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(REVIEW ARTICLE)

Factors of successful technology transfer in higher education: A literature review

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Abstract

Technology transfer within universities is essential for fostering innovation, productivity, and competitiveness, as demonstrated by the comprehensive analysis of 13 articles focused on successful technology transfer in higher education. The study employed the systematic literature review using PRISMA framework to ensure the selection of relevant and comprehensive articles. Findings revealed that the key factors are adapting, modifying, assimilating, and creating new technology, utilizing systems thinking and transformative organizational approach, synergizing the innovation ecosystem of university and industry, and cultivating knowledge-driven ecosystems. It emphasizes the value of adaptability, collaboration, transformational thinking, and information management. Thus, higher education institutions may promote innovation, stimulate economic growth, and help to define a future that is driven by scientific and technical breakthroughs by adopting these ideas.

Keywords: Successful Technology Transfer; Higher Education; Systematic Literature Review; Education; Research Utilization

1. Introduction

In recent years, the university's role in the economy has undergone a significant transformation due to the recognition of knowledge as a crucial driver of economic growth. Traditional scholarly research alone is no longer sufficient; universities are now embracing the entrepreneurial model [5]. Given this scenario, technology transfer is essential for promoting economic progress and prosperity. Technology transfer helps businesses and economies to innovate, increase productivity, and gain a competitive edge in the global market by facilitating the diffusion and use of information [21].

Academic knowledge disseminates to the broader society through a wide array of avenues. These pathways include the licensing of valuable intellectual assets like patents, trade secrets, and know-how, as well as the establishment of startups originating from university innovations [4]. The two main methods for transferring knowledge from universities to companies are licensing agreements and the creation of spin-off businesses. Compared to licensing agreements, which are the more traditional approach, spin-offs are a more innovative way to convey knowledge [25]. This means that in the entrepreneurial society, the university assumes a more substantial role beyond its facilitation of technology transfer via patents, spin-offs, and university-affiliated startups [5].

Additionally, collaborative endeavors such as research joint ventures, cooperative research initiatives between universities and industries, and engagements in contract research and consulting are vital mechanisms that facilitate the transfer of knowledge [4]. To ensure effective knowledge transfer, mechanisms and institutions have been established to bridge the gap between academia and industry. The focus has shifted from knowledge generation to practical application and real-world impact. Through active collaboration with external stakeholders, universities can develop innovative solutions that contribute to economic development. The key emphasis now lies in fostering productive exchanges of ideas and utilizing knowledge for the greater benefit of society [5].

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This is not the first literature review on technology transfer in higher education. The literature review by Hayter and Rooksby focused on the legal implications of technology transfer, stressing the need for more research and comprehension of the diffusion and commercialization of academic technology [23]. The legal viewpoint is acknowledged as an important resource in ongoing inquiries in this field. Additionally, it has been noted that it is crucial to perform a more thorough investigation of the formal components used by regional governments to promote innovation and entrepreneurship, such as their policies, programs, incentives, and strategies, particularly with the use of technology transfer in universities [13].

To strengthen the relevance of the findings of technology transfer, this study also adhered to the proposal that future research include an individual-level unit of analysis that explicitly focuses on academic entrepreneurs such as education institutions [4]. It has also been noted that there is still limited understanding of the fundamental ramifications, such as the ongoing improvements in human capital in science and technology [16]. Similarly, there remains a lack of understanding of how technology transfer operations affect institutions, their frameworks, and their complete range of capabilities.

Given the dearth of resources on technology transfer, particularly in higher education, these gaps raise serious concerns about the availability of empirical evidence. The benefits of technology transfer have also not yet been fully embraced and investigated by a sizable number of higher education institutions (HEIs), despite the fact that this approach is gradually gaining favor in this industry. They forfeit opportunities for creativity, collaboration, and economic impact as a result. To close these gaps, a systematic literature review was done to determine the key factors influencing successful technology transfer in HEIs. This review may provide information to advance effective technology transfer practices, foster innovation, and advance societal progress.

