ADDIS ABABA UNIVERSITY SCHOOL OF COMMERCE

COLLEGE OF BUSINESS AND ECONOMICS

M.A. BUSINESS LEADERSHIP

The Effect of Technology-Driven Leadership on Human-Machine Collaboration in Decision making in Ethiopia

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College of Business and Economics

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A Project Work Submitted To Addis Ababa University, School Of Commerce In Partial Fulfillment Of The Requirements For The Degree Of Masters Of Business Leadership

Advisor: Bahran Asrat (PhD)

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Approved by the Board of Examiner

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JULY,2025

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STATEMENT OF CERTIFICATION

This is to certify that Nebyat Ahmed project work on the topic entitled “The Effect of Technology-Driven Leadership on Human-Machine Collaboration in Decision making in Ethiopia” is her original work and suitable for submission for the award of Master’s Degree in Business Leadership. The project paper is submitted for examination with my approval as a university advisor.

_____

Bahran Asrat (PhD) (Advisor)

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Acronyms

- AI – Artificial Intelligence
- ICT – Information and Communication Technology
- IT – Information Technology
- IoT – Internet of Things
- ML – Machine Learning
- DL – Deep Learning
- ERP – Enterprise Resource Planning
- WEF – World Economic Forum
- UNESCO – United Nations Educational, Scientific and Cultural Organization
- MoIT – Ministry of Innovation and Technology (Ethiopia)
- HRM – Human Resource Management
- OECD – Organisation for Economic Co-operation and Development
- GDP – Gross Domestic Product
- CRM – Customer Relationship Management
- R&D – Research and Development
- CEO – Chief Executive Officer
- CIO – Chief Information Officer
- ICT4D – Information and Communication Technology for Development
- SMEs – Small and Medium Enterprises
- SPSS – Statistical Package for the Social Sciences

Abstract

This research is about how emerging forms of technology-driven leadership are shaping the integration of human-machine collaboration in business strategies within Ethiopia's financial sector. As technologies such as artificial intelligence (AI), big data, and intelligent systems become increasingly embedded in organizational processes, leaders are required to adapt their approaches to effectively align human capabilities with machine intelligence.

The study determinate the relationship between leaders' digital competencies, trust in technology, and the organizational environment in facilitating machine integration. Based on data collected from 186 senior leaders in banks, insurance companies, and audit firms in Addis Ababa, the analysis utilized descriptive statistics, correlation, and multiple linear regression techniques.

Results indicate that leaders who demonstrate high levels of technology acceptance and digital competence are significantly more likely to adopt and support human-machine collaboration. Among all variables, technology acceptance was identified as the strongest predictor of collaboration success. While the infrastructure and strategic intent are generally in place, the findings highlight a need for improved training in data analytics and machine-based decision-making.

The study concludes that Ethiopia's financial institutions are progressing toward digitally enabled leadership but must strengthen capacity-building efforts and ethical oversight to fully realize the benefits of AI-human collaboration. The research offers practical recommendations for advancing leadership readiness and organizational support in the age of digital transformation.

KEYWORDS

digital competencies: Leadership that uses digital technologies (such as AI and data systems) to drive organizational change, strategy, and innovation.

Artificial Intelligence (AI) Adoption: The process of implementing AI technologies within organizations for automation, analysis, or enhanced decision-making.

Multiple Linear Regression: A statistical method used to understand the relationship between one dependent variable and multiple independent variables.

Chapter 1

INTRODUCTION

The 21st century has brought technological advancements which are changing leadership practices and decision-making worldwide. Business leadership has undergone transformation through human-machine collaboration because machines now assist human judgment through innovations such as Artificial Intelligence (AI) and Big Data and IoT and automation. (McKinsey & Company, 2021)

The leadership models in Ethiopia is traditional methods based on hierarchy because the country has not adopted Technology mainly. Ethiopia advances its digital transformation through Digital Ethiopia 2025 and increasing internet availability. The young population of Ethiopia demonstrates great potential to connect leadership with technological advancements. (Federal Democratic Republic of Ethiopia, 2020)

The research investigates methods for Ethiopia to develop leaders who can work effectively with machines. The research evaluates leaders' understanding and acceptance of technology-based leadership while developing recommendations to facilitate this transition. The research aims to provide academic and practical value by delivering insights which help business leaders and peoples in academic sector develop adaptive leadership for Ethiopia's digital future.

1.1 Background of the Study

Human-machine collaboration involves a strong interaction where humans provide contextual decision, emotional intelligence, and ethical reasoning, while machines contribute speed, data processing power, and predictive insights. In this model, leadership becomes more dynamic and evidence-based, HMC is increasingly being adopted in high-performing organizations globally, with leaders use intelligent systems to make faster, more accurate, and more inclusive decisions. (Akinnagbe, 2024; Alamu, 2025)

However, in the Ethiopian context, this transformation remains unpoplular. Leadership in Ethiopia continues to be traditional it is by hierarchical models with limited use of data or intelligent systems in strategic planning or operations. Most Ethiopian leaders—particularly in the public sector and

small-to-medium enterprises—lack to know or use AI or machine learning tools, and there is almost none integration of such technologies in leadership education or practice. The challenge is infrastructural limitations, low levels of digital literacy among leadership ranks, and insufficient policy emphasis on preparing leaders for the fourth industrial revolution. (Policy Studies Institute, 2024; Shega, 2023; Trade.gov, 2023).

Ethiopia is at a critical turning point. With the government's push toward such as Digital Ethiopia 2025, there is growing acceptance for embedding technology into national development. This digital strategy tells the importance of innovation, digital skills, and data use—but it has yet to address how leadership itself must integrate to guide organizations through this digital era. (Federal Democratic Republic of Ethiopia, 2025; Kaspersky, 2024).

Furthermore, while there is increasing interest in AI and Big Data in the tech community and higher education institutions in Ethiopia, these advancements are not yet aligned with leadership structures. The current gap between technological development and leadership presents both a challenge and an opportunity: a challenge because it limits Ethiopia's ability to use on the digital economy, and an opportunity because it opens the door for leadership capacity-building.

This research is based on the belief that Ethiopia cannot be observer of global technological change. To remain competitive and inclusive in the global economy, Ethiopian leaders must begin to understand and strategically collaborate with machines. Human-machine collaboration, if carefully introduced and used based on organization context, the potential to win leadership in Ethiopia—not by replacing human leaders, but by showing their good ability in business practice

This study will therefore determinant how Ethiopian leadership can transition toward a technology-driven, collaborative model by identifying current gaps.

1.2 Statement of Problem

Despite Ethiopia's growing ambition to participate in the global digital economy, many business leaders are not equipped to lead in a technology-driven environment. The integration of Artificial Intelligence (AI), Big Data, and other intelligent technologies into business strategy demands a new form of leadership — one that requires collaboration between humans and machines. However, Ethiopian leaders are facing several challenges that could hinder the country's ability to fully embrace this new leadership model (Smith, 2020).

First Problem is , there is a leadership knowledge gap. Many Ethiopian business leaders lack a understanding of how human-machine collaboration works and how these technologies can be applied strategically to enhance decision-making and business outcomes. This gap in knowledge not only prevents organizations from rethinking leadership practices in a digital context but also slows down the adoption of critical technologies needed for business innovation and growth (Johnson & Lee, 2019).

Second problem is , there is a lack of skills and training. Leadership development programs in Ethiopia often fail to provide the digital competencies necessary for leading in a technology-driven environment. Skills such as data-driven decision-making, AI literacy, and the effective use of machine learning or automation are largely absent from the leadership education landscape (Brown, 2021). As a result, many leaders who are willing to adopt digital tools face difficulties in integrating human-machine collaboration into their business strategies (Adams, 2018).

Finally, there is resistance to accept Technology . Cultural factors and traditional leadership models often create psychological barriers for Ethiopian leaders, making them hesitant to trust or adopt new technologies. Many see AI and machine-driven systems as threats to their authority or control, fearing errors, loss of human touch, or job displacement. This resistance to change is a significant roadblock to embracing technology-driven leadership models that are critical for organizational success in the digital age (Zhang & Wang, 2020).

If these challenges are not addressed, Ethiopian organizations risk falling behind in the global race for technological advancement. This research aims to identify these gaps and provide practical solutions to help Ethiopian leaders embrace human-machine collaboration effectively, ensuring that Ethiopia remains competitive in the digital era.

1.3 Research Questions

Ethiopian businesses are beginning to see the value of human-machine collaboration in improving leadership effectiveness. However, even as the growing of technologies like Artificial Intelligence (AI) and machine learning, there remains a significant gap in the leadership needed to effectively use these tools in business strategies.

1. To what extent does digital leadership competence influence human-machine collaboration in leadership?
2. How does technology acceptance affect human-machine collaboration in leadership?
3. In what ways does organizational support impact human-machine collaboration in leadership?

1.4 Research Objectives

1.4.1 General Objective:

The general objective of this research is to explore the challenges and opportunities associated with integrating human-machine collaboration into leadership practices within Ethiopian businesses, focusing on understanding the factors that influence the adoption of AI and machine-driven technologies in organizational decision-making.

1.4.2 Specific Objectives:

1. To examine the effect of digital leadership competence on human-machine collaboration in leadership.

2. To examine the influence of technology acceptance on human-machine collaboration in leadership.

3. To evaluate the impact of organizational support on human-machine collaboration in leadership

1.5 Significance of the Study:

This study is important because it helps Ethiopian leaders understand how to work effectively with technology in a rapidly changing world. As businesses shift toward digital solutions, the research shows how Human-Machine Collaboration (HMC) can support better decision-making, drive innovation, and improve performance. It offers practical advice on the skills leaders need—like data literacy and managing change—while also addressing real challenges such as resistance to new technologies. By focusing on Ethiopia, the study fills a gap in global research and highlights how responsible use of AI can boost the economy, support small businesses, and promote ethical leadership that values fairness and privacy.

1.6 Scope of the Study

This study focuses on technology-driven leadership and human-machine collaboration within Addis Ababa's financial sector, particularly evaluate the roles of AI, big data analytics, and digital transformation. It targets banks, insurance companies, and microfinance institutions to explore key themes such as the leadership skills gap in using AI, Big data, Digital Automation for decision-making, barriers to adoption like resistance to change and infrastructure limitations. The research is targated at Ethiopian business leaders—CEOs, senior managers, and decision-makers—whose insights will be gathered through surveys. The study use quantitative research method to explore how digital tools affect leadership in Ethiopia's financial landscape.

1.7 Potential Limitations of the Study

This study faces several limitations that may affect the scope of its findings. By focusing only on Addis Ababa and the financial sector, the research may not fully see how AI and big data are being used in other regions or industries across Ethiopia. AI and big data are still new fields in Ethiopia, access to up-to-date, detailed information may be limited. While the study centers on leadership, it may overlook the technical and operational perspectives, as well as the experiences of employees, which are also useful to successful digital transformation.

