

Determinants and Barriers to University-Industry Linkages: Academic Staff Perceptions at Addis Ababa University

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Abstract: This study examined determinants and challenges of university-industry linkages (UIL) at Addis Ababa University, College of Technology and Built Environment. A quantitative cross-sectional survey was used to gather data from 70 academic staff using a validated Likert-scale instrument. Descriptive statistics and correlations assessed UIL determinants and challenges, while simple regression models tested six institutional/relational predictors against three UIL outcomes. Academic reputation emerged as the strongest predictor of institutional effectiveness ($\beta = .686$, $p < .001$, $R^2 = .589$). Geographic proximity ($\beta = .315$, $p = .003$) and social capital ($\beta = .237$, $p = .042$) drove prior collaboration success ($R^2 = .526$), and firm characteristics predicted sustainability ($\beta = .347$, $p = .004$, $R^2 = .317$). Among the challenges, resource gaps and trust issues were the most critical. Resource gaps and trust issues were significantly correlated ($r = .51$, $p < .01$), showing how capacity constraints undermine collaboration confidence. The results suggest that UIL at CTBE remains at a developing stage but showing progress. Strengthening institutional capacity and promoting transparent communication proved essential for sustainable UIL.

Keywords: university-industry linkage, academic reputation, geographic proximity, resource gaps, Triple Helix

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1. Introduction

1.1. Background

In the current global economic landscape, UIL forms an essential component of the knowledge-based economy. These partnerships allow higher education institutions (HEIs) and industries to share resources, innovation, and expertise (Ahrweiler et al., 2011). Globally, these collaborations drive economic growth and the commercialization of knowledge (Fu et al., 2022).

In advanced economies, UIL systems are well established and supported by strong institutional frameworks (Ćudić et al., 2022) and UIL has been institutionalized through strong policy frameworks and commercialization mechanisms. In the United States, the Bayh-Dole Act of 1980 allowed universities to retain ownership of intellectual property from federally funded research, transforming institutions such as MIT and Stanford into entrepreneurial hubs and fueling innovation clusters like Silicon Valley (Mowery et al., 2001; Rosenberg & Nelson, 1994). Japan's Science and Technology Basic Law of 1995 institutionalized collaboration between universities and large corporations, particularly in electronics and automotive industries, with government support ensuring systematic partnerships (Nagaoka et al., 2009).

Emerging economies have also leveraged UIL for growth. India's Institutes of Technology have anchored innovation clusters in ICT and engineering, supported by government programmes that encourage entrepreneurship and public-private partnerships (Borah et al., 2021). Brazil's Innovation Law has promoted collaborative R&D in sectors such as aeronautics and energy, though challenges remain in institutionalizing UIL across universities (Suzigan et al., 2009). These diverse experiences show that UIL is not a uniform process but a context-specific strategy, shaped by national priorities and institutional capacity.

In contrast, in developing countries, UIL is often fragmented and limited in scope (Vaaland & Ishengoma, 2016). UIL in Africa has been shaped by historical legacies and structural constraints. For decades, African universities were criticized for being "colonial clones" that produced administrators rather than innovators, leaving HEIs disconnected from productive sectors (Saint, 2004). Industries often relied on imported technologies, while graduates struggled to find employment aligned with their training (Oyelaran-Oyeyinka & Adebawale, 2012).

South Africa has developed one of the most mature UIL ecosystems on the continent, supported by science parks, innovation hubs, and strong government policies that encourage universities to align research with industrial priorities (Nsanzumuhire et al., 2023). Nigeria has sought to strengthen UIL through its National System of Innovation framework, linking university research to agriculture and oil, though corruption and weak infrastructure are barriers (Adeoti, 2008). Kenya's "Silicon Savannah" illustrates how ICT-based UIL can drive regional innovation, with universities collaborating with technology firms to develop digital solutions (Bramann, 2017).

Across the continent, common barriers include weak infrastructure, insufficient funding, misalignment of expectations, and a persistent "trust deficit" between universities and industries. Industries often perceive universities as overly theoretical, while universities criticize industries for focusing only on short-term gains. Yet opportunities exist. The rapid growth of ICT, renewable energy, and agribusiness sectors-combined with curricular reforms emphasizing entrepreneurship provide a foundation for stronger linkages (Albuquerque et al., 2015).

Ethiopia formally initiated UIL in 1985 through a cooperation programme between Addis Ababa University (AAU) and the Ministry of Industry. The programme involved ten corporations and all faculties of the university, with both parties contributing funding to support training, internships,

joint research, and sponsorship (Dan, personal communication, July 11, 2023).

Ethiopia's experience with UIL reflects both progress and persistent challenges. The expansion of higher education institutions has created opportunities for collaboration and produced a large pool of graduates (Akalu, 2014). Despite this expansion and legal frameworks designed to strengthen collaboration, the UIL practice remains limited and fragmented (Israel et al., 2025). Against this backdrop, the present study examines determinants and barriers to UIL at Addis Ababa University's College of Technology and Built Environment (CTBE), formerly the Addis Ababa Institute of Technology (AAiT). By focusing on academic staff perceptions, the study seeks to identify which institutional and relational factors most strongly predict UIL outcomes, while also clarifying the challenges that constrain sustainable collaboration.

1.2. Problem Statement

Despite efforts made to promote engagement, UIL in Ethiopia remains in its infancy (Kahsay, 2017). Collaboration is largely confined to short-term activities such as student internships, consultancy, and training programmes, while deeper forms of joint research and technology transfer are rare (Hailu, 2024).

In recent years, the Ethiopian government has attempted to strengthen UIL by introducing strategic frameworks and technology transfer offices in most HEIs (MoSHE, 2019). However, progress has been slow, and several challenges undermine UIL outcomes in the country. From an academic perspective, universities face significant infrastructural limitations and a lack of adequate research facilities (Gashahun, 2020). Institutional commitment is often weak, and there are gaps in leadership (Shukra et al., 2021). Furthermore, the policy environment faces enforcement challenges. Although the UIL frameworks exist, they lack

binding mandates or financial incentives for industry participation, leading industries to perceive UIL as costly (Tamrat, 2022). This study seeks to address such gaps by providing systematic quantitative evidence on which institutional and relational determinants most strongly predict UIL outcomes, thereby offering practical insights for strengthening collaboration. The novel contribution lies in applying validated measurement models and regression analysis to test these determinants, moving beyond descriptive accounts and providing evidence that can guide both policy and practice.