2. Methods

To find relevant research resources, a comprehensive search was conducted across many scholarly databases, including ERIC, IEEE Explore, JSTOR, and Google Scholar. The depth of information in these databases about research studies, conference papers, and book chapters about technology transfer in higher education was a deciding factor in their selection. In order to find research published from 2009 onwards, peer-reviewed academic publications in the disciplines of education, educational technology, and technology integration were rigorously analyzed.

By employing targeted keywords and Boolean operators, a methodical search of the literature was conducted to identify relevant articles, papers, and books. The search was focused on recent research specifically related to technology transfer in higher educational institutions, with careful restrictions set to include materials published from 2009 onwards.

Relevant information, such as author names, publication years, research objectives, methodologies, key findings, and implications, were extracted from the selected papers. A thematic analysis was employed to identify common themes, variables, and key factors pertaining to technology transfer in higher education.

A thorough analysis of the condition of technology transfer in higher education was provided using a thorough synthesis and interpretation of the data that had been obtained. The results were grouped topically and presented coherently to satisfy the goals of the literature review research and provide a clear and thorough grasp of the subject.

The following research question served as the review's objective:

- What are the key factors influencing the successful technology transfer in higher education institutions?

2.1. Inclusion and Exclusion Criteria

The inclusion criteria for the selected studies were as follows: (1) Only research articles, conference papers, and book chapters that had undergone thorough peer review or were published in respected conference proceedings or edited volumes were considered; (2) The resources had to be relevant to technology transfer, specifically discussing or providing insightful information on how technology transfer occurs in higher education institutions; and (3) Research methodologies such as case studies, surveys, experimental designs, and studies utilizing qualitative, quantitative, or mixed methods approaches were deemed appropriate (see Table 1).

Studies conducted before 2009, those written in languages other than English, inaccessible via the ERIC, IEEE Explore, JSTOR, and Google Scholar, or not directly addressing technology transfer in higher education institutions were

excluded. By employing these inclusion and exclusion criteria, the literature review ensured the inclusion of contemporary, relevant, and academically significant sources that significantly advanced the understanding of technology transfer in higher education institutions.

The focus of the chosen literature is on technology transfer, which is the dissemination of technical knowledge, assets, and innovations within the setting of higher education institutions. It covers the transfer of scientific and technological discoveries, research findings, and practical applications from a range of sources, including academic institutions and industry, to higher education institutions. Making it simpler for students to access these resources enhances the educational experience, fosters creativity, and equips them with the knowledge and abilities they will need for professional work in a culture that values digital technology.

