Vol. 16, No. 1 (2025), pp.31–46

CHITKARA UNIVERSITY

Journal of Technology Management for Growing Economies

Leveraging Artificial Intelligence for University-Industry Creativity and Sustainability

Nimota Jibola Kadir Abdullahi

University of Ilorin, Ilorin 240102, Kwara, Nigeria.

abdullahi.njk@unilorin.edu.ng

RESEARCH ARTICLE **Open Access**

ARTICLE INFORMATION

Received: 2 February, 2025
Accepted: 24 June, 2025
Published Online: 21 August, 2025

Keywords:
Research and development collaboration, Technology transfer, Curriculum management, Sustainability

DOI: 10.15415/jtmge/2025.161003

ABSTRACT

Purpose: Despite the growing recognition of the importance of university-industry partnerships, a significant gap exists in understanding how such collaborations can be optimized to foster sustainability and creativity in AI development.

Methods: This study examined the relationship between leveraging artificial intelligence and university-industry creativity and sustainability in Nigeria. A structured survey was used to gather quantitative data for the study.

Findings: The target population was the academics, entrepreneurs, and students in Nigeria's public universities. SmartPLS tools were used to analyze the data.

Implications: The findings suggest that university-industry sustainability and creativity are significantly influenced by the effective leveraging of artificial intelligence, such as research and development collaboration, technology transfer, and curriculum management.

Originality: The study's conclusions show that research and development collaboration, curriculum management, university-industry sustainability, and creativity have a significant association. According to the study, to achieve effective university-industry sustainability and creativity. Government, school administrators, and industry professionals should pay adequate attention to research and development collaboration, technology transfer, and curriculum management. This study proves that leveraging AI (research and development collaboration and curriculum management) positively correlates with university-industry sustainability and creativity. This study also shows how technology transfer can enhance university-industry sustainability and creativity.

1. Introduction

A paradigm change has occurred in several industries, including knowledge generation, as a result of artificial intelligence (AI). AI technology holds significant potential for transforming business models. Further investigation is required to connect the operations of firms with certain AI applications and to segment them based on their industry. The importance of industry-academia collaboration has received a lot of attention. When a university works with industry to promote values in its collaboration, it can lead to a fruitful and long-lasting academia-industry alliance. University-industry collaboration may help students' exposure to leading-edge technology utilized in business, as well as build professional networks, acquire employability skills, and get a job in the sector. Participation in dissertation committees, research project sponsorship, and industry placement programs may provide businesses with access to specific expertise in the commercialization of their goods and services, as well as a "try-before-you-buy" perspective on students.

Teaching and research have long been acknowledged as important university disciplines with well-defined performance criteria; industry involvement is a less well-defined field. For example, student assessments have been used to evaluate teaching. Also, citations, publications, patents, grant revenue, and other metrics have been used to evaluate research. In the university sector, reward programs like promotions and performance reviews are typically framed within teaching and research measures. However, there are still unclear measures for university-industry collaboration and a lack of integration with relevant processes concerning teaching and research. This is problematic since it may cause university-industry sustainability and creativity to be underestimated in the amount of effort and time required. Furthermore, a lack of clarity may result in academic institutions failing to fully capitalize on university-industry sustainability and creativity opportunities that could enhance the significance and impact of their teaching and research.

Sustainability appears as a guiding concept influencing organizational procedures as well as technical innovation within this cooperative framework. By utilizing AI-driven solutions, businesses can maximize resource utilization, reduce environmental impact, and address urgent global issues like social inequity, resource scarcity, and climate change. Furthermore, academic institutions and corporate sectors are progressively coordinating their endeavors with the United Nations Sustainable Development Goals (SDGs), utilizing artificial intelligence (AI) to propel projects concerning health, education, environmental preservation, and financial well-being.

This article investigates the relationship between leveraging artificial intelligence and university-industry collaboration, looking at how these synergies support sustainability and creativity in the digital age.

Numerous research studies have been conducted on artificial intelligence and sustainability. Ahmad (2023) focused on leveraging AI solutions to bridge sustainable creativity and foster academic integrity in an innovative society. The study examines how generative AI solutions, such as text-to-image generators, can help students create innovative and sustainable designs while promoting academic integrity. The article shows how AI in art and design education can equip students with the skills and knowledge to succeed in a rapidly changing digital landscape. This research uses a qualitative method by analyzing the applications and literature reviews in journals and documents related to the problems studied. Goralski and Tan (2020) look at artificial intelligence and sustainable development.

Also, Opesemowo and Adekomaya (2024) carried out a study onharnessing artificial intelligence to advance sustainable development goals in South Africa's higher education system. The study seeks to leverage AI technologies to advance Sustainable Development Goals (SDGs) within South Africa's higher education system. Qualitative research was used to employ the constructivist principle to unravel the dynamics of AI in advancing SDGs. Lecturers from the Department of Information Sciences were the participants of the study. In-depth interviews and focused group discussions were employed to generate and estimate responses using thematic content analysis. The result revealed that AI technology has increased the chances for collective learning. The study further proved that integrating AI technology into education has shown promising results in improving student outcomes and fostering a more collaborative learning atmosphere.

Additionally, Jirapong *et al.* (2021) wrote a treatise on University–Start-Up Collaboration and Sustainability. A quantitative study design was used. Questionnaires were used to collect data from entrepreneurs and start-ups that are spin-offs of Berlin and Brandenburg's 10 top universities (Germany). According to the findings, cooperation encourages universities to provide funding for new businesses, particularly those that are socially conscious, to help them achieve sustainability and fulfill their third purpose of assisting society. However, it is worth noting that none of the authors cited in this study specifically addressed leveraging Artificial Intelligence (AI) and university-industry sustainability and creativity. Additionally, previous studies did not emphasize the importance of research and development collaboration, technology transfer, and curriculum management as critical variables to measure leveraging artificial intelligence. The reason why this study focuses on the three variables is that universities frequently have state-of-the-art research facilities, and companies have resources suitable for large-scale implementations. Working together makes it possible for these resources to be shared, which boosts productivity and lowers expenses. Students and researchers who work on R&D projects acquire skills that are relevant to the industry, which improves their employability. Academics bring new viewpoints and innovative ideas to the sector. Also, innovative technologies are frequently developed in universities, but they can stay in the laboratory if the industry doesn't collaborate.

