains the relationship between two other variables (authentic, transactional, or transformational leadership) and an outcome variable (innovation performance). The result shows that there is a significant demand for digitalization capabilities required for successful relationships between leadership and innovation performance in Ethiopian HEIs.

The analysis provides a theoretical framework for understanding the relationship between leadership styles (authentic, transactional, and transformational), digital leadership, and innovation performance in Higher Education Institutions. It demonstrates how the findings align with existing academic literature and contributes to the understanding of these relationships within the Ethiopian HEIs. This study proved the role played by digital leadership towards innovative universities by exploring the leadership characteristics and innovativeness of Ethiopian HEIs. HEIs are working towards exploiting know-how through collaboration with public and private firms.

3.7.2. The Moderating Effect of Digitalization Capabilities between Digital Leadership and Innovation Performance of HEIs

In the following section, we discuss the moderating analysis of digitalization capabilities between digital leadership and HEI innovation performance. HEIs digitalization capabilities refer to the construct and its subconstructs including IT infrastructure integration, business process integration, and data integration. These capabilities play a vital role in the relationship between digital leadership and Ethiopian HEI innovation performance.

Hypotheses 4 and 5 proposed model hypothesis testing shows that integration capabilities of the IT infrastructure influence the HEI Innovation performance. The evaluated results reveal that the integration capabilities of the IT infrastructure have a significant positive influence on the HEI innovation performance of HEIs. Data Integration Capabilities Influence HEI Innovation Performance. The evaluated results reveal that Data Integration capabilities have a significant positive influence on the HEI innovation performance of HEIs.

Moreover, other researchers propose that digitalization capabilities serve as a mediating factor within the link connecting digital leadership and innovation performance within Higher Education Institutions (HEIs). Taleb & Pheniqi (2022) conducted a study revealing that IT agility positively impacts innovation performance within Moroccan public universities. In a separate study, Tjahjadi et al., (2022)found that absorption capacity partially mediates the association between information technology capabilities and innovative performance across manufacturing and service enterprises. Sasmoko et al., (2019) demonstrated a robust direct and indirect relationship between digital leadership and dynamic capability. This outcome is shaped by the cultivation of innovation capability, fostered by digital leadership grounded in market orientation.

However, Tjahjadi et al., (2022)demonstrated that open innovation does not act as a mediator for the influence of the global market orientation strategy on HEIs' performance. In contrast, intellectual capital readiness fully mediates the impact of the global market orientation strategy on performance. Collectively, these studies underscore the mediating role played by digitalization capabilities in the connection between digital leadership and innovation performance within the domain of HEIs.

3.7.3. The Moderating Effect of Digitalization Capabilities between Organizational Capabilities and Innovation Performance of HEIs

To address the inquiry into the moderating role of digitalization capabilities concerning the relationship between digital leadership and innovation performance within Higher HEIs – as hypothesized in H4, 5a, 5b, and 5c – this study delved into the perceptions and experiences of HEI leaders in Ethiopia. The examination involved an evaluation of the mediating influence of digitalization capabilities and their sub-constructs. However, the hypothesis regarding the moderating impact of infrastructure integration capabilities and business process integration capabilities on HEI innovation performance failed to find support. This outcome underscores the absence of a significant effect stemming from IT infrastructure integration and business process integration in augmenting the association between digital leadership and innovation performance within Ethiopian HEIs.

This outcome resonates with Khin & Hung Lee (2022) discovery that digital capability exerts a positive influence on digital innovation, subsequently mediating the effects of technology orientation and digital capability on both financial and non-financial performance. Likewise, Wei et al., (2022) determined that IT capability fosters positive outcomes in terms of knowledge breadth and depth, thereby enhancing digital innovation. They also highlighted the moderating role of the institutional environment on the connection between IT capability and the knowledge base. Building on this, Sasmoko (2019) concluded that digital leadership establishes both a robust direct and indirect association with dynamic capability. Furthermore, the development of innovation capability spurred by digital

leadership rooted in market orientation is identified as pivotal in fostering dynamic capability.

Upon analyzing the outcomes of the mediating role of digitalization capabilities and data integration capabilities, hypotheses 4 and 5c garnered support. This alignment mirrors earlier research that accentuates the significance of organizational capabilities, encompassing organizational learning capacities, knowledge management proficiencies, and IT capabilities, in propelling innovation within HEIs. The positive correlation observed between organizational capabilities and innovation performance suggests that institutions with well-honed capabilities are more likely to attain elevated levels of innovation. Additionally, the results underscore the moderating function of digitalization capabilities in this connection. The moderation effect of digitalization capabilities suggests that the relationship between organizational capabilities and innovation performance varies contingent on the level of digitalization capabilities within an organization.

Based on the CB-PLS results on the moderations of digitalization capability shows that when digitalization capabilities are high, the positive relationship between organizational capabilities and innovation performance becomes even stronger. This finding suggests that organizations that effectively leverage digital technologies and have a robust digital infrastructure are more likely to enhance their innovation performance. Digitalization capabilities enable organizations to efficiently collect, process, and utilize vast amounts of data. They enhance communication and collaboration and facilitate innovative ideas.

On the other hand, when digitalization capabilities are low, the relationship between organizational capabilities and innovation performance is weaker. This indicates that the absence or limited adoption

of digital technologies may hinder the translation of organizational capabilities into improved innovation performance. Without the necessary digital tools and capabilities, organizations may face challenges in effectively accessing and utilizing knowledge, resources, and information. These challenges are critical for innovation.

Hence, this study highlights the importance of organizational capabilities and digitalization capabilities in fostering innovation performance. The findings suggest that organizations need to develop and maintain strong organizational capabilities while embracing digitalization to fully unlock their innovation potential. By doing so, organizations can stay competitive and adapt to the rapidly evolving business landscape driven by digital transformation.

3.8. Implications

The research studies the role of digital leadership, organizational capabilities, and digitalization capabilities for innovation in Ethiopian HEIs. Furthermore, the study also looked at areas not explored in previous studies on leadership's role in HEI innovation performance. The findings of this research help policymakers in HEIs of Ethiopia and elsewhere to increase efforts towards the digital competence, skills, and attitude of leadership in improving HEI innovation performance. The following section discusses the various implications based on the findings:

3.8.1. Theoretical Implications

The current study attempts to fill multiple gaps. Due to the lack of a framework, not enough empirical research has been conducted on HEI innovation. This study is the first to consider empirical research on HEIs innovation performance on innovative curriculum, innovation in research,

innovation process, organizational innovation, and innovation towards the third mission in Ethiopia. The following are some theoretical implications for Ethiopian HEIs from the findings:

First, HEIs should prioritize developing and nurturing digital leadership skills within their organizational structure. This implies that institutional leaders, such as university administrators and department heads, should possess the necessary knowledge and competencies to effectively lead digital transformation initiatives within the institution. By doing so, they can provide clear vision, guidance, and support to faculty members, staff, and students. This will enable them to adapt to the digital age.

Second, the results highlight the importance of fostering organizational capabilities that align with HEI digitalization efforts. These capabilities can include developing digital infrastructure, enhancing data analytics capabilities, promoting digital literacy among faculty and staff, and fostering a culture of innovation and collaboration. HEIs should invest in building these capabilities to support their digitalization initiatives, as they can significantly impact the institution's ability to innovate and remain competitive in the ever-evolving higher education landscape.

Third, the study indicates that strong digitalization capabilities moderate the relationship between digital leadership and innovation performance in HEIs. This implies that while digital leadership is essential, its impact on innovation performance depends on the institution's digitalization capabilities. HEIs should, therefore, focus on developing digital leadership but also invest in building robust digitalization capabilities to maximize their innovation potential.

In general, theoretical implications emphasize the significance of digital leadership, organizational capabilities, and digitalization capabilities in

driving innovation performance within HEIs. By recognizing and addressing these factors, HEIs can adapt to the digital era. They can also enhance their competitive advantage and make contributions to knowledge and social advancement.

3.8.2. Managerial Implications

The study provided several managerial implications for leaders in HEIs and policymakers to help them improve university and national innovation performance. Survey respondents suggested strengthening leadership, organizational capabilities, and digitalization capabilities, including digital literacy, for better innovation performance. The study suggested the following managerial implications:

First, in this study, all respondents are from public higher education institutions and have worked as leaders in their academic units or programs for at least two years before being invited to participate in this study. There is little effort being made to commercialize the research output of these researchers despite their perceptions and lived experiences that show that this should be a priority. The HEIs' institutional digitalization capabilities are further needed to contribute to the innovation ecosystems via entrepreneurial education and techno start-up and virtues.

HEI managers must focus on improving business process integration and data integration into their digitalization capabilities to improve organizational innovation performance. The integration of business processes demonstrates that institutional information and activities pertaining to leaders are not instantaneous and that various separate systems must be integrated to provide the best possible service for leaders.

Develop Digital Leadership Programs: HEIs should prioritize the development of digital leadership programs to equip their academic and

administrative leaders with the necessary skills and competencies to navigate the digital landscape. These programs should focus on fostering a strategic mindset, promoting innovation and collaboration, and leveraging digital technologies to enhance teaching, learning, and administrative processes. By developing digital leadership capabilities, HEIs can drive digital transformation and innovation within their institutions.

Foster Organizational Capability Building: HEIs should invest in building strong organizational capabilities that support digital transformation and innovation. This involves developing robust processes and structures, fostering a culture of innovation and collaboration, and aligning resources and initiatives to drive innovation in teaching, research, and administration. HEIs should provide training and development opportunities for faculty and staff to enhance their digital and innovation skills. They should also create platforms for knowledge sharing and collaboration to foster a culture of continuous improvement and innovation.

Integrate Digitalization Capabilities: HEIs need to integrate digitalization capabilities throughout their institutions. This includes investing in technological infrastructure, developing digital skills among faculty, staff, and students, and leveraging data analytics and other digital tools. This will support decision-making and enhance student experiences. HEIs should prioritize the adoption and integration of digital platforms, learning management systems, and online collaboration tools. This will enable effective communication, collaboration, and access to educational resources.

Adopt a Holistic Approach to Digital Transformation: HEIs should take a holistic approach to digital transformation by aligning digital leadership strategies, organizational capabilities, and digitalization efforts. This involves creating a shared vision and strategy for digital transformation.

It also ensures coordination and collaboration across different departments and stakeholders and integrates digital initiatives within the institution's overall strategic goals. By adopting a holistic approach, HEIs can maximize digital transformation efforts and achieve sustainable innovation outcomes.

Foster a Culture of Innovation and Learning: HEIs should foster a culture of innovation and learning that encourages experimentation, creativity, and risk-taking. This can be achieved by creating spaces for faculty and students to collaborate on digital projects, promoting interdisciplinary research and teaching, and providing support for innovative pedagogical approaches and technologies. HEIs should also establish mechanisms to capture and share best practices in digital innovation. They should also provide opportunities for continuous professional development to ensure faculty and staff stay abreast of emerging trends and technologies.

To sum up, HEIs should develop digital leadership programs, foster organizational capability building, integrate digitalization capabilities, adopt a holistic approach to digital transformation, and foster a culture of innovation and learning. By embracing these implications, HEIs can effectively leverage digital leadership, organizational capabilities, and digitalization to drive innovation, enhance teaching and learning experiences, and stay at the forefront of the evolving digital landscape in higher education.