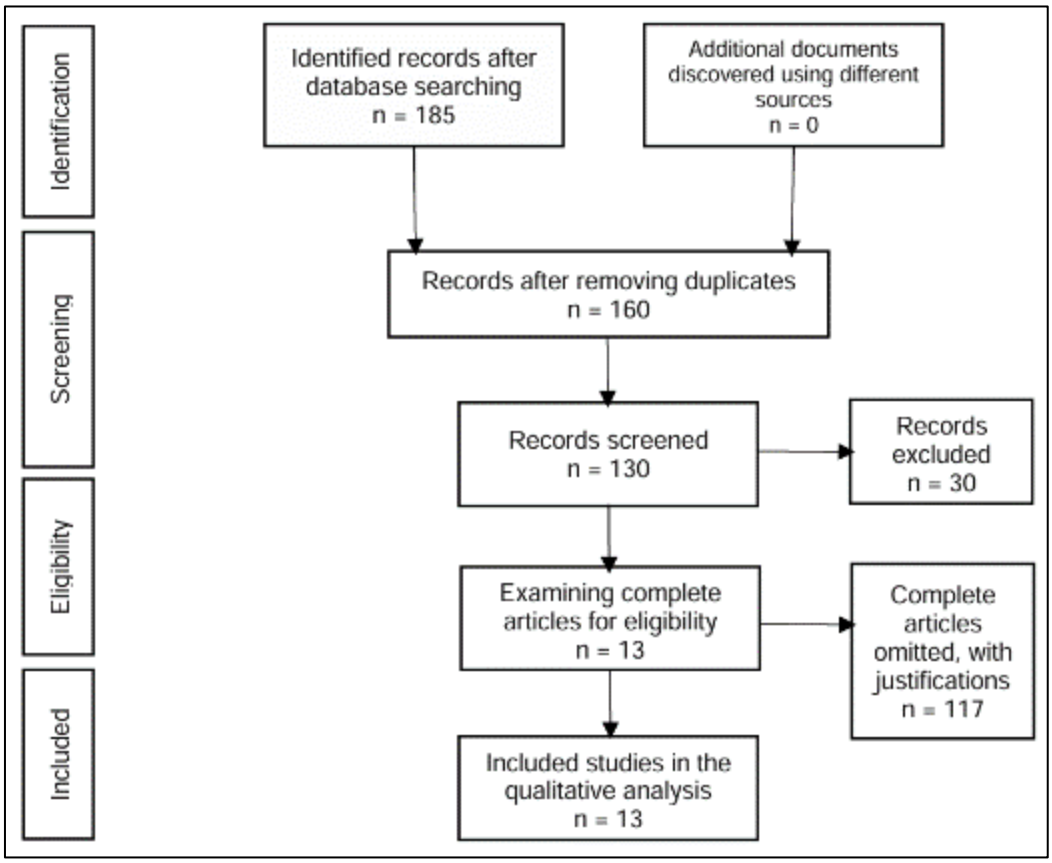

Figure 1 PRISMA Flow Diagram of the Study

Table 1 Inclusion and Exclusion Criteria of the Literature Review

Eligibility Criteria	**Inclusion**	**Exclusion**
Time Frame/ Years	2009 to 2022	Below 2009
Language	English	Other Languages
Methodology	Quantitative/ Qualitative/ Mixed Methods	
Electronic Databases	ERIC, IEEE Explore, JSTOR, and Google Scholar	Other Sources/ Inaccessible Studies
Publication Status	Published in Journals/ Books	

2.2. Search Strategy

A comprehensive search was conducted on electronic databases including ERIC, IEEE Explore, JSTOR, and Google Scholar until March 2023, with a specific focus on the years 2009 to 2022, using key terms such as "Technology Transfer in Higher Education," "University Technology Transfer," and "Technology Transfer in Education." The reference lists of the included studies and related reviews were carefully reviewed to identify any additional relevant articles.

Duplicate results were eliminated after exporting all queries to Endnote. The titles and abstracts were independently reviewed by the researcher, excluding any irrelevant material. The full-text versions of the selected articles were examined by CFG, who was not involved in the initial search, based on predetermined inclusion and exclusion criteria. Any disagreements that arose during the review process were addressed and resolved.

2.3. Data Extraction

The data extraction process from the chosen studies encompassed various elements, including author, publication year and country, study design, participant characteristics, study aims, definitions, results and discussions, conclusions, and recommendations/ implications. The data was initially gathered by one researcher and subsequently verified by another researcher who was not part of the data search. In the event of any disagreements, a consensus was reached through a discussion to resolve them (see Table 2).

Table 2 Reviewed Studies on the Key Factors of Successful Technology Transfer in Higher Education

ID	Author/s, Year	Country	Research Design	Respondents/ Data Source	Research Focus
1	Stankeviciene et al. (2017)	Lithuania	Correlation	Twenty-five experts from seven main HEIs operating in Lithuanian regions	This article looked at the role that technology transfer plays in value development. It offered a fresh method for identifying and rating technology transfer initiatives that most significantly contribute to value generation.
2	Romanovich et al. (2014)	Russia	Literature Review	Not identified	The research explored the multitude of benefits that universities can attain by prioritizing the development of technologically advanced multifunctional complexes. This systematic approach towards promoting innovation not only grants colleges a competitive advantage but also offers them a diverse range of advantages.
3	Alshumaimri et al. (2010)	Saudi Arabia	Literature Review	Not identified	This article delves into Saudi Arabia's technology transfer revolution, aiming to establish a globally competitive knowledge-based creative economy. It examines the rationale, methodologies, and newly established organizations and regulations that facilitate knowledge and technology transfer from universities.
4	González-Pernía et al. (2013)	Spain	Binomial Regression	Public and private universities and public research institutes and hospitals	The influence of university characteristics and technology transfer offices on the diffusion of scientific information, particularly in terms of licensing and the creation of spin-off firms, was thoroughly investigated in this study.
5	Audretsch (2014)	USA	Literature review	Not identified	This research critically evaluated the dynamic growth of the university's role in society while examining the numerous factors that have impacted the university's transformation over time.