1.8 Organization of the Study

This research is carefully divided into five separate chapters, each of which adds something essential to the larger framework:

Chapter 1: Introduction: Provides a thorough overview of the study's history, problem statement, research questions, and aims, setting the stage for the rest of the thesis. It also addresses the study's importance, describes its parameters, and points out any possible drawbacks.

Chapter 2: Review of Related Literature: Examines prior research on the topic and offers a critical evaluation of pertinent theoretical frameworks and empirical study findings. It shows its distinct contribution to the discipline and lays the groundwork for the current research.

Chapter 3: Research Methodology - Outlines the selected research methodology, study design, data sources, data collection techniques, data analysis approach, and covers validity and reliability issues. It also serves as a road map for the research process. It also describes how research ethics should be followed.

Chapter 4: Data Analysis and Results - Provides a comprehensive interpretation of the study's findings in relation to the research questions and objectives, as well as a clear and organized presentation of the data analysis procedure.

Chapter 5: The final chapter summarizes the key findings of the study and provides conclusions based on the analysis. It outlines the study’s contributions to the field of AI-driven leadership and technology adoption in the Ethiopian finance sector. The chapter also offers recommendations for future research and actionable steps for Ethiopian business leaders.

1.9 Definition of Key Terms

Human-Machine Collaboration (HMC): refers to the interaction between humans and machines working together to achieve specific goals. In leadership, HMC involves the use of AI, machine learning, and big data analytics to support strategic decisions and drive innovation. (Davenport & Kirby, 2016)

Leadership: the action of leading a group of people or an organization. (Oxford Languages, n.d.).

Artificial Intelligence (AI): the capability of computational systems to perform tasks typically associated with human intelligence, such as learning, reasoning, problem-solving, perception, and decision-making. Wikipedia. (2024, June 14)

Big Data: extremely large data sets that may be analyses computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions. (Oxford Languages, n.d.).

Digital Transformation (DT): is the process of adoption and implementation of digital technology by an organization in order to create new or modify existing products, services and operations by the means of translating business processes into a digital format. Oxford Languages, n.d.).

Data-Driven Decision Making (DDDM): is an approach that emphasizes using data and analysis instead of intuition to inform business decisions. (Mucci, n.d.)

Technology-Driven Leadership: focuses on using digital tools and innovations to enhance leadership effectiveness and competitiveness in the digital age. **(**Kane, G. C. 2019).

Algorithmic Bias: refers to unfair outcomes in AI systems caused by flawed data or biased programming. This can affect decisions in areas like hiring or customer service. **(**O'Neil, C. 2016).

Digital Competency: includes the knowledge and skills needed to use technologies like AI and big data effectively. For leaders, this means being able to apply digital tools strategically. **(**European Commission 2017)

CHAPTER 2: REVIEW OF RELATED LITERATURE

Introduction

The integration of human-machine collaboration (HMC) into leadership practices is changing how organizations innovate, make decisions, and be competitive in a technology-driven world. As artificial intelligence, big data, and automation continue to advance, leaders are required to adapt their approaches to effectively collaborate with intelligent systems. This study explores the growing importance of human-machine collaboration, and identifies key competencies and challenges leaders face in using this transformation. The review also see global and Ethiopian perspectives, based on the foundation for understanding of leadership adaptation in the digital era.

2.1 Conceptual review

2.1.1 Leadership: Adapting to Human-Machine Collaboration

Leadership now is more than vision and management skills; it now requires the ability to see and integrate technological advancements into everyday organizational practices. Human-Machine Collaboration (HMC) is at the heart of this evolution, where leaders must work with intelligent systems such as AI, machine learning tools, and data-driven technologies to improve decision-making, improve operational efficiency, and drive innovation.

The New leadership is different from traditional leadership models that focus only on human interaction and hierarchical decision-making, modern leadership emphasizes flexibility, adaptability, and the ability to use both human intuition and machine intelligence. Leaders today must understand not only business strategies but also the capabilities and limitations of machines where humans and technology complement each other's strengths.

Adapting to HMC also requires a shift in leadership mindsets. Trust in technology, openness to digital transformation, continuous learning, and ethical responsibility become essential traits. Leaders must balance technical proficiency with creativity, and critical thinking to guide teams through change while ensuring that technology serves human-centered goals.

In the context of Ethiopia, where digital transformation is still new, leadership adaptation becomes even more critical. Ethiopian leaders must fill the gap between traditional leadership approaches

and the new digital economy. This requires active investment in digital literacy, a strong commitment to ethical technology use, and the collaborative cultures that use both human and machine ability.

2.1.2 Digital Competencies for Technology-Driven Leadership

In the digital age, effective leadership goes beyond traditional management skills; it requires leaders to be proficient in using technology to drive decision-making and innovation. Digital competencies encompass the ability to interpret data, utilize AI and big data, and adapt strategies to leverage technology for business success.

For Ethiopian leaders, developing these skills is needed as the country start to integrate into the global digital economy. However, many Ethiopian leaders face challenges due to limited digital skills, which reduce their ability to incorporate technology effectively into their leadership practices.

By building digital competencies, Ethiopian leaders can improve decision-making, foster innovation, and better navigate the rapidly evolving business.

2.2 Theoretical Review

2.2.1 Concept of Technology-Driven Leadership and Human-Machine Collaboration (HMC)

Technology-driven leadership refers to the integration of digital tools, such as Artificial Intelligence (AI), Big Data, machine learning, and automation, into leadership practices to enhance decision-making, innovation, and organizational efficiency. In the modern business, leaders must be able to harness technological advancements to drive growth, manage change, and stay competitive.

Human-Machine Collaboration (HMC) is the partnership between humans and intelligent machines, where both entities complement each other to achieve business objectives. In this collaboration, humans provide judgment, creativity, and ethical oversight, while machines offer data analysis, automation, and predictive insights. The synergy between human intelligence and

machine capabilities is reshaping how leadership is approached, enabling leaders to make more informed decisions and strategize effectively.

2.2.2 Theories of Technology-Driven Leadership and Human-Machine Collaboration

Theories of technology-driven leadership and HMC provide the framework for understanding how technology influences leadership behaviors and organizational outcomes. Below are key theories that underpin these concepts:

2.2.2.1 Transformational Leadership Theory

Transformational leadership theory, proposed by Bernard Bass, emphasizes the importance of leaders inspiring and motivating their followers to achieve extraordinary outcomes. In the context of technology-driven leadership, transformational leaders encourage innovation and foster a culture of continuous learning. By embracing digital tools, transformational leaders can create a vision for the future and guide their organizations through the complexities of the digital age.

Figure 1Transformational Leadership

2.2.2.2 Contingency Leadership Theory

The contingency theory, proposed by Fred Fiedler, argues that the effectiveness of leadership

depends on the situation and the leader's ability to adapt their style to meet the challenges of that environment. When it comes to technology-driven leadership, this theory suggests that leaders must adapt their strategies to leverage emerging technologies like AI and Big Data, depending on the specific needs of the organization.

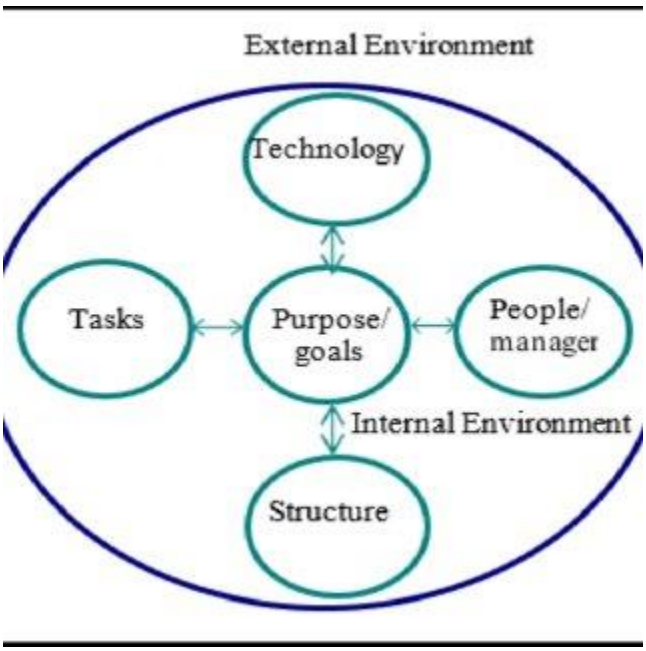


Figure 2 Contingency Leadership Theory

2.2.2.3 Distributed Leadership Theory

Distributed leadership focuses on leadership as a collective and collaborative process rather than being vested in a single individual. In the context of HMC, this theory suggests that leadership is not limited to human leaders but can be distributed among both humans and machines. Machines, equipped with advanced data analytics and AI capabilities, can share the leadership load by

providing insights that influence decision-making, while humans provide the ethical, contextual, and interpersonal components of leadership.

Figure 3Distributed leadership

2.2.2.4 Technological Acceptance Model (TAM)

The Technological Acceptance Model (TAM), developed by Fred Davis, helps explain how users come to accept and use technology. TAM posits that perceived ease of use and perceived usefulness are the primary factors that determine whether individuals adopt new technologies. For leaders to successfully implement technology-driven leadership, they must ensure that AI, Big Data, and other digital tools are not only useful but also easy to integrate into existing organizational structures.

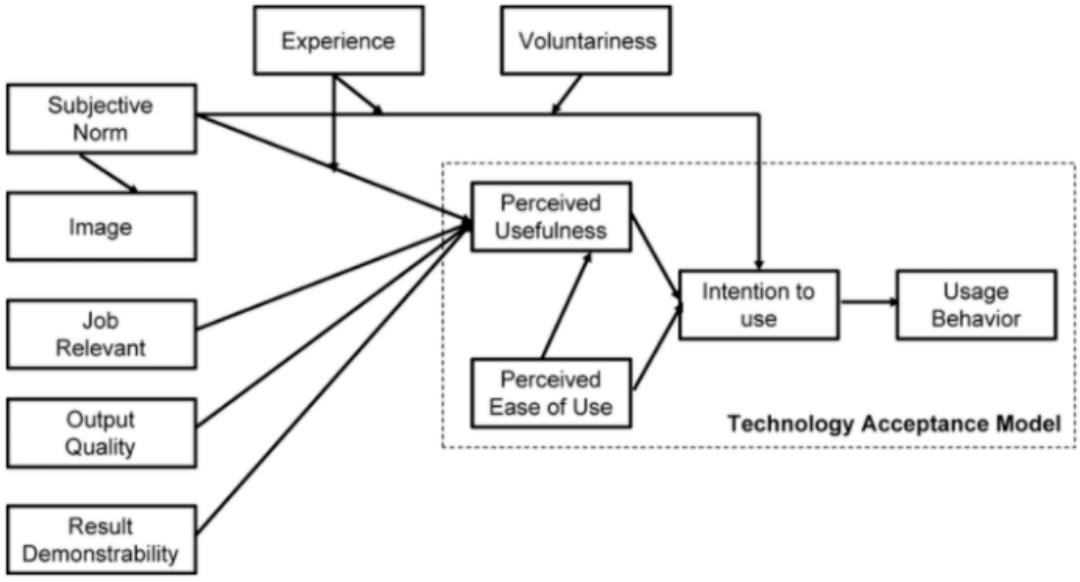


Figure 4Technological Acceptance Model(TAM)

2.2.2.5 Sociotechnical Systems Theory

Sociotechnical systems theory suggests that the interaction between people, technology, and organizational processes creates a system that can either enhance or hinder organizational performance. The theory emphasizes that technology should complement human skills and organizational needs, which is central to the concept of human-machine collaboration. In technology-driven leadership, leaders must ensure that human and machine elements work together seamlessly to achieve optimal performance.