3.9. Conclusions and Contributions

In conclusion, the study answers the research questions shown in the following section: As a first step, this paper examines how the leadership of Ethiopia's HEIs has a substantial impact on the innovation performance of the institution. Second, HEIs' organizational capabilities play a vital role in innovation performance. Third, the mediating constructs of digitalization with its sub-construct show that they are important mediators of digitalization capabilities between digital leadership and HEI innovation performance. Authentic leadership does not have a statistically significant impact on innovation performance among the three leadership styles.

As the study is limited to exploring the context of Ethiopian Public HEIs, the sample size and the study type might need to be considered for further research. Therefore, these research findings are limited to Ethiopian public HEIs' efforts toward innovation and thereby to 3GU. The role of digital leadership and organizational capabilities in HEI innovation performance for their transition towards 3GU was positively significant. Such a measurement was not conducted in previous research.

The study adds to the existing literature on the role of digital leadership in HEI innovation performances which is working with conceptualizations of innovation digital leadership frameworks in HEIs that can support institutional performance improvement and transition towards third-generation universities. Moreover, the study contributes to the current research on digital leadership and innovation performance of HEIs for their transition towards competitive HEIs. To achieve this, it is necessary to improve the performance of the institution and enhance its sustainability.

Building upon existing theories, this study enriches the contemporary comprehension of digital leadership and innovation performance within Higher Education Institutions (HEIs), offering a springboard for fresh insights among fellow researchers. Similar avenues of investigation have been undertaken by other scholars. For instance, (Promsri, 2019) pursued a study that corroborates the positive influence of digital leadership on innovation performance. Antonopoulou et al., (2020) arrived at the conclusion that the practice of digital leadership and the capacity for innovation wield an impact on innovative performance, particularly within small and medium-sized enterprises. Wang et al., (2022) formulated a model that elucidated the affirmative impact of digital leadership on exploratory innovation, with this relationship mediated by innovative entrepreneurial orientation and a digital organizational culture.

Zhao et al., (2022) discovered that enterprise digital transformation fosters a positive impact on innovation performance, affording competitive advantages and augmenting competitiveness. However, (Mihardjo et al., 2019) underscored that the connection between digital leadership and innovation management is subject to moderation by market orientation. Collectively, these studies underscore the significance of digital leadership as a determinant of innovation performance, albeit one that might be influenced by concurrent factors, including market orientation.

On a parallel trajectory, the study underscores the statistical significance of organizational capabilities in shaping the innovation performance of HEIs. Concurrent researchers have also showcased the impact of organizational capabilities on innovation performance within higher education institutions. Tong et al., (2022) identified five primary factors that favorably influence the operational performance of innovation systems in high-tech enterprises, encompassing collaboration abilities and management prowess. Lewrick et al., (2012) determined that an organization's innovation capabilities stand as a

pivotal determinant of innovation success, with customer intelligence and market orientation correlating with heightened business performance. Hoonsopon &Ruenrom (2012) investigated the ramifications of organizational capabilities on both radical and incremental product innovation, alongside product innovation performance. Their findings indicate that organizational capabilities exert a significant influence on both forms of innovation. Moreover, Huda & Hussin (2016) devised an IT innovation effectiveness model tailored to HEIs, spotlighting the significant roles of top management support and implementation policies and practices in the realm of successful IT innovation effectiveness.

In light of these insights, it is evident that further research is requisite to facilitate the shift towards third generation universities in developing countries. Enhancing innovation performance mandates due consideration of digital leadership and organizational capabilities. By immersing themselves in these domains, HEIs are poised to contribute substantively to the socio-technical and socioeconomic dimensions of their respective regional societies.

3.10. Limitation of the study

In the first place, the cross-sectional study was limited to 11 Public HEIs in Ethiopia, and the rate of response varied based on the busy schedules of the individuals who participated in the survey as respondents. In addition, there are only a few studies that evaluate the role that digital leadership plays in enhancing innovation performance within the education sector. The conceptualizations of the Digital Leadership framework and the Innovation Performance of HEIs can be attributed to the reason for this. In the first study of its kind, there is a limited amount of information on the control variables, therefore it cannot be statistically tested since there is limited information on them.

Chapter-4: Institutional Collaboration among Ethiopian HEIs for Knowledge Generations: A SNA of Publications with Spatial Dimensions

4.1. Introduction

The use of technology in education has led to new approaches to teaching and learning, especially in higher education. The digital transformation in higher education involves the integration of digital tools to improve processes related to teaching, research, learning, and administration. The affordability and accessibility of digital tools have accelerated this transformation, resulting in new instructional and learning models like blended learning, flipped classrooms, and MOOCs (Dabbagh & Kitsantas, 2012). This transformation also has important implications for knowledge creation, including the need for new standards of assessment, innovative types of knowledge, interdisciplinary collaboration, and new skills and competencies (Gellert et al., 2018). HEIs play a vital role in creating new knowledge through research and teaching. As centers of research, universities facilitate the exploration of new ideas, theories, and technologies in various fields, involving partnerships with industry, government agencies, and other academics. The dissemination of research results is accomplished through academic publications, conferences, and other forms of communication. Alongside research, universities also generate knowledge by educating students, equipping them with the necessary skills and knowledge to thrive in their desired professions (Leydesdorff & Etzkowitz, 1998).

It's widely accepted that the contribution and impact of HEIs to create, access, and use knowledge and technology is a fundamental determinant of long-term development and competitiveness. It's also important for HEIs to

play an important role in the ever-increasing globalization as a key to gaining new knowledge and innovations. HEIs drive innovation by creating a conducive environment for the creation and commercialization of new ideas and technologies (Etzkowitz et al., 2000). Partnerships with industry and government support innovation and entrepreneurship through technology transfer programs, research collaborations, and incubators. They also provide entrepreneurial education programs, allowing students to acquire the necessary knowledge and skills to start their own businesses.

HEIs are also important catalysts for collaboration, as they bring together researchers, academics, and students from different disciplines, as well as industry and government partners. Collaboration can lead to new research ideas and innovation, as well as the development of new products and services. Universities often work in partnership with other universities and institutions to share knowledge, resources, and expertise. The researchers identified various preconditions for inter- and intra-organizational collaborations, such as necessity, reciprocity, efficiency, stability, legitimacy, and asymmetry (Oliver, 1990). Collaborations of HEIs and other research institutions with the aim of attaining among the above factors. Collaboration can also lead to the development of interdisciplinary research programs, which can have a significant impact on society (B. R. Clark, 1998). Therefore, the root cause of such problems lies in the lack of a stable, sustainable, and effective education-focused innovation ecosystem as opposed to one that focuses on other research.

The objective of this study was to examine the ways in which researchers collaborate and share knowledge in interdisciplinary research, whether they come from the same or different affiliations. Joint knowledge creation, multidisciplinary education, and research are crucial to the

promotion of the innovativeness of HEIs and institutional transitions. The study focuses on the following two research questions.

RQ1: *What is the role of Intra-affiliation and Supra-affiliation Joint Knowledge creation towards Institutional quality research?*

RQ2: *What is the impact of the distance between the institutions on Joint Knowledge creation?*

To further enhance this study, this essay delves into the current state of Ethiopian HEIs and selected national research institutes to analyze their Institutional collaborations of joint knowledge creation for institutional transitions with a focus on institutional proximity.

4.2. Literature Review

4.2.1. Joint Knowledge Creation and Innovation

HEIs play a crucial role in promoting joint knowledge creation and innovation through various initiatives such as research partnerships, technology transfer programs, incubators, and innovation centers. These initiatives foster collaboration and knowledge sharing between different stakeholders, leading to new ideas and innovative solutions. This fosters collaboration among different stakeholders, leading to enhanced research output, industry-academia collaboration, improved teaching and learning, and increased funding opportunities. Innovation and Knowledge creation become the most significant for organizations to compete and play pivotal roles in the socioeconomic development of the nation and a region at large (Etzkowitz et al., 2000). Traditional universities focus on teaching and research activities. However, 3GU universities with the third mission, sometimes referred to as “Entrepreneurial Universities”, focus on the transfer of technology and the commercialization of know-how or exploiting know-how.

Networks refer to formal and informal connections between individuals, groups, organizations, or institutions that share common interests or objectives. These networks can facilitate the exchange of knowledge, ideas, and resources, thereby contributing to the generation and dissemination of knowledge and innovation in the future.

Through these networks, HEIs can access a broader range of expertise, resources, and knowledge, expanding their capacity for research and innovation. Networks can also facilitate the dissemination of knowledge and innovation beyond the academic community and into the industry, government, and society at large. Networks within HEI, both internal and external, play a vital role in promoting knowledge generation and innovation. Internal networks within HEIs refer to the relationships and interactions between various departments, faculties, and individuals within the institution. These networks facilitate knowledge generation and innovation within the institution. For example, interdisciplinary research groups and collaborations between different faculties can lead to the creation of creative ideas and approaches that are not possible within a single discipline or department (Limoges et al., 1994). Furthermore, internal networks can facilitate knowledge transfer between different parts of the institution. This can lead to the development of novel areas of research and innovation (Laudel & Gläser, 2008). Whereas External networks refer to the relationships and interactions that occur between the institution and external organizations, such as industry, government agencies, and other HEI. These networks can facilitate the transfer of knowledge and resources between different organizations. This can contribute to the development of new products, services, and technologies.

For example, collaborations between HEIs and industry can lead to the development of new products and technologies with commercial

applications (Leydesdorff & Etzkowitz, 1998). Furthermore, external networks can facilitate the dissemination of knowledge generated within the institution. This can lead to the adoption of cutting-edge approaches and technologies by external organizations.

Interdisciplinary programs and research typically involve collaboration between faculty members and students from different departments or disciplines to provide a more comprehensive and integrated understanding of complex issues and problems and to encourage innovative approaches to knowledge creation and problem-solving. It also helps in tackling complex problems, advancing innovation, and a broader range of career opportunities, fostering collaboration, and addressing societal challenges (Yarime et al., 2012).

First and second-generation universities are challenged by the advent of technological development resulting from the rise of multi-and interdisciplinary research, which emerged in the 1960s (Wissema, 2009). At the first and second-generation universities, science was conducted as monodisciplinary research, but now multidisciplinary, transdisciplinary, and interdisciplinary research and development involve multiple scientific, technological, or design disciplines that collaborate in complementary but separate ways (Abbas et al., 2019; Cargill & others, 2007; Fong, 2003). The Triple Helix Model describes the relationship between universities, government, and industry in fostering innovation and economic development, while the Quadruple Helix framework adds civil society as a fourth actor (Etzkowitz et al., 2000; Leydesdorff & Etzkowitz, 1998). HEIs play a critical role in collaboration as key sources of knowledge and talent that can drive innovation (Anselin et al., 1997; Fritsch & Slavtchev, 2007; Jaffe & Trajtenberg, 2002). Knowledge spillovers occur largely at the regional level, with informal networking and formal research collaborations

crucial to promoting enduring social relationships between researchers and future knowledge exchange (Anselin et al., 1997; Breschi et al., 2003, 2006; Fritsch & Slavtchev, 2007; McKelvey et al., 2003). University-industry collaboration is an essential channel for academic knowledge spillovers in science-based industries (Etzkowitz, 1998).