Technology transfer makes sure that these inventions are made available for purchase, which benefits society and brings in money. Technology interchange encourages a two-way learning process. Industries can profit from the most recent academic research, while universities can learn about real-world industrial difficulties. Furthermore, universities can create curricula that address the demands of the industry both now and in the future by working closely with the industry. By doing this, graduates› readiness for the workforce is guaranteed. Universities may better include creative thinking and problem-solving techniques in their curricula with the support of industry. Universities may educate students to think critically about sustainability by developing curricula that reflect sustainable industry practices. This will lead to future inventions that strike a balance between environmental responsibility and economic prosperity. The great difference in the geographic locations and regions covered by the available studies is another important gap that prompted this investigation. Therefore, the purpose of this study is to close the gaps left by other researchers.

2. Related Literature Review

2.1. Leveraging Artificial Intelligence

Leveraging is the process of maximizing an advantage or profit by making use of resources, connections, or talents to achieve results (Ahmad, 2023). It entails using strengths or resources strategically to achieve objectives quickly and successfully. To maximize results or obtain a competitive edge in business or other endeavors, this may entail utilizing technology, knowledge, funds, networks, or other assets.

Artificial Intelligence (AI) is the theory and development of computer systems that can do tasks like speech recognition, visual perception, decision-making, and language translation that often need human intelligence (Dhiman *et al.*, 2024). Artificial intelligence is a technology that is designed to behave like a human. Enholm *et al.* (2022) defined artificial intelligence (AI) as the science and engineering of creating intelligent devices and intelligent computer programs. Artificial intelligence (AI) does not have to limit itself to biologically observable techniques; however, it is related to the comparable goal of utilizing computers to study human intellect. The application of human intellect to robots that can think and learn like people is known as artificial intelligence. Artificial intelligence (AI) refers to computer systems that can accomplish activities that often need natural human intellect because of their self-learning behavior (Mishra *et al.*, 2022). To estimate trendy scenarios, artificial intelligence extrapolates historical trends, usually in the form of big data (Minh *et al.*, 2022). This process is enhanced by self-learning processes that add value to the business models that become more resilient and sustainable. In general, artificial intelligence (AI) is defined as the study of how digital computers and algorithms carry out operations and resolve complicated issues that would typically require (or surpass) human intelligence, reasoning, and prediction power necessary to adapt to changing circumstances" (Obschonka & Audretsch, 2020; Henderson & Serafeim, 2020). In this study, "leveraging AI" refers to curriculum management, technology transfer, and research and development collaboration.

Research and development collaboration is the cooperation of organizations, institutions, or individuals to conduct research and develop new technologies, procedures, or products (Jirapong *et al.*, 2021).Research collaboration aimed at achieving or promoting cooperation between nations and sectors. Even within this specific SDG, Sustainable Development Goals cannot be fully achieved by a single actor (Orazbayeva & Plewa, 2020). This is because sustainable development is a difficult undertaking that calls for cooperation from external players in addition to internal resources to overcome organizational barriers. The significance of cooperation as a means of promoting sustainability and creativity has been underscored by an expanding corpus of existing research. According to Hermundsdottir and Aspelund (2021), a variety of cooperation patterns help partners in cooperative projects create and share knowledge and skills about sustainable development. Collaboration between businesses and academic institutions is certainly not new. Academics have been seeing universities as significant sources of information for decades (Vazquez-Brust, 2021). Furthermore, there are reciprocal benefits for the institution and the company, which allow both to convey knowledge and technology to the community and speed up innovation (Dudkowsk, 2021). From the perspective of the company, businesses benefit from several factors, including patents, licensing, and the transfer of innovative information, all of which can be used to produce new products and services and get around resource limitations. Consequently, businesses get a competitive edge that propels expansion (Marijan & Gotlieb, 2021; Chedid *et al.*, 2020). From a university standpoint, universities view external money as a complementary source of funding for their faculty, staff, laboratories, and students (Marijan & Gotlieb, 2021). Universities also raise the quality of their research and teaching by using it, getting fresh ideas for future studies from application feedback, and eventually boosting their standing and recognition (Shi *et al.*, 2020; Song *et al.*, 2020).

Technology transfer refers to the process of transferring discoveries, research, and technical developments from academic institutions to industry partners (De Moortel & Crispeels, 2018). Technology transfer is the process of transferring skills, knowledge, manufacturing techniques, facilities, and technologies across governments, institutions, and private sector businesses to guarantee that scientific and technological advancements are available to a larger variety of users (De Wit-de Vries *et al.*, 2019). Through this technology transfer, parties that might find it challenging to make innovations and advancements alone can pool their combined experience, resources, and capacities.

This technology transfer allows parties that might find it difficult to innovate and advance on their own to combine their skills, resources, and experience. The term "curriculum" refers to a structured set of educational activities designed to promote students' development and learning. To effectively and efficiently accomplish organizational goals, management is the process of organizing, planning, leading, and controlling resources (including people, money, and materials) (Abdullahi, 2023).

It involves tasks like setting objectives, allocating resources, motivating employees, making decisions, and evaluating performance to ensure the organization operates smoothly and achieves its desired outcomes. To make sure the business runs smoothly and produces the intended results, it entails duties like establishing goals, assigning resources, inspiring staff, making choices, and assessing performance. In order to ensure that the curriculum is successful in meeting learning objectives and meeting the needs of educators, students, and other stakeholders, curriculum management refers to the strategies and tactics used in its development, implementation, evaluation, and modification (Abdullahi, 2023). Therefore, cooperation, decision-making, and continuous improvement projects are necessary to maximize the educational experience for all parties involved.

2.2. University-Industry Sustainability and Creativity

University education encompasses the pursuit of higher learning, typically at an institution of higher education such as a university or college. Students can earn undergraduate, graduate, and postgraduate degrees through academic study, research, and the acquisition of knowledge and skills in a variety of fields (Dudkowski, 2021). In addition to preparing students for the workforce, university education aims to develop critical thinking and problem-solving abilities, encourage intellectual and personal development, and advance knowledge and society overall. Opportunities for networking, extracurricular activities, and personal growth are also frequently included.