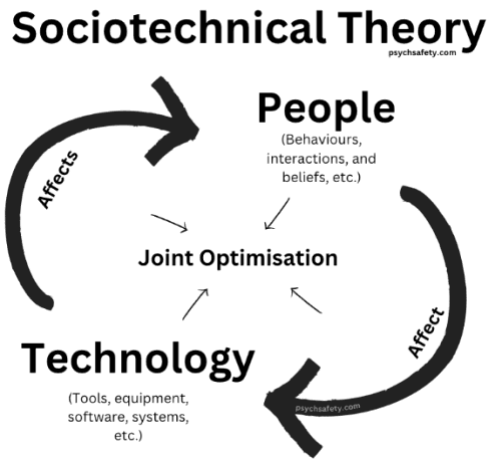


Figure 5Sociotechnical

2.2.3 Leadership Styles in Technology-Driven Leadership and Human-Machine Collaboration

2.2.3.1 Transformational Leadership

Transformational leadership is essential for organizations undergoing technological transformations. These leaders guide their teams through the complexities of adopting and integrating new technologies like AI and machine learning. They encourage employees to see the potential of human-machine collaboration and focus on future growth rather than just immediate results.

2.2.3.2 *Situational* Leadership

Situational leadership, Leaders need to adjust their approach based on the stage of technology adoption. Early on, a more directive approach may be necessary to ensure that employees understand how to use new tools. Over time, as employees become more comfortable with the technology, the leader may shift to a more supportive or delegating style, allowing for greater autonomy.

2.2.3.4 Adaptive Leadership

Adaptive leadership is crucial when implementing new technologies because it enables leaders to navigate the uncertainties and challenges that come with technological integration. This style emphasizes flexibility, learning from failure, and continuously adjusting strategies as new challenges arise.

2.3 Empirical Review

The evolution of leadership in the digital era has been widely explored through empirical studies across different contexts. Research conducted globally and in Ethiopia highlights both the opportunities and challenges that technology-driven leadership and human-machine collaboration (HMC) present for organizations. This section reviews key studies that provide insights into leadership transformations influenced by artificial intelligence (AI), big data, and automation.

2.3.1 Studies Related to Technology-Driven Leadership in Ethiopia

Several studies have investigated the role of leadership in promoting digital transformation in Ethiopia.

Abebe and Alemu (2021) studied the impact of digital leadership on organizational performance among Ethiopian enterprises. Their findings revealed that organizations with leaders who encouraged the adoption of digital technologies experienced higher levels of efficiency, innovation, and competitiveness. However, they also identified a gap in digital competencies among many Ethiopian leaders, which often slowed the integration of emerging technologies like AI and data analytics.

In another study, Tadesse (2020) explored the barriers to digital transformation in Ethiopian small and medium enterprises (SMEs). Leadership resistance to technological change, lack of awareness

of digital tools, and fear of job losses associated with automation were noted as major hindrances. Tadesse emphasized the need for transformational leadership approaches that could inspire confidence and willingness to embrace human-machine collaboration.

Getahun and Kebede (2022) focused on leadership practices in Ethiopian public institutions undergoing digital reforms. Their research demonstrated that leadership commitment to technology adoption was a crucial factor for success. However, they found that limited exposure to international best practices and low investment in leadership training programs restricted progress toward a technology-driven leadership culture.

These studies suggest that while Ethiopian leaders recognize the importance of digital transformation, there remains a significant need for capacity building, strategic vision, and leadership styles that encourage innovation and technology adoption.

2.3.2 Global Research on Technology-Driven Leadership and Human-Machine Collaboration

Globally, a growing body of empirical research examines how leaders adapt to the integration of intelligent technologies. Westerman et al. (2014) conducted a large-scale study on digital leadership in various industries and found that organizations led by digitally savvy executives outperformed their competitors in innovation, customer satisfaction, and operational efficiency. Their research emphasized the role of leadership in shaping organizational culture to be more adaptive to technological changes.

Brynjolfsson and McAfee (2017) studied leadership in the age of artificial intelligence and highlighted that leaders who leveraged data-driven decision-making and encouraged collaboration between humans and machines were more successful in creating agile, competitive organizations. They emphasized the importance of rethinking traditional decision-making processes to incorporate AI-generated insights while preserving human creativity and ethical judgment.

Davenport and Kirby (2016) explored the concept of "augmentation strategy," where human-machine collaboration is not about replacing workers but enhancing human abilities through AI support. Their research demonstrated that effective leaders positioned AI as a partner rather than a threat, fostering environments where human and machine skills complemented each other.

These global studies show that successful leadership in a technology-driven environment requires not only the adoption of digital tools but also a transformation of leadership styles toward adaptability, openness to innovation, and ethical governance of technology.

2.3.3 Human-Machine Collaboration and Leadership Transformation

Empirical studies also highlight the growing importance of Human-Machine Collaboration (HMC) in leadership. Huang and Rust (2021) researched the interaction between human leaders and intelligent systems, finding that leaders who incorporated AI into strategic decision-making could react faster to market changes and create more personalized customer experiences. However, they noted that human oversight remained critical to ensure ethical outcomes and organizational alignment with values.

In a study on AI and decision-making, Jarrahi (2018) argued that leaders must treat machines as collaborators rather than mere tools. His research found that organizations that embedded AI into leadership practices saw improvements in operational speed and decision accuracy, but success depended heavily on the leader's ability to balance human judgment with machine-generated insights.

2.4.4 Gaps Identified in the Literature

While empirical studies offer valuable insights, there are gaps in the research, especially technology-driven leadership in Ethiopia.

Most existing studies focus on developed economies with advanced technological infrastructure, leaving a research gap in understanding how Ethiopian leaders, with different technological and cultural realities, can effectively integrate human-machine collaboration into their business strategies.

Few studies have investigated ethical issues in HMC from a leadership perspective, particularly how Ethiopian leaders manage risks like algorithmic bias, transparency, and trust-building when deploying AI systems.

There is limited empirical evidence on leadership training programs specifically designed to enhance digital competencies among Ethiopian business leaders.

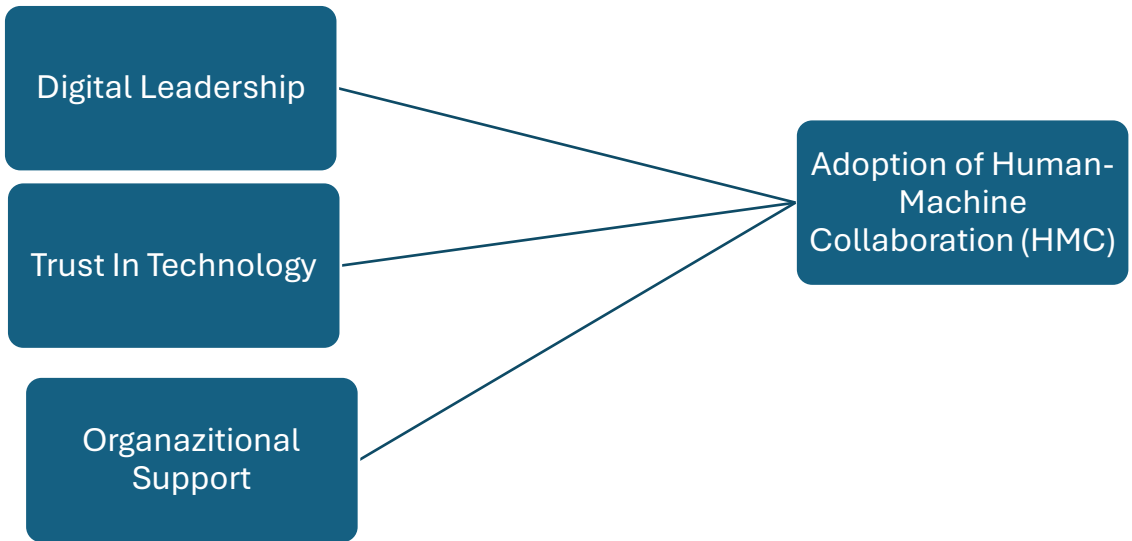
This study seeks to address these gaps by focusing on Ethiopian leadership practices in the context of emerging digital technologies and proposing practical frameworks for strengthening human-machine collaboration in business strategy.

2.4 Research Hypotheses

- **H1:** Digital Leadership Competence positively affects Human-Machine Collaboration in Leadership.
- **H2:** Technology Acceptance positively influences Human-Machine Collaboration in Leadership.
- **H3:** Organizational Support positively impacts Human-Machine Collaboration in Leadership..

2.5 Conceptual framework

The conceptual framework of this study focuses on how Ethiopian business leaders can successfully integrate Human-Machine Collaboration (HMC) in their organizations. At its core, the framework looks at how leaders work with advanced technologies like AI and big data with human Decision. The success of this collaboration depends on several real-world factors, such as how much leaders trust the technology they're using, how prepared they are to lead in a digital environment, and whether their organizations provide the right kind of support. When leaders have confidence in the tools, know how to use them effectively, and have backing from their institutions, HMC is more likely to succeed. However, the journey isn't always smooth challenges like fear of change or lack of digital skills can get in the way. This framework helps to understand both the opportunities and the struggles leaders face as they try to bring people and machines together in a way that benefits their organizations.



CHAPTER 3: RESEARCH METHODOLOGY

3.1 Research Design

This research adopts the quantitative method, through structured surveys, to collect numerical data regarding business leaders' knowledge, attitudes, and practices related to AI, big data, and digital transformation. Descriptive and explanatory methods are also used. This approach is appropriate as it enables the study to provide statistical generalizations.

3.2 Description of Study Variables

The study involves both independent and dependent variables:

3.2.1 Independent Variables:

Digital Leadership Competence: This refers to a leader's ability to effectively guide and manage in a digital environment. It includes understanding digital tools, embracing innovation, and being able to inspire teams through technological change. Leaders with strong digital competence are more likely to recognize the value of AI and big data and know how to use them strategically to improve their organizations. (Tuschner et al., 2023)

Technology Acceptance: This reflects how open and willing leaders are to adopt and use new technologies like AI and data analytics in their day-to-day decision-making. Acceptance is often shaped by factors such as perceived usefulness, ease of use, and trust in the technology. Leaders who are more accepting of digital tools are more likely to integrate them successfully into their leadership practices. (Davis, 1989; Choung et al., 2022)

Organizational support : This represents the extent to which an organization provides the necessary environment for digital transformation. It includes things like access to technology, training programs, supportive policies, and a culture that encourages innovation. Strong organizational support makes it easier for leaders to experiment with and implement Human-Machine Collaboration effectively. (IntechOpen, n.d.; Alvesson, 1993; Kim et al., 2022).