ID	Author/s, Year	Country	Research Design	Respondents/ Data Source	Research Focus
6	Choi (2009)	Not applicable	Book chapter	Not applicable	This book delves into the essential elements of a successful technology transfer, highlighting the significance of comprehending technology conceptions, setting up efficient communication channels, looking at influencing factors, and creating a strong transfer model to improve the entire process.
7	Feng et al. (2012)	Taiwan	Structural Equation Modelling	49 Universities	With a focus on university TT offices (UTTOs), this study presented a theoretical model that analyzes the relationship between intellectual capital, research outcomes, and technology transfer performance (TTP). It finds that universities with specialized UTTOs significantly increase TTP by encouraging university-industry collaboration.
8	Bertrand (2010)	USA	Literature review	Universities	This paper focused on the review of rapid advancements and interconnected nature of the world, it is imperative to foster a global culture of lifelong learning and adopt new higher education models.
9	Heinzl et al. (2013)	Austria	Multi-phase: Literature review, Ethnographic research, & Exploratory research	Applied Sciences Universities	This paper unveiled four models: the Generic Technology Transfer Model (Section 5.1), the Idiosyncrasies Model for the Austrian Universities of Applied Sciences (Section 5.2), the Idiosyncrasies-Technology Transfer Effects Model (Section 5.3), and the Idiosyncrasies-Technology Transfer Cumulated Effects Model (Section 5.3). The study included a variety of research techniques, such as interviews, focus groups, participant observation, and literature surveys.
10	Kim (2013)	USA	Data Envelopment Analysis	200 Colleges and Universities	This study investigated how productivity in university technology transfer has changed over time.
11	Goncharenko (2021)	Ukraine	Data Flow Diagram Method	Not identified	In order to foster an innovation ecosystem, this research examined the underutilization of technologies and innovations from higher education institutions in Ukraine.
12	Caldera & Debande (2010)	Spain	Modelling	Universities in Spain	This paper conducted a comprehensive investigation into the performance of technology transfer among universities in Spain, utilizing a distinct and specialized dataset that

ID	Author/s, Year	Country	Research Design	Respondents/ Data Source	Research Focus
					specifically focused on university-level information.
13	Guerrero & Urbano (2012)	Spain	Structural Equation Modeling	50 Spanish Public Universities	In order to better understand the complex interactions that affect institutional missions, this research identified key drivers, presented an empirical measurement model informed by institutional economics, and took a resource-based perspective.

2.4. Risk of Bias (Quality) Assessment

A modified technique created for assessing research articles was used to evaluate the quality and bias risk of each included article. Research design, randomization, blinding, and the availability of complete outcome data were taken into consideration for quantitative experimental studies. On the other side, observational research was assessed based on the appropriateness of sampling, the justification of the measurements utilized, and the treatment of confounding factors. The goals of the study, suitability of the design or procedure, justification for the sampling, participant description, techniques of data collection and analysis, and reflexivity of the researchers in the discussion were all taken into consideration.

2.5. Data Synthesis

Demographic information encompassing the study year, location, and research focus/topic area was gathered from the compiled literature. Thematic analysis was employed to emphasize the significant findings, providing a comprehensive view that aligned with the review's objectives of synthesizing data from the analyzed articles based on the research questions.

As shown in Figure 2, the concentration of the literature review spans from the years 2009 to 2017. The papers from this timeframe contribute to the discussion on various aspects related to the research topic at hand.