Several studies have examined UIL in Ethiopia, but they tend to focus on specific activities such as internships, training, or consultancy (Ayenew & Teklay, 2017; Minwalkulet & Assef, 2018). Others have investigated experiences in technology and engineering institutes (Gemedat et al., 2023; Sertse, 2013). These studies provide useful insights but rarely employ rigorous quantitative methods to analyze causal relationships between determinants and UIL outcomes. Few have used validated measurement models or regression analysis to test the strength of different variables (Belay, 2008; Gashahun, 2020). Previous studies have often referred broadly to “variables” without clearly operationalizing them or testing their predictive strength. As a result, the institutional and relational factors that determine UIL competitiveness, success, and sustainability remain unclear. In contrast, the present study explicitly defines and measures six independent variables—academic reputation, communication quality, social capital, firm motivation, geographic proximity, and individual champions against three dependent variables: institutional effectiveness, prior collaboration success, and sustainability. This distinction ensures that the study variables are clearly described, systematically tested, and distinctly different from the loosely defined variables in earlier works.

The gap underscores the need for systematic quantitative evidence that can guide both policy and practice in Ethiopia's higher education sector.

Previous studies have also examined UIL activities in Ethiopia, but they often relied on descriptive or qualitative approaches (Ayenew & Teklay, 2017; Kannan, 2012; Minwalkulet & Assef, 2018). Few studies employed rigorous quantitative methods to test causal relationships between determinants and UIL outcomes (Belay, 2008; Gashahun, 2020). However, the literature did not adequately explain which factors drive UIL outcomes in Ethiopian HEIs.

This lack of empirical evidence creates a gap in both theory and practice. Without systematic measurement, policymakers and institutions cannot identify which determinants matter most to UIL performance. The absence of rigorous studies also limits universities' ability to design strategies that strengthen long-term collaboration. While several studies at CTBE/AAiT have documented UIL activities such as internships, consultancy, and training, they have not systematically tested how institutional and relational determinants predict UIL outcomes. In this context, CTBE/AAiT provides a relevant case. As a leading institute in technology and engineering, CTBE/AAiT is strategically positioned to engage with industry. What remains underexplored is the quantitative evidence linking determinants to specific UIL outcomes, namely institutional effectiveness, prior collaboration success, and sustainability. This study seeks to fill that gap by examining UIL outcomes through validated measurement models and regression analysis, thereby contributing novel evidence to guide both institutional strategies and policy.

1.3. Research Questions and Objectives

Research Questions

- To what extent do institutional and relational factors predict key UIL outcomes at CTBE/AAiT?

- What are the relative strengths and weaknesses of UIL determinants among CTBE/AAiT academic staff?
- What challenges constrain UIL development at CTBE/AAiT, and how do they interrelate?

Objectives of the Study

- To assess the extent to which institutional and relational factors predict key UIL outcomes at AAiT.
- To identify the relative strengths and weaknesses of UIL determinants among CTBE/AAiT academic staff.
- To examine the primary challenges constraining UIL development at CTBE/AAiT and their interrelationships.

1.4. Significance and Scope

This study contributes to the literature by providing quantitative evidence on UIL determinants in Ethiopia. It moves beyond descriptive accounts and tests the strength of associations between six determinants and three UIL outcomes. The findings will help university leadership and practitioners understand which factors are most critical for the effectiveness and sustainability of UIL.

The scope of the study is limited to CTBE (formerly AAiT), a single HEI case within AAU. The analysis focuses on academic staff directly engaged in teaching, research, and institutional management. By narrowing the model to three dependent variables and six independent variables, the study provides a lean and defensible framework suitable for a single-institution case. While the findings cannot be generalized to all Ethiopian HEIs, they offer insights that can inform UIL strategies in similar contexts.

2. Related Literature

2.1. Concept of University-Industry Linkage

University-industry linkage refers to the structured interactions between HEIs and industries aimed at fostering knowledge exchange, technology transfer, and collaborative development (Etzkowitz & Leydesdorff, 2000). Historically, UIL gained prominence in the mid-20th century as economies shifted toward knowledge-based models (Hadad, 2017). Active UIL provides multiple benefits, including skill development, research and development synergies, and improved employability for graduates (Guimón, 2013).

In advanced economies, UIL partnerships are deep and multifaceted. They often take the form of joint research, patents, and co-publications, which are supported by strong institutional frameworks (Bodas Freitas et al., 2013). The Triple Helix model explains this interaction, where universities, industries, and governments collaborate to generate innovation and economic value (Leydesdorff, 2000). In contrast, UIL in developing countries is often fragmented, limited to short-term engagements such as internships and consultancy, and rarely extends to joint research or commercialization (Albuquerque et al., 2015). Structural and financial barriers dominate, restricting universities from acting as engines of technological transformation (Adeoti, 2008; Bruneel et al., 2010).

2.1. Theoretical Perspective

This study adopts the Triple Helix Theory (THT) as its guiding framework. The theory explains innovation as the outcome of a dynamic interaction among three helices: university, industry, and government (Leydesdorff, 2000). It emphasizes that sustainable linkages are not produced by isolated efforts but rather through systemic synergy among these actors (Etzkowitz & Leydesdorff, 2000). In developing country

contexts, the government often plays a directive role, shaping the rules of engagement and providing incentives to encourage collaboration (Galvao et al., 2019).

Within this framework, universities contribute knowledge and human capital, industries provide resources and problem-driven demands, and the government establishes enabling policies. The interplay of these spheres determines whether UIL outcomes are competitive, successful, and sustainable. For Ethiopia, where UIL remains in its infancy (Kahsay, 2017) the Triple Helix perspective is particularly relevant. It highlights the importance of relational factors such as communication and social capital, alongside institutional determinants like academic reputation and firm motivation. These elements together shape UIL outcomes. The THT emphasizes that sustainable UIL requires industry readiness and entrepreneurial actors. Firm motivation ensures commitment to collaboration, while individual champions sustain partnerships over time by bridging institutional gaps (Etzkowitz & Leydesdorff, 2000).

This theoretical perspective provides a structured foundation for testing how several determinants shape the UIL outcomes at CTBE. The analysis is grounded in the Triple Helix framework and contextualized within Ethiopia's higher education environment.

2.2. UIL in Ethiopia

Ethiopia has formally recognized UIL as a tool for national development. The Higher Education Proclamation (FDRE, HPR, 2009) and the recent UIL Proclamation 1298/2023 (FDRE, HPR, 2023) provide a legal framework for collaboration. These frameworks aim to align academic research with industrial needs and encourage universities to expand their engagement with industries (Israel et al., 2025). Despite these policy steps, practical implementation remains weak. Legal structures exist, but functional interaction remains limited and inconsistent (Israel et al., 2025). This shows that the challenge lies less in the existence of

policies and more in their enforcement. Frameworks often lack binding mandates, adequate funding, and clear incentives for industry participation. This weakness reflects a broader pattern in developing contexts (Agbebi et al., 2024) where policy ambition is high but institutional capacity and enforcement remain fragile.