3.2.2 Dependent Variables:

Human-Machine Collaboration in Leadership: This is the outcome the study aims to understand. It describes how well leaders are able to work alongside machines—like AI systems and data-driven tools—to make decisions, solve problems, and drive progress. Effective HMC in leadership means using both human intuition and machine intelligence in a balanced way, leading to smarter, faster, and more innovative outcomes. (National Research Council, 2012)

3.3 Description of Study Area and Target Population

The research focuses on Addis Ababa, where most financial institutions and corporate headquarters are located. The city's status as the country's center for innovation and leadership makes it an ideal site for the investigation of technology-driven leadership. The study targets a population that includes senior and middle-level managers, as well as executives from finance-related firms such as commercial banks, insurance companies, and microfinance institutions. Additionally, it focuses on department heads and key decision-makers in areas such as information technology, operations, and strategic planning.

3.5 Sampling Technique/Methods and Sample Size

This study investigates Technology-driven leadership and its impact on business strategy in Ethiopia's financial sector, with a focus on institutions operating in Addis Ababa. The target population consists of leaders at the level of District Manager and above, as these individuals are directly involved in strategic planning, innovation adoption, and organizational decision-making

The selection of participating organizations was purposeful, based o n their strategic relevance, scale, and ongoing investment in technological advancement within the finance sector. The institutions include:

- **Commercial Bank of Ethiopia (CBE)** – The largest public bank in the country, CBE is a frontrunner in adopting advanced digital banking platforms, making it essential to understanding leadership at scale in public-sector finance.
- **Bank of Abyssinia (BoA)** – Chosen for its active role in digital transformation, BoA exemplifies how mid-sized private banks integrate technology into their strategic leadership practices.

- **Awash Bank** – As one of the oldest and most profitable private banks, Awash has significantly invested in core banking systems, IT infrastructure, and mobile services, making it a rich case for studying technology-influenced strategy.
- **Cooperative Bank of Oromia (Coop)** – Selected for its unique focus on financial inclusion through digital channels, particularly in cooperative and community banking environments.
- **Amhara Bank** – A new entrant to the sector, Amhara Bank was chosen to reflect the leadership dynamics of younger institutions that are building digital strategies from the ground up.
- **Nile, Nyala, and Awash Insurance Companies** – These insurance firms represent the core of Ethiopia's evolving insurance sector, which is undergoing digitization in claims, customer service, and risk analysis—areas deeply tied to leadership strategy.
- **HST Consulting and EY Ethiopia (Audit Firm)** – Included due to their role in providing strategic advisory services to financial institutions on digital transformation, regulatory compliance, and leadership consulting. Their perspective enriches the study with insights into external technology leadership dynamics.

Collectively, these organizations provide a balanced representation of Ethiopia's financial sector, encompassing public and private, traditional and emerging, and banking and non-banking financial institutions.

Leader Population by Institution

The selected institutions and their respective leader populations are:

Sector	Institution	Number of Leaders Targeted
Banking	Commercial Bank of Ethiopia (CBE)	120
	Bank of Abyssinia (BoA)	100
	Awash Bank	60
	Cooperative Bank of Oromia (Coop)	60
	Amhara Bank	20
Insurance	Nile, Nyala, and Awash Insurance	30
Audit Firm	HST Consulting or EY Ethiopia	10
Total		**400 leaders**

Table 1 Population by Institution

A probability sampling method, specifically simple random sampling, was employed to select participants. This approach was chosen because it gives each individual in the population an equal chance of selection, thereby minimizing selection bias and ensuring that the findings can be generalized to a broader leadership population. Lists of eligible leaders were obtained from official organizational records, and a random number generator was used for fair selection.

Sample Size Determination

To determine the required number of participants from the total identified population of 400 leaders, Yamane's (1967) formula for sample size calculation was applied using a 95% confidence level and a 5% margin of error:

$n = N / (1 + N * e^2)$

Where:

- n = sample size
- N = population size (400)
- e = margin of error (0.05)

$n = 400 / (1 + 400 * 0.05^2)$

$n = 400 / (1 + 1)$

$n = 400 / 2$

$n = 200$

Thus, the final sample size is 200 leaders.

This sampling method ensures the credibility, reliability, and generalizability of the study, offering a strong basis for understanding how leaders across the financial sector in Addis Ababa are responding to technological change through strategic leadership.

3.5 Data Sources and Types

To achieve the research objectives and answer the research questions effectively, both primary and secondary data sources were used.

- **Primary Data:**
  The main source of data for this study was primary data collected directly from leaders working in the financial sector, including commercial banks, insurance companies, and audit firms. Structured questionnaires were used as the primary instrument for data collection. The questionnaire focused on leaders' experiences, competencies, challenges, and perceptions regarding technology-driven leadership and human-machine collaboration.

Data Types:

- **Quantitative Data:**
  Data collected from questionnaires provided quantitative data that could be statistically analyzed. Variables such as leadership competency levels, frequency of technology adoption, and organizational performance indicators were measured numerically.

By using quantitative types of data, the study ensured a comprehensive analysis that captured both measurable trends and deeper contextual understanding.

3.6.1 Data Collection Instrument and Procedure

3.6.1.1 Data Collection Instrument:

The primary instrument used for data collection was a structured questionnaire. The questionnaire was designed to capture information related to leaders' digital competencies, their experiences with human-machine collaboration (HMC), the challenges they face, and the impact of technology-driven leadership in the financial sector.
The questionnaire included :

- Closed-ended questions (using Likert scales, multiple-choice, and ranking questions) to allow for quantitative analysis.

The questionnaire was divided into several sections:

- Demographic information (e.g., position, experience, type of organization)
- Digital competencies and skills
- Human-machine collaboration experiences
- Organizational support and challenges

3.7 Data Analysis – Model, Techniques, Software, etc.

3.7.1 Data Analysis Model:

The study applied a quantitative analysis model to examine the relationship between technology-driven leadership practices, human-machine collaboration (HMC), and leadership effectiveness.

The model aimed to determine how digital competencies and the integration of AI and big data influence leadership performance in the financial sector.

Techniques Used:

- Descriptive Statistics: Frequencies, percentages, means, and standard deviations were used to describe the demographic characteristics of respondents and summarize the study variables.
- Inferential Statistics:
    - Correlation Analysis was employed to determine the strength and direction of relationships between key variables.
    - Multiple Regression Analysis was used to predict the impact of human-machine collaboration and digital leadership competencies on leadership outcomes.
    - T-tests and ANOVA were used to compare differences between groups (e.g., leaders in banks versus audit companies).

Software:

- SPSS version 26 was used as the primary software tool for data coding, analysis, and hypothesis testing.
- Microsoft Excel supported data entry, visualization (charts and graphs), and preliminary organization of raw data.

Presentation of Results:
The results were presented using tables, figures, and narrative explanations to clearly show the statistical findings and how they support the research objectives and hypotheses.

3.8 Reliability and Validity Analysis

3.8.1 Reliability Analysis:

To assess the internal consistency of the measurement instruments used in this study, Cronbach's Alpha was calculated for each construct. The results are presented in the table below.

	Reliability Statistics		
Reliability test	N	Cronbach's Alpha	N of Items
Digital Leadership Competence	181	.690	5
Human-Machine Collaboration in Leadership	177	.790	5
Technology Acceptance	182	.871	5
Organizational Support	185	.781	5

Table 2 Reliability Statistics

3.8.2 Validity Analysis:

Validity ensures that the research instrument truly measures what it's meant to. In this study, several forms of validity were addressed to strengthen the survey's accuracy. Content validity was ensured through expert reviews from professionals in leadership, digital transformation, and Human-Machine Collaboration. Construct validity was established by aligning the questionnaire items with relevant theories and previous studies. Additionally, face validity was checked by piloting the survey with non-expert participants to confirm that the questions made sense and reflected real leadership challenges. Together with reliability checks, these steps helped ensure

the data collected is both credible and meaningful for understanding leadership in Ethiopia's financial sector.

3.9 Research Design

In this study, ethical considerations were taken into account to ensure the protection of participants and the integrity of the research process. Participants, leaders in the financial sector, were fully informed about the study's purpose and gave their written consent to participate. Their confidentiality was guaranteed, with personal information kept anonymous and securely stored. The study ensured that no sensitive information was disclosed and that participants would not experience any harm. Ethical approval was obtained from the relevant ethics committee before data collection began, and the findings were presented honestly and transparently. These measures helped ensure the study adhered to the highest ethical standards.

CHAPTER 4: DATA PRESENTATION, RESULTS, AND ANALYSIS

Introduction

This chapter presents the results and discussion of the data collected from selected banks, insurance companies, and an audit firm in Ethiopia. The findings are analyzed and presented using frequency tables, cross-tabulations, correlation, and regression analysis. The analysis and interpretation of the data are guided by the research objectives, from which recommendations are made based on the findings. This section provides a detailed descriptive analysis of the data collected from leaders in the financial sector. The analysis includes percentages, means, and standard deviations for all key variables. It also outlines the demographic characteristics of the respondents and their perceptions regarding various aspects of human-machine collaboration in Ethiopia's financial sector. The main variables analyzed include Digital Leadership Competence, Human-Machine Collaboration in Leadership, Technology Acceptance, Organizational Support, and Ethical and Cultural Considerations.

4.1 RESPONSE RATE

A total of 200 questionnaires were distributed to leaders across selected financial institutions in Addis Ababa, including banks, insurance companies, and an audit firm. Out of these, 186 questionnaires were returned fully completed and valid for analysis. This represents a response rate of 93%.

The high response rate indicates strong engagement and interest from financial sector leaders in the subject of technology-driven leadership and human-machine collaboration. It also enhances the reliability and generalizability of the findings, making the collected data a solid foundation for analysis and interpretation.

4.2 DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENT

The below table presents the demographic profile of the respondents. The detailed explanations are presented below the table for each category.

Statistics								
		Gender	Age_Group	Educational_ Qualification	PositionJobTitle	Exp_Leadership	Org_Type	Org_Size
N	Valid	186	185	186	186	181	186	186
	Missing	0	1	0	0	5	0	0

4.2.1 Gender

The gender distribution of respondents is presented in the table below. Out of the 186 valid responses collected, 154 (82.8%) were male and 32 (17.2%) were female.

This result clearly shows that the majority of leadership positions in the selected financial institutions are held by males. The low representation of females (17.2%) highlights the ongoing gender imbalance in leadership roles within Ethiopia's financial sector. This may be due to structural or cultural barriers that limit women's advancement to executive and managerial positions in banking, insurance, and audit firms.