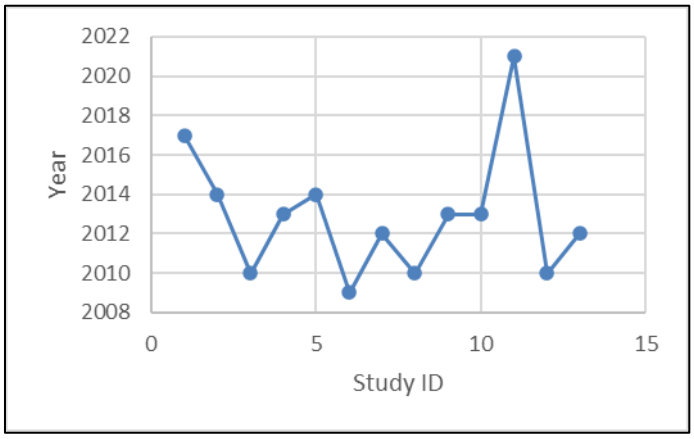

Figure 2 Distribution of Reviewed Articles with respect to Year of Publication

Table 3 presents a literature review that incorporates studies conducted in various countries such as Lithuania, Russia, Saudi Arabia, Spain, the USA, Taiwan, Austria, Ukraine, and also includes papers where the country of study locale was not specified. The distribution shows that both the USA and Spain account for 23 percent (23%) of the studies, while the remaining countries share seven percent (7%) each. The inclusion of these diverse geographical locations enhances the comprehensiveness of the research topic from a global standpoint.

Table 3 Distribution of the Reviewed Studies by Country

Place of Publication/ Study	Total
Austria	1
Lithuania	1
Russia	1
Saudi Arabia	1
Spain	3
Ukraine	1
USA	3
Taiwan	1
Not applicable	1
Total	13

3. Results and discussion

3.1. Key Factors of Successful Technology Transfer in Higher Education

Based on the reviewed articles, the key factors for a successful technology transfer in higher education includes Adapting, Modifying, Assimilating, and Creating New Technology, Utilizing Systems Thinking and Transformative Organizational Approach, Synergizing the Innovation Ecosystem of University and Industry, and Cultivating Knowledge-driven Ecosystems (see Table 4). These elements together highlight the importance of flexibility, teamwork, transformational thinking, and a strong emphasis on information production and distribution. Higher education universities may promote innovation, stimulate economic growth, and sculpt a future fueled by scientific and technical breakthroughs by adopting these concepts.

3.1.1. Adapting, Modifying, Assimilating, and Creating New Technology

To foster innovation and entrepreneurship within the academic community, higher education institutions must promote and provide resources to startups and spin-offs. Universities may enable these endeavors to thrive and contribute to economic growth and societal impact by providing direction, financial possibilities, and access to networks [3,5,12,4,10].

The spin-off business model is underscored as an exceptionally potent strategy that significantly bolsters the commercialization of intellectual property at esteemed institutions [26]. The findings of recent research validate prior studies by illustrating a significant correlation between funding, patents, and incentives, underscoring their pivotal role in fostering spin-off creation [27]. The outcomes highlight the crucial significance of financial support, patent procurement, and effective compensation systems in cultivating a conducive environment for spin-off ventures.

University researchers may start the process of turning their intellectual property and outputs into real commercial value by securing patents and licenses for educational breakthroughs. Universities may bridge the gap between academics and business, drive economic growth, and maximize the societal effect of their educational breakthroughs by safeguarding and commercializing these inventions [5,12,7,10].

University patents function as diverse indicators of scholarly research accomplishments and as a way to obtain funds from research grants and licensing contracts. They do not obstruct the advancement of basic research, as evidenced by their close ties to extensive and resource-intensive research projects. These patents show how universities develop industrial knowledge, establishing a mutually beneficial partnership between academics and industry. Rather than producing significant income through licensing, these patents' relevance lies solely in their potential to indicate innovation. However, significant infrastructure investments, including the employment of specialist personnel within the technology transfer office, are necessary for the proper administration of university patents [14].

Leveraging the economic potential of academic research and development requires encouraging the transfer of university-based technologies into commercial goods. Universities have the power to stimulate innovation, provide new employment opportunities, and support the expansion of a capital-driven economy by bridging the knowledge gap between academics and the market [6,7,9,13,1].

In the innovative world, inventors recognize the pivotal role of patents in applied research, enabling them to secure funding, forge industry partnerships, and enhance the reputation of their research group. However, the lack of funding for research and development, rigid negotiation procedures, and onerous royalty requirements were challenges faced by inventors, as well as rigid administrative procedures in universities and the limited market viability of patents. It is noteworthy to reexamine the function of patents within universities, reviewing curricula, and evaluating committees, and allocating resources to science translational units to improve the efficacy of university patenting and technology transfer efforts [17].