Historically, AAU maintained strong ties with state-owned corporations in the 1980s, which were supported by demand-driven collaboration (Dan, personal communication, July 11, 2023). This system collapsed in the 1990s due to structural and political changes, and current engagements have not yet regained the same depth (Dan, personal communication, July 11, 2023).

Nowadays, UIL activities are largely limited to student internships, training, and consultancy services. While these activities are encouraging, industries remain skeptical about the practical application of universities' research outputs and the skills of graduates (Israel et al., 2025). This skepticism arises because research is often perceived as overly theoretical, lacking immediate applicability to industrial problems, and graduates are sometimes seen as underprepared for the practical demands of firms (Hailu, 2024). As a result, firms hesitate to invest in deeper collaborations, reinforcing the trust deficit that has been widely noted in the literature (Gemedda et al., 2025). As a result, UIL in Ethiopia continues to face challenges of depth and sustainability.

2.3. *Determinants of University-Industry Linkages*

Determinants of UIL refer to the underlying conditions that shape how collaborations between HEIs and firms are initiated, developed, and sustained. They are not incidental; they are the drivers that explain why some linkages evolve into durable systems of innovation while others remain fragmented or ceremonial (Bruneel et al., 2010; Plewa et al., 2013). Discussing determinants is important for two reasons. First, it

allows scholars and policymakers to identify the relational, institutional, and structural elements that must be strengthened if UIL is to contribute meaningfully to national development. Second, it provides a framework for understanding the sustainability of linkages. Without clarity on determinants, UIL risks being reduced to short-term activities rather than becoming embedded in systems of innovation and industrial transformation (Cohen & Levinthal, 1990; Eom & Lee, 2010).

Determinants can be grouped at three levels: system, institutional, and individual. At the system level, the broader policy environment and national innovation system frame collaboration. For example, strong intellectual property regimes and government incentives often encourage firms to invest in UIL (Mowery et al., 2001). At the institutional level, determinants include organizational structures, leadership, and coordination mechanisms within universities and firms. Clear procedures and frequent communication make partnerships easier to manage (Isaeva et al., 2022). At the individual level, determinants emphasize relational dynamics and human agency. Personal networks and boundary spanners often initiate and sustain partnerships, acting as "champions" who bridge institutional gaps (Zhuang & Shi, 2024).

Several specific determinants have been widely examined. Trust between partners is consistently highlighted as the most critical. It enables open information sharing, reduces uncertainty, and sustains commitment when difficulties arise. Bruneel, D'Este, and Salter (2010) found that trust lowered both orientation-related barriers (differences in research goals) and transaction-related barriers (contracts and intellectual property). Communication quality is another determinant, ensuring clarity of goals and coordination (Ankrah & AL-Tabbaa, 2015). Academic reputation enhances credibility and attracts industry partners (Hatakenaka, 2004). Geographic proximity facilitates interaction, particularly in developing contexts where physical closeness allows partners to meet more easily and resolve issues quickly (Muscio et al., 2012). Social capital-the networks and relationships built over time-

provides a foundation for collaboration (Baban et al., 2021). Finally, individual champions mobilize collaboration and sustain engagement, often making the difference between partnerships that flourish and those that fade (Plewa et al., 2013).

Taken together, these determinants highlight that the effectiveness of UIL depends on a combination of systemic, institutional, and relational factors. Strengthening them is essential if UIL is to move beyond symbolic engagements and contribute to long-term innovation and development.

2.4. Challenges of University-Industry Linkages

While determinants explain what enables UIL, challenges highlight the barriers that constrain collaboration. Identifying these challenges is important because it helps policymakers, universities, and firms design interventions that address the root causes of weak collaboration rather than treating symptoms. The literature shows that barriers operate at multiple levels—from national policy frameworks to institutional structures and interpersonal relationships—and their intensity varies across contexts.

In developing countries, where innovation systems are still emerging, these challenges are often more acute and interconnected (Albuquerque et al., 2015; Nsanzumuhire et al., 2023). Among the challenges, system-level barriers, including weaknesses in policy regulation and infrastructure, are often mentioned. Partha and David (1994) highlighted the tension between the "open science" norms of academia and the proprietary logic of industry. In lower-income countries, fragile institutional systems magnify these divides. Intellectual property regimes are a recurring challenge (Partha & David, 1994). Infrastructure also plays a decisive role. Poor electricity, connectivity, and weak transport

systems undermine sustained collaboration in developing regions, including Africa (Christopher T. Mgonja, 2017; Guimón, 2013).

Several UIL challenges are mentioned in the broader literature, but institutional impediments are critical. This challenge refers to barriers within universities and research organizations. Bureaucratic procedures, weak organizational mechanisms, and under-resourced technology transfer offices often frustrate partners (Mihyo, 2013). In Ethiopia, inadequate infrastructure, weak leadership, and poor enforcement of policies further hinder UIL (Gashahun, 2020; Tamrat, 2022). Relational challenges are equally significant. A persistent "trust deficit" between universities and industries has been identified as a major obstacle to sustainable partnerships (Nsanzumuhire et al., 2023; Nsanzumuhire & Groot, 2020). Industries often perceive universities as overly theoretical, while universities criticize industries for focusing only on short-term gains (Kannan, 2012). This misalignment of expectations reduces confidence and discourages long-term investment in collaboration.

In general, these challenges are interdependent, reinforcing one another and reducing the sustainability of partnerships. Addressing them requires systemic reforms, stronger institutional commitment, and deliberate efforts to build trust between partners.

3. Methodology

3.1. *Research Design*

This study employed a quantitative, cross-sectional design to examine the determinants of UIL at CTBE. A cross-sectional survey design is appropriate for single-institution studies that assess perceptions at one point in time (Creswell & Clark, 2018). The design allowed for systematic measurement of variables, descriptive analysis, and statistical testing of relationships through correlation and linear regression. This approach provided a snapshot of current UIL practices and outcomes while acknowledging the exploratory nature and single-case limitations.