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	32	17.2	17.2	17.2
	Male	154	82.8	82.8	100.0
	Total	186	100.0	100.0	

4.2.2 Age Group

The table below presents the age distribution of the respondents. Out of 186 respondents, 185 provided valid responses regarding their age, while one response was missing. The majority of respondents, 95 (51.4%), were in the age group 45–54, followed by 42 (22.7%) in the 25–34 age range. Respondents aged 35–44 accounted for 17.3%, while those 55 and above made up 7.0%. A small portion (1.6%) of respondents were under the age of 25. showing that leadership roles are rarely given to very young people. Overall, this age breakdown helps explain how different age groups might view and use technology in leadership.

This distribution suggests that leadership roles in the financial sector are predominantly occupied by experienced individuals in the mid-to-late stages of their careers. The relatively lower numbers in younger age groups highlight that ascending to leadership positions typically comes after years of service and experience

Age_Group					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under 25	3	1.6	1.6	1.6
	25–34	42	22.6	22.7	24.3
	35–44	32	17.2	17.3	41.6
	45–54	95	51.1	51.4	93.0
	55 and above	13	7.0	7.0	100.0
	Total	185	99.5	100.0	
Missing	System	1	.5		
Total		186	100.0		

Table 3 Age_Group

4.2.3 Leadership Experience of Respondents

The table below shows the distribution of respondents by their years of leadership experience. Out of the 186 total respondents, 181 provided valid responses for this question, while 5 were missing.

The majority of respondents, 90 (49.7%), have between 11 to 20 years of leadership experience. This is followed by 34 (18.8%) with 1 to 5 years, and 27 (14.9%) each with 6–10 years and more than 20 years of experience. A small number, 3 (1.7%), have less than 1 year of leadership experience.

This distribution indicates that most leadership roles in the selected financial institutions are held by individuals with considerable professional experience, suggesting a mature and seasoned leadership population across the finance sector in Addis Ababa.

Exp_Leadership					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	3	1.6	1.7	1.7
	1–5 years	34	18.3	18.8	20.4
	6–10 years	27	14.5	14.9	35.4
	11–20 years	90	48.4	49.7	85.1
	More than 20 years	27	14.5	14.9	100.0
	Total	181	97.3	100.0	
Missing	System	5	2.7		
Total		186	100.0		

4.2.4 Type of Organization

The table below presents the distribution of respondents based on the type of organization they represent. Out of the 186 respondents, the majority, 129 (69.4%), were from banks, followed by 35 (18.8%) from insurance companies, and 19 (10.2%) from an audit firm. One response (0.5%) was unclear or incomplete and has been excluded from the valid percentage.

This distribution reflects the primary focus of the study on the banking sector, while also incorporating the perspectives of leaders from insurance companies and audit firms to provide a broader understanding of technology-driven leadership across different segments of the financial sector.

Org_Type					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		3	1.6	1.6	1.6
	Audit Firm	19	10.2	10.2	11.8
	Bank	129	69.4	69.4	81.2
	Insurance	35	18.8	18.8	100.0
	Total	186	100.0	100.0	

4.2.5 Educational Qualification of Respondents

The educational qualifications of the respondents are summarized in the table below. Among the 186 respondents, the majority—118 (63.4%)—held a Master's Degree, followed by 47 (25.3%) with a Bachelor's Degree. Additionally, 16 (8.6%) had obtained a Doctoral Degree, and 2 (1.1%) selected "Master's Degree" with an added note (possibly a double entry or additional detail). A small portion (3 respondents, 1.6%) did not clearly specify their qualification.

This distribution indicates a highly educated leadership base in the financial sector, with over 70% of the respondents holding postgraduate degrees. Such educational attainment suggests strong academic preparation among leaders navigating technology-driven changes in business strategy.

Educational_Qualification					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		3	1.6	1.6	1.6
	Bachelor's Degree	47	25.3	25.3	26.9
	Doctoral Degree	16	8.6	8.6	35.5
	Master's Degree	118	63.4	63.4	98.9
	Master's Degree,	2	1.1	1.1	100.0
	Total	186	100.0	100.0	

4.3 DESCRIPTIVE RESULT ANALYSIS OF THE VARIABLES

This section provides a comprehensive descriptive analysis of the major variables considered in the study. The analysis aims to explore the perceptions, experiences, and attitudes of financial sector leaders in Ethiopia regarding the evolving role of technology in leadership and strategic decision-making. Descriptive statistics such as frequencies, percentages, means, and standard deviations are used to summarize and interpret the responses.

The following key variables were measured in the study, each playing a significant role in understanding the landscape of technology-driven leadership:

- **Digital Leadership Competence**: This variable measures leaders' ability to integrate digital tools and technologies into their leadership practices. It is included to assess how well leaders are prepared to lead in digital environments.
- **Human-Machine Collaboration in Leadership**: This captures how leaders interact with and manage the integration of artificial intelligence, automation, and digital systems in their strategic roles. It is vital for understanding the balance between human judgment and machine intelligence in modern leadership.
- **Technology Acceptance**: This variable reflects the openness of leaders toward adopting and using new technologies. It is based on the Technology Acceptance Model (TAM) and helps to evaluate the readiness and willingness of leaders to embrace technological change.

Organizational Support: This measures the degree to which organizations provide resources, training, and an enabling environment for digital transformation and innovation.

4.3.1 Digital Leadership

Statement	SDA (%)	DA (%)	A (%)	SA (%)	N (%)	Mean (M)	Std. Dev. (SD)
I use digital technologies (e.g., AI, Big Data) to support strategic leadership decisions (e.g., goal setting, resource allocation, market analysis).	1.1	0.5	14.0	31.2	52.7	4.35	0.82
I encourage my team to use digital technologies to improve performance.	0.5	5.4		42.5	51.6	4.45	0.624
I am confident making decisions based on data analytics.	3.8	8.1	21.5	36.6	30.1	3.81	1.072
I provide guidance on the effective use of digital tools.	3.2	15.6	44.1	34.9	2.2	4.13	0.797
I understand how digital transformation aligns with our strategic goals.	0.0	0.0	9.1	51.1	39.8	4.31	0.63

Table 4 Digital Leadership Statistics

There is a significant presence of digital leadership competence among respondents in selected financial institutions in Ethiopia, as revealed by the descriptive statistics in Table 9. With mean scores ranging from 3.81 to 4.45, the responses reflect a generally positive perception and engagement with digital technologies in leadership practices. This suggests that many leaders are actively embracing digital tools to drive strategic objectives and improve performance outcomes in their organizations. according to Joshi et al. (2015), a mean score above 4.0 on a 5-point Likert scale indicates strong agreement, while scores above 3.5 suggest moderate to high agreement.

For instance, the item *"I encourage my team to use digital technologies to improve performance"* received the highest mean score of 4.45 with a low standard deviation (SD = 0.624), indicating strong and consistent agreement across participants. Similarly, the statement *"I use digital*

technologies (e.g., AI, Big Data) to support strategic leadership decisions" had a mean of 4.35, showing that leaders are not only open to digital tools but also strategically deploying them for goal setting, resource allocation, and market analysis.

However, a slightly lower mean of 3.81 was observed for the item *"I am confident making decisions based on data analytics"*, with a higher standard deviation (SD = 1.072), suggesting some variability in confidence levels among respondents. This points to a potential skill gap in data literacy and analytics interpretation, which may need to be addressed through training and capacity building.

This pattern aligns with research by Avolio et al. (2014) and Westerman et al. (2011), who emphasize that digital leadership is a crucial capability for organizations undergoing digital transformation. They argue that leaders who are competent in digital tools and data analytics can better align their strategic goals with technological opportunities. Kane et al. (2015) further highlight that digital-savvy leaders can influence organizational culture by promoting agility, innovation, and responsiveness.

While overall leadership engagement with digital tools is strong, the variability in confidence regarding data-driven decision-making indicates a need for further development in analytical competencies. Strengthening this area would enhance leaders' ability to extract insights from complex data and use it effectively in high-stakes decision environments.

According to literature, leaders who both embrace technology and guide their teams in its effective use tend to foster a culture of digital innovation and readiness (El Sawy et al., 2016; Davenport & Ronanki, 2018). Therefore, institutions should continue to support digital leadership development through structured training, mentoring, and investment in digital infrastructure.

These findings suggest that Ethiopia's financial sector leaders are on a promising path toward technology-driven leadership. However, attention must be given to boosting confidence and capability in data analytics, ensuring that leaders are not only users but strategic interpreters of digital information. This will be key in leveraging human-machine collaboration for enhanced decision-making and long-term competitiveness.

4.3.2 Human-Machine Collaboration in Leadership

Human-Machine Collaboration in Leadership Statistics									
	Valid	Missing	SDA	DA	N	A	SA	M	SD
I have experience using AI-powered tools (e.g., chatbots, predictive analytics) in strategic decisions.	185	1	0	1.6%	11.9%	53.0%	33.5%	4.18	.698
I feel comfortable collaborating with intelligent systems (AI, Big Data, digital assistants, etc.).	184	2	0	1.6%	2.7%	14.7%	52.2%	4.04	.832
I believe digital tools help reduce human bias in decision-making.	184	2	0	0	7.6%	51.1%	41.3%	4.34	.615
I see AI and data tools as partners that enhance my leadership capabilities.	183	3	0	0	12.0%	49.7%	38.3%	4.26	.661
Human oversight is necessary when implementing technology-supported decisions.	185	1	0	1.1%	5.9%	43.8%	49.2%	4.41	.654

Table 5 Human-Machine Collaboration in Leadership statistics

There is a clear indication of growing alignment between leadership practices and human-machine collaboration in the finance sector, as shown in the descriptive statistics in Table 10. With mean scores ranging from 4.04 to 4.41, respondents reported a generally positive attitude toward integrating artificial intelligence (AI) and digital tools into leadership roles. This high level of agreement reflects confidence in the strategic use of AI to enhance leadership effectiveness and support decision-making.

For instance, the statement *"I use AI in leadership tasks such as decision-making and market analysis"* had a mean score of 4.18, with 86.5% of leaders agreeing or strongly agreeing. This suggests that digital leadership is increasingly reliant on data-driven insights, a trend supported by studies emphasizing AI's role in strategic functions like performance forecasting, risk analysis, and market scanning (Davenport & Ronanki, 2018). The comfort level in collaborating with AI systems was also high (M = 4.04), pointing to a shift toward shared decision-making models between humans and intelligent technologies, echoing findings by El Sawy et al. (2016) on cognitive collaboration between leaders and machines.

A strong agreement was also noted in the belief that *digital tools reduce human bias in leadership* (M = 4.34), as more than 92% of respondents agreed with this statement. This supports research suggesting that AI, when properly implemented, can enhance objectivity and reduce decision-making errors rooted in human limitations (Kane et al., 2015). Additionally, leaders showed a mindset of integration, with 88% agreeing that they view AI not just as a tool but as a *partner in leadership* (M = 4.26). This aligns with Avolio et al. (2014), who argue that effective digital leadership integrates machine intelligence into core leadership behaviors rather than treating it as a peripheral support.