Table 4 Themes on the Key Factors of Successful Technology Transfer in Higher Education

Themes on the Key Factors of Successful Technology Transfer in Higher Education	**Characteristics**	**Study ID**	**Number of Studies**
Adapting, Modifying, Assimilating, and Creating New Technology	Providing assistance to startups and spinoffs	[3] [4] [5] [10] [12]	5
	Commencing the process of obtaining patents and licenses	[5] [7] [10] [12]	4
	Promoting the conversion of university-based technology into marketable products	[1] [6] [7] [9] [10] [13]	6
Utilizing Systems Thinking and Transformative Organizational Approach	Utilizing the potential of a systemic framework to facilitate support and streamline processes	[1] [6] [9] [12]	4
	Fostering a paradigm shift within the organization to cultivate positive attitudes and forward-thinking intentions	[6] [11] [13]	3
	Attracting and cultivating top-tier faculty members through strategic recruitment and comprehensive research and development training	[3] [7] [8] [9]	3
Synergizing the Innovation Ecosystem of University and Industry	Collaborating with public and private sectors	[1] [2] [3] [7] [9]	5
	Establishing strong ties with the business sector	[1] [6] [7] [9]	4
	Engaging in partnerships with research and development institutions and industry organizations	[1] [2] [3] [8] [10] [11]	5
	Operating beyond the traditional confines of the university framework	[1] [4] [6]	3
Cultivating Knowledge-driven Ecosystems	Dedicating resources to the advancement of scientific and technological education	[1] [3] [5] [8] [10] [11]	6
	Establishing a knowledge-based economy	[1] [3] [4] [5] [7] [9]	6
	Creating technology parks for innovation	[3] [6] [8] [12]	4

	Building infrastructure and allocating resources for university development	[8] [9] [11]	3
	Disseminating innovations through publication	[8] [11]	2

3.1.2. Utilizing Systems Thinking and Transformative Organizational Approach

Universities enhanced their assistance for technology transfer and streamlined procedures by utilizing a holistic framework, ensuring a smooth transition from research to commercialization. This strategy allowed stakeholders to work together efficiently, improved communication channels, and strategically allocated resources, thereby facilitating the successful transfer of technology from the academic setting to the market [6,12,9,1].

In order to cultivate constructive attitudes and visionary intentions toward successful technology transfer, higher education institutions promoted a paradigm change. This transition involved encouraging entrepreneurial thinking, cultivating an innovation-driven culture, and fostering a climate of risk-taking and teamwork. Universities achieved this by fostering an atmosphere that motivated staff, researchers, and students to actively participate in technology transfer activities and enhance the social impact of their research projects [6,11,13].

The research reinforces the notion that continuous and substantial engagement of institutions in knowledge exchange interactions, as indicated by network centrality, plays a pivotal role in achieving successful open innovation. These ongoing collaborations facilitate the development of embedded connections, enabling the establishment of new avenues for knowledge exchange. This cultivation of openness occurs as these partnerships mature and yield increasingly advantageous outcomes, with research-intensive universities typically demonstrating the requisite frameworks and protocols to effectively manage the flow of knowledge across these channels [24].

Universities attracted and developed top-tier faculty members through deliberate recruiting strategies and extensive training programs in research and development. These programs intended to recruit outstanding academics with a range of specialties and give them the tools and support they needed to succeed in their research activities. Universities strengthened their research capacities and contributed to the development of knowledge in their respective domains by investing in the recruitment and training of great staff [3,8,7,9]. Organizations can use tactics like secondment, staff exchange, and the hiring of graduates, Master's, and PhD students to improve knowledge transfer and absorptive ability. Successful information transmission depends critically on compatibility in knowledge base [19].

In fact, the abundance of information, skills, and capacities acquired via education and professional training make up human capital, which stands out as a significant asset in the context of corporate and societal advancement. This priceless asset acts as a catalyst for the use of technology, innovation, and the stimulation of economic growth. The interaction of human capital, intellectual property rights (IPRs), and innovation also plays a crucial role since it encourages the development of human capital investments in emerging countries, which in turn spurs an increase in inventive activities while reshaping the environment for IPR protection [20].