To identify the relationships and collaboration patterns and statistical significance, SNA is used. SNA is commonly used to measure collaborations between actors in economic development in metropolitan areas and has been applied to examine the relationship between HEIs and innovation performance (Reid, 2011). Studies show that HEIs play a central role in joint knowledge creation and affiliation networks, and the quality and structure of these networks are key determinants of innovation outcomes (Lyu et al., 2019). In the context of third-generation universities, SNA has been used to understand the role of social networks in facilitating knowledge creation and transfer, particularly in multidisciplinary research projects and collaborations between academia and industry (Allen & Henn, 2007; Rodan & Galunic, 2004). SNA is a useful method for identifying key individuals and departments critical to the knowledge-creation process and for identifying gaps and opportunities for collaboration (Kuwashima, 2018).

4.2.2. Spatial Dimensions and Institutional Collaborations

To explore the impact of proximity on the formation and operation of collaborations, the data underwent a meticulous analysis, with a conceptual framework serving as a guiding compass. This process involved crafting narratives for each project, extracting from the transcripts and narrating the project's journey from conceptualization to (Steinmo & Rasmussen, 2018). These narratives were then scrutinized to unveil proximities between partners. The assessment revolved around understanding their roles in the initiation and operation of the projects, thus yielding theoretical propositions that elucidated

these roles. The analysis encompassed a two-stage thematic approach: firstly, coding the transcripts using a predetermined stage framework, and secondly, subjecting the narratives to thematic scrutiny to discern the roles of proximity (Fereday & Muir-Cochrane, 2006). For establishing a robust theoretical foundation for the coding model, the constructs of proximity were defined with a reliance on existing literature (Eisenhardt, 1989).

Scholars have adopted both direct and indirect methodologies to capture the essence of proximity (Fitjar et al., 2016). Direct measures entail seeking respondents' ratings of pre-established indicators of proximity. These measures encompass facets like perceived closeness among partners in terms of factors such as knowledge base, operational methodologies, or network affiliations (Fitjar et al., 2016; Garcia et al., 2018; Nilsen & Lauvås, 2018). On the other hand, indirect measures pivot on constructing a comprehensive narrative of the collaboration and subsequently retrospectively evaluating the presence of proximities between actors based on behaviors. This approach facilitates the identification of causal links by scrutinizing the impact of these proximities on unfolding events. This holistic approach permits the exploration of the entire spectrum of socio-relational elements within the context of collaborative connections between small and medium-sized enterprises (SMEs) and universities (Al-Tabbaa & Ankrah, 2016; Broström, 2010). Moreover, owing to the diversity inherent in SMEs, their alliances, and innovation practices (Branzei & Vertinsky, 2006; Franco & Haase, 2015), this methodology enables the observation of both disparities and parallels in behaviors and events.

Table 18: Summary of related works and research gap

Author	Knowledge creation and collaborations				Spatial Proximity considerations	Interdisciplinary Research for Institutional Transition and Innovations		Country	Methodology used	Research Focus
	Knowledge creation	Co-authoring	Collaboration in HEIs	Collaboration with Other Sector		Interdisciplinary	Innovation oriented			
(Etzkowitz, 1983, 1998; Etzkowitz et al., 2000)	✓	✓	✗	✓	✗	✓	✓	Brazil	Quantitative	The Triple Helix and the role of interdisciplinary researchers in collaboration

(Oliver, 1990)	✓	✓	✗	✓	✓	✗	✓	NA	Qualitative	Developments of determinants of inter-organizational relationships
(de Araujo et al., 2019)	✓	✓	✗	✓	✗	✓	✓	Brazil	Network Analysis	Co-patting and co-authorship of research for regional collaborations
(Wissema, 2009)	✓	✓	✓	✓	✗	✓	✓	Netherlands	Case Studies	The transition of university
(Castiaux, 2007)	✓	✓	✗	✓	✓	✗	✓	Belgium	Qualitative	Collaborative research project
(Ronda-Pupo & Guerras-Martín, 2016)	✓	✓	✗	✓	✗	✓	✗	USA	Network Analysis	Institutional ranking on collaboration network of knowledge creation
(Huang & Hung, 2018)	✓	✓	✓	✗	✗	✓	✓	Singapore	Qualitative	Management of Education research

(Capaldo & Petruzzelli, 2014)	✓	✓	✓	✓	✗	✓	✗	Italy	Quantitative	knowledge creating alliance and innovation
(Knoben & Oerlemans, 2006)	✗	✗	✓	✗	✓	✗	✗	NA	SLR	Inter-organizational collaboration
Current Study	✓	✓	✓	✓	✓	✓	✓	Ethiopia	Quantitative	Role of Digital Leadership for Innovative HEIs

Note: ✓ refers to study covers, ✗= the study does not cover, NA= Not Available

As shown in table 18 various researchers have examined the issue of collaborations between industries and academia. Researchers utilized a variety of research methodologies to study the collaborations of organizations toward knowledge creation. These institutions also examined the extent of collaborations for jointly creating knowledge and the interdisciplinary nature of knowledge creation. Based on this, this research explores the institutional collaborations of HEIs on joint knowledge creation for quality research and higher institutional performance for institutional transition.

4.3. Hypothesis Formulation

4.3.1. Intra-affiliation Versus Supra-affiliation Institutional Collaborations

Spatial proximity refers to the geographical distance between institutions or individuals, emphasizing the geographical location of different institutions and their physical proximity. Institutions located close together have easier collaboration, face-to-face interactions, regular meetings, and shared resources. Proximity facilitates communication, idea exchange, joint research projects, and partnerships. For example, institutions in the same city or region have more collaborative opportunities due to their close physical proximity.

Social proximity highlights a network of connections, relationships, and networks among individuals or institutions. It is based on familiarity, trust, and shared values, not physical distance. Social proximity develops through personal relationships, mutual acquaintances, mutual interests, or previous collaborations. In HEIs, social proximity is vital for knowledge exchange, resource sharing, and expertise collaboration. Institutions with a history of collaboration or shared research interests are more likely to engage in joint projects, publications, and other collaborative initiatives.

Technological proximity in HEIs' institutional collaboration refers to the compatibility and alignment of IT infrastructure, tools, and capabilities between collaborating institutions. It enables the effective integration and utilization of technology in collaborative initiatives, facilitating communication, information sharing, and joint activities. Technological proximity encompasses factors like network connectivity, hardware, software systems, shared platforms, and compatibility of communication and information systems. It also involves data management practices, storage capabilities, and data-sharing mechanisms. Harmonizing data formats, ensuring data privacy and security, and leveraging e-learning, virtual collaboration, and technological expertise enhance collaboration and innovation in teaching, research, and other joint endeavors.

In contrast, “knowledge spillover” refers to the transfer of knowledge or ideas from one context to another, leading to novel concepts and innovations. The nature of the topic and the interdisciplinary focus of the joint publication can influence knowledge spillover. Additionally, citing each other’s work allows collaborators to acknowledge and build upon each other’s ideas, potentially leading to new insights and innovations. References cited in the joint publication can also serve as a resource for other researchers to build upon, further promoting knowledge spillover.

Effective collaboration in scientific research requires extensive social interaction, making physical proximity a significant factor in research collaboration as noted by various researchers (Hoekman et al., 2010; Sidone et al., 2017). Communication is essential at every stage of collaboration, from identifying potential partners to executing joint work plans and tasks. Frequent communication allows collaborators to build relationships, make decisions, track progress, and engage in other joint activities, providing more opportunities for information exchange.

Advances in information and communication technologies (ICTs) have made collaboration between geographically distant communities more feasible and cost-effective. However, even with ICT benefits, physical distance can still hinder collaboration. Developing countries may lack the infrastructure and expertise necessary to take advantage of ICTs, putting them at a disadvantage. In many countries, academic and research institutions are typically located in capitals or larger urban centers. This distribution pattern aims to make these institutions more accessible to society and promote development across the country (Vieira, 2022). In examining institutional collaborations, interdisciplinary research, and multiple researchers affiliated with Ethiopian institutions, this study explores intra-affiliation and supra-affiliation (Mali et al., 2012). A study by Mali et al., (2012) investigates the relationship between supra-affiliation and intra-affiliation collaborations and citation rates between scientists, comparing their impact on innovation performance and the quality of research.

Other researchers in the field also explored that intra-affiliation and supra-affiliation joint knowledge creation play important roles in institutional quality research. Stephens & Cummings (2021) found that shared institutional affiliations and physical proximity positively influence knowledge creation and impact biomedical science collaboration. Castiaux (2007) explored the role of university-industry collaborative research projects in inter-organizational knowledge transfer and found evidence supporting the existence of a knowledge spiral as a dynamic for the whole project. Lyall et al., (2013) highlighted the importance of funding agencies in creating interdisciplinary knowledge and suggested practical organizational steps to promote and support collaborative working and integration for large-scale interdisciplinary research initiatives. (Ronda-Pupo & Guerras-Martín (2016) measured the relevance of institutions in the academic community involved in creating and disseminating

knowledge in the field of management through their position in the collaboration network and found that major institutions collaborate less with each other. This researcher suggested that intra-affiliation and supra-affiliation joint knowledge creation are important factors in institutional quality research. Hence, the study formulated the hypothesis using Spearman's correlation ranking as follows:

$$r_s = \frac{\sum_i (x_i - \underline{x})(y_i - \underline{y})}{\sqrt{\sum_i (x_i - \underline{x})^2 \sum_i (y_i - \underline{y})^2}}$$ *Equation 1: Spearman's Correlation ranking formula*

Hypothesis 1: *Collaboration with supra-affiliation can perform better quality research than intra-affiliation in Joint Knowledge creation.*

4.3.2. Impact of spatial Proximity on HEIs Collaborations

HEIs play a crucial role in the generation of knowledge, innovation, and collaboration in any society. The Ethiopian government recognizes the importance of HEIs and has made significant efforts to improve their quality and relevance in the past two decades. This paper ex- amines the current state of knowledge generation, innovation, and collaboration in Ethiopian HEI and provides a review of the relevant literature.

Research on Knowledge Generation in Ethiopian HEI Ethiopian HEI has made significant strides in knowledge generation, particularly in research and publication. The number of research articles published by Ethiopian researchers has increased significantly in recent years, with most of the publications coming from HEI (Ayenalem et al., 2022). Innovation in Ethiopian HEIs has been at the forefront of innovation, particularly in the areas of technology and agriculture.

However, innovation in Ethiopian HEIs is impeded by several factors, including limited funding and a lack of collaboration between HEIs and industry. Many HEIs in Ethiopia lack the resources necessary to support innovation and there is limited interaction between academia and industry. Additionally, the focus on research and publication rather than innovation has limited the potential for innovation in HEIs.

Collaboration between HEIs and other institutions, such as industry and government, is essential for the success of HEIs. Ethiopian HEIs have made some progress in collaboration, particularly around research. There are few research collaborations between Ethiopian HEIs and national, and international institutions, and the government has also supported such collaborations (Tadesse, 2014).