Industry refers to a specific sector or category of economic activity characterized by the production and sale of goods or services. It encompasses businesses, organizations, and enterprises engaged in similar types of production or offering similar services. Industries can vary widely, ranging from manufacturing and technology to healthcare and finance. Understanding industry dynamics is crucial for strategic planning, market analysis, and competitive positioning within a particular sector (Song *et al.*, 2020; Shi *et al.*, 2020).

University education has a significant role in accomplishing the Sustainable Development Goals listed in the 2030 Agenda because of its main goals of knowledge generation, teaching, and social innovation for sustainability. Policy frameworks that could help implement sustainable development should include «collaboration, partnership, education, outreach, teaching and learning, staff development, curriculum review, research, campus operations, and policy, among other things» (Vargas *et al.*, 2019; Tejedor *et al.*, 2019). The potential shortage of skilled labor is a major worry for the industry. A growing demand exists for highly skilled multidisciplinary professionals with a wide variety of abilities who can design, develop, and integrate new technologies used in the alternative and renewable energy technology sector (Weng *et al.*, 2019).

Generally, sustainability was defined as satisfying current needs without sacrificing the capacity of future generations to satisfy their own. Since then, the concept has been developed by authors, who separated it into three different dimensions or pillars: environmental, social, and economic (Purvis *et al.*, 2019).

Van Wynsberghe (2021) highlights the contradiction between using AI to achieve sustainability and the sustainability of utilizing AI systems. As per extant research, the swift expansion of artificial intelligence has prompted apprehensions over its ecological and societal viability. (Chen *et al.*, 2023). According to Yıldırım (2021), sustainability is also a critical development process that is being worked on by several disciplines on a national and international level. The concept of sustainability holds that resources used by humans today should be used in a way that guarantees their continued use by future generations (Aral & Kiliçoğlu, 2022). Therefore, sustainability is seen to mean maintaining people's current standards of economic, social, and environmental functioning. Another way to think about sustainability is to improve human well-being while maintaining the environment's natural balance.

Creativity is defined as the capacity to produce original and useful ideas that foster innovation in products, services, organizational procedures, and processes (Mohadeseh *et al.*, 2017). According to Abdullahi (2021), creativity may be utilized as a technique to enhance the entrepreneurial potential and aptitude of both individuals and organizations. Being creative is a valuable talent for job seekers these days. A creative person goes above and beyond to approach non-routine work in a proactive, creative, and innovative way (Birgili, 2015). It implies that creative kids who think critically and on their own challenge conventions, presumptions, and the status quo. Moreover, creativity is the capacity to generate an original method or instrument for resolving an issue (Kalu & Peace, 2017). Students who are not creative and imaginative will not succeed in the business world. As a result, students need to be creative all the time to stay relevant in the global economy.

2.3. Theoretical Background

This study's theoretical foundation is the Triple Helix idea put forth by Etzkowitz and Leydesdorff (1995). For policymakers looking to foster innovation and promote economic growth, the Triple Helix model of innovation is an essential tool. Specifically, it encourages the development of stronger collaboration between academics, industry, and government in order to stimulate innovation. The institution is currently drawing more attention to encouraging entrepreneurship and acting as a middleman to advance high-tech advancements (Brem & Radziwon, 2017; Zhou & Etzkowitz, 2021). According to Sarpong *et al.* (2017), the triple helix is essential to the integration of governments, businesses, and universities because of their tight relationship and best-in-class cooperation, which helps countries predict how they can generate wealth and develop a knowledge-based society. Though it is difficult to separate sustainability from technological advancement, humanity faces. There are major challenges in achieving a harmonious and mutually reinforcing dynamic between the two while minimizing the negative social and economic effects on a global scale, such as resource depletion, environmental degradation, rising inequality, and population explosion (Cai & Etzkowitz, 2020). As such, it is critical to evaluate how well the global Triple Helix system is operating.

Numerous studies have demonstrated that the shared interests that industry and academic institutions have in working together are one of the factors that motivate them to build collaborations with each other. According to Dudkowski (2021) and Song (2020), private companies can work with universities to gain access to basic and applied research findings and economically relevant scientific and technological knowledge, build and test prototypes, and receive assistance in solving product-related issues. This can help these companies become more innovative and maintain a competitive edge. As this was going on, universities benefited from their partnerships with businesses by receiving funding, fresh insights, best practices, and industrial data. They also had access to information that could be used for research and instruction in academia.

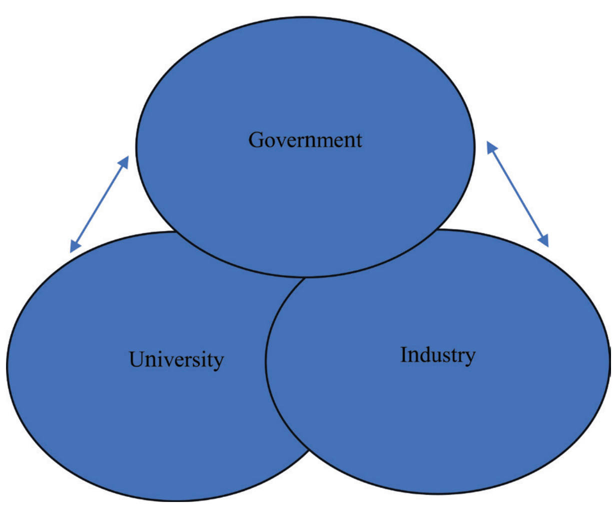

Figure 1: Shared Interests – University, Industry, and Government
Source: Adapted from Etzkowitz (2008)

Applying this theory to the educational sector is a viable strategy for businesses seeking to gain genuine competitive advantages through technical differentiation.Also, it will provide opportunities for students and researchers to engage in real-world sustainability projects and enhance employability.This study is a Triple Helix anchored on the Triple Helix theory in that it enhances the competitive edge of industries by integrating sustainable practices and innovations into their operation as well as helping universities and industries gain recognition and prestige for their contributions to sustainability. This is consistent with Zhou and Etzkowitz (2021) that the interaction between academia and business develops into a useful tool for strengthening enterprises' competitive positions through the adoption of cutting-edge, novel, and value-added technology (AI).

2.4. Hypotheses to be Tested

The following theories were developed and tested:

- Research and development cooperation and university-industry creativity and sustainability do not significantly correlate.
- Technology transfer and university-industry creativity and sustainability do not significantly correlate.
- Curriculum management, university-industry creativity, and sustainabilitydo not significantly correlate.
- Using artificial intelligence has no discernible impact on university-industry sustainability and innovation.