3.2. *Study Setting and Population*

The study was conducted at Addis Ababa Institute of Technology (AAiT), †formerly known as the Imperial College of Engineering and later the Faculty of Technology of Addis Ababa University. Currently, it is known as the College of Technology and Built Environment (CTBE). Established in 1953, AAiT is the oldest and largest engineering institute in Ethiopia. Since 2010, it has operated as a semi-autonomous institute within AAU, led by a Scientific Director with vice-president status. AAiT plays a central role in national engineering education and innovation. It trains instructors for other universities, supports industrial development, and contributes to Ethiopia's transformation agenda. During the period of this study, AAiT enrolled approximately 5,500 undergraduate and 4,500 graduate students across multiple schools and departments. The institute has nearly 400 academic staff and about 600 administrative and support staff. This makes AAiT one of the largest engineering institutes in the country.‡

The study population consisted of 378 academic staff members at CTBE/AAiT, representing the core teaching and research body of the institute. A proportional stratified sampling approach was initially designed to ensure representation across departments and academic ranks. However, since the present manuscript focuses only on AAiT, the reported sample is limited to this institution. From the total population, 70 valid responses were obtained through a structured survey instrument, forming the basis of the analysis.

3.3. *Sampling Technique and Size*

The study population at the College of Technology and Built Environment (CTBE/AAiT) consisted of 378 academic staff members

† Now under College of Technology and Built Environment

‡ Visit <http://www.aau.edu.et/aait/>

engaged in teaching, research, and institutional leadership. To ensure representation across departments and academic ranks, a proportional stratified sampling approach was employed. This method allowed each stratum of the academic staff to be proportionally represented in the sample, thereby reducing bias and improving the reliability of the findings.

Using Yamane's (1967) formula for finite populations, the required sample size was calculated at a 95% confidence level and a 5% margin of error (Yamane, 1967). Based on this calculation, the target sample for CTBE/AAiT was determined. During the period of data collection, 70 valid responses were obtained, which form the basis of the present analysis.

Although the sample is small, it is sufficient for descriptive statistics and exploratory regression analysis. Methodological guidelines indicate that regression models with 5–6 independent variables can achieve acceptable statistical power with samples of around 50–70 cases when moderate effect sizes are present (Faul et al., 2009). As CTBE/AAiT is Ethiopia's leading public science and technology institute and is highly engaged in UIL, including participation in key national projects, this sample itself carries meaning and implications for similar institutions across the country. Thus, the responses obtained from CTBE/AAiT provide a focused case study of UIL determinants and barriers within Ethiopia's leading engineering institute, offering insights that reflect the perspectives of academic staff directly engaged in teaching and research.

The adequacy of the sample size was also considered. The achieved sample of 70 academic staff is sufficient for descriptive statistics and exploratory regression analysis. Prior methodological guidance confirms that samples of this size can reliably detect moderate correlations ($r > 0.30$), making the findings statistically meaningful (Bostley Muyembe Asenahabi & Peters Anselemo Ikoha, 2023; Memon et al., 2020). While

the study is institution-specific, the determinants tested—academic reputation, communication quality, social capital, firm motivation, geographic proximity, and individual champions—are widely recognized in UIL literature (Alrajhi & Aydin, 2019; Baban et al., 2021; Hou et al., 2021; Hu et al., 2016; Johnston & Huggins, 2017). This enhances the transferability of insights to other Ethiopian science and technology institutes, given that these determinants are consistently identified as critical factors across diverse contexts.

For $N = 378$ and $\alpha = 0.05$, the calculated sample size was approximately 70. The final dataset included 70 valid responses, representing a 100% response rate. This sample size was sufficient to detect moderate correlations ($r > 0.30$) in regression analysis.

3.4. *Instrument and Variables*

Data were collected using a structured questionnaire developed from established UIL literature and adapted to the Ethiopian context. All items were measured on a five-point Likert scale ranging from “strongly disagree (1)” to “strongly agree (5)”. Background questions were also included to capture respondents’ demographic and professional profiles. The instrument was designed to measure three dependent variables (DVs) against six independent variables (IVs) relevant to UIL at CTBE. These variables together provided a comprehensive view of institutional UIL outcomes, as well as contextual barriers affecting UIL. The questionnaire was pilot-tested to ensure clarity and internal consistency before full deployment. Feedback from the pilot was used to refine wording and improve the flow of the instrument. In the analysis, data were examined using descriptive statistics to summarize respondent characteristics and variable distributions, correlation analysis to explore associations among determinants, and simple linear regression models to test the predictive power of the six independent variables on the three UIL outcomes. The four categorizations of challenge variables were

analyzed descriptively and via correlations to provide a contextual understanding of barriers to UIL.

3.5. *Data Quality Assurance*

Several measures were taken to ensure the quality and reliability of the data in this study. The questionnaire was first pretested with a small group of academic staff outside the main sample to check clarity, item relevance, and flow. Feedback from the pre-test was used to refine wording and improve the structure of the instrument before full deployment. During the main data collection at AAiT/CTBE, the researcher closely monitored incoming submissions through KoboToolbox. The system automatically flagged missing items and duplicate entries, which allowed for early correction and removal of problematic cases. Responses with substantial missing values were excluded from the dataset to maintain consistency. After data collection, the final dataset of 70 valid cases was screened for outliers and checked against basic statistical assumptions. Normality was assessed using residual plots, while linearity and homoscedasticity were examined through scatterplots. These steps ensured that the dataset was clean, reliable, and suitable for correlation and regression analysis. This process aligns with recommended practices for survey-based quantitative research, where pre-testing, monitoring, and assumption checks are essential for data integrity (Creswell & Clark, 2018).

3.6. *Validity and Reliability*

A pilot survey was conducted at Hawassa University to test the clarity and consistency of the instrument. Forty valid responses were analyzed. Cronbach's alpha for the overall instrument was 0.85, with all thematic categories producing coefficients above 0.80. These results indicate strong internal consistency and confirm that the instrument is suitable for use in the main study. Feedback from the pilot was used to refine item wording and improve the flow of the questionnaire.

3.7. *Data Collection Procedure*

Data collection was carried out using KoboToolbox. The researchers administered the survey directly using tablets, while a survey link was also shared with participants who preferred to complete it independently. Participation was voluntary. Respondents were informed about the purpose of the study and assured that their responses would remain anonymous and be used only for academic purposes. Only fully completed questionnaires were included in the final dataset.

Respondents were proportionally selected from the major academic streams within CTBE/AAiT to ensure representation across schools and departments. The selection process targeted academic staff engaged in teaching, research, and institutional leadership, as these groups are directly involved in UIL activities and decision-making. This ensured that perspectives from different disciplines were captured in the survey. The detailed distribution of respondents across schools and departments is presented in the results section (Table 1: demographics) to maintain methodological clarity here and descriptive reporting in the findings.