However, there needs to conduct research on collaboration and joint knowledge to be an improvement in collaboration between Ethiopian HEIs and other institutions. There is limited collaboration between academia and industry, and many HEIs lack the necessary resources to establish meaningful partnerships. Additionally, the focus on research and publication rather than collaboration has limited the potential for collaboration in HEIs. Hence, Ethiopian HEIs have made significant progress in knowledge generation, innovation, and collaboration. However, these areas still have significant challenges, including limited resources, lack of experienced researchers, limited funding, and limited collaboration between HEIs and other institutions. Addressing these challenges is essential for the continued growth and success of Ethiopian HEIs.

To address complex issues, third generation universities emphasize interdisciplinary research. These universities recognize that collaboration across multiple disciplines is necessary, and they create an environment that fosters collaboration. This involves bringing together researchers from different fields to work on common problems. This leads to new insights, approaches, and solutions that would be difficult to achieve through traditional disciplinary research alone. Interdisciplinary research centers, institutes, and graduate programs are often established at these universities to promote collaboration among researchers from diverse fields. These fields include engineering, biology, the social sciences, and the humanities. However, there are challenges in knowledge generation in Ethiopian higher education institutions (HEIs), including limited research resources, lack of infrastructure and equipment, shortage of experienced researchers, and limited access to research funding.

Despite these challenges, a collaboration between researchers and academic institutions is recognized. Efforts are made to promote interdisciplinary research and collaboration in Ethiopian HEIs. This

includes exploring incentives for professors to engage in knowledge creation and evaluating university management support. Co-authorship and co-affiliation among researchers can be used to create networks that provide insights into research collaborations and connections between universities and research institutes. This can contribute to knowledge creation advancement and transition towards third-generation universities.

The interest in social network analysis has experienced a substantial surge in recent times, leading to the advancement and utilization of network analysis methods and tools to uncover fresh patterns. The objective of this study is to investigate the role of supra-affiliation and intra- affiliations for joint knowledge creation and its transition towards 3GU.

The existence of more than one author (co-authors) in a patent document performs a co-inventorship (Pechter & Kakinuma, 1999). In this academic patenting, the inventors are associated with their universities or affiliations. A researcher should have only one affiliation, which in this case is a university. In addition, an inventor is also associated with a department in the university.

The diagram shown in Figure 12 depicts creating a university network using the co-authorship or co-affiliations among researchers. In this method, any publication that involves collaboration between two or more authors is considered a node in the network. For example, Research Publication R1, which has three inventors (R1, R2, and R3), forms a network of co-affiliations. R1 and R2 are affiliated with the same university, U1, while R3 belongs to a different university, U2. The formation of the researchers' network from co-affiliated research papers is illustrated in Figure 12 (b) When all researchers contribute equally to the research, a network of researchers can be created, either as a complete graph or with a one-to-all relationship among researchers. The number of connections in such a network, given n researchers, can be calculated as (n(n-1))/2 The Scopus

academic records contain information linking each researcher to their respective university or research institute in Ethiopia. Consequently, it is possible to construct a network of universities and national research institutes by leveraging the network of researchers. Figure 12 (c) illustrates the creation of a university network from publication records based on the research network for a specific example. The strength of the connections between universities and national research institutes is determined by aggregating the connections between researchers from two universities or institutes (Huang & Hung, 2018).

Proximity is the main determinant of innovation. This is specifically more important in knowledge-intensive organizational relationships. As the research considers the knowledge-based view of institutional collaborations for joint knowledge creation, there were few researchers who conducted similar research with mixed results on the relationship between distance and joint knowledge creation. For instance, Stephens & Cummings (2021) found that physical proximity and shared institutional affiliations positively influence knowledge creation and impact biomedical science collaboration. Capaldo & Petruzzelli (2014) found that geographic distance and organizational proximity have a contingent effect on the innovative performance of knowledge-creating alliances. Reinold et al., (2013) found that crossing national borders has a positive effect on joint scientific knowledge generation, but language barriers negatively affect the joint generation of commercially relevant knowledge. (Bergendahl & Magnusson (2015) suggests that input from other individuals improves the generation of novel and valuable ideas but does not directly address the relationship between distance and joint knowledge creation. Hence, most researchers argue that the relationship between distance and joint knowledge creation is complex and contingent on various factors, including the type of collaboration, the nature of the knowledge being generated, and the

organizational and cultural context of the collaborators. It has been shown that proximity is a major determinant of innovation (Amin & Wilkinson, 1999; Oerlemans et al., 2001), and several dimensions of proximity, such as geographical, organizational, cognitive, social, cultural, institutional, and technological, have been studied in previous studies as relevant to interorganizational collaboration (Knoben & Oerlemans, 2006). As a result of the proliferation of proximity dimensions, ambiguity has been introduced into the concept of proximity, which has the risk of diluting its significance and impact in the long run. The conceptual overlap between the dimensions also hinders empirical research, making it difficult to compare them meaningfully.

Therefore, this is aimed at exploring the case of Institutional collaborations in Ethiopian HEIs and NRIs by formulating the hypothesis based on the spatial proximity of distance on the quality of the collaborations as follows:

Hypothesis 2: *The longer the distance between the institutions, the better the quality of Joint Knowledge creation.*

4.4. Methodology

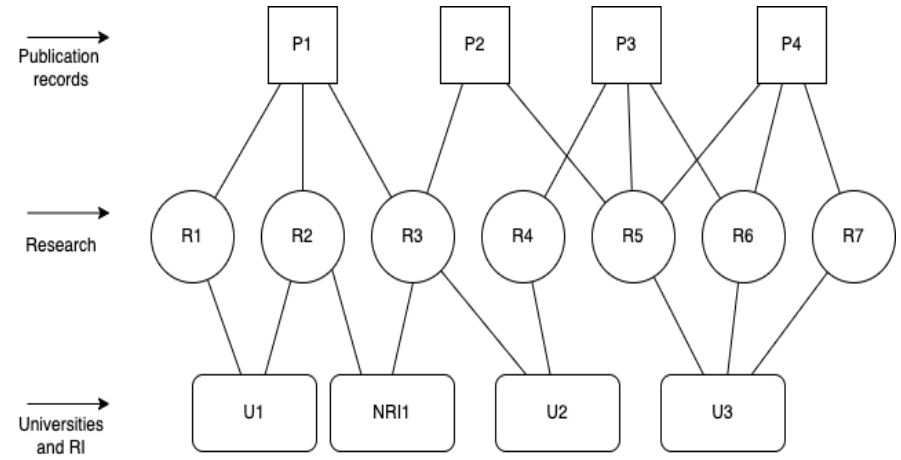
4.4.1. Dataset Preparation

In this study, Ethiopian academic and research institutes affiliations data were collected from the Scopus database with a social network analysis approach that considers the spatial proximity of affiliations to explore the role of institutional collaborations of joint knowledge creation for innovation and institutional transitions. As part of this study, a social network analysis of Scopus publication data is performed. Journals are selected as the standards for developing countries are more accessible to Scopus databases. For this analysis, we used 13 years of publication data extracted on a yearly basis with affiliation with Ethiopia. At the initial stage, 48,600 publications lists were extracted from 2010 to 2022 with at least one author affiliation as "Ethiopia".

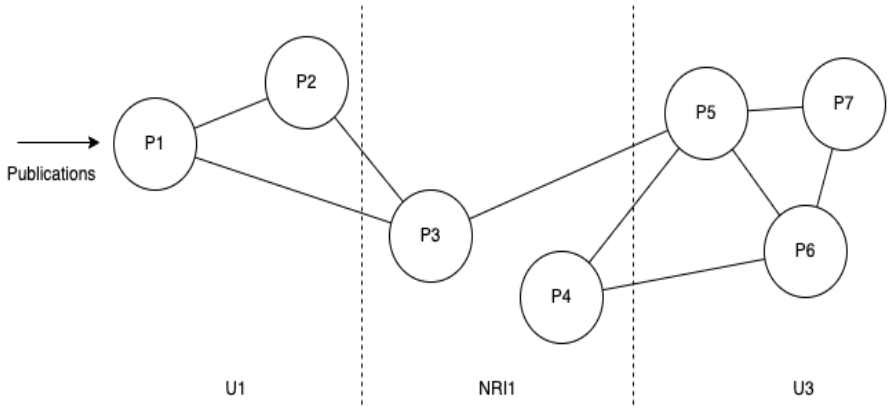
The key element in citation-based analysis lies in the quality of the data, which involves the selection of an appropriate data source and the thorough cleaning of bibliographic metadata (Glauber et al., 2015; Wollersheim et al., 2015). For this study, we have chosen Scopus as our primary data source. Scopus is widely acknowledged as one of the most comprehensive databases for scholarly work, indexing thousands of journals, including highly reputable ones (Dahlander & Gann, 2010). Moreover, Scopus is considered suitable for overview analysis due to its wealth of citation data for documents. In this study, we retrieved data from the SSCI databases as the International Research Collaboration falls within the realm of social sciences.

As part of the evaluation of joint knowledge creation and collaboration between academic and research institutions, the next study explores the role of collaborations between Ethiopian HEIs and research institutions as a

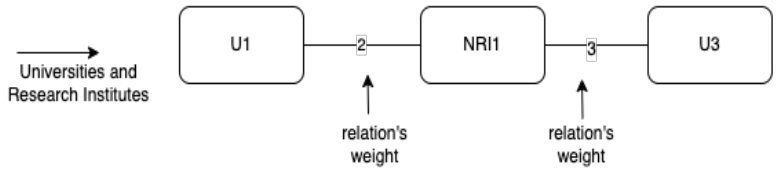
knowledge generator. The publication data are taken from the Scopus database for this work. Here, all publications were collected from Scopus, where at least one author is from Ethiopia. Within the expanded search mode of the Scopus database, which allows you to access up to 20,000 records at a time, data of 48,000 publication records were gathered from 2010 to 2022. The advanced search retrieved publications with at least one affiliation name "Ethiopia" irrespective of the subject matter. These publications were collected and downloaded in comma-separated values (CSV) file formats.



(a) Knowledge graph of co-authorship of research paper.



(b) Co-authorship context with affiliation domain



(c) A university to university and University to National Research Institute projection network based on co-affiliation research network.

Figure 12: The construction of a university network based on co-authorship relations in Research.

4.4.2. Spatial Distances

In the globalized economy within digital transformations geographical proximity remains relevant. Geographic proximity is under research, and researchers are working on the extent to which collaborations may or may not be affected by geographical proximity. In the study of joint knowledge generation, based on published data. Therefore, we need to check the distances between the different affiliations, in kilometers. This covers the distance between Ethiopian institutions and their individual cooperation patterns. In this regard, the co-authors' exact geographical positions have been conducted as follows:

As a first step, we used the detailed information of Ethiopian Higher Education Institutes (HEIs) and National Research Institutes (NRIs), since it is possible to filter out everyone's specific address based on the details provided by the institution. After discovering the affiliation lists, unique publications were screened for additional affiliation lists. Then the latitude and longitude (X and Y) coordinates of the institutions were collected. This process is repeated to determine the final affiliation lists. Thus, we have used the geographical proximity of 1000 KM to include all affiliation institutions.