3. Methodology

3.1. Research Design

This research employs a quantitative research design. Quantitative data analyses are those that make use of numerical data and are employed to forecast future events or to characterize the current condition of affairs. This type of analytical process can be used to establish facts about a topic that applies to a wider audience. The ability to analyze quantitative data through statistical analysis is one advantage of using it. Scientists view the quantitative approach as logical and objective, as statistics is a mathematical science (Mugenda&Mugenda, 2013; Sekaran & Bougie, 2016; Neuman, 2013).

3.2. Population and Sampling Procedure

A total of 500 academics, entrepreneurs, and university undergraduate students from Kwara State were purposively sampled, and 450 participants responded to the survey.

Some questions were eliminated during data cleaning because they were deemed inappropriate for use. Eventually, 425 questionnaires (120 academics, 85 entrepreneurs & 220 students) were used for this study. The questionnaire for this study consisted of 26 questions. Based on this, the study progressed with 425 correctly answered questionnaires, yielding a response rate of 85% for the final assessment of the study hypotheses.

3.3. Measures

A structured questionnaire was employed for the target participants to complete over the Internet by filling out a Google Forms survey. There were four variables, namely research and development collaboration, technology transfer, curriculum management, and university-industry sustainability and creativity, with 26 items adapted as an instrument.Two specialists from the departments of test and measurement and educational management validated the instrument. The instruments used for each variable were adapted from prior studies in which all variables amounted to 26 items. Specifically, research and development collaboration was measured with six items adapted from Shi *et al.* (2020), Song *et al.* (2020), and Chedid *et al.* (2020). Technology transfer was assessed with six items adapted from De Wit-de Vries *et al.* (2019) and De Moortel and Crispeels (2018). Curriculum management with six items (Abdullahi, 2022). University-industry sustainability and creativity with eight items (Jirapong *et al.*, 2021; Hermundsdottir & Aspelund, 2021). All items used a five-point Likert scale ranging from 1 for strongly disagree to 5 for strongly agree based on the findings of Mayer (2013), Miller *et al.* (2013), and Diamantopoulos *et al.* (2012), suggesting that this scale offers a quicker and simpler response format compared to scales with 7 points.

3.4. Data Gathering Method

Google Forms was used to develop online surveys that were distributed to participants via WhatsApp to collect data for this study. All participants were informed of the study's purpose and methods in the introduction. The survey questionnaire includes the ethical consent that the participants have to agree to before proceeding to answer the questionnaire. In this study, participation was completely optional, and participants were allowed to withdraw at any time without giving a reason. The participants' identities remained anonymous because their data was kept secret and confidential. This approach was adopted following the principles outlined by Dillman *et al.* (2014) and Choy (2014).

3.5. Data Analysis

SMART PLS 4.0 was employed to analyze the data collected for this study. It was selected because SMART PLS comes with a wide range of tools and subroutines for formative and reflective assessments as well as structural models, like goodness of fit, bootstrap-based significance testing, PLS prediction, and the heterotrait-monotrait (HTMT) criterion. It makes it possible to perform extra statistical studies, including tetrad analysis confirmation. Among the methods are latent class segmentation, importance-performance map analysis, and higher-order models. Using SMARTPLS, the measurement model had to be done first by testing for discriminant validity, convergent validity, construct validity, and reliability. Secondly, a structural model is created to test the hypotheses (Hair *et al.*, 2019). The second step involves evaluating the structural model, which includes calculating effect sizes, determining if the model is predictive relevant, and determining how well endogenous constructs explain variance.

4. Result

4.1. Measurement Model Assessment

The first step of SMARTPLS analysis looks at the measurement model to determine how the components relate to the theoretically stated constructs. The estimation of the measurement model in this study incorporates four latent constructs. This study employed the reflective measurement approach, which postulates that a construct affects the variation of its indicators (manifest variables) (Hair *et al.*, 2014). An arrow linking a construct to its indications is displayed in the model. A reflective measurement paradigm necessitates validity and reliability evaluations such as discriminant validity, convergent validity, internal consistency reliability, and indicator reliability tests (Hair *et al.*, 2021).

A measurement model is deemed to have sufficient internal consistency reliability if the composite reliability (CR) of every construct is more than the established threshold point of 0.7 (Kilic, 2016; Hair *et al.*, 2021). Table 1 shows that the results demonstrate that the items' internal consistency reliability for the constructs is adequate. The convergent validity of the measurement model was evaluated in this study by analyzing the average variance extracted (AVE) value. As suggested by earlier studies, convergent validity is deemed sufficient when constructs exhibit AVE values of approximately 0.5 or above (Hair *et al.*, 2019). All of the constructions show AVE values above 0.5, according to the output shown in Table 1. This finding implies that there is a strong degree of convergent validity in the measurement model.

Table 1: Summary of Measurement Model (Construct Reliability and Validity) (p<0.01)

Constructs	Items	Factor Loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Research and development collaboration (RC)	RC1	0.896	0.844	0.886	0.567
	RC2	0.725			
	RC3	0.677			
	RC4	0.782			
	RC5	0.777			
	RC6	0.632			
Technology transfer (TECT)	TECT1	0.655	0.770	0.839	0.502
	TECT3	0.656			
	TECT3	0.874			
	TECT4	0.562			
	TECT15	0.640			
	TECT16	0.685			
Curriculum Management (CM)	CM1	0.785	0.877	0.902	0.619
	CM2	0.777			
	CM3	0.738			
	CM4	0.822			
	CM6	0.880			
	CM6	0.707			
University-industry Sustainability and creativity (UISD)	UISD1	0.859	0.893	0.914	0.573
	UISD2	0.828			
	UISD3	0.620			
	UISD4	0.807			
	UISD5	0.678			
	UISD6	0.805			
	UISD7	0.722			
	UISD8	0.702			

Note: RC: Research and development collaboration, TECT: Technology Transfer, CM: Curriculum Management; UISD: University-industry Sustainability and Creativity.