Despite the optimistic view, respondents maintained a critical stance on the need for ethical and strategic oversight. The highest agreement was recorded on the statement *"There is a need for human oversight when using AI in leadership decisions"* (M = 4.41), with 93% in agreement. This highlights a responsible attitude, suggesting that while AI is welcomed, it must be guided by human leadership values and accountability—an issue frequently raised in the context of ethical leadership in digital environments (Zhang et al., 2021).

These findings support emerging leadership theories that suggest digital maturity is not only about embracing technology but also about maintaining balance and accountability. Leaders in Addis

Ababa's finance sector appear to be aligning with this principle, recognizing both the potential of AI to enhance leadership and the ongoing need for human ethical governance.

4.3.3 Technology Acceptance

The descriptive statistics in Table 11 indicate that overall, respondents exhibited a strong level of technology acceptance in leadership functions. Mean values across all items ranged between 3.98 and 4.27, showing widespread agreement on the importance, ease, and intention to use digital tools in leadership roles. This is consistent with growing global trends that highlight digital readiness as a key element of effective leadership in the digital age.

The statement *"I find it easy to adapt to new digital technologies"* had a high mean score of 4.25, with over 87% of respondents agreeing or strongly agreeing. This suggests that leaders in the financial sector of Addis Ababa perceive digital adaptability as a natural part of their role. Research by Venkatesh and Davis (2000) emphasized that perceived ease of use significantly influences technology acceptance in organizational contexts.

A similarly high level of agreement was observed in the perception that *"Digital tools improve leadership effectiveness"* (M = 4.27), with more than 91% of respondents endorsing the statement. This reflects confidence in the ability of digital tools to enhance communication, data analysis, and decision-making—critical areas of modern leadership. These findings align with Kane et al. (2015), who identified digital leadership capabilities as a strategic asset in adapting to technological change.

The intention to adopt new technologies was also strong (M = 4.21), with nearly 88% indicating a proactive attitude toward innovation. According to the Technology Acceptance Model (TAM), behavioral intention is a strong predictor of actual technology use (Davis, 1989). This result is further supported by the work of El Sawy et al. (2016), who emphasized the role of leadership intention in driving digital transformation initiatives.

Interestingly, while leaders expressed strong intent and adaptability, the mean score for *confidence in independently using digital tools* was slightly lower at 3.98, with 22% of respondents indicating only moderate confidence. This suggests that while most leaders are willing and capable of using technology, some may still require additional training or support to develop full digital autonomy.

This finding is supported by Avolio et al. (2014), who pointed out that leadership development in the digital era requires more than access to tools—it demands deliberate competency-building.

Finally, the availability of organizational support for using technology was also rated positively (M = 4.06), with 81.7% of respondents agreeing that their institutions support digital adoption. This affirms the importance of institutional backing in shaping user confidence and actual usage, aligning with Zhang et al. (2021), who argue that organizational infrastructure and culture play a pivotal role in enabling technology integration.

In conclusion, the results show that technology acceptance among leaders in the Addis Ababa finance sector is high, driven by ease of use, perceived usefulness, and strong organizational support. However, there remains a modest gap in independent confidence, indicating a potential area for targeted leadership development.

Technology Acceptance Statistics									
	N							Mean	Std. Deviation
	Valid	Missing	SDA	DA	N	A	SA		
I find it easy to learn and adapt to new digital technologies.	186	0	0	0.5%	12.4%	48.4%	38.7	4.25	.686
I believe using digital tools improves my leadership effectiveness.	186	0	0	0.5%	8.6	55.4	36.0	4.27	.611

I intend to continue adopting new technologies to support leadership and human-machine collaboration	185	1	0	0	11.3	56.5	31.7	4.21	.626
I feel confident using digital tools without requiring constant technical support.	183	3	0	4.3	17.7	51.6	24.7	3.98	.781
My organization provides sufficient technology to support my leadership role.	186	0	0	3.8	14.5	53.2	28.5	4.06	.761

Table 6Technology Acceptance statistics

4.3.4 Organizational Support

The descriptive analysis presented in Table 12 indicates a strong level of perceived organizational support for digital transformation initiatives among leaders in the financial sector of Addis Ababa. Mean scores across the five items measuring this construct ranged from 4.09 to 4.40, reflecting overall agreement among respondents that their organizations are enabling and committed to the integration of technology in leadership and strategic functions.

The highest agreement was observed for the statement *"Our infrastructure supports the use of digital technologies"*, which recorded a mean score of 4.40 (SD = 0.669), with more than 92% of participants agreeing or strongly agreeing. This finding suggests that the majority of institutions surveyed have invested in a reliable technological foundation, which is widely recognized as essential for successful digital transformation (Westerman, Bonnet, & McAfee, 2011).

Similarly, participants strongly endorsed the presence of a *clear digital strategy* (M = 4.26, SD = 0.664) and the view that *organizational leadership promotes the use of technology* (M = 4.20, SD = 0.706). These results suggest strategic alignment and leadership commitment to technological advancement—both of which are considered critical enablers for institutional innovation and agility in the digital age (Kane, Palmer, Phillips, Kiron, & Buckley, 2015).

Support in the form of *training and capacity building* was also evaluated positively (M = 4.12, SD = 0.792), indicating that most organizations provide learning opportunities to strengthen employees' digital competencies. However, approximately 17.2% of respondents expressed neutral or negative views on training availability, pointing to a potential gap in continuous professional development. As Avolio, Walumbwa, and Weber (2014) note, sustained digital leadership effectiveness depends not only on infrastructure and strategic vision, but also on the ongoing development of digital skills across all levels of the organization.

The lowest score within this dimension was recorded for the statement *"Employees are rewarded for technological innovation"* (M = 4.09, SD = 0.725). While a majority (71.1%) agreed with the statement, this result highlights a relative weakness in the organizational reward systems. Recognition and incentives for innovation are critical to fostering a culture of experimentation and forward-thinking, particularly in rapidly evolving technological environments (Davenport & Ronanki, 2018).

In conclusion, the results suggest that financial institutions in Addis Ababa provide a supportive environment for digital leadership, particularly in terms of infrastructure, strategic direction, and leadership engagement. However, there is room for improvement in the areas of incentive structures and employee training. A well-rounded approach to organizational support—including technical, strategic, and human resource dimensions—is essential for cultivating adaptive, technology-driven leadership (El Sawy, Kræmmergaard, Amsinck, & Vinther, 2016).

Organizational Support Statistics									
						N			Std.
	Valid	Missing	SDA	DA	N	A	SA	Mean	Deviation
We have the infrastructure (internet, electricity, device) to support digital innovation.	186	0	0	1.1	7.0	42.5	49.5	4.40	.669
Our leadership promotes the adoption of new technologies.	186	0	0	.5	15.1	47.8	36.6	4.20	.706
Innovation through technology is recognized and rewarded in my organization.	185	1	0	2.2	15.7	53.5	28.6	4.09	.725
We have a clear and defined digital strategy.	186	0	0	0	12.4	49.5	38.2	4.26	.664
My organization offers sufficient training on new digital tools.	186	0	0	4.3	12.9	48.9	33.9	4.12	.792

Table 7 Organizational Support Statistics

4.4 CORRELATION ANALYSIS

		DigitalLeadership	Human Machine Collaboration_in leadership	Technology Acceptance	Organizational Support
Digital Leadership	Pearson Correlation	1	.617**	.589**	.566**
	Sig. (2-tailed)		<.001	<.001	<.001
	N	186	186	186	186
Human_Machine_Collaboration_in_Leadership	Pearson Correlation	.617**	1	.689**	.607**
	Sig. (2-tailed)	<.001		<.001	<.001
	N	186	186	186	186
TechnologyAcceptance	Pearson Correlation	.589**	.689**	1	.716**
	Sig. (2-tailed)	<.001	<.001		<.001
	N	186	186	186	186
OrganizationalSupport	Pearson Correlation	.566**	.607**	.716**	1
	Sig. (2-tailed)	<.001	<.001	<.001	
	N	186	186	186	186

Table 8 CORRELATION ANALYSIS

The correlation analysis was conducted to examine the relationship among the five major constructs: Digital Leadership, Human-Machine Collaboration in Leadership, Technology Acceptance, Organizational Support, and Ethical and Cultural Considerations (see Table 13). The results reveal statistically significant positive correlations across all variables, suggesting a mutually reinforcing relationship among them in the context of technology-driven leadership.

Digital Leadership showed a strong positive correlation with Human-Machine Collaboration in Leadership ($r = .617$, $p < .001$), indicating that as leadership becomes more digitally competent, collaboration with intelligent systems is more readily embraced. This aligns with research suggesting that digital leaders often spearhead AI-integrated change (Avolio et al., 2014).

Similarly, Digital Leadership was positively correlated with Technology Acceptance ($r = .589$, $p < .001$), Organizational Support ($r = .566$, $p < .001$), and Ethical and Cultural Considerations ($r = .356$, $p < .001$), implying that effective digital leadership plays a critical role in influencing not only the adoption of new technologies but also the ethical frameworks and support systems around them.

Human-Machine Collaboration in Leadership was strongly correlated with Technology Acceptance ($r = .689$, $p < .001$) and Organizational Support ($r = .607$, $p < .001$), suggesting that employees who are comfortable collaborating with AI tend to perceive higher institutional support and greater ease in adopting digital tools.

The strongest relationship in the matrix was observed between Technology Acceptance and Organizational Support ($r = .716$, $p < .001$). This finding underscores the critical role that organizational infrastructure, training, and strategic alignment play in fostering a positive attitude toward technology integration — a theme well supported in the literature on digital transformation (Davenport & Ronanki, 2018).

Overall, these correlations suggest that digital leadership, AI collaboration readiness and organizational structures and collectively influence the successful implementation of technology-driven strategies in leadership contexts.

4.5 REGRESSION ANALYSIS

To assess the influence of key leadership-related factors on Human-Machine Collaboration in Leadership (HMCL), a linear regression analysis was conducted using SPSS Version 29.0. This statistical technique was used to determine how well the independent variables— Digital Leadership (DL), Technology Acceptance (TA), and Organizational Support (OS)—predict changes in the dependent variable.

The analysis included the following variables:

- **X_1: Digital Leadership** – representing leaders' capacity to drive innovation and transformation through technology.
- **X_2: Technology Acceptance** – referring to the degree of willingness and ability within the organization to embrace technological tools in decision-making and leadership tasks.
- **X_3: Organizational Support** – the extent to which the organization provides the necessary infrastructure, encouragement, and environment for human-machine integration.

The dependent variable was:

- **Y: Human-Machine Collaboration in Leadership** – which captures how effectively leadership practices incorporate collaboration between human intelligence and machine-based systems (e.g., AI, data analytics, automation).