We found 959 km between Kabri Dehar and Mizan Tepi universities as an example. Second, it is assumed that any collaboration further away than 1000 km is no longer considered regional. Therefore, more than 1000 km no longer depends on the cooperation activity of Ethiopian HEIs and NRIs. As each co-author, as well as each Ethiopian HEI, got individual latitude and longitude, all distances could be calculated and assigned using the further self-written R-Program. The Haversine theorem does the calculation itself (Gellert et al., 2018).

$d = 2r\ arcsin\left(\sqrt{sin^2\left(\frac{\varphi_2 - \varphi_1}{2}\right) + cos\varphi_1 . cos\varphi_2 . sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)}\right)$, *Equation 2: Spatial measurement affiliations*

Where:

d=distance between two points

r = earth's radius

φ_1 = latitude of point 1

φ_2 = latitude of point 2

λ_1= longitude of point 1

λ_2= longitude of point 2

4.4.3. Strategy for Hypothesis Testing

The geographical distance impacts knowledge flow and collaborations, knowledge acquisitions, knowledge generation, and the flow of knowledge between and within organizations. The following section describes the strategy to test the hypotheses Hypothesis 1 is about measuring collaboration between authors or researchers from the same affiliation or from different affiliations. That means researchers research individually or in groups for research publications and collaborations. The research uses Spearman's correlation to rank the two observations between supra-affiliation and intra-affiliations using the formula:

$p = 1 - \frac{6\sum d_i^{\ 2}}{n(n^2 - 1)}$ *Equation 3*

To ensure the normality of the data, the Anderson-Darling estimation normality test was applied for the goodness of fit. According to (Anderson & Darling, 1954; Boos, 1982), the cumulative probability of the standard normal distribution (snd) was checked and the result is compared to 2.492. After data normality is confirmed, the two groups, intra-affiliations and supra-affiliations, data cannot be ensured, and then the Mann-Whitney U test is performed. As the study is focused on nonparametric data we can apply

for the two samples Mann- Whitney test or Wilcoxon rank tests, which helps to compare the distribution between the groups.

To answer hypothesis 1, the correlation between the quality of research in terms of the number of citations between the supra-affiliation and intra-affiliation were conducted using Spearman's correlation coefficient (p) for ranking between the two. As the distance between the results shows the supra-affiliation, the p-value ($p<2.2e{-}16$) is positive and very small, closer to zero, indicating that as x increases y decreases.

Hypothesis 2 explored whether geographic distance has an impact on the collaborations of institutions referred to as institutional spatial proximity based on the spatial data of the institutions' affiliation coordinates taken from Google Maps. The greater the distance, the greater the correlation between the distance and the citation using the Mann-Whitney test applied.

4.5. Results

4.5.1. Descriptive Results

Once data was imported into the R program, it was filtered repeatedly for additional processing. The data was cleaned by matching them with lists of HEIs and national research institutes to establish their affiliations. Consequently, the final lists of 26,230 unique publication records were generated, as illustrated in Figure 4.2. 4.2 shows the yearly publications on the creation of joint knowledge from 2010 to 2022 showing a steady increase in the number of joint research and interdisciplinary research between various researchers from selected affiliations. From this above chart, the analysis uses 13 years of publication data where at least one author is from Ethiopian universities and research institutes. In the first three years from 2010 to 2012, the yearly publications were much less than 500, whereas slow progress of yearly publications was observed. In the last recent three years, the joint publication and collaboration show significant increases as shown in Figure 14.

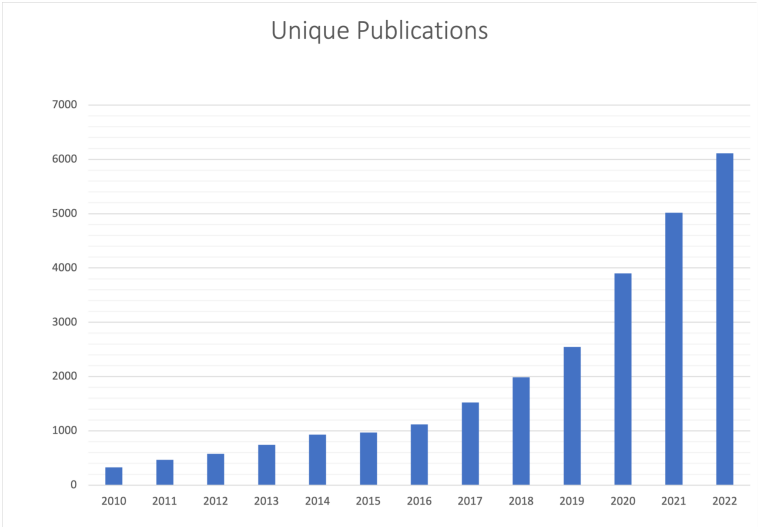


Figure 13: Annual Publications of Ethiopian by Number

Years	0-20	21-60	61-100	101-200	>201
2010	176	113	22	13	1
2011	279	141	37	9	0
2012	356	165	37	18	0
2013	448	240	36	15	2
2014	588	279	49	11	7
2015	612	297	41	11	10
2016	745	313	43	9	11
2017	1095	367	24	17	21
2018	1610	341	19	11	17
2019	2206	302	19	11	8
2020	3670	188	22	11	7
2021	4904	100	5	2	4
2022	6111	3	0	1	0

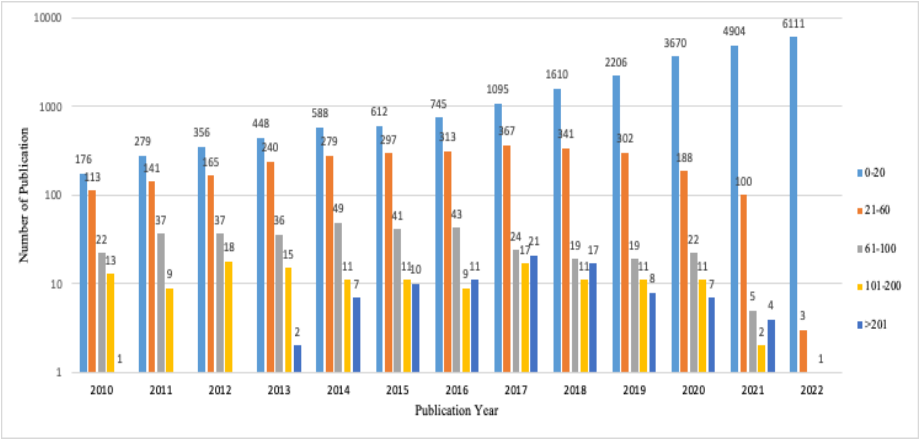


Figure 14: Annual Publications with their number of citations

As shown in Table 13 and Figure 14, joint yearly publications from 2010 to 2022 are classified according to the number of citations they have received, which are indicators of the quality of research performed. The first column shows citations below 20. It should be noted that the second, third, fourth, and fifth columns indicate citations in the ranges of 21-60, 60-100, 101-200, and more than 201.

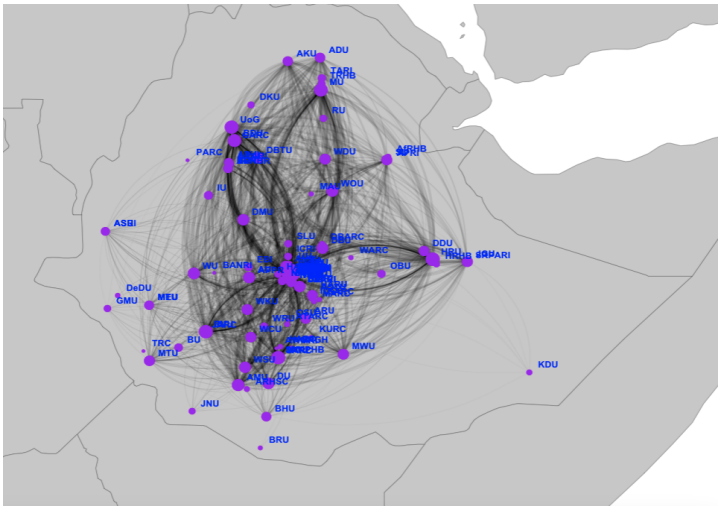


Figure 15: University and Research Institutes Publication Network of Affiliations of Ethiopia geographic map from 2010-2022

*The size of the nodes represents the degree centrality of the institutions, and the thickness of the lines represents the co-occurrence frequency between institutions.

Many different institutional affiliations exist among the researchers involved in the joint research generations, as shown in Table 4.5. Institutional affiliations are primarily concentrated in the central part of the country where the capital city and other academic institutions are all located within a 250km radius. There is a strong correlation between the size of the dots at the edge and the presence of more institutional collaborations. Descriptive statistics of intra and supra-affiliation of Ethiopian researcher collaborations for research.

Table 19: Descriptive statistics of Intra-affiliation and Supra-affiliation

	N	Min	Median	Mean	Max	SD
Supra-affiliation citation	121,093	0.0	17.0	253.5	7969.0	642.4246
Intra-affiliation citation	141,400	0.0	3.0	30.17	5732.00	198.0438

* SD far more higher than the mean indicates that the data is over-dispersed or not normal in its distribution -> this is the reason why we use different tools for testing the hypothesis.

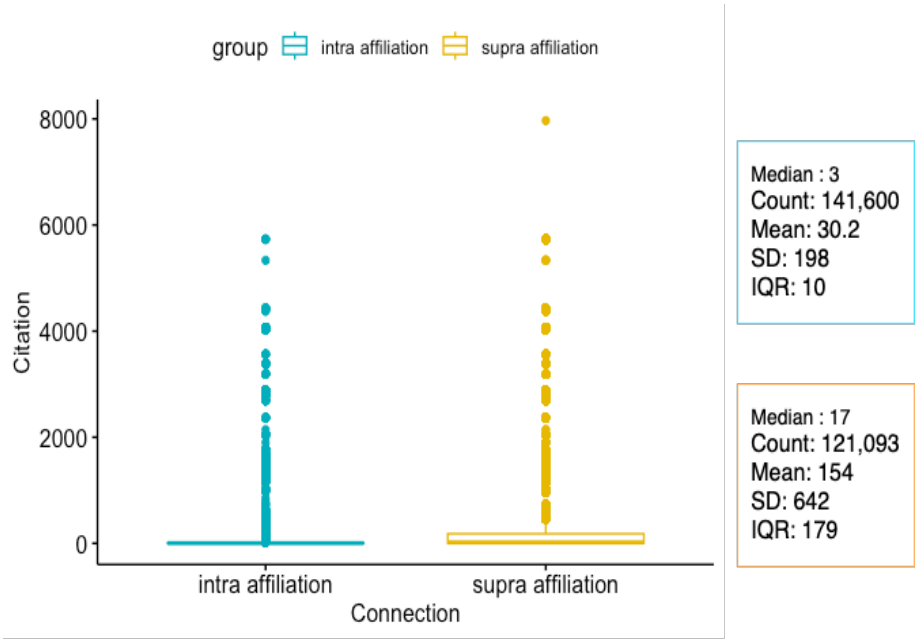


Figure 16: *Plot of the publication's activities in all Ethiopian HEIs & NRIs, Intra-affiliation vs Supra-affiliation 2010-2022(Created by means of R- Program).*

Figure 16 shows the comparison of two groups of data intra-affiliation and supra-affiliation connectivity of Ethiopian higher education institutions using a boxplot. The mean of supra-affiliation connection data is higher than intra-affiliation connection, but so is the standard deviation. To ensure the

difference between the two groups of data, an equality distribution test is required. The result of the test is described in the subsection below.