Factor loadings are essential for evaluating the measurement model to show reliability. Essentially, higher average loading levels will lead to increased reliability (Sarstedt *et al*., 2021). When each item's loading estimate is more than 0.6 of the factor loading, a measurement model shows adequate indicator reliability. However, depending on the underlying reasoning, this threshold may vary, such that when the AVE of the constructs is more than 0.50 for the entire sample, there is no need to delete factor loading (Afthanorhan, 2020). Table 1 above displays the factor loadings for each of the four constructs. Most factor loadings of the 26 items (observed variables) varied with positive values, indicating greater than 0.6 and significant at the 1% level. As a result, every item used in this investigation has an acceptable degree of indication dependability.

In a structural equation model, discriminant validity ensures that a measurement for a concept is unique and precisely captures the elements of interest that were not previously covered by other measurements (Hair *et al*., 2021). In other words, discriminant validity is mostly used to determine whether or not the variables have a significant multicollinearity issue. Hair *et al.* (2021) proposed the Fornell-Larcker criterion as the traditional method commonly used for evaluating discriminant validity, whereas Henseler *et al.* (2015) noted the widespread application of the Heterotrait-Monotrait Ratio (HTMT) for the same purpose.

Henseler *et al.* (2015) introduced the HTMT, which is thought to be a more rigorous approach than the traditional method. HTMT is the most recent set of criteria for evaluating discriminant validity.As suggested by previous studies, HTMT is appropriate when it is less than 0.85. The HTMT 0.85 results met the established threshold of less than 0.85 recommended by Ab Hamid *et al.* (2017) and Kline (2015), as Table 2 illustrates.The results demonstrate a satisfactory level of validity. Additionally, since the HTMT is less than 0.85, it can be said that the data has been obtained correctly and does not have any problems with discriminant or convergent validity, based on both internal and external correlation.

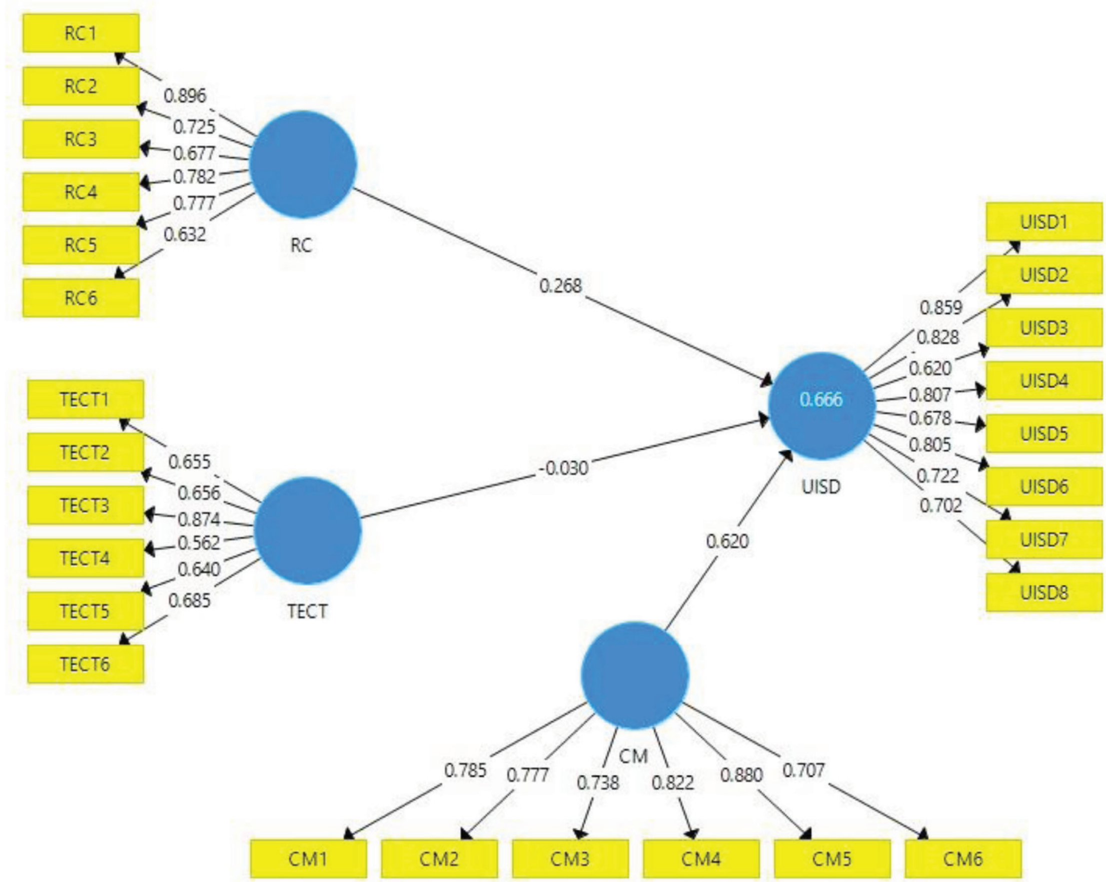

Figure 2: Construct Measurement Model

Table 2: HTMT Values of the Construct

	CMGT	EMGT	RMGT	USD
CM				
RC	0.840			
TECT	0.808	0.821		
UISD	0.846	0.792	0.706	

According to Fornell and Larcker (1981), discriminant validity is demonstrated when a latent variable explains a larger percentage of the variance in the indicator variables it is associated with than it does with other constructs in the same model. Comparing the squared correlations between each construct's average variance extracted (AVE) and the other constructs in the model is necessary to meet this requirement (Henseler *et al.*, 2015). Table 3 shows results using the Fornell-Larcker criterion, which uses the square root of the constructs, demonstrating that the construct's ability to differentiate itself from others satisfies the requirements for discriminant validity proposed by Henseler *et al.* (2015). Overall, the measurement model's analysis confirms that the survey instrument's items are trustworthy and dependable.

Table 3: Fornell and Lacker Criterion

	CM	RC	TECT	UISD
CM	**0.787**			
RC	0.744	**0.753**		
TECT	0.683	0.724	**0.709**	
UISD	0.739	0.705	0.615	**0.757**

Note(s): The diagonal is the square root of AVE, while the off-diagonal numbers are the correlations between latent variables.