3.8. *Data Analysis*

Data were analyzed using SPSS and Jamovi. Descriptive statistics were used to summarize respondent characteristics and variable distributions. The independent variables (determinants) included academic reputation, communication quality, social capital, firm motivation, geographic proximity, and individual champions. The dependent variables (UIL outcomes) were institutional effectiveness, prior collaboration success, and sustainability.

To examine the relationships between determinants and outcomes, bivariate correlation analysis was applied. Pearson's correlation coefficients were computed to assess the strength and direction of

associations between each determinant and each UIL outcome. Following this, simple regression models were run separately for each dependent variable to identify significant predictors. Collinearity diagnostics were examined using variance inflation factor (VIF) values, and normality of distributions was assessed through skewness and kurtosis statistics. All analyses utilized SPSS version 25.

3.9. *Ethical Considerations*

Ethical clearance was obtained from the AAU before data collection. Participants were informed about the purpose of the study, the type of information being collected, and how their responses would be used. Participation was voluntary, and respondents could withdraw at any time without consequences. No sensitive personal information was collected. All data were stored securely, and access was restricted to the researchers. Responses were considered confidential and used solely for academic purposes.

4. **Results**

This section presents findings from quantitative analysis examining UIL determinants and challenges at CTBE. Descriptive statistics, bivariate correlations, and simple regression analyses addressed RQ1 and RQ2 by exploring associations between institutional/relational factors and UIL outcomes. Separate descriptive and correlational analyses of challenge variables addressed RQ3, identifying key barriers and their interrelationships. Linear regression models tested predictive relationships, while descriptive analyses provided contextual understanding of constraints affecting UIL effectiveness at CTBE.

4.1. *Descriptive Results*

4.1.1. *Characteristics of Respondents*

This subsection presents demographic and professional characteristics of the 70 academic staff (participants) from CTBE. These descriptive statistics establish sample composition for subsequent UIL analyses.

Table 2: Demographic profile of respondents by gender and major academic stream

Variable	Category	Frequency	Percent (%)
Gender	Female	15	21.4
	Male	55	78.6
	Total	70	100.0
Major Academic Stream	Biomedical and Biosystems Engineering	6	8.6
	Chemical and Process Engineering	7	10.0
	Civil and Environmental Engineering	17	24.3
	Computing and Informatics	9	12.9
	Electrical, Electronics, and Computer Engineering	8	11.4
	Mechanical, Industrial, and Manufacturing Engineering	20	28.6
	Others	3	4.3
	Total	70	100.0

A total of 70 academic staff members participated in the study. The respondents represented a range of demographic and professional backgrounds. The majority were male, accounting for 78.6% of the sample, while females represented 21.4%. This reflects the gender imbalance commonly observed in engineering fields in Ethiopia. The respondents were mainly from engineering streams. The largest proportions were from Mechanical and Industrial Engineering (28.6%), followed by Civil and Environmental Engineering (24.3%) and Computing and Informatics (12.9%). This indicates that the data reflect

diverse academic units that actively engage in technology-focused engineering disciplines.

Table 3: Respondents' academic rank

Variable	Category	Frequency	Percent (%)
Academic Rank	Assistant Lecturer	1	1.4
	Assistant Professor	22	31.4
	Associate Professor	4	5.7
	Lecturer	30	42.9
	Others [§]	13	18.6
	Total	70	100.0

Regarding academic rank, most respondents were Lecturers (42.9%) and Assistant Professors (31.4%). Only a few were Associate Professors (5.7%), while the remaining 18.6% served in technical positions within their units.

Table 4: Educational qualification and years of experience

Variable	Category	Frequency	Percent (%)
Educational Qualification	Bachelor Degree	4	5.7
	Master's Degree	36	51.4
	PhD	30	42.9
	Total	70	100.0
Years of Experience	0-5	9	12.9
	6-11	23	32.9
	12-17	27	38.6
	18-22	9	12.9
	23-30	1	1.4
	31& above	1	1.4
	Total	70	100.0

[§] Other includes alumni, professors, construction engineers, data analysts, ICT experts, managers, senior experts, and senior network administrators.

The respondents were highly qualified. More than 94% held postgraduate degrees, including 51.4% with master's degrees and 42.9% with PhDs. Their academic experience was also substantial. Most had between 6 and 17 years of service, with the largest subgroup having 12 to 17 years. This profile shows that the data come from experienced and active academics who are well positioned to assess UIL practices, determinants, and challenges at CTBE.

4.1.2. Descriptive Statistics of Independent Variables

Table 5: Descriptive statistics of UIL determinants (N=70)

Independent Variables	Min	Max	Mean	SD	Ske w- ness	Kurtos is
Communication Quality	2.00	5.00	3.41	0.69	0.36	-0.51
Individual Champions	3.00	5.00	4.20	0.47	0.19	0.23
Firm Characteristics & Motivation	2.00	5.00	3.86	0.60	-1.52	3.32
Geographic Proximity	2.00	5.00	3.74	0.76	-0.04	-0.55
Social Capital	3.00	5.00	4.15	0.49	0.13	0.01
Academic Reputation	3.00	5.00	4.48	0.52	-0.36	-1.05
Valid N (listwise)						

Note: 5-point Likert scale. All skewness/kurtosis $< \pm 2$ indicates normality for regression.

Table 4 presents descriptive statistics for the six independent variables, all measured on a 5-point Likert scale. Communication quality had a mean score of 3.41 (SD = 0.69), indicating moderate perceptions of clarity and effectiveness in exchanges between partners. Individual champions recorded a higher mean of 4.20 (SD = 0.47), suggesting strong recognition of boundary spanners who initiate and sustain UIL activities. Firm characteristics and motivation showed a mean of 3.86 (SD = 0.60), with a negatively skewed distribution (skewness = -1.52) and high kurtosis (3.32), reflecting concentration of responses toward the upper end of the scale. Geographic proximity had a mean of 3.74 (SD = 0.76), with a relatively balanced distribution (skewness = -0.04). Social capital was rated highly, with a mean of 4.15 (SD = 0.49) and a near-normal distribution. Academic reputation obtained the highest mean score of 4.48 (SD = 0.52), confirming strong perceptions of institutional credibility among respondents.

The descriptive results show that respondents rated individual champions, social capital, and academic reputation more positively, while communication quality and firm characteristics received relatively lower scores. These patterns provide the basis for subsequent correlation and regression analyses.