4.5.2. Validation of Hypotheses

As the result shown in Figure 16, the median for Supra-affiliation is greater than the intra-affiliation showing that there is better quality research conducted when there is collaboration in supra-affiliations.

Hypothesis 1 explores the difference in citations received by articles authored by at least two Ethiopian researchers in comparison to their collaboration with intra-affiliation or supra-affiliation partners. To test this hypothesis, two groups' data distribution test is utilized. This study utilizes the Mann-Wheitney-Wilcoxon rank sum test. This test is chosen because the normality of data distribution of those two-group data cannot be ensured. Some other tests, such as the Kruskal-Wallis test can also be used, but the Mann-Wheitney-Wilcoxon is dedicated to two groups of data while the Kruskal-Walis test is for more than two (citation). The result of this test shows the p-value < 2.2e-16, which means that the equality of the two-group data is rejected. Since the mean and the median of supra-affiliation connectivity data is higher than the intra-affiliation data, it is statistically proven that the citations earned by articles written by supra-affiliation collaborations are higher than those written by intra-affiliation collaborations.

Hypothesis 2 is about whether the distance of collaborations influences the number of citations earned by the research articles written by at least two Ethiopian researchers. In this case, only supra-affiliation connectivity is calculated to see the distance variable. A Spearman's rank correlation test is used when looking for new ideas to create values in longer distances (Myers & Sirois, 2004; Tushman & Nadler, 1986). The result shows p-value

< 2.2e-16 with S = 2.2635e+14. It means the correlation is positive and significant. Hence, hypothesis 2 is supported.

The open innovation theory emphasizes collaboration with external partners and the creation of joint knowledge with them and its sharing as a means of fostering innovation. HE institutions can apply this theory by engaging in strategic partnerships with industry, the government, and other educational institutions. By collaborating with external stakeholders, HE institutions can leverage their expertise, technologies, and resources to accelerate digitized solutions and practice adoption. They can also embrace open educational resources (OER) to make education more accessible and promote collaboration among educators and learners. There are various ways higher education institutions can foster innovation and empower the community. This is done by involving students, faculty, and staff in digital initiatives co-creation, and co-design. Cultivating an entrepreneurial mindset among stakeholders, equipping them with digital skills, and establishing open innovation platforms are also critical aspects of digital leadership in HE institutions.

4.6. Implications

As a result of analyzing institutional collaborations between researchers with spatial dimensions and SNA, the findings indicate the following.

The first hypothesis examined the institutional collaboration on the hypothesis testing confirmed that supra-affiliation outperforms intra-affiliation. It is apparent from this that by changing the way R&D and innovation are oriented for competitive advantage and globalization, the geographical distance between the collaborating authors has less impact. Thus, Ethiopian HEIs can collaborate with other universities and NRIs to improve their research outputs and commercialize them. Similar results were also reported by researchers like (Li-Ying et al., 2022; Lovakov et al., 2022) research collaborations improve the quality of the research output for commercialization. The research collaboration does not occur in academic/research, but the level or extent of knowledge sharing among the actors varies between institutions and countries (Fari & Ocholla, 2016).

Based on the second hypothesis, the distance between the two collaborating researchers does not have statistical significance as showing the more the distance the better the research quality conducted by collaborating researchers. This indicates the more the collaborators from the far distance the better the quality of the research. A study by Carillo et al., (2013) supports this view further by highlighting the fact that the authors work with a number of interdisciplinary researchers from different institutions located in different geographies.

A theory of inter-organizational relationships that focuses on the formation of relationships between organizations and proposes alternative

theories about relationship formation (Oliver, 1990). It focuses on the environmental context of interconnectedness. The organization's survival and performance depend on transaction flows and the linkage between them and other organizations in its environment. They suggest that alternative theoretical perspectives on relationship formation provide essential but only partial insights into why organizations enter relationships with one another. Relationship formations are influenced by a variety of inter-organizational determinants, including necessity, asymmetry, reciprocity, efficiency, stability, and legitimacy.

Based on the findings, it is suggested that joint knowledge generation and institutional collaboration contribute to institutional transition through quality research and innovation. The theory of innovation, interdisciplinarity research, and the theory of inter-organizational relations supports institutional collaboration for institutional transitions.

4.7. Conclusions

This essay explores Ethiopian researchers' institutional collaborations for joint knowledge creation for interdisciplinary research. This is to contribute to innovation and transition toward the 3GU. Here the geographical proximity of researchers was considered to determine whether intra-affiliation and supra-affiliation have better performance for interdisciplinary research. Institutional collaborations are crucial to innovation. Citations were used to measure their performance and quality, with more citations showing better results.

Scopus database was used to check the findings for Ethiopian affiliated researchers on institutional collaboration and performance. Dataset cleaning and screening were conducted to prepare the data and descriptive statistics

were conducted through boxplots for intra-affiliation and supra-affiliation. After performing non-parametric tests using Mann-Wheitney- Wilcoxon was performed to determine if supra-affiliations outperform intra-affiliations and it is statistically proved by $p<2.2e-16$. According to the results, supra-affiliation citations outperformed intra-affiliation citations. The second hypothesis was also tested to determine whether the collaborations of the two researchers are influenced by the distance between them. The significance was evaluated using Spearman's rank correlation, with $p=2.2e-16$ and $S=2.2635e+14$. Therefore, the hypothesis is supported and the more distance there is, the better the quality of the research.

The results show that the supra-affiliation performance is better than intra-affiliations showing that the collaboration with other institutions is better performing than within their institutions in the case of Ethiopian researchers. Prior studies also support that researchers who collaborate more at the national level tend to have better performance than their national colleagues (Abramo et al., 2011, 2018). On the other hand, it also shows that the distance for institutional collaboration yields better performances and contributes to innovations and improving the quality of knowledge generated. This is also supported by (Autant-Bernard et al., 2007) that the geographical distance less matters than the social distance for R&D collaborations.

A study by Ponds et al., (Ponds et al., 2007) suggests that geographical distance impacts institutional joint research collaborations. It also found that collaborations between different types of organizations are more geographically localized than collaborations between similar organizations due to institutional proximity. Bignami et al., (2020) concluded that collaborations in basic science and core knowledge areas are more negatively affected by geographical distance than collaborations within

clinical science and exploration knowledge areas. Hoekman et al., (2010) found that physical distance still affects research collaboration across European regions, even as territorial borders are removed. Reuer & Lahiri (2014) found that the likelihood of alliance formation is negatively related to geographical distance, even within clusters, but this effect is diminished when firms have prior ties, operate in the same product market, or possess similar technological knowledge. Overall, these papers suggest that geographical distance plays a role in institutional joint research collaborations. However, the extent of this impact depends on the type of knowledge being transferred and the specific context of the collaboration.

Enhancing innovation and quality of research through interdisciplinary research, this study investigates institutional collaborations of scholars with at least one author affiliated with Ethiopian Higher Education Institutions and NRIs in geographical proximity for joint knowledge generation. By improving their innovations and institutional collaborations universities are striving to respond to the global knowledge economy. The models proposed for this study are limited to institutional-level innovation and collaborations to transition toward 3GU.

Interdisciplinary research collaborations between researchers to improve the quality of research for the commercialization of university research outputs to overcome funding challenges. As part of this study, we explore the research gap related to how institutional collaborations between academic and research institutions generate quality research that can be commercialized and improve innovations that contribute to the national innovation ecosystem and contribute to the socioeconomic conditions of the regional society through the collaboration of academic and research institutions with industries, spinoff companies, and techno startups.

Chapter 5: Discussions and Conclusions

5.1. Summary

Ethiopia, a country with over 120 million people and more than 30 million students enrolled in schools at different levels needs attention to prepare the upcoming generation with innovative education that equips them for global knowledge economy and globalized competitions. This research explores the potential of transition toward third generation universities by exploring the role of digital leadership and organizational capabilities for innovation and institutional collaborations for joint knowledge creation. As a result of further exploration of organizational capability and digital leadership, the research aims to assess the challenges and prospects of 3GU in assessing organizational capability and digital leadership. Furthermore, the study explored the collaboration between Ethiopian higher education institutions and national research institutes to promote innovation, interdisciplinary research, and quality research. As a result, this facilitates the transition toward the 3GU.

This work focuses on two studies. The first study focuses on exploring the role of digital leadership and organizational capabilities in innovation. It is very important that innovation and education be linked to or nurtured for the upcoming labor market to link or nurture the next generation. As the first study exploring innovation and education, the study used SEM methodology to investigate the possible transitions and the contributions of leadership. This was done by creating a conducive school environment for innovation and commercialization of research outputs. The second study also investigates the institutional collaborations of research publications with spatial dimensions. It checks the impact of spatial distance on joint publication and citation for improving research quality using SNA techniques.

Researchers suggest that patents, citations, and innovations are windows into the knowledge economy (Jaffe & Trajtenberg, 2002). An emerging knowledge economy based on competent human resources from HEIs requires digital leaders and organizational capabilities to drive this forward. The transition to a knowledge economy requires institutional collaboration and innovation. As for the innovation performance of higher education institutions and their collaborations in research and innovation, universities in developing countries face several challenges, including the availability of adequate research and information technologies infrastructures, university cultures, leadership, and adequate facilities supporting universities' third mission. To contribute to institutional collaboration on knowledge generation and innovation in Ethiopian HEIs, the following section summarizes the findings of both studies separately to contribute to collaboration and innovation.

5.3. Implications

5.3.1. Theoretical Implications

From a theoretical perspective, this research dissertation provides several implications based on the two research essays. Using spatial dimensions and digital leadership, the study examines the role of institutional collaborations between academic and research institutes. Based on these findings, the following section discusses the overall theoretical implications for domain researchers. To further understanding and extend this research work, this is necessary.

First, this study examines the conceptualization and understanding of HEIs' innovation performance using empirical studies of Ethiopian HEIs. This is from a leadership and governance perspective. This is mainly to show innovation and education is underexplored in literature. According to open

innovation theory and inter-organizational relationships theory, academic performance in innovation and R&D helps the transition to HEI innovation and commercialization.

Secondly, leadership theories led to digital leadership as a framework for exploring HEI innovation for the transition to knowledge economies. The development of the upcoming leadership theory for digital leadership is given due importance since these theories are interconnected with strategic management, knowledge-based views, and resource-based views of dynamic capabilities.

Third, factors determining HEI innovations were explored in various literature to develop the proposed hypothesis for this study. There are still areas to align innovation and institutional innovation cultures based on each HEI's digital transformation roadmap. It is essential that these roadmaps align with national innovation ecosystems.

Fourth, among the factors that underlie innovation performance at higher education institutions, digitalization and organizational capabilities were identified as critical factors that enabling HEIs to become digital leaders through digital transformation. Leadership and digital competence also contribute to the transition toward the third generation university to mobilize the resources of academia/ research and technology transfer toward entrepreneurs, startups, and spin-offs at the University level.