4.2. Assessment of the Structural Model

The structural model is examined using PLS-SEM analysis once the measurement model as a whole has been evaluated. The structural model method is usually evaluated in this context to take important analytical elements into account while testing the suggested research hypotheses. Additionally, this phase analysis is necessary to acquire significant data and assess the quality of the model (Hair *et al.*, 2017). In this study stage, the main goal is to identify important variables to test the suggested research hypotheses. This analytical process is essential for drawing significant conclusions and evaluating the model's suitability. The coefficient of determination (R2), effect size (f2), model fit, path coefficients, predictive relevance or cross-validated redundancy (Q2) for endogenous constructs, and the significance levels of t-values and p-values are among the important metrics taken into consideration in this context.

4.3.Quality of Fits

As per the researchers' recommendations, a goodness-of-fit test for the proposed model should be conducted as the following step in the structural model study. It shows the fitness of the model and aids in the discovery and elimination of redundant information and abnormalities. SMART-PLS evaluates the goodness of fit using RMS-theta and Standardized Mean Square Residual (SRMR). Research indicates that if the SRMR cut-off value is less than or equal to 0.80 (Tuksino, 2016), which represents its absolute state, then it is good. Similarly, it will be deemed well-fit if its values are less than or equal to 0.80. Furthermore, for good fitness, the RMS-theta value should be less than or equal to 0.70 (Steiger, 2007). Also, A value of CFI should be greater than or equal to 0.90 (Hair *et al.*, 2014), and a value of TLI should be greater than or equal to 0.90 (Awang, 2015). The fit statistics indicate adequate fit between the hypothesized model and the data ($\chi 2/df$ = 3. 12, d_G= .80, d_ULS = .04, CFI= .96, TLI= 0.94, and RMSEA= .04, SRMR= .05). The current study's model fits values fall within the acceptable range, demonstrating the model's good fit for the investigation and potential prediction of the components and their interactions. Table 4 illustrates the values for the goodness of fit.

Table 4: Quality of Fits

Goodness of Fit	Value	Rule of Thumbs	Justification	Interpretation
SRMR	.05	<.08	Tuksino (2016)	Fulfill
RMS-theta	.04	<.07	Steiger (2007)	Fulfill
CFI	.96	>.90	Hair *et al.* (2013)	Fulfill
TLI	.94	>.90	Awang (2015	Fulfill
d_ULS	.04	<.08	Hair *et al.* (2013)	Fulfill
d_G	.08	<.10	Hair *et al.* (2013)	Fulfill
Chisq/df	3.12	<.5.0	Awang (2015)	Fulfill

Following an evaluation of the structural model's quality, the bootstrapping process was used to test the proposed connections between the impacts of latent components and ascertain the statistical significance of the structural model's parameters. The Smart PLS 4.0 tool was used to conduct the bootstrapping procedure, which allowed for the generation of t-statistics for significance testing. Then, performbootstrapping @ 5,000 as suggested by Ramayah *et al.* (2018). Figure 3 and Table 5 summarize the hypothesized relationship from the bootstrapping procedure.

Table 5: Result of Structural Model (Path Coefficient)

Hypotheses	Original sample (Beta)	Standard Deviation (STDEV)	t-Value	P Value	Decision
RC -> USD	0.275	0.065	4.220	0.000	Supported
TECT -> USD	-0.047	0.057	0.825	0.410	Not Supported
CM -> USD	0.628	0.057	10.982	0.000	Supported

Note: *t-value >∝=0.05, **t-value >∝=0.01 with two tailed test

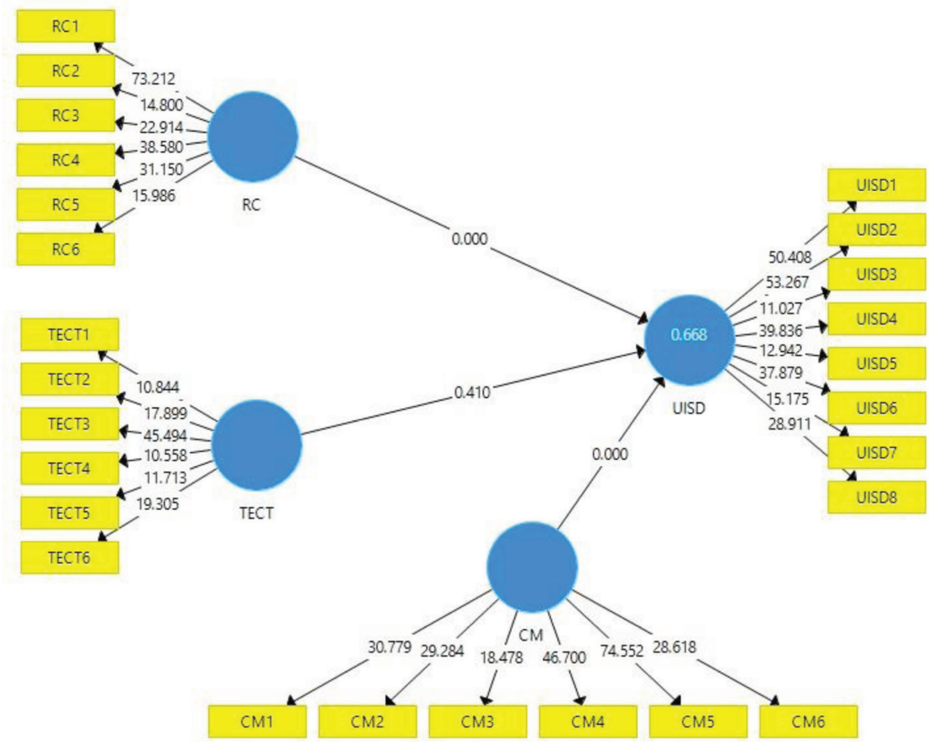

Figure 3: Structural Model of the Study (Bootstrapping @5000)