3.1.3. Synergizing the Innovation Ecosystem of University and Industry

Universities started technology transfer programs in partnership with the public and private sectors. Through the interchange of information, resources, and experience made possible by these relationships, universities have been able to successfully commercialize the results of their research and innovation [3,7,9,2,1]. Strong connections between higher education institutions and the business community allowed for successful technology transfer cooperation. Through the promotion of knowledge, resource, and expertise exchange, these collaborations helped academia and business successfully commercialize their joint research and innovation outputs [6,7,9,1].

De Wit-de Vries et al. stress the significance of industry partners' purpose compatibility in assessing the value of information. Difficulties arise from different knowledge application needs, especially when it comes to safeguarding sensitive information after dissemination. It is crucial to have open and effective communication, which includes talking about shared objectives and exchanging information, in order to build trust and get through these barriers. Additional factors, including thorough project planning, the use of management tools, competence in academic engagement, and focused cooperation with specific partners, all help to improve knowledge and satisfy industrial expectations [19].

Similarly, universities collaborated with organizations in the industry and in research and development to commercialize the results of technology transfer. These partnerships made it easier for creative concepts and scientific discoveries to go from academic settings to real-world commercial applications. Universities were able to effectively

transfer their technology to the commercial sector by utilizing the knowledge and resources of these companies, which had a positive influence on the economy and society [3,8,11,10,2,1].

The study emphasizes the value of trust and collaborative know-how, confirming the significance of past collaborative experience in higher education institution-industry collaboration. While collaborative know-how creates intangible advantages like knowledge transfer and learning, trust is essential for delivering real benefits such as breakthroughs in products and processes. Recognizing that prior experience alone is insufficient, it is crucial for companies to create strategic competencies to harness the potential of academic relationships. Governmental efforts should put a high priority on creating effective channels and resources that encourage cooperation between industry and academics, with an emphasis on helping small firms [15].

Furthermore, findings reveal that higher education institutions offered students the chance to work in businesses or labs outside the campus, expanding their operations beyond the usual parameters of the university framework. Through these opportunities, students were immersed in the processes of technology transfer, obtaining useful knowledge and exposure to situations seen in the real world. Universities promoted a thorough and practical learning environment by going beyond the standard classroom setting, equipping students for fruitful technology transfer attempts [6,4,1].

3.1.4. Cultivating Knowledge-driven Ecosystems

Universities and other organizations invested funds in research and development as well as scientific and technological activities carried out inside the institution to promote scientific and technological education. By encouraging an innovative culture, financing research projects, and aiding the creation of cutting-edge technologies, these programs sought to enable technology transfer. Universities and organizations accelerated the effective transfer of technology from academic settings to real-world applications by giving these investments top priority, spurring economic development and societal advancement [3,5,8,11,10,1].

Hamilton and Philbin found that successful knowledge deployment, specifically through patent licensing and startup creation, positively influenced the performance of technology transfer. However, the presence of knowledge infrastructure, such as incubators and medical schools, did not show significant effects on licensing effectiveness, overall technology transfer office (TTO) success, or startup formation [22].

On the other hand, the HEIs created a knowledge-based economy by emphasizing the development of an environment that valued innovation and intellectual capital. This entailed funding R&D, encouraging entrepreneurship and information transfer, and working with businesses and government agencies [3,5,4,9,1].

Indeed, universities are highly regarded for their research since it may generate new information and make it easier for that knowledge to spread to other industries. Governments and other key stakeholders have so significantly increased their spending in universities as a means of fostering knowledge-based regional economic growth [18]. Further, in the context of knowledge-based economies, the collaboration between academic institutions and corporate enterprises has become highly significant. Recognizing universities as valuable sources of scientific knowledge, industries actively seek partnerships to expand their knowledge base and gain a competitive advantage. These collaborations provide businesses with access to state-of-the-art research, valuable knowledge, and abundant resources, driving innovation and fostering economic growth [29].

In order to facilitate the smooth capture of technology transfer, technology parks were established. Similar to science parks, these parks promoted collaborative settings that hastened the transfer of information and technical developments for use in practical applications. They also encouraged curriculum exchange between academic institutions, business, and the web [3,8,12,6]. In addition, a focus on improving human capital, providing required resources, and assisting diverse activities led to the construction of university infrastructure and the allocation of resources for the growth of the institution [8,11,9].