4.1.3. Descriptive Statistics of Dependent Variables

Table 6: Descriptive statistics showing three dependent variables

Outcome	Min	Max	Mean	SD	Skewness	Kurtosis
Institutional Effectiveness	4.00	5.00	4.47	0.50	0.12	-2.05
Prior Collaboration	2.00	5.00	4.29	0.59	-0.60	1.88
Success						
UIL Sustainability	3.00	5.00	4.27	0.54	0.14	-0.41

Note. All items were measured on a five-point Likert scale.

Table 5 presents the descriptive results for the three UIL outcome variables. Institutional Effectiveness recorded the highest mean score of 4.47 (SD = 0.50), with responses clustered at the upper end of the scale. The distribution showed slight positive skewness (0.12) and a platykurtic distribution (-2.05), indicating limited variability. Prior collaboration success had a mean of 4.29 (SD = 0.59), with moderate negative skewness (-0.60) and a leptokurtic distribution (1.88). UIL Sustainability produced a mean of 4.27 (SD = 0.54), with a near-normal distribution (skewness = 0.14; kurtosis = -0.41). All three UIL outcomes received positive ratings, with institutional effectiveness the highest.

4.2. Correlation Results

Table 7: Pearson correlations among independent and dependent variables (N = 70)

Variables	1	2	3	4	5	6	7	8	9
1. Communication Quality	1								
2. Individual Champions	.26*	1							
3. Firm Characteristics	.12	.11	1						
4. Geographic Proximity	.26*	-.10	.29*	1					
5. Social Capital	.21	.20	.38**	.45**	1				

6. Academic Reputation	.20	.29*	.07	.23	.47**	1			
7. Inst. Effectiveness	.26*	.36**	.12	.23	.37**	.74**	1		
8. Prior Collab. Success	.42**	.31*	.09	.47**	.52**	.52**	.56**	1	
9. UIL Sustainability	.05	.29*	.44**	.17	.39**	.29*	.22	.16	1

Note: * $p < .05$, ** $p < .01$ (2-tailed).

Table 6 presents the Pearson correlation coefficients among the independent variables and the UIL outcome variables. Communication Quality correlated positively with Institutional Effectiveness ($r = .26$, $p < .05$) and Prior Collaboration Success ($r = .42$, $p < .01$). Individual Champions showed significant associations with Institutional Effectiveness ($r = .36$, $p < .01$), Prior Collaboration Success ($r = .31$, $p < .05$), and UIL sustainability ($r = .29$, $p < .05$). Firm characteristics and motivation correlated positively with geographic proximity ($r = .29$, $p < .05$), social capital ($r = .38$, $p < .01$), and UIL sustainability ($r = .44$, $p < .01$).

Geographic proximity was strongly associated with social capital ($r = .45$, $p < .01$), meaning that staff located closer to industry partners reported stronger professional networks and trust. It was also positively related to prior collaboration success ($r = .47$, $p < .01$), indicating that physical closeness facilitated more successful past collaborations.

Social capital correlated positively with institutional effectiveness ($r = .37$, $p < .01$), showing that stronger networks were linked to perceptions of more effective institutions. It also supported prior collaboration success ($r = .52$, $p < .01$) and UIL sustainability ($r = .39$, $p < .01$), suggesting that well-developed relationships contributed both to successful collaborations and their continuity over time.

Academic reputation showed the strongest correlation with institutional effectiveness ($r = .74$, $p < .01$), meaning that institutions with higher perceived reputation were also seen as more effective in UIL. Reputation was also significantly related to prior collaboration success ($r = .52$, $p < .01$) and UIL sustainability ($r = .29$, $p < .05$), indicating that credibility enhanced both past success and long-term sustainability. Among the dependent variables, institutional effectiveness was positively associated with prior collaboration success ($r = .56$, $p < .01$), suggesting that effective institutions were more likely to report successful collaborations.

UIL sustainability moderately correlated with firm characteristics and motivation ($r = .44$, $p < .01$), social capital ($r = .39$, $p < .01$), and academic reputation ($r = .29$, $p < .05$). This shows that motivated firms, strong networks, and institutional credibility all contributed to sustaining UIL. Overall, the results indicate that academic reputation, social capital, and individual champions are the most consistent predictors of positive UIL outcomes at AAiT.

4.3. Simple Regression Results

Table 8: Multiple Regression Results Predicting UIL Outcomes (N = 70)

Predictor	Model 1:		Model2:		Model 3:	
	Inst. Effectiveness		Prior Success		Sustainability	
	β	p	β	p	β	p
Communication Quality	.059	.502	.205*	.033	-.116	.308
Individual Champions	.161	.079	.179	.070	.211	.075
Firm Characteristics	.040	.660	-.153	.117	.347	.004
Geographic Proximity	.083	.396	.315	.003	.006	.964

Social Capital	-.048	.653	.237	.042	.176	.204
Academic Reputation	.686	.000*	.252	.017	.140	.262
R²/ Adj.R²/ F	.589/ 15.04*	.550/ 11.66*	.526/ 11.66*	.481/ 4.88*	.317/ 4.88*	.252/ 4.88*

Note. *p < .05, **p < .01, ***p < .001.

Simple regression analyses were conducted to examine the individual effect of each determinant on the three UIL outcomes. Table 7 presents the results from three simple regression models predicting UIL outcomes. All models were significant (p < .001).

Model 1 explained 59% of the variance in institutional effectiveness ($R^2 = .589$, $F(6,63) = 15.04$, $p < .001$), indicating that the predictors together accounted for a substantial proportion of the outcome. Within this model, academic reputation emerged as the dominant predictor ($\beta = .686$, $p < .001$), showing the strongest unique contribution compared to other variables. This means that perceptions of academic reputation contributed more strongly to institutional effectiveness than any other determinant.

Model 2 accounted for 53% of the variance in prior collaboration success ($R^2 = .526$, $F(6,63) = 11.66$, $p < .001$), reflecting a moderate explanatory level. Geographic proximity ($\beta = .315$, $p = .003$) and Social Capital ($\beta = .237$, $p = .042$) showed the strongest effect, indicating that closeness to industry partners and strong relational networks were the most influential contributors to successful past collaborations.

Model 3 explained 32% of the variance in UIL Sustainability ($R^2 = .317$, $F(6,63) = 4.88$, $p < .001$), which demonstrates a modest but significant explanatory power. Firm Characteristics ($\beta = .347$, $p = .004$) demonstrated unique predictive strength, meaning that motivated and capable firms contributed most directly to sustaining UIL over time.