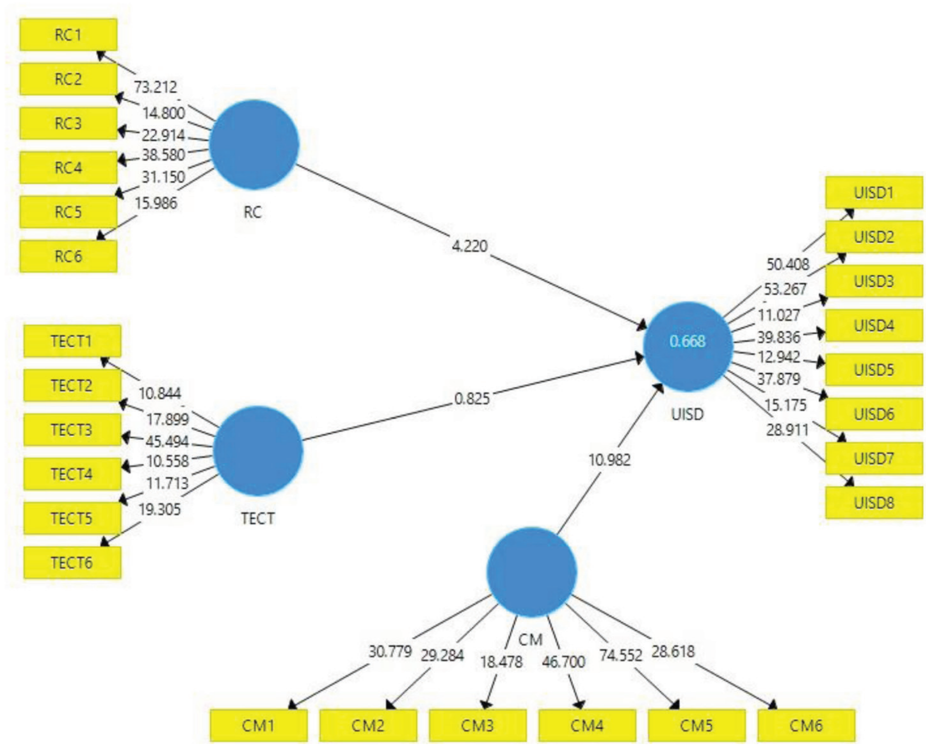

Figure 4: Structural Model of the Study

Table 5 and Figure 4 above illustrate the findings of the structural model evaluation. Hypotheses 1 and 3 were shown to have a significant effect on university-industry sustainability and creativity (β= 0.275, p < 0.00) and (β= 0.628, p >0.0). However, the technology transfer (β=-0.047, p>0.410) had no significant impact on university-industry sustainability and creativity.

The Triple Helix provides a thorough framework for understanding essential questions in innovation processes, which encompass government, business, and academia. This makes it crucial for boosting sustainability and creativity. The three elements are supported by the Triple Helix hypothesis, which makes it helpful for comprehending the dynamics of innovation at the local, national, or global level. The industry producing goods and services engages in high-level research and training (via the corporate university). In addition, the government sets market regulations, corrects market failures, and modifies public policies; it also provides venture capital to launch new businesses, especially high-risk ones. Furthermore, universities work hard to capitalize on knowledge, patents, and startup businesses to maintain their traditional responsibilities for teaching and research.

Triple Helix encourages technology transfer in a way that transforms basic or applied research at universities into something of commercial value. Universities' ability to train and develop graduates with entrepreneurial skills, who can support economic growth by starting new businesses and creating jobs, has improved as a result of their technology transfer programs. Universities all across the world are currently offering a variety of entrepreneurship courses to foster new learning approaches, cultivate an entrepreneurial mindset as an added advantage when it comes to approaching careers, and develop entrepreneurial skills and experience in both theory and practice, while building a business. Faculty members can also benefit from academic entrepreneurship. They can obtain more funding for research projects, maintain the stability of their research laboratories and the ongoing involvement of the students employed by the laboratory, become more responsive to the needs of local businesses and entrepreneurs, and test their expertise outside of university boundaries, which frequently has an impact on the local and national economies. The triple helix theory also has an impact on curriculum management to align learning objectives for all students while also making results easier for teachers. Curriculum management strategies generally seek to ensure that all students get the most out of their education. For education to be meaningful, learners must derive the appropriate behavior, attitudes, values, knowledge, and skills from the curriculum.

The lack of association between technology transfer and university-industry sustainability and creativity might be attributed to a mismatch of objectives, as universities prioritize teaching, research, and community service. The movement of people from academia to business is a critical knowledge transfer. However, consulting engagements of faculty members may also have negative effects, such as a diminished emphasis on student education and possible conflicts of interest regarding the use of university resources for industry advantage. Many academics worry that their research independence will be restricted or that their involvement in entrepreneurship will result in subpar academic work. Because of cultural differences and competing interests between businesses and universities, relationship conflict can occasionally arise at the university-business interface. If left unchecked, these issues can hinder information exchange and create difficulties for joint initiatives. The Triple Helix theory underlined that universities play a larger role in society as we move towards a knowledge-based economy. Universities' status as knowledge producers is growing as innovation becomes more and more dependent on scientific understanding. Because of this, Zhou and Etzkowitz (2021) contend that there is greater equality between academia, business, and government. Informal conversations, conferences, or industry interest in academic publications are among other ways that universities and industry can share knowledge.

5. Discussion and Implications

The current study makes its contribution by empirically examining the impact of leveraging Artificial Intelligence (AI) on university-industry sustainability and creativity. The findings revealed that two indicators of leveraging AI (research and development collaborationand curriculum management) have a positive relationship with university-industry sustainability and creativity. Hypothesis one (H1) shows that research and development collaboration has a positive and significant relationship with university-industry sustainability and creativity, such that itprovides students with the knowledge and skills needed to address sustainability challenges in various industries, as well as enhances the reputation of both universities and industries as responsible corporate citizens committed to environmental stewardship. This result supports the findings of Orazbayeva and Plewa (2020), Hermundsdottir and Aspelund (2021), Marijan and Gotlieb (2021), Dudkowsk (2021), and Jirapong *et al.* (2021) that innovative research can be used to leverage industries to create new products or enhance existing ones, which in turn promotes sustainability and economic growth. Furthermore, this finding is consistent with research by Song *et al.* (2020), Di Vaio *et al.* (2020), and Chedid *et al.* (2020) on the critical role that consulting and collaboration in research and development play in boosting the firms' capacities and innovative activities. Stephan (2001) criticizes university-industry collaboration for losing out on developing the next generation of innovators by luring brilliant faculty members into industry-funded research and rewarding them with contract research at the expense of students' education.