Universities shared their research results, inventions, and spinoffs through publications in order to hasten the technology transfer process. These initiatives sped up the dissemination of information and made it easier for academic breakthroughs to be put to use in a variety of fields and sectors [8,11].

These key factors considerably increase the effect and success of technology transfer in higher education institutions. Universities may continue to be at the forefront of innovation by embracing flexibility and actively participating in altering, integrating, and developing new technologies. Systems thinking is used to expedite transfer procedures, and transformational organizational techniques are adopted to promote an innovative culture. Combining the innovation

ecosystems of universities and business while developing knowledge-driven ecosystems encourages cooperation, strengthens research-commercialization collaborations, and has a positive influence on the economy and society.

4. Conclusion

The aim of this research was to conduct a comprehensive analysis of 13 studies utilizing the PRISMA model for a systematic literature review. The focus was on identifying the key factors contributing to the successful transfer of technology in HEIs.

Based on the findings, HEIs assist companies and spinoffs, provide financial possibilities, and ease access to networks to encourage innovation and entrepreneurship. Funding, incentives, and patents are a few examples of the aspects that might affect a spin-off venture's success. Universities may examine the role of patents, update curriculum, and allocate resources to increase the success of patenting and technology transfer initiatives in order to solve issues like limited financing and the commercial viability of patents.

They also use comprehensive frameworks to speed up technology transfer procedures, facilitating effective resource allocation and collaboration. They invest in hiring and training top-tier faculty members to leverage human capital for technology use, innovation, and economic growth while also acknowledging its impact on creative activities and IPR protection.

Moreover, universities have effectively commercialized research and innovation outputs by partnering with industry, exchanging knowledge and resources. Successful collaborations require effective communication, trust, and strategic competencies, highlighting the importance of government support. Furthermore, universities provide practical learning experiences for students by involving them in technology transfer activities beyond the classroom, enhancing their practical skills and knowledge.

Investments in research and development by universities and organizations foster an innovative culture and enable technology transfer. The deployment of knowledge through patent licensing and startups has a significant impact on technology transfer, while the influence of knowledge infrastructure is limited. Universities play a vital role in knowledge-based economies, providing valuable scientific knowledge, driving innovation, and contributing to economic growth, with technology parks and university infrastructure facilitating the transfer of technology, and publications aiding the dissemination of research results and inventions.

This review provides a comprehensive overview of the key findings from previous studies and offers potential avenues for future research. In particular, future studies could examine the barriers and challenges encountered in technology transfer within higher education institutions (HEIs), employing both qualitative and quantitative data to gain a deeper understanding of the topic. To address the research gap within the local context, future studies on technology transfer in HEIs can specifically concentrate on the Philippines. By exploring technology transfer practices and challenges unique to the Philippine HEI landscape, researchers can contribute valuable insights and recommendations for enhancing technology transfer efforts in the country.

4.1. Strengths and Limitations

This study fills a significant gap in the literature by providing an in-depth review of technology transfer in higher education institutions (HEIs). The findings of this study offer valuable insights and essential information for decision-makers and university administrators to shape future initiatives and policies related to technology transfer within the academic setting. While efforts were made to explore relevant literature, the search was limited to available research search engines, which were chosen based on accessibility and comparability with other platforms.

While this study had certain limitations, it is important to acknowledge that the search was conducted within a specific timeline, and there may have been additional relevant papers available online. Researchers interested in building upon this review can expand the search terms and explore further to ensure a more comprehensive inclusion of relevant literature in their own studies.

Compliance with ethical standards

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Disclosure of Conflict of interest

I, Prima C. Canillas, declare that I have no conflicts of interest or competing interests to disclose regarding the publication of this manuscript or any institution, product, or entity mentioned herein. Furthermore, I have no affiliations with, or financial interests in, any products or organizations that could influence the study outcomes presented or compete with those discussed in the manuscript.

Statement of ethical approval

All ethical standards were strictly followed in the conduct of this study, including the use of the PRISMA framework. All sources and authors referenced in the manuscript were properly cited in accordance with academic and ethical guidelines.

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