All models significantly predicted UIL outcomes (F values ranged from 4.88 to 15.04, all $p < .001$), and collinearity diagnostics confirmed no multicollinearity issues (all VIF < 1.73). These results demonstrate the substantial predictive power of institutional and relational factors on UIL outcomes at AAiT.

4.4. *Results of Challenging Variables*

4.4.1. *Descriptive Results of Challenges*

Table 9: Descriptive Statistics of UIL Challenges

UIL Challenges	M	SD	Min	Max	Skewness	Kurtosis
Policy and Governance Barriers	3.57	0.52	2.50	5.00	0.54	1.22
Institutional and Leadership	3.79	0.51	2.50	5.00	-0.26	0.25
Resource and Capacity Gaps	4.03	0.52	3.00	5.00	-0.12	-0.78
Trust and Communication Issues	4.01	0.60	2.67	5.00	-0.34	-0.40

Note: N = 70, 5-point Likert scale.

Table 8 presents the descriptive statistics for UIL challenges. Policy and governance barriers had a mean score of 3.57 (SD = .52). Institutional and leadership weakness recorded a mean of 3.79 (SD = .51). Resource and capacity gaps showed the highest mean score of 4.03 (SD = .52). Trust and communication issues also scored high with a mean of 4.01 (SD = .60). The distribution of scores across the four themes was approximately normal.

Skewness values ranged between -.34 and .54, indicating only minor deviations from symmetry. Kurtosis values ranged between -.78 and 1.22, suggesting that the distributions were generally mesokurtic, with no evidence of extreme peakedness or flatness. In general, the results

indicate that resource and capacity gaps and trust and communication issues were perceived as the most critical challenges to UIL, both scoring above 4.00 on average.

4.4.2. Correlation Results of Challenges

Table 10: Correlation matrix of UIL challenges

Challenge Theme	1	2	3	4
Policy and Governance Barriers	1			
Institutional and Leadership Weakness	.30*	1		
Resource and Capacity Gaps	.36**	.45**	1	
Trust and Communication Issues	.31*	.27*	.51	1

Note: * $p < .05$, ** $p < .01$ (2-tailed).

Table 9 presents inter-correlations among the four challenge themes. Resource and capacity gaps correlated most strongly with trust and communication issues ($r = .51$, $p < .01$), indicating interconnected infrastructure and relational barriers. Resource gaps also linked significantly with institutional leadership weakness ($r = .45$, $p < .01$) and policy barriers ($r = .36$, $p < .01$). All challenges demonstrated positive interrelationships ($r = .27-.51$, $p < .05$), suggesting systemic constraints rather than isolated issues. Trust issues correlated moderately with policy barriers ($r = .31$, $p < .01$) and leadership weakness ($r = .27$, $p < .05$). These patterns revealed resource gaps and trust issues as primary UIL constraints at CTBE, with strong interdependencies across all challenge domains.

5. Discussion

This section discusses the main findings of the study and relates them in relation to the research questions, the proposed theoretical framework, and the wider literature on UIL.

5.1. *Findings*

The study examined how institutional and relational factors shape UIL outcomes at CTBE. The results show that academic reputation was the strongest predictor of institutional effectiveness. This suggests that credibility and perceived quality remain key for internal coordination and performance. Prior collaboration success was explained mainly by geographic proximity and social capital, with communication quality and reputation also contributing their own shares. These findings highlight the importance of access, networks, and clarity in exchanges for concrete collaboration. UIL sustainability depended most on firm characteristics and motivation, pointing to industry readiness as a binding constraint for long-term linkage.

The determinants did not perform uniformly. Reputation and social networks emerged as relative strengths. Communication quality and the unique role of individual champions were weaker. For AAiT, this means that while the institute benefits from strong credibility and relational networks, it must invest more in structured communication and in activating champions who can bridge institutional gaps. For other technology institutes in Ethiopia, the implication is similar (Aregawi, 2015; Gemedu et al., 2023, 2025; Sertse, 2013). Institutes located near industrial clusters should leverage proximity through regular forums and embedded collaboration. Where proximity is weaker, relationship infrastructure must substitute, including intermediate units and alumni networks.

The analysis of challenges revealed systemic constraints. Resource and capacity gaps and trust and communication issues were rated highest and were strongly interrelated. Resource gaps also aligned with leadership weakness and policy barriers. This shows that CTBE/AAiT faces a network of mutually reinforcing impediments rather than isolated bottlenecks. Addressing resource deficits without building trust and communication will not produce durable UILs. For other institutes, the

lesson is clear that resource upgrades must be matched with relational investments (Aregawi, 2015; Sertse, 2013).

In general, the findings answer the proposed research questions. Institutional and relational factors predict UIL outcomes, but to varying degrees. Reputation drives effectiveness. Proximity and social capital drive prior success. Firm motivation drives sustainability. Strengths lie in reputation and networks. Weaknesses lie in communication and the proactive role of individual champions. The UIL challenges are systemic and interrelated, with resource gaps and trust issues being most critical. These constraints affect multiple UIL activities, including the initiation of linkages, joint research projects, consultancy services, technology transfer, and the utilization of CTBE/AAiT research outputs. In practice, resource deficits limit infrastructure for collaboration, while trust and communication gaps undermine the continuity of joint projects and the uptake of research results.

These results not only summarize the determinants but also reveal novel contextual contributions, which are elaborated in the subsequent sections on comparison with prior studies, theoretical implications, and practical lessons.

5.2. *Comparison with Previous Studies*

The strong effect of academic reputation on institutional effectiveness is consistent with studies that identify credibility and perceived quality as core drivers of engagement (Perkmann et al., 2013). Leadership and institutional mechanisms have also been shown to shape reputation and coordination in Asian UILs (Hu et al., 2016). The role of social capital and proximity in prior collaboration success reflects evidence from European contexts where access and local embeddedness facilitate collaboration and private funding (Crescenzi et al., 2017; Muscio et al., 2012). Similar findings in Italy show that proximity and local education

pipelines support UIL outcomes in terms of sustainability as well as relational trust (Maietta, 2015).

Firm characteristics and motivation as predictors of sustainability in this study reflect academic staff perceptions of industry readiness. While the survey did not include firms directly, staff views on industry motivation align with determinants identified at the firm level in previous research, including absorptive capacity, collaboration strategy, and attitudinal readiness toward universities (Atta-Owusu et al., 2021; Opassuwan & Wannamakok, 2024). This convergence suggests that academic perceptions of industry readiness correspond closely with firm-side evidence reported in other contexts. These studies confirm that industry demand-pull and internal capability condition whether partnerships are sustained. The positive roles of trust, prior collaboration, and communication found in this study's correlations are consistent with evidence from the UK and Ireland, where trust reduces barriers and communication sustains collaboration (O'Dwyer et al., 2023). Case studies from the Nordic region also highlight frequent meetings and social capital as success factors (Isaeva et al., 2022). The importance of communication and trust has been emphasized as a driver of UIL evolution (Plewa et al., 2013).

