

Industry-academia Collaboration: A Literature Review

Nidhi Nischal^{1,*}, Swamy D.R.², Veerappaji B.S.³, Vanishree Beloor⁴

Abstract

This literature review article thoroughly investigates the history, evolution, consequences, Trends, barriers and benefits of Industry Academia Collaboration (IAC) across the globe. The introduction sheds light on the origins of IAC in the early 20th century and its significance in bridging the gap between academia and industry, leading to mutual benefits and knowledge exchange. By examining studies from different countries, the literature review explores the trends, barriers, and drivers of IAC, highlighting the increasing interest in this field. It underscores the significance of effective partnerships, interdisciplinary collaboration, and supportive institutional frameworks in improving collaboration outcomes. Furthermore, this article offers valuable insights into the dynamics and mechanisms of IAC while suggesting future research directions and practical implications in this vital realm of knowledge transfer, innovation, and economic development. The history of Industry Academia Collaboration (IAC) dates back to the early 20th century when industries began partnering with academic institutions to tackle technological and engineering challenges. Predominately, IAC refers to the collaboration between industry and academic institutions for mutual benefit and knowledge exchange. It involves academic researchers, faculty, and others working together with industrial partners to develop new technologies, products, and services, as well as to share knowledge and resources. The objective of IAC is to bridge the gap between academia and industry, promoting innovation, economic growth, and societal development.

Keywords: Industry-Academia, Industry-University Collaboration, Industry-Academia Collaboration, economic growth, innovation

INTRODUCTION

In the United States, IAC gained momentum during World War II as the government sought to develop military technologies, leading to the establishment of research universities and a formal system of technology transfer from universities to industry (Lowe, 2011) [34]. In Europe, IAC evolved in the 1960s and 1970s in response to economic challenges such as declining productivity and competitiveness [2]. Countries like Germany established "Fraunhofer Institutes" to support collaboration between industry and universities in applied research, while the United Kingdom created the Science and Engineering Research Council (SERC) as a mechanism for IAC in 1981 [4].

The importance of IAC is widely recognized in Japan, where government initiatives have promoted collaboration between industry and universities since the 1970s. Similarly, Taiwan established the Industrial Technology Research Institute (ITRI) in 1973 to facilitate IAC under the Ministry of International Trade and Industry (MITI). In other parts of Asia, such as China, the government has played a key role in promoting IAC through initiatives like the establishment of "National Key Laboratories" [7].

*Author for Correspondence

Nidhi Nischal

E-mail: nidhinischal2001@gmail.com

1Research Assistant, Visvesvaraya Technological University, Belagavi, Karnataka State, India 2Professor, Visvesvaraya Technological University, Belagavi, Karnataka State, India 3Research Scholar, JSS Academy of Technical Education, JSS campus, Bengaluru. 4Assistant Professor, Department of Industrial Engineering and Management, Technological University, Belagavi, Karnataka State, India

Received Date: June 13, 2023

Accepted Date: June 25, 2023

Published Date: July 20, 2023

Citation: Nidhi Nischal, Swamy D.R., Veerappaji B.S., Vanishree Beloor. Industry-academia Collaboration: A Literature Review. NOLEGEIN Journal of Corporate & Business Laws. 2023; 6(1): 28-40p.

Today, IAC has become a global phenomenon, with companies and universities collaborating in various ways to solve complex problems and drive innovation. Governments continue to play a significant role in fostering collaboration between industry and academia [14]. For instance, China's network of National Key Laboratories facilitates university-industry partnerships, while other countries like Australia strive to optimize their public research investments and overcome challenges in forming partnerships between academia and industry [16].

In the current rapidly changing world, acquiring new competencies and skills is crucial for individuals to thrive. Collaboration between industry and academia is pivotal for technological advancements and improving business competitiveness [19]. The digital revolution has further transformed socio-economic aspects and altered the way individuals and businesses interact and collaborate. Engineering academic institutions face the challenge of selecting appropriate industry-institute collaborations to ensure graduate readiness and meet industrial needs [26].

Aligning academic curricula with industrial requirements is essential to reduce the gap between graduate skills and industry expectations [27]. Technology plays a critical role in IAC, as it facilitates economic growth, addresses societal challenges, and transforms industries by replacing outdated technologies [32]. Close collaboration between industry and academia is crucial in addressing the technological, economic, and societal challenges of the 21st century. Overall, the evolution of IAC worldwide reflects the growing recognition of the importance of collaboration between industry and academia in driving innovation and economic growth [34].

LITERATURE REVIEW

Academic engagement, characterized by inter-organizational collaboration between universities and other entities, particularly firms, often involves direct interactions between individuals. Informal collaborations between universities and consulting firms have been observed in the form of student traineeships, faculty interactions, and industry final projects undertaken as part of degree programs. In the knowledge-based economy, enhancing industrial competitiveness relies on accelerating technological innovation, establishing efficient knowledge transfer processes, accumulating knowledge, and safeguarding intellectual property rights.

Extensive literature exists on university-industry linkages, encompassing research conducted in various countries such as the US, UK, Germany, Japan, China, Russia, Brazil, and Malaysia. These studies have provided insights into the trends, implications, barriers, and causes of industry-academia collaboration (IAC). Notably, international institutes have conducted studies focused on strengthening university-industry linkages, including programs facilitated by governments to intensify industry-academia collaboration for human resource development. The terms were searched in several databases (Google Scholar, Publish or Perish, and Web of Science [WoS]). The search terms and their combinations used are as follows:

Search Terms

Industry-Academia, Industry-University Collaboration, Industry-Academia Collaboration, Industry Institute Interaction's framework, Industry-Academia Partnerships.

Search Strings

Used are as follows—"Industry" AND "University"; "Industry" AND "Academia."

Based on the relevance and objective of the review, 34 research articles were considered for the review process. The objective, methodology and results of all the 34 articles are presented in Table 1.

Figure 1 presents the total number of publications from 1995 to 2022. The number of papers has increased in the last decade, indicating that the investigated topic has become more relevant in recent years. The significant proportions of articles were published during 2005-2009 and in the recent years, inferring IAC's current and growing interest.

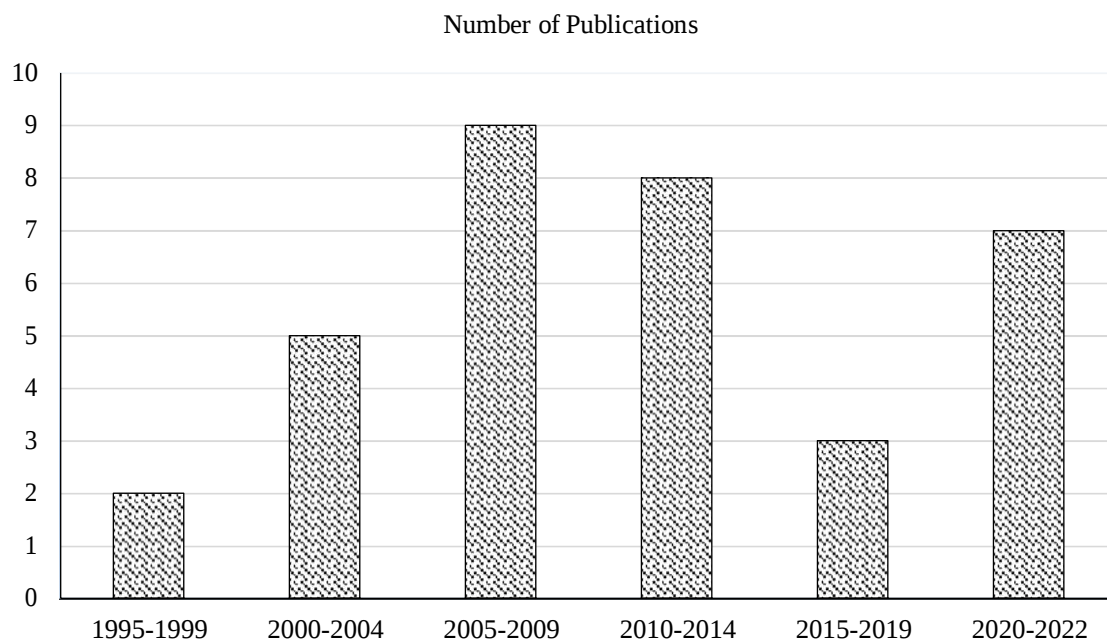


Figure 1. Number of Publications.

Table 1. Questionnaire.

S.N.	Author	Objective	Data	Method	Result
1	Lee, Y.-S et al., 1996	To explore the boundaries and limitations of university-industry collaboration in technology transfer.	Interview, Survey	Qualitative or Quantitative analysis	The paper presents findings regarding the boundaries and limitations identified in university-industry collaboration for technology transfer [22].
2	Blumenthal et al., 1996	To investigate the nature and extent of faculty-industry relationships at a particular university.	Survey	Descriptive statistics	The paper presents insights into the prevalence, nature, and benefits of faculty-industry collaborations at the surveyed university [9].
3	Lee et al., 2000	To empirically assess the sustainability of university-industry research collaborations.	Survey, Interview, Case study	statistical analysis and qualitative analysis	The paper provides insights into the factors that contribute to the long-term sustainability of university-industry research collaborations [23].
4	Santoro and Gopalakrishnan et al., 2000	To examine the relationship dynamics between university research centers and industrial firms and their impact on technology transfer activities.	Survey, questionnaire	Network analysis	The paper presents findings on the nature of relationships between university research centres and industrial firms and their implications for technology transfer [31].
5	Barnes et al., 2002.	To evaluate the effectiveness of collaborative R&D projects in university-industry interaction.	Multi-case study analysis	Qualitative analysis	The paper presents insights into the key elements and practices that enhance the effectiveness of collaborative R&D projects between universities and industry [5].
6	Santoro and Chakrabarti et al., 2002.	To investigate the role of firm size and technology centrality in industry-university interactions.	Survey	Statistical analysis	The paper provides insights into how firm size and technology centrality influence interactions and collaborations between industry and universities [30].
7	Lovrek et al., 2003	To explore the role of information technology in	literature review, case	Qualitative analysis	The paper provides insights into how information technology can

		facilitating knowledge transfer between universities and industry.	studies, or surveys		be utilized to enhance knowledge transfer between universities and industry [40].
8	Rohrbeck and Arnold et al., 2006	To examine a case study of university-industry collaboration in the Deutsche Telekom Laboratories and compare it with existing literature on the topic.	Interview	Qualitative analysis	The paper provides insights into the factors, challenges, and success factors of university-industry collaboration based on the case study and its comparison with existing literature [29].
9	Azagra - Caro et al., 2006	To examine science and technology policies related to university-industry linkages in Latin America, specifically focusing on Argentina and Mexico.	Questionnaires	Comparative analysis	The paper provides insights into the policy frameworks and initiatives implemented in Argentina and Mexico to promote university-industry linkages. It also discusses the effectiveness of these policies and offer recommendations for enhancing collaboration between universities and industries in Latin America [41].
10	Dooley, L., & Kirk, D et al., 2007	This paper aims to explore and analyse the dynamics of university-industry collaboration, particularly focusing on how the entrepreneurial paradigm can be integrated into academic structures.	Case study	Qualitative analysis	The paper says that Ancillary services act as a significant factor to strengthen the relationship between firms and academia [15].
11	Azagra - Caro, et al., 2007	This paper aims to examine the factors influencing the interaction between different types of faculty members and firms in the context of university-industry collaboration, with a particular focus on understanding the reasons for the delocalization of these interactions.	Survey	Regression	The paper provides insights into the factors influencing the types of faculty members who engage in university-industry interactions and the types of firms they collaborate with [42].
12	Bozeman and Gaughan, et al., 2007	This paper aims to examine how grants and contracts received by academic researchers impact their interactions with industry, particularly in terms of collaboration and knowledge transfer.	Survey	Quantitative analysis	The paper provides insights into the impacts of grants and contracts on academic researchers' interactions with industry [10].
13	Arvanitis et al., 2008	The objective of this paper is to explore the perspectives of university scientists in Switzerland regarding cooperation with private enterprises and to gain insights into their perceptions of knowledge and technology transfer activities between academia and industry.	Survey	Regression	The paper presents the findings of the survey and provides insights into the attitudes and perceptions of university scientists in Switzerland towards cooperation with private enterprises [3].
14	Bekkers and Freitas et al., 2008	This paper aims to analyse the knowledge transfer channels between universities and industry and explore the extent to	Questionnaires	Statistical analysis	The paper presents findings on the nature and effectiveness of knowledge transfer channels between universities and industry, taking into account the

		which different industry sectors influence the nature and effectiveness of these channels.			influence of different industry sectors [6].
15	Bjerregaard, et al., 2009	This paper aims to provide a micro-level perspective on universities-industry collaboration strategies, focusing on understanding the factors that shape collaboration at the individual researcher or research group level.	Interviews	Qualitative analysis	The paper presents insights into the micro-level dynamics of universities-industry collaboration strategies. It discusses the motivations, barriers, and strategies employed by individual researchers or research groups to initiate and sustain collaboration with industry [8].
16	Ponds et al., 2009	This paper aims to investigate the relationship between innovation, spillovers, and university-industry collaboration using an extended knowledge production function approach. It seeks to understand the mechanisms through which university-industry collaboration contributes to innovation and knowledge spillovers.	Patents	Econometric techniques and statistical analysis	The paper presents findings on the effects of university-industry collaboration on innovation and knowledge spill overs. It discusses the mechanisms through which collaboration contributes to innovation, such as knowledge transfer, research mobility, and joint research projects [28].
17	Bruneel et al., 2010	This paper aims to investigate the factors that reduce the barriers to university-industry collaboration, focusing on understanding the mechanisms that facilitate effective knowledge exchange and collaboration between academia and industry.	Survey	Regression and Thematic	The paper provides insights into the factors that mitigate barriers to university-industry collaboration. It discusses strategies, mechanisms, and policies that can help foster effective collaboration and knowledge exchange between academia and industry [11].
18	Abramo et al., 2011	This paper aims to explore the evaluation of research output, focusing on the transition from traditional informed peer review to the use of bibliometric indicators.	Research articles	Critical Analysis	The paper provides a comprehensive assessment of the strengths and weaknesses of informed peer review and bibliometrics in evaluating research [1].
19	D'este and Perkmann et al., 2010	This paper aims to explore the motivations of academics for engaging with industry and examines the role of the entrepreneurial university in fostering and shaping these motivations.	Surveys	Thematic analysis/ Ground analysis	The paper provides insights into the motivations of academics for engaging with industry and how the concept of the entrepreneurial university influences these motivations [11].
20	De and Dutrénit et al., 2012	This paper aims to identify and analyse the best channels or modes of interaction between academia and industry that lead to long-term benefits for both parties.	Surveys	Statistical analysis	The paper provides insights into the best channels or modes of academia-industry interaction that lead to long-term benefits [42].
21	Comacchio et al., 2012	This paper explores the role of Technology Transfer Centres (TTCs) in facilitating boundary	Surveys	Thematic analysis and descriptive statistics	The paper provides insights into the role and effectiveness of TTCs as intermediaries in facilitating boundary spanning

		spanning between industry and universities.			between industry and universities [13].
22	Freitas et al., 2013	The objective of this study is to examine the impact of university-industry collaboration on innovation in both emergent and mature industries in new industrialized countries.	Survey	Statistical Analysis	The paper provides insights into the impact of university-industry collaboration on innovation in emergent and mature industries in new industrialized countries [18].
23	Soh and Subramanian et al., 2014	This paper aims to investigate the conditions under which firms benefit from university-industry R&D collaborations.	Financial data, Publication data Patent data	Regression	The paper provides insights into the factors that influence the benefits firms derive from university-industry R&D collaborations [34].
24	Hemmert et al., 2014	The objective of this study is to examine the formation of trust in university-industry research collaborations in the United States, Japan, and South Korea.	Interview	Comparative Analysis	The paper provides insights into the cultural factors that influence trust formation in university-industry research collaborations [21].
25	Franco and Haase et al., 2015	The objective of this study is to investigate the motivations of researchers for engaging in university-industry cooperation and explore the different channels of interaction between academia and industry.	Survey, Interview	Regression	The paper provides insights into the diverse motivations of researchers for engaging in university-industry cooperation and shed light on the preferred channels of interaction [17].
26	Bstieler et al., 2017	The objective of this study is to examine the formation of mutual trust in university-industry research collaborations.	Survey questionnaire	Thematic analysis or content analysis	The paper provides insights into the dynamic nature of trust formation in university-industry research collaborations. The conclusions sheds light on the factors that contribute to the initial establishment of trust, as well as the mechanisms that sustain trust over time [12].
27	Mikkonen et al., 2018	The objective of this study is to explore the concept of continuous and collaborative technology transfer in the context of software engineering research	Case Study	Thematic analysis and pattern matching	The paper provides insights into the practices and dynamics of continuous and collaborative technology transfer in software engineering research. The conclusions highlights the benefits of ongoing collaboration between researchers and industry practitioners in achieving real-time impact on industry practices [25].
28	Marijan and Gotlieb et al., 2021	The objective of this paper is to present and examine the Certus model, which is a specific framework for industry-academia research collaboration in the field of software engineering.	Workshops, group discussion	Descriptive statistics or inferential tests	The paper provides an evaluation of the Certus model and its impact on industry-academia research collaboration in software engineering. The conclusion discusses the effectiveness of the model in promoting collaboration, knowledge exchange, and research outcomes [24].
29	Hegade et al., 2021	The objective of this paper is to explore the principles and best practices of elective design courses that	Survey and Interview	Comparative Analysis	The paper provides an overview of the principles and best practices of elective design courses with industry-institute

		incorporate industry-institute collaboration.			collaboration. They highlight the key findings from the data analysis and provide recommendations for designing and implementing effective elective courses that leverage industry expertise [20].
30	Benjamin et al., 2021	The objective of this paper is to examine the impact of university-industry collaboration on the development of innovative products, specifically within the healthcare industry.	Surveys	Mixed methods analysis	The paper presents the findings of the study, highlighting the impact of university-industry collaboration on the development of innovative products in the healthcare industry. They also address any challenges or limitations identified during the research process [39].
31	Castellacci et al., 2020	The objective of this paper is to investigate the relationship between automation, workers' skills, and job satisfaction	Survey and case studies	Qualitative analysis	The paper presents the findings of the study, providing insights into the relationships between automation, workers' skills, and job satisfaction [38].
32	Kwok, L et al., 2022	The paper aims to identify the underlying causes of the labor shortage and proposes a collaborative approach between the industry and academia to address this challenge effectively.	Mixed-methods approach	Thematic analysis	The paper emphasizes the importance of collaboration between the industry and academia to address this challenge effectively. It proposes various strategies such as developing industry-driven educational programs, promoting internships and apprenticeships, and fostering research partnerships [37].
33	Kleiner - Schaefer, T., & Schaefer, K. J. et al., 2022	The paper aims to provide firm-level evidence regarding the challenges faced by companies in establishing and maintaining effective collaborations with universities and to propose recommendations for improving such collaborations.	Survey	Descriptive statistics and inferential analysis	The paper highlights the need for policy interventions and organizational initiatives to address these barriers effectively. Recommendations may be provided, such as establishing intermediary organizations to facilitate collaboration, fostering a collaborative culture, enhancing intellectual property rights regulations, and promoting funding mechanisms that support collaborative research and development [36].
34	Osorno-Hinojosa, R, Koria, M, & Ramírez Vázquez, D. D. C. et al, 2022	The paper aims to shed light on how collaborative partnerships between universities and industries can foster open innovation practices and lead to the creation of value for all stakeholders involved.	Interview	Quantitative Analysis	The study highlights how collaborative partnerships between universities and industries facilitate the exchange of knowledge, resources, and expertise, leading to the generation of innovative ideas and the development of new products, services, or processes [35].

From the Table 1, we can conclude that most of the studies used surveys and questionnaires followed by collecting data from interviewing professionals from different industries and university faculties. The above-mentioned authors have studied the benefits, key success factors, and impediments for the success of IAC.

DISCUSSIONS

Trend of IAC across the Globe

The above papers can be grouped based on the similarity of research focus and themes, including faculty-industry relationships, collaboration sustainability, entrepreneurial paradigm, structural integration, motivations, policies, and trust formation in industry-academia collaboration.

Group 1: Understanding faculty-industry relationships and collaboration boundaries

- Lee (1996)
- Blumenthal, Gluck, and Louis (1996)

Group 2: Sustainability and effectiveness of industry-academia collaboration

- Lee (2000)
- Santoro and Gopalakrishnan (2000)
- Barnes, Pashby, and Gibbons (2002)
- Santoro and Chakrabarti (2002)
- Lovrek, Novak, and Skala (2003)
- Azagra-Caro, Consoli, and Navarro (2006)
- Azagra-Caro (2007)
- Bozeman and Gaughan (2007)

Group 3: Entrepreneurial paradigm and structural integration

- Rohrbeck and Arnold (2006)
- Dooley and Kirk (2007)

Group 4: Motivations, policies, and trust formation

- Abramo and D'Angelo (2011)
- D'Este and Perkmann (2011)
- De Fuentes and Dutrénit (2012)
- Comacchio, Bonesso, and Pizzi (2012)
- Freitas, Marques, and e Silva (2013)
- Soh and Subramanian (2014)
- Hemmert, Bstieler, and Okamuro (2014)
- Franco and Haase (2015)
- Berbegal-Mirabent, García, and Ribeiro-Soriano (2015)
- Scandura (2016)
- Bstieler, Hemmert, and Barczak (2017)

Barriers of IAC

Several common barriers to industry-academia collaboration (IAC) can be identified from the above research articles. These barriers include:

- *Boundaries of collaboration:* Lee (1996) highlights the challenges and limitations faced in establishing university-industry collaborations, including issues related to intellectual property rights, confidentiality, and cultural differences.
- *Elusive faculty-industry relationships:* Blumenthal, Gluck, and Louis (1996) emphasize the difficulties in establishing and maintaining connections between faculty members and industry partners. Barriers may include differences in research priorities, conflicting expectations, and limited time availability.
- *Sustainability of collaboration:* Lee (2000) uncovers potential barriers that hinder the long-term engagement and success of university-industry research collaboration. These barriers may include funding uncertainties, changing priorities, and limited institutional support.

- *Relationship dynamics*: Santoro and Gopalakrishnan (2000) explore potential obstacles to effective technology transfer between university research centers and industrial firms. Barriers may arise from differences in organizational cultures, communication gaps, and power imbalances.
- *Barriers in collaborative R&D projects*: Barnes, Pashby, and Gibbons (2002) identify barriers that can hinder effective industry-academia interaction in collaborative R&D projects. These barriers may include conflicting goals, limited resources, difficulties in intellectual property management, and challenges in aligning research timelines.
- *Firm size and technology centrality*: Santoro and Chakrabarti (2002) highlight potential challenges associated with firm size and technology centrality in industry-university collaborations. Barriers may arise from mismatched expectations, limited resources, and difficulties in integrating different organizational structures.
- *Integration of information technology*: Lovrek, Novak, and Skala (2003) discuss barriers in the integration of information technology into knowledge transfer strategies. These barriers may include lack of technical infrastructure, data privacy concerns, and resistance to change.
- *Science and technology policies*: Azagra-Caro, Consoli, and Navarro (2006) examine potential barriers arising from science and technology policies related to university-industry linkages. These barriers may include bureaucratic processes, limited funding opportunities, and regulatory complexities.
- *Grafting of the entrepreneurial paradigm*: Dooley and Kirk (2007) address barriers arising from integrating the entrepreneurial paradigm into academic structures. These barriers may include conflicting norms and values, risk aversion, and limited support for commercialization activities.
- *Delocalization of university-industry interaction*: Azagra-Caro (2007) sheds light on potential barriers to effective collaboration due to the delocalization of university-industry interaction. Barriers may include geographical distance, language barriers, and lack of institutional frameworks for international collaboration.
- *Impacts of grants and contracts*: Bozeman and Gaughan (2007) highlight potential barriers arising from funding mechanisms, such as grants and contracts, which may affect academic researchers' interactions with industry. These barriers may include compliance requirements, conflicts of interest, and limitations on intellectual freedom.
- *Barriers in providing R&D services*: Berbegal-Mirabent, García, and Ribeiro-Soriano (2015) discuss barriers that may arise in university-industry partnerships providing R&D services. These barriers may include pricing challenges, conflicting expectations, and difficulties in balancing research and client needs. These studies collectively contribute to understanding the barriers to industry-academia collaboration, providing insights into the challenges, limitations, and potential obstacles faced in establishing and maintaining successful partnerships between academia and industry.

Drivers of IAC

The drivers of industry-academia collaboration have been explored in various research articles, shedding light on the factors that motivate and promote these partnerships. These drivers include:

- *Technology transfer*: Lee (1996) emphasizes the importance of technology transfer in driving university-industry collaboration. The transfer of knowledge, expertise, and technology from academia to industry motivates and promotes these partnerships.
- *Faculty