The standard linear regression model applied is expressed as:

Y=β0+β1X1+β2X2+β3X3+ϵY = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \epsilonY=β0+β1X1+β2X2+β3X3+ϵ

Where:

- YYY is the predicted level of human-machine collaboration,
- β0\beta_0β0 is the intercept (baseline value of YYY when all predictors are zero),
- β1\beta_1β1, β2\beta_2β2, and β3\beta_3β3 are the coefficients representing the influence of each predictor variable,
- ϵ\epsilonϵ is the error term accounting for variability not explained by the model.

The findings indicate that the model is statistically significant and explains a considerable proportion of the variance in HMCL. Among the predictors, Technology Acceptance emerged as the most influential variable, followed by Digital Leadership, Organizational Support had a borderline effect but was still within the threshold of statistical significance.

These results reinforce the importance of technological readiness and digitally capable leadership in promoting effective human-machine synergy in leadership contexts. The regression model suggests that organizations aiming to enhance their leadership effectiveness through intelligent systems must prioritize digital capability, foster a culture of technology adoption, and provide consistent support.

4.4.1 Diagnostic Tests

4.4.1.1 Normality Test

To verify the normality assumption of the regression residuals, a histogram and a Normal P-P plot of the standardized residuals were examined.

4.4.1.1.1 Histogram

The histogram depicted illustrates the distribution of the standardized residuals for the dependent variable Human Machine collaboration in leadership . The visual representation indicates that the residual approximate a normal distribution, as evidenced by the bell-shaped curve overlaying the histogram bar. This adherence to normality is crucial for validating the assumptions underlying linear regression models specifically that the residuals should be normally distributed According to Field (2013), normally distributed residuals ensure the reliability of the statistical inferences drawn from the regression analysis. In the context of this research, this suggests that the impact of Digital Leadership, Technology Acceptance, and Organizational Support on Human-Machine Collaboration in Leadership can be interpreted with confidence, as the residuals meet the assumption of normality. This finding aligns with previous literature, which emphasizes the importance of normally distributed residuals in validating regression models (Osborne & Waters, 2002).

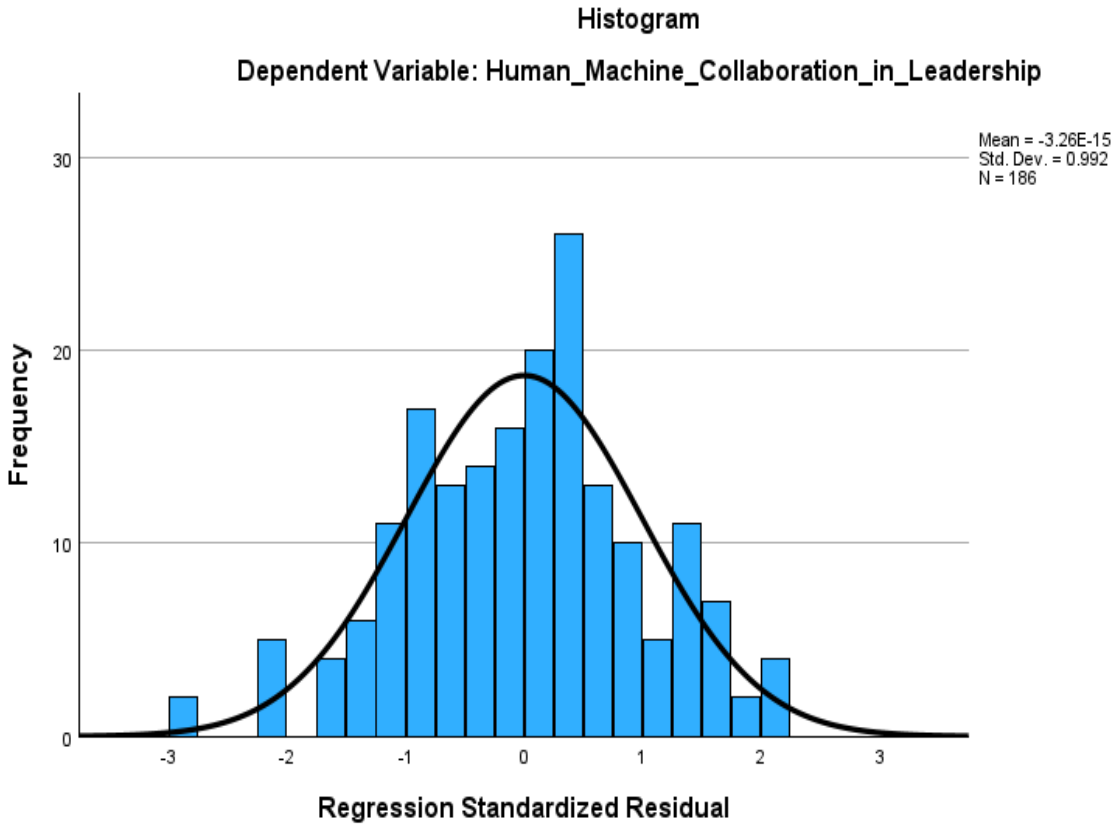


Figure 7 Histogram

4.4.1.1.2 Normal P–P Plot

The Normal P–P Plot of standardized residuals was examined to assess the normality assumption of the regression model. The plot showed that the points closely followed the diagonal reference line, indicating that the residuals are approximately normally distributed. According to Field (2013), normally distributed residuals enhance the reliability of statistical inferences in regression analysis. In this study, this supports the validity of interpreting the influence of Digital Leadership, Technology Acceptance, and Organizational Support on Human-Machine Collaboration in Leadership. This observation is consistent with Osborne and Waters (2002), who highlight the importance of normally distributed residuals in regression model validity.

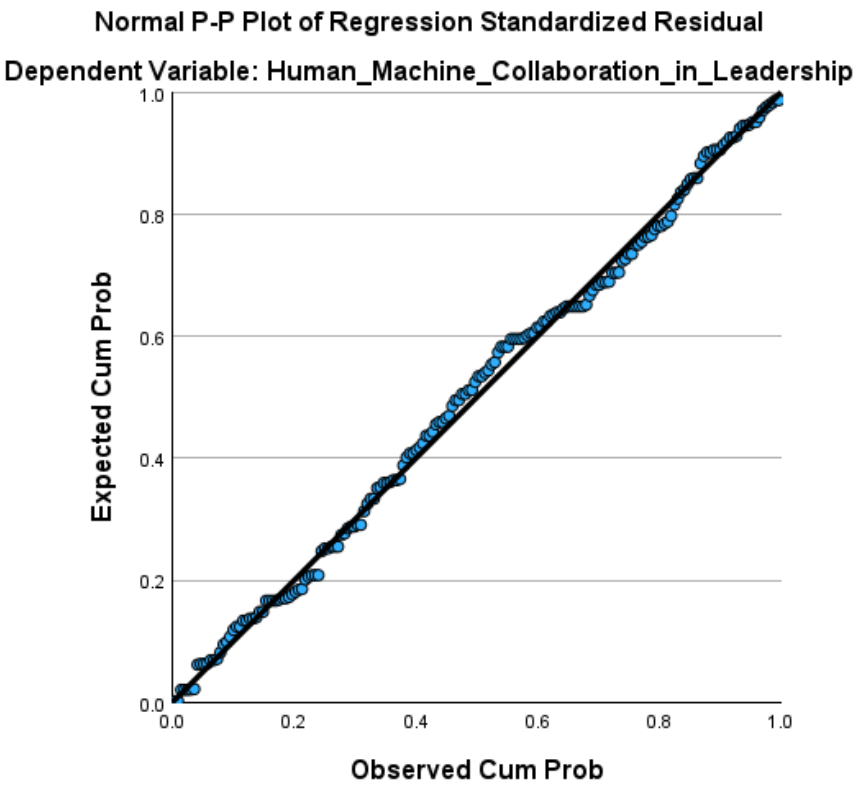


Figure 8 Normal P–P Plot

4.4.1.2 Multicollinearity Test

Multicollinearity among the independent variables was assessed using Variance Inflation Factor (VIF) and Tolerance values. The VIF values for Digital Leadership (1.639), Technology Acceptance (2.287), and Organizational Support (2.197) were all below the common threshold of 5, indicating no severe multicollinearity issues. Tolerance values were all above 0.4, which further supports the absence of problematic multicollinearity in the model. Additionally, the Condition Index values were below 30, confirming the stability of the regression coefficients.

4.4.1.3 Homoscedasticity Test

Homoscedasticity was checked using a scatterplot of standardized residuals vs. predicted values. The plot revealed no visible pattern or funnel shape, indicating constant variance of residuals.

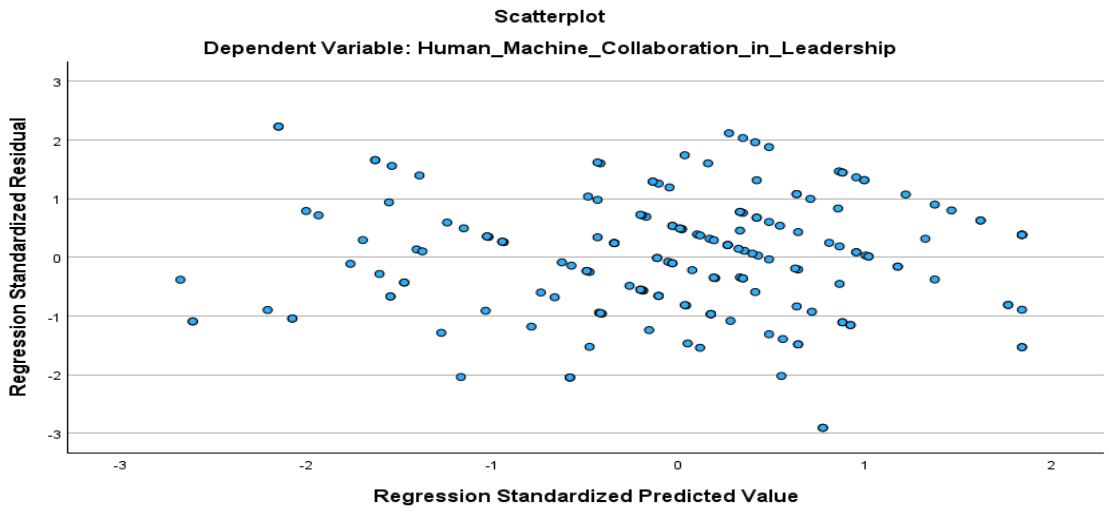


Figure 9 Scatterplot

4.4.2 Linear Regression Analysis

The regression model was analyzed using the Standard Method to determine the effect of the three independent variables. The results are as follows:

Model Summary

The model summary showed an R-squared value of 0.553, indicating that 55.3% of the variance in Human-Machine Collaboration in Leadership was explained by the predictors. The Durbin-Watson statistic of 2.104 suggests no autocorrelation among residuals.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.743[a]	.553	.545	.31335	.553	74.990	3	182	<.001	2.104

a. Predictors: (Constant), OrganizationalSupport, DigitalLeadership, TechnologyAcceptance

b. Dependent Variable: Human_Machine_Collaboration_in_Leadership

ANOVA Table

The ANOVA results indicated that the overall model was statistically significant, $F(3, 182) = 74.990$, $p < 0.001$, confirming that the predictors as a group explain a significant amount of variance in the dependent variable.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.089	3	7.363	74.990	<.001[b]
	Residual	17.870	182	.098		
	Total	39.958	185			
a. Dependent Variable: Human_Machine_Collaboration_in_Leadership						
b. Predictors: (Constant), OrganizationalSupport, DigitalLeadership, TechnologyAcceptance						

Table 9 ANOVAa

Regression Coefficients

All three independent variables had a statistically significant and positive influence on the dependent variable. Technology Acceptance had the strongest effect, followed by Digital Leadership and Organizational Support.