Lastly, institutional collaboration in knowledge creation using spatial dimensions was also examined to determine whether the supra-affiliation outperforms the intra-affiliation collaboration using research citations. And also, whether the distance between two collaborating researchers impacts the quality of research in Ethiopian HEIs. This is for institutional collaborations toward innovation and institutional transitions. Both were found significant,

and institutional collaboration plays a vital role in enabling quality knowledge creation and contributes to institutional transformation.

5.3.2. Policy Implications

Universities need institutional innovation to be competitive. Here are the implications of the research for Ethiopian higher education institutions in terms of institutional innovation and transition.

First, in this study, we analyze how digitalization capabilities contribute to HEI institutional innovation by demonstrating how they work together with digitalization capabilities. The results show that HEIs have better ICT infrastructure than National Research Institutes and institutional innovation is fragmented.

Second, the study provides novel ways of comparing innovation studies in the education sector with other sectors. This helps policymakers and educators understand how the education system changes over time. It also indicates the extent to which leadership type influences innovation success in HEIs and NRIs for innovation integration and coordination in national innovation systems.

Third, university leaders and policymakers can use it to focus on higher education institutions' innovation and the role they play in that innovation. University administration needs to pay special attention to institutional and technological startups.

Fourth, there is an inadequate understanding of the university's third mission. In addition, there is an inadequate understanding of the university's innovation and innovation performance in relation to the third mission. This leads to a lack of adequate resources, both technical and financial, within the

technology transfer offices to be able to execute the commercialization of technology outcomes derived from research.

Fifth, there is a need for further research on university innovation systems and technology transfer and commercialization of outcomes. Evidently, that university patenting is at a very early stage and is not properly organized at the moment. Regional innovation ecosystems contribute least to regional integration between universities in the regions. University innovations contribute to society's economy and regions. Provide insights for researchers and leaders on the importance of innovation and digitalization for university competitiveness.

5.4. Contributions

This research work consists of two studies focusing on innovation and innovation performance for the transition of Ethiopian HEIs towards 3GU. It uses the role of digital leadership and organizational capabilities for innovation and institutional collaborations toward joint knowledge generation for institutional innovation with spatial dimensions for overall contribution toward the institutional transition.

In the first study, data is collected from 11 higher education institutions in Ethiopia to conduct an empirical study. It investigates the role of leadership and organizational capabilities toward innovation and transition toward 3GU. Among the survey participants were members of the university's top, middle, and lower management, lecturers, and senior ICT administrators. They could understand digitalization capabilities in terms of data, infrastructure, and business processes at their respective universities. The study was collected using a Google form survey and analyzed with PLS-SEM and CB-SEM using SmartLLS4. An analysis of publications from the Scopus database with spatial dimensions focuses on institutional collaborations between researchers

affiliated with Ethiopian academic and research institutes. The study contributes to theoretical and practical knowledge as follows:

First, this study extends the theory of leadership and organizational capabilities with HEI digitalization capabilities toward innovation performances. Innovation performance research in HEIs is nowadays becoming vital due to the low level of digital transformation of HEIs compared to other sectors. Previous research has largely focused on studying digital leadership at the senate and secondary school levels during the emergence of the Covid-19 reform era. It has been found that no empirical research has been conducted on the role of digital leadership and organizational capabilities towards the transition to 3GU, which is one of the main contributions made by this study.

Second, the study further contributes to the literature through the integration of digital leadership and organizational capabilities toward the transition to 3GU. It was also observed that digital leadership acted as a moderator between leadership styles and innovation performance in this study. The empirical evidence was verified by evaluating the level of moderation, which shows whether it is strong or weak. This would also help researchers in similar areas in the future to consider studying the transition of HEIs towards 3GU using moderating factors and digital leadership.

Third, the study further contributes to the literature by integrating of theories from leadership, strategic management, dynamic capabilities, knowledge-based view, and resource-based views together for an effective and efficient transition of HEIs toward 3GU.In this way, the proposed research model can be developed by bringing together the knowledge of these different theories. As a result, this contributes to the body of knowledge through theoretical lenses which will help accelerate the transition toward a knowledge-based economy.

Fourth, the study contributes to academic and research collaboration among Ethiopian universities and research institutes. This study contributes to the body of literature by extending research conducted from the perspective of spatial dimensions. No research has been conducted on Ethiopian soil to investigate the contribution that joint knowledge generation makes towards innovation and the national innovation system so far. This can serve as an initial step toward building a centralized innovation ecosystem in Ethiopia.

Fifth, practical contributions for policymakers and governments towards improving the digitalization capabilities, digital literacy, and innovation performance of the HEIs and national innovation systems. This will contribute to the regions' sociotechnical and socioeconomic transitions. This study provided recommendations for formulating national and institutional policies to improve innovation and innovation performance based on an empirical study conducted by public higher education institutions.

Finally, the practical contributions to the need for institutional collaborations in joint knowledge/technology creation and dissemination with research institutes and industries. This research also paves ways to further call for researchers to conduct extension or similar research in the areas of innovation and innovation performance. This will enable them to establish regional innovation systems and HEI transitions towards 3GU.

5.5. Limitations and Future Research

The two studies in this research have several shortcomings that need to be acknowledged. HEIs' innovation performance is impacted by digital leadership and organizational capabilities in the first study, which is an empirical study. In this study, out of the leadership styles, digital leadership was constructed using the most common three leadership styles for measuring digital leadership. This may affect the ability to comprehensively collect all the digital skills and competencies of the leadership. This study focuses only on academic leadership, excluding the professors, students, and administration from the university community, so making general conclusions is difficult.

In the first study, innovation originated from companies, firms, or other sectors. In academic institutions, innovation definitions differ based on HEI literature. Due to there being no framework designed for digital leadership, the study used a proposed model to evaluate digital leadership through the blended and most common leadership styles from literature. Measurement items are also adopted from the common literature. There are only a few studies that evaluate digital leadership's role in innovation performance in the education sector after the Covid-19 outbreak. The findings are specific to limited HEIs in Ethiopia to explore the 3GU transition potential. Hence the empirical study provides insights into the transition to 3GU and encourages further studies on proving generalizations of the model. To begin with, the control variables are not statistically tested because there is limited information available to draw conclusions from them. The comparisons of CB-SEM and PLS-SEM have some differences in hypothesis support as the analysis shows, which limits the ability to draw conclusions and needs further research.

In a second study, social network analysis was used to analyze how spatial dimensions of publications from the Scopus database are used to analyze how

institutional collaborations of researchers generate knowledge. The study findings were also hampered by a low publication rate and insufficient interdisciplinary involvement from different institutions. It recommends using more databases in future studies and limitations on the affiliation information due to low standards on using affiliations in Ethiopian HEIs. Finally, future studies are also anticipated to further expand the use of qualitative studies for improving institutions such as HEIs and NRIs. In addition, they are expected to expand the work further to national innovation systems through partnerships with industries. In addition, they are expected to integrate patenting trends from universities and industries.

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Appendix 1

Dear Sir/Madam

I'm a Ph. D candidate of TEMEP conducting a survey as part of my dissertation on **"The Role of Digital Leadership and Organizational Capabilities to innovation performance for HEIs transition towards 3GU " for** Selected Ethiopian Higher Education Institutions (HEIs). Kindly spare a few minutes of your time to respond to the questionnaires.

This survey questionnaire is designed to assess the perception of the Roles played towards the transition to 3GU by Digital Leadership and Organizational capabilities through innovation performance. The respondents of this questionnaire are university leadership (Presidents /V/President, Deans / Vice-Deans, Department/ Program Heads), IT Leaders, and Lecturers from Ethiopian HEIs. Data collected by this survey is anonymous and used to address the study on exploring the Role of digital leaders and Organizational Capabilities towards the transition to 3GU via examining the Innovation performance of HEIs. It also helps the Ethiopian HEIs to make policies that improve their leadership, organizational capabilities, innovation performance, and Joint Knowledge generation.

Thank you.

Faithfully, Yours

Kassahun Gelana

Part I: Demographic Information:

Variable	Characteristics	Group
	Name of HEI	----(a list of Ethiopian HEIs)
	Gender	Male, Female

Age group	Less than 30, 31-40, 41-50, 51-60, more than 60
Years of Service in Higher Education	0-5, 6-10, 11-20, and more than 20
Years of service as Management	1-5, 6-10, 11-20, and more than 20
Job Level/Management Level	Top Management, Middle Management, Lower Management, Lecturer, IT Leaders
Academic Level	Ph.D. and above, master's degree, BSc/BA Degree
Your Academic Field	Commerce and Management, Engineering and Natural Science, Social Sciences and Humanities, and Medical and Health Science

Part II: Main Questionnaire

Constructs	Indicators	The Questions	Source
Transformational Leadership	TRF1	I work for the sake of collective interests at the expense of personal interest	
	TRF2	I talk about important values and beliefs	
	TRF3	I Emphasize the importance of collective mission	
	TRF4	I actively talk about what matters must be done	
	TRF5	I will not take the fruits of others as their own	
	TRF6	Allowing employees to understand the development prospects of organization/departments	
	TRF7	I Re-check whether the key assumptions are correct	
	TRF8	Consider different points of view when solving problems	
	TRF9	I recommend completing the task in new ways	

	TRF10	Guide employees see the problem from different angles
Transactional Leadership	TRC1	I focus to solve problems, misunderstandings, and complaints as a “fireman”
	TRC2	I guide staff to focus on the errors
	TRC3	Focus on situations that are not in compliance with the rules and obligations
	TRC4	I intervene only when the problem becomes serious
	TRC5	I take action only when failing
	TRC6	I Think that if something is not destroyed, it is necessary to repair
	TRC7	I take action only when the problem becomes long term
Authentic Leadership	AUL1	I’m aware of myself including weakness and limitation and acknowledge them and seek feedback from others
	AUL2	I’m transparent while communicating with others and encourage others to do the same.