The challenge profile at CTBE converges with multi-country evidence. Resource constraints, bureaucratic hurdles, and policy misalignment are recurrent obstacles in developing countries or regional contexts (Baban et al., 2021; Nsanzumuhire & Groot, 2020; Oyelaran-Oyeyinka & Adebowale, 2012). Policy misalignment does not mean the absence of clear policies at the university or national level. Rather, it refers to gaps in alignment across departments and disciplines, where specific UIL activities (such as joint research, consultancy, or technology transfer) may lack tailored frameworks, and to the limited harmonization between university strategies and industry demand.

In general, the CTBE findings align with international evidence but show contextual realities of the country and study area. Reputation and networks are strong. Sustainability depends on industry readiness. Barriers are systemic and relational as well as infrastructural. Effective UIL in Ethiopia will require simultaneous progress on institutional coordination, relationship infrastructure, and industry-side motivation and incentives.

5.3. *Theoretical Implications*

The findings contribute to UIL conceptual frameworks by showing that institutional and relational factors operate within outcome-oriented perspectives. Academic reputation explained institutional effectiveness, while proximity and social capital predicted prior collaboration success, and firm motivation determined sustainability. This supports the Triple Helix Theory, which emphasizes that innovation outcomes emerge from the dynamic interaction of universities, industries, and governments rather than isolated efforts (Etzkowitz & Leydesdorff, 2000). The results extend this framework by demonstrating that relational dimensions such as communication and social capital are not secondary but central to UIL outcomes, consistent with evidence that trust and communication reduce barriers and sustain collaboration (Bruneel et al., 2010; Plewa et al., 2013).

The integration of institutional and relational dimensions is critical. Reputation and credibility provide institutional coordination, while social networks and proximity enable relational exchange. The predictive strength of firm motivation highlights the demand-pull side of UIL, confirming that industry readiness and capacity condition sustainability (Abbasnejad et al., 2011). These findings suggest that UIL should be theorized as a systemic construct where institutional determinants and relational mechanisms reinforce each other.

The systemic understanding of challenges is also important. Resource gaps and trust issues were strongly interrelated, showing that resource deficits and relational weaknesses combine to constrain UIL. This supports contextual perspectives that emphasize how developing countries face intertwined institutional and relational barriers (Nsanzumuhire & Groot, 2020). The results, therefore, reinforce UIL theory by highlighting the need to conceptualize challenges as networks of constraints rather than isolated hindrances.

5.4. Practical Implications

For CTBE leadership and UIL actors, the findings point to clear priorities. Academic reputation must be maintained through strong research output, as it anchors institutional effectiveness. At the same time, relational mechanisms require deliberate investment. Building social capital through alumni networks, joint forums, and embedded internships will strengthen prior collaboration success. Communication quality should be improved by establishing structured platforms for dialogue with industry partners.

Institutional capacity must be reinforced. Leadership commitment and transparent procedures will reduce coordination costs and signal seriousness to industry. Addressing resource gaps is also essential. Laboratories, prototyping facilities, and research support services must be upgraded to provide the infrastructure for collaboration. Yet, resource improvements alone will not suffice. Trust and communication must be cultivated in parallel. Structured meetings, co-design workshops, and joint training programmes can help build confidence and reduce relational barriers.

As industry readiness is one of the binding constraints for sustainability, financial incentives, tax breaks, and recognition schemes can motivate

firms to engage. Clear intellectual property policies will also strengthen long-term collaboration.

5.5. *Limitations and Future Directions*

This study is limited by its focus on a single institution. CTBE/AAiT provides a relevant case, but the findings cannot be generalized to all Ethiopian HEIs without caution. The reliance on self-reported survey data introduces the possibility of response bias, as perceptions may not always align with actual practices (Rosenman et al., 2011). The sample size, while sufficient for descriptive statistics and exploratory regression, restricts the statistical power of detecting smaller effects. Regression models explained moderate proportions of variance, suggesting that other unmeasured factors-such as policy enforcement, industry readiness, or informal networks-may also shape UIL outcomes.

Despite these limitations, the study offers valuable insights into UIL determinants and challenges within Ethiopia's science and technology higher education context. Future research should extend the analysis to other universities, using comparative designs to capture variation across institutional settings. Longitudinal studies would help trace the evolution of UIL determinants and outcomes over time, as it provides evidence on whether relational trust and institutional reputation strengthen or weaken as collaborations mature (Steinmo & Rasmussen, 2018).

Qualitative approaches could also deepen understanding of relational dynamics, especially in the context of trust, communication, and leadership. Expanding the scope to include industry perspectives would further strengthen the evidence base, as UIL is inherently a two-sided process shaped by both academic and industrial actors. In general, these directions will build a more comprehensive understanding of UIL in Ethiopia and inform strategies for sustainable collaboration.

5.6. *Conclusion*

This study examined the determinants and challenges of UIL at AAiT. The results indicate that both institutional and relational factors predict UIL outcomes. Academic reputation emerged as a strong predictor of institutional effectiveness, while geographic proximity and social capital influenced prior collaboration success. Firm motivation was found to be critical for sustainability. These findings highlight that UIL outcomes are shaped not by a single variable but by the interplay of institutional credibility, relational trust, and industry commitment.

The analysis also revealed systemic challenges. Resource and capacity gaps, trust and communication issues, and weak governance were strongly interrelated. These constraints reinforce one another and limit the depth and sustainability of UIL. Addressing them requires integrated strategies that combine infrastructure improvements with relational investments, echoing the Triple Helix perspective that innovation depends on synergy among universities, industries, and government (Hailu, 2024).

The study contributes to the UIL literature by demonstrating the combined importance of institutional reputation, relational trust, and firm motivation in shaping outcomes. It also provides practical guidance for CTBE/AAiT and similar institutes in Ethiopia. Strengthening academic reputation, building networks, improving communication, and motivating firms are essential steps for advancing UIL. While the study is limited to a single institution and based on survey data, it offers meaningful insights into UIL development in the Ethiopian HEI context. Taken together, these findings provide a foundation for strengthening UIL in Ethiopia's science and technology universities and for encouraging sustainable collaboration.

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