The regression analysis demonstrated that Digital Leadership, Technology Acceptance, and Organizational Support significantly predict Human-Machine Collaboration in Leadership. All assumptions of multiple regression were satisfied, confirming that the model is statistically sound and reliable

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.972	.221		4.398	<.001		
	DigitalLeadership	.269	.059	.291	4.590	<.001	.610	1.639
	TechnologyAcceptance	.384	.070	.413	5.509	<.001	.437	2.287
	OrganizationalSupport	.128	.064	.146	1.984	.049	.455	2.197

a. Dependent Variable: Human_Machine_Collaboration_in_Leadership

Table 10 Coefficientsa

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Hypothesis Testing Results

The multiple regression analysis was conducted to examine the effects of Digital Leadership Competence, Technology Acceptance, and Organizational Support on Human-Machine Collaboration in Leadership.

The overall model was found to be statistically significant, $F(3,182)=74.990, p<0.001$F(3,182) = 74.990, p < 0.001F(3,182)=74.990,p<0.001, indicating that the predictors collectively explain a significant portion of the variance in Human-Machine Collaboration in Leadership ($R2=0.553$R^2 = 0.553R2=0.553).

Regarding the individual predictors:

- Digital Leadership Competence was found to have a positive and significant effect on Human-Machine Collaboration in Leadership ($\beta=0.269$\beta = 0.269β=0.269, $t=4.590$t =

4.590t=4.590, p<0.001p < 0.001p<0.001). This supports the hypothesis that leaders with higher digital competence are more effective in collaborating with AI and data-driven tools.

- Technology Acceptance also showed a positive and significant influence on Human-Machine Collaboration in Leadership (β=0.384\beta = 0.384β=0.384, t=5.509t = 5.509t=5.509, p<0.001p < 0.001p<0.001), confirming that leaders who are more willing to adopt new technologies tend to engage better with human-machine collaboration.
- Organizational Support demonstrated a positive and statistically significant impact on Human-Machine Collaboration in Leadership (β=0.128\beta = 0.128β=0.128, t=1.984t = 1.984t=1.984, p=0.049p = 0.049p=0.049). This finding indicates that when organizations provide sufficient support, leaders are better positioned to integrate machine collaboration effectively.

In summary, all three independent variables—Digital Leadership Competence, Technology Acceptance, and Organizational Support—have significant positive effects on Human-Machine Collaboration in Leadership.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Key Findings

This study aimed to investigate the role of technology-driven leadership in facilitating human-machine collaboration within Ethiopian businesses, particularly in the financial sector. The research focused on three main hypotheses and associated questions concerning digital leadership, technology acceptance, organizational support, and ethical-cultural considerations.

The findings strongly support the research hypotheses:

- **Digital leadership competence** significantly influences the adoption of AI and digital tools in leadership roles.
- **Technology acceptance** among leaders is the most crucial predictor of successful human-machine integration.
- **Organizational support** also play important roles, although with moderate influence.

The statistical analysis (including descriptive, correlation, and regression) confirms that technology-ready leaders supported by a digital-friendly organizational culture are more likely to integrate AI and automation effectively into business strategy.

5.2 Discussion of Research Questions

RQ1: Ethiopian financial leaders generally are well-prepared to use human-machine collaboration, though some need more confidence in data analytics.

RQ2: A lack of skills and training, especially in data analysis, limits AI's full potential; more training is needed.

RQ3: Effective leadership combines digital skills, willingness to adopt technology, and strong organizational backing.

5.3 Conclusion

Ethiopian financial institutions are progressing toward technology-integrated leadership. The study provides empirical evidence that digitally competent leaders who trust technology and receive organizational support are more likely to integrate AI and human collaboration into business practices.

While infrastructure and vision are largely in place, the study highlights the need for:

- Ongoing training in data analytics and AI tools
- Enhanced reward systems for technological innovation

These findings align with global research emphasizing that successful digital transformation is not just about adopting technology but fostering a culture of innovation, transparency, and ethical leadership.

5.4 Recommendations

1. Leadership Training and Capacity Building

Institutions should offer specialized training in data analytics, AI fundamentals, and decision-making under uncertainty. Workshops, online courses, and mentoring programs can address the confidence gap in data interpretation.

2. Strengthen Technology Acceptance Initiatives

To increase trust in AI, leaders should be engaged in early-stage technology planning. Introducing user-friendly tools, involving end-users, and showcasing success stories can improve openness and reduce resistance.

3. Expand Organizational Support Structures To support successful digital transformation, organizations must ensure that their efforts are guided by clear strategies and supported with resources. It is also important to improve reward systems to recognize and encourage innovation, especially when it leads to performance improvements by AI. Additionally, improve access to digital infrastructure and providing strong technical support are good to enable leaders and employees to effectively use new technologies.

5.5 Areas for Future Research

Future research should consider expanding the scope of the study to include non-financial sectors and rural businesses in Ethiopia to gain a broader understanding of technology-driven leadership across diverse contexts. Long studies are also recommended to track the evolution of human-machine collaboration over time, offering a dynamic perspective on how leadership and technology interact. Finally, investigating employee perceptions of AI integration under different leadership models would help identify factors that influence acceptance and effectiveness, contributing to more tailored and successful implementation strategies.

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7. Appendices

7.2 Research Instrument

ADDIS ABABA UNIVERSITY

To be filled by Employee

Research Title:

Technology-Driven Leadership in Ethiopia's Financial Sector

Researcher:

Nebyat Ahmed

Business Leadership Department

Addis Ababa University

Dear Participant,

You are being invited to participate in a research study titled "Technology-Driven Leadership in Ethiopia's Financial Sector." The purpose of this study is to explore the role of leadership in adopting and integrating technology such as Artificial Intelligence (AI), big data, and other digital tools within the financial sector in Ethiopia. We aim to understand how leaders like yourself perceive the impact of these technologies on organizational decision-making and leadership effectiveness, and what challenges and opportunities they present in shaping the future of leadership in the sector.

This research focuses on leaders in the financial sector, as your insights are invaluable in understanding the broader trends, challenges, and opportunities that technology-driven leadership offers. The findings from this study will provide useful recommendations for enhancing leadership practices and fostering digital transformation in the sector.

Confidentiality:

Your participation in this study is completely voluntary. Any information you provide will be treated with the utmost confidentiality and will only be used for research purposes. Your responses will be anonymized, and no identifying information will be shared in the results.

Instructions:

Please answer the questions as honestly and thoughtfully as possible. There are no right or wrong answers. The survey is designed to capture your personal experiences, opinions, and insights regarding leadership in the digital era.

Estimated Time to Complete:

It should take approximately 10-15 minutes to complete this questionnaire.

Your participation is highly appreciated and will contribute significantly to advancing knowledge in the field of leadership in the context of digital transformation in Ethiopia's financial sector.

If you have any questions or concerns regarding this research, please feel free to contact me at NebyatAhmed21@gmail.com.

Part 1: General Information

This section gathers demographic and organizational background to better understand your responses. All information will remain confidential and used for research purposes only.

Gender

☐ Male

☐ Female

☐ Other (Please specify): _____

Age Group

☐ Under 25

☐ 25–34

☐ 35–44

☐ 45–54

☐ 55 and above

Educational Qualification

☐ High School

☐ Bachelor's Degree

☐ Master's Degree

☐ Doctoral Degree

☐ Other (Please specify): _____

Position/Job Title

☐ CEO/Managing Director

☐ Senior Manager

☐ Department Head

☐ Other (Please specify): _____

Years of Experience in a Leadership Role

☐ Less than 1 year

☐ 1–5 years

☐ 6–10 years

☐ 11–20 years

☐ More than 20 years

Type of Organization

☐ Commercial Bank

☐ Insurance

☐ Audit Firm

Size of the Organization

☐ Small (1–50 employees)

☐ Medium (51–200 employees)

☐ Large (201+ employees)

Part II: Thematic Questionnaire

Please indicate your level of agreement with the following statements using this scale:

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

A. Digital Leadership Competence

Statement	1	2	3	4	5
I use digital technologies (e.g., AI, Big Data) to support strategic leadership decisions (e.g., goal setting, resource allocation, market analysis).	☐	☐	☐	☐	☐
I encourage my team to use digital technologies to improve performance.	☐	☐	☐	☐	☐
I am confident making decisions based on data analytics.	☐	☐	☐	☐	☐
I provide guidance on the effective use of digital tools.	☐	☐	☐	☐	☐

I understand how digital transformation aligns with our strategic goals.	☐	☐	☐	☐	☐

B. Human-Machine Collaboration in Leadership

Statement	1	2	3	4	5
I have experience using AI-powered tools (e.g., chatbots, predictive analytics) in strategic decisions.	☐	☐	☐	☐	☐
I feel comfortable collaborating with intelligent systems (AI, Big Data, digital assistants, etc.).	☐	☐	☐	☐	☐
I believe digital tools help reduce human bias in decision-making.	☐	☐	☐	☐	☐
I see AI and data tools as partners that enhance my leadership capabilities.	☐	☐	☐	☐	☐
Human oversight is necessary when implementing technology-supported decisions.	☐	☐	☐	☐	☐

C. Technology Acceptance

Statement	1	2	3	4	5
I find it easy to learn and adapt to new digital technologies.	☐	☐	☐	☐	☐
I believe using digital tools improves my leadership effectiveness.	☐	☐	☐	☐	☐
I intend to continue adopting new technologies to support leadership and human-machine collaboration..	☐	☐	☐	☐	☐

I feel confident using digital tools without requiring constant technical support.	☐	☐	☐	☐	☐
My organization provides sufficient technology to support my leadership role.	☐	☐	☐	☐	☐

D. Organizational Support

Statement	1	2	3	4	5
We have the infrastructure (internet, electricity, device) to support digital innovation.	☐	☐	☐	☐	☐
Our leadership promotes the adoption of new technologies.	☐	☐	☐	☐	☐
Innovation through technology is recognized and rewarded in my organization.	☐	☐	☐	☐	☐
We have a clear and defined digital strategy.	☐	☐	☐	☐	☐
My organization offers sufficient training on new digital tools.	☐	☐	☐	☐	☐