	AUL3	I have strong integrity and consistently act with principles	
	AUL4	I take sufficient opinions and viewpoints prior to making important decisions	
Digital Leadership	DLD1	My Leadership understands the changing environment in digital technologies	(Claassen et al., 2021; Promsri, 2019; Sasmoko et al., 2019)
	DLD2	My leadership believes the digital transformation influences your organization	
	DLD3	I believe my leadership have clear vision and purpose about the digital transformation	
	DLD4	I believe that my leadership communicate the vision to all level of employees of the organization	
	DLD5	I believe my leadership understands the consumer needs and changes	
	DLD6	I believe my leadership understands the effect of digital transformation on the consumers	

DLD7	My leadership is agile, flexible, and adaptive to rapidly changing environment	(DasGupta, 2011; Whitehurst, 2015)
DLD8	I believe my leaders are establishing agile work for digital transformation	
DLD9	My leader create atmosphere to try new things without hesitating failure	
DLD10	My leader encourages to collaborate across boundaries to succeed for digital transformation success	
DLD11	My leader can take advantage of the opportunities offered by ICT, especially the Internet	
DLD12	My leader can ensure more efficient performance of different types of digital organization (ERP, e-Protocol, CRM)	
DLD13	My leader can identify, research, and exploit opportunities for new ways of conducting educational processes (eg e-learning, video conferences, webinars)	
DLD14	My leader can create research-educational partnerships with corresponding structures abroad, taking	

		advantage of the opportunities provided by the Bilateral and Multilateral and others.	
	DLD15	My leader can manage innovative ideas and inventions (eg patents) by leveraging ICT developments	
	DLD16	Which of the following digital technologies can you/your leader take advantage of and consider essential for a Leader: Big Data; Cloud Computing; Mobile App; Complex Business Systems; Web Development and Tools; Digital Architecture; Security Skills; ERP Systems; social media	
Organizational Capabilities	OCA1	Our university has an effective leadership capability to provide direction and guidance for the institution, including the ability to set a vision and strategy, communicate effectively, manage resources, and build relationships with stakeholders	(Gold et al., 2001; Goldstein, 2010; Hoonsopon & Ruenrom,
	OCA2	My university has resource management capabilities, including a budget, facilities, equipment, and human resources	

	OCA3	My university has innovation and change management capabilities that adapt to changing landscape.	2012; Lewrick et al., 2012)
	OCA4	My university has governance and compliance capabilities, including internal policies, procedures, structure, processes, and systems	
	OCA5	My university has teaching and learning capabilities including effective course delivery, student assessment, and provide support services	
	OCA6	My university has research and development capabilities including securing funds, managing research projects, and disseminating research findings	
IT Infrastructure Integration (DIT)	DIT1	Our university have an IT infrastructure integrated across the organization	(Ahmad et al., 2021; Promsri, 2019;
	DIT2	Our university have a centralized IT infrastructure that supports all department	
	DIT3	Our IT standardized across the organizations	

	DIT4	Our IT systems integrated to provide a seamless user experience	Schneider & Kokshagina, 2021)
Business Process Integration (DBP)	DBP1	Our IT systems continuously reviewed and improved to enhance performance and security	
	DBP2	Our business processes are properly mapped into our organization	
	DBP3	Our business processes documented and communicated across the organization	
	DBP4	Our business process standardized across the organization	
Data Integration (DDI)	DDI1	Our business processes fully automated to eliminate manual intervention	
	DDI2	Our business process continuously reviewed and improved to enhance efficiency and effectiveness	
	DDI3	Our organization (university) have data collected, stored, and processed properly	
	DDI4	Our university have centralized data repository and accessible for all departments	

Digitization Capabilities (DCA)	DCA1	The data we have in our university is highest standard of quality for decision making	
	DCA2	The data in our university is real time and accessible across all work units	
	DCA3	We have a mechanism to use the data analytics to make organizational decisions	
Innovation Performance (IPF)	IPF1	My university has Innovative curriculum/Academic Program	(Antonopoulou et al., 2021a; Claassen et al., 2021; Tierney & Lanford, 2016; Vidicki et al., 2023)
	IPF2	My university has structure that empowers the academic workforce	
	IPF3	Is the Institutional System encouraging the creation and presentation of applied knowledge	
	IPF4	Does the University have a mechanism for the Development of Entrepreneurial culture?	
	IPF5	Does Leadership and governance work towards economic growth?	
	IPF6	My university has a mechanism for Knowledge spillover	

IPF7	My university has Knowledge collaboration and commercialization to markets
IPF8	My university has a strong strategy for globalization
IPF9	My university has strong publications, citations, and awards in producing knowledge
IPF10	My institution has strong R& D Expenditure
IPF11	My university has strong mechanism towards patent registration
IPF12	My university has a mechanism in a spinoff or in transferring knowledge and technology into commercialization.
IPF13	My university has strong in collaborations with industries and other organizations
IPF14	My university has strong techno-starters and incubations

Part III: other Additional Questions

Characteristics	**Source**
Institutional IT strategy	

Do you have an IT Strategy?	Yes, No
Digital Literacy	
Does your University Have a mechanism for digital Literacy strategy for the university community?	Yes, No, Not Sure
Is Digital Literacy Supported by University Leadership?	Yes, No, Not Sure
How long was your IT Strategy established, in years?	<1, 1-5,6-10,11-15, more than 15
Is your IT strategy publicly available to the university community?	Yes, No, Not Sure
University Size	
How Many Schools/Colleges Does Your University Have?	
How many Students (Graduate and undergraduate students) does your University Have?	<10,000, 10,000-15000,15,001-20,000,20,001-30,000, >30,000
How many Employees (Academic and Admin. support staff) does your university have?	<1000, 1000-2000,2001-3000,>3000
Which category do you perceive your university categorized in?	Research University, Applied University, General University, and Science and Technology University

University IT Investment	
How much have you invested in IT development in the last five years? (in Million USD)	<1, 1-5, 6-10, 11-15, >15
Source of the Budget for IT investment?	government budget, From Internal Sources, Knowledge Exploitation (Revenue)
What is the age of your institution? (In years?	0-5, 6-10, 11-20, 21-30, 31-50, >50

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초 록

고등교육기관(HEI)은 교육 및 연구 활동과 별도로 '제 3 의 사명', 즉 사회공헌에 집중해야 한다는 압박을 받고 있다. 넓은 의미에서 세 번째 임무는 여러 분야에 걸쳐 복잡하고 진화하는 현상입니다. HEI 는 국가에서 사회경제적 및 사회정치적 기관 역할을 합니다. 에티오피아의 HEI 는 100 년 미만이지만 공공 및 민간 기관 모두 인적 자원 요구에 기여함으로써 국가 경제 및 사회적 변화에 기여하는 데 중요한 역할을 해왔습니다. 그러나 HEI 는 지리적 위치 및 거버넌스 메커니즘으로 인해 전략적 목표를 달성하는 데 몇 가지 문제에 직면합니다. 학생 수의 확장, 연구 자금의 감소, 최첨단 실험실 시설의 부족, 21 세기 HEI 의 세 번째 임무를 달성하기 위한 경험이 부족한 관리 및 리더십을 포함하여 이와 관련된 몇 가지 문제가 있습니다. 에티오피아에서 HEI 의 품질과 접근성을 향상시키기 위해 개혁이 시행되었습니다. 이러한 개혁에는 공공 HEI 확장 규제와 같은 조치가 포함되었습니다. 학문적 초점 영역 혼합에 대한 수정 사항 중에는 독일과 한국과 같은 선진국에서 국제 경험과 전문 지식을 갖춘 외국인 교수진과 지도자를 유치하는 것이 있습니다. 이러한 이니셔티브에도 불구하고 에티오피아를 포함한 개발도상국의 HEI 는 지식 개발 및 혁신에 대한 수요 증가와 같은 문제에 계속 직면하고 있습니다. 또한 그들은 전 세계적으로 최고의 학생 및 교수진을 놓고 치열한 경쟁에

직면해 있습니다. 디지털 변환의 출현은 HEI, 지식 소스 및 혁신의 개발 및 기여에 중요한 역할을 했습니다.

이 연구는 에티오피아 HEI 및 NRI 의 공동 지식 생성에 대한 디지털 리더십 및 조직 기능과 기관 협력을 사용한 혁신을 통해 에티오피아 공공 HEI 가 3 세대 대학으로 전환하는 과정을 탐구합니다. 특히 혁신 및 제도적 전환을 위한 리더십 역할 및 조직 역량에 대한 HEI 리더의 인식과 생생한 경험을 조사합니다. 공동 지식 생성을 사용하여 HEI 의 혁신 성과를 개선하고 기관 간 협업을 통해 HEI 의 혁신 성과를 개선하고 기관 간 협력을 촉진하는 것을 목표로 합니다. 이 연구는 혁신과 교육을 평가하는 두 개의 별도 에세이와 공동 지식 생성에 대한 제도적 협력으로 구성됩니다. 또한 이 연구는 리더십, 혁신 및 공동 지식 생성 측면에서 학술 리더와 연구자의 역할을 평가합니다. 철저한 문헌 검토 후, 에티오피아의 HEI 전환에 대해 연구자들의 관심을 끌기 위해 두 개의 에세이가 수행되었습니다. 첫 번째 에세이는 3GU 로의 전환에서 디지털 리더십과 조직 역량의 역할을 탐구합니다. HEI 의 혁신 및 전략적 관리에서 선택된 이론을 기반으로 제도적 성과 및 전환의 척도가 채택되었습니다. 11 개 에티오피아 공립 고등 교육 기관의 학계 리더, 강사 및 IT 리더를 대상으로 온라인 설문 조사를 실시했습니다. 데이터는 SEM(구조 방정식 모델)을 사용하여 적절하게 코딩되고 정규화되었습니다. 이 도구는 PLS-SEM4.0.9.2 버전에 사용되었습니다. 둘째, 공동지식창출의 맥락에서 양질의 연구성과를 위한 혁신을 위한

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첫 번째 연구 결과는 기관의 지식 경제로의 전환을 위한 혁신 및 교육의 개념화를 제안했습니다. 혁신에서 디지털 리더십의 역할에 대한 연구가 수행되었습니다. 결과는 제도적 변화가 그들의 임무를 제 3 의 임무 활동으로 확장할 수 있음을 나타냅니다. 조직의 역량과 디지털 리더십은 HEI 성과에 긍정적인 영향을 미칩니다. 디지털화 기능은 데이터, IT 인프라 및 비즈니스 프로세스와 같은 하위 구성에서 중재 역할을 합니다. 이는 HEI 혁신 성과에 상당한 영향을 미칩니다. 두 번째 에세이는 학제 간 및 공동 연구 협력에서 지리적 위치의 역할을 조사하기 위해 공간 분석과 함께 소셜 네트워크 분석을 사용합니다. 이 연구에서 초소속은 양질의 연구에서 기관 간 협력을 위해 내부소속을 능가합니다. 또한 지리적 거리는 기관 간의 공동 지식 생성에 미치는 영향이 적습니다. 이를 통해 기관은 혁신, 기관 변화 및 학제 간 연구를 위해 더 나은 품질의 연구원을 양성할 수 있습니다.

에티오피아 HEI 의 HEI 혁신 및 혁신 성과 연구는 중요합니다. 첫 번째 에세이는 HEI 리더십이 리더십 수준에서 하위 수준으로 수행해야 하는 역할에 대해 논의하여 조직의 역량과 디지털 리더십을 연결하려는 노력이 혁신을 어떻게 개선하는지 보여줍니다. 본 연구는 에티오피아를 비롯한 개발도상국의 학술/연구/기술 이전 및 노하우 사업화에 최초로 기여하고 있습니다. 결과에 따르면 국가 혁신

시스템은 연구 기관과 학술 기관 간에 조정되지 않습니다. 중간 및 하위 수준의 에티오피아 HEI 리더에 비해 최상위 HEI 리더의 응답자가 여전히 적다는 사실로 인해 이 연구가 제한적이라는 점에 유의하는 것이 중요합니다. 연구는 산업과의 협업에 초점을 두고 학술 및 기업 특허 동향을 활용한 국가 혁신 시스템에 대한 연구를 확장해야 합니다.

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주요어: 디지털 리더십, HEI 혁신 성과, 조직 역량, 기관 협업, 학제간 연구, 3 세대 대학.

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