The finding of hypothesis three shows that there is a positive relationship between curriculum management and university-industry sustainability and creativity. As a result, the findings are validated by Abdullahi (2023) validated that curriculum management allows the integration of sustainability principles and practices into educational programs. On the other hand, H2is not supported. Consequently, this finding shows that the role of technology transferinuniversity-industry sustainability and creativity is not important. One of the main reasons why technology transferdoesn't have much of an effect on university-industry sustainability and creativity might be that it isn't encouraged in universities, and there is no regular system for evaluating such interactions betweenuniversities and industries (De Wit-de Vries, 2019).

The results of the present research will help the government, industries, educational managers, and other stakeholders in Nigeria to create a theory that will lead to effective leveraging of Artificial Intelligence to enhance university-industry sustainability and creativity. From a theoretical standpoint, this study adds to the body of literature. Firstly, it provides evidence that leveraging AI (research and development collaboration,and curriculum management) has a positive relationship with university-industry sustainability and creativity. This study also sheds light on how technology transfer can enhance university-industry sustainability and creativity. Secondly, the overall framework of the study will add unique insights into theTriple Helix model literature. Finally, very few studies analyzed this relationship, especially in academic organisations in Nigeria. This is the main contribution of the study.

This study also provides insightful information to companies looking to collaborate with academic institutions. As part of their community engagement and corporate social responsibility initiatives, companies should urge their staff members to stay in touch with their lecturers and participate as industry supervisors for projects, since the findings showed how vital it is for individuals like alumni to play this role. Furthermore, government organisations tasked with fostering innovation to connect industry and academia should support the dissemination of placement opportunities and success stories via websites. Governments and organizations in charge of economic development might be interested in fostering job creation through innovative goods and services.In conclusion, to achieve university-industry sustainability and creativity, all three factors of leveraging AI (research and development collaboration, technology transfer,and curriculum management) are important.

The government may put the study's findings into practice by offering tax breaks, grants, and other financial possibilities to institutions and businesses that work together on AI research and development initiatives. Establish technology transfer offices to speed up university research commercialisation in order to promote collaboration and make it easier for industry and academic institutions to share AI advancements. In order to ensure that the educational system meets the demands of the labour market and the goals of sustainable development, governments can support initiatives that encourage curriculum reform. Through this integration, sustainability is promoted by equipping students with the skills and knowledge necessary to tackle present and future technical, social, and environmental challenges. Giving students the interdisciplinary knowledge and practical skills they need to solve creative problems in fast-paced industrial settings encourages creativity. To work on win-win R&D projects, universities can set up specialised AI research facilities in partnership with businesses. These laboratories can offer a setting for evaluating artificial intelligence (AI) solutions for specific business issues.Academic institutions and business experts can work together to develop AI-related courses that address contemporary problems and emerging trends in the field. This curriculum should include industry case studies, internships, and cooperative education programmes.

Universities should form industry advisory committees with leading figures in the field to make sure AI research initiatives and courses meet industry demands.Collaboration between academic institutions and industry can result in AI talent development initiatives that ensure sustainability and innovation, such as professional certification programmes and executive education. Funding from industry organisations is available to universities that wish to carry out specific AI research projects.The sector's long-term strategic goals may align with this funding.AI fellowships and scholarships can be sponsored by industries to draw top talent to university AI departments. These programs give students exposure to the real world through internships and industry-guided research projects. Provide online spaces where academic institutions, businesses, and startups can freely communicate and work together on AI initiatives. Technology transfer can be more effectively accomplished by using these platforms to facilitate the sharing of AI algorithms, patents, and solutions.

The implications for the present study necessitate that leveraging Artificial Intelligence can positively influence university-industry sustainability and creativity. Implementing strategies that foster effective research and development collaboration, technology transfer,and curriculum management can create an environment that stimulates positive collaboration between the university and industry. This study shows that Artificial Intelligence (AI) facilitates collaborative research and development (R&D) projects between universities and industries by providing advanced tools for data analysis, predictive modeling, and problem-solving. These collaborations can focus on sustainable technologies, innovative products, and creative solutions to societal challenges. Furthermore, this study highlights the benefits of using AI to accelerate the transfer of technology and knowledge from universities to industries and vice versa. This implies that universities can leverage AI to identify commercially viable research outcomes and intellectual property that can be transferred to industry partners for further development and implementation. Conversely, industries can share real-world data and challenges with universities to inspire research and innovation. The research also indicates that curriculum management plays a crucial role in encouraging collaborative learning and providing professional development to facilitate the exchange of ideas and knowledge between university lecturers and industries. This in turn, can enhance university-industry sustainability and creativity.

Based on the findings of data analysis and the conclusion of the research, this study took the three most considered leveraging Artificial Intelligence (AI) indicators for achieving university-industry sustainability and creativity. However, in the future, researchers can explore any other indicators of leveraging AI. Also, it is essential to carry out more research studies to explore AI relationships and effects in polytechnics, colleges of education, basic education, and high schools. Further study is required, which should involve industry-specific company segmentation and matching of activities with targeted AI applications.

6. Conclusion and Recommendations

The findings of this study show that effective leveraging of AI can enhance university-industry sustainability and creativity. Hypotheses 1 and 3 were shown to have a significant effect on university-industry sustainability and creativity; however, hypothesis 2 had no significant impact on university-industry sustainability and creativity. Also, this study sheds light on how technology transfer can improve university-industry sustainability and creativity. University administrators and industry professionals should continue to improve on research and development collaboration to facilitate a two-way flow of knowledge, where academic expertise can help industries tackle specific sustainability challenges, and industry insights can inform future university research. Additionally, school administrators and industry professionals should give room for technology transfer to foster continuous improvement and adaptation of sustainable technologies, benefiting both parties and society at large. Furthermore, government, school administrators, and industry professionals should continue to effectively manage the curriculum to give room for continuous collaboration between the university and industry to enhance sustainability and creativity.

Acknowledgement

The author declares that there are no acknowledgements for this research paper.

Authorship Contribution

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

Funding

The author received no external funding to conduct this study.

Declaration

The author hereby declares that this research paper is an original work conducted by the author. All sources and references have been properly acknowledged, and the work has not been submitted or published elsewhere.

Conflict of Interest

The author declares that they have no conflict of interest regarding the publication of this paper.

AI Usage Statement

The author employed Grammarly, an AI technology, in the study to improve the written content. To be more precise, this technology was used to make the content more coherent, guarantee grammatical accuracy, and improve sentence structure. Grammarly's recommendations and edits to maximize readability and linguistic fluency helped polish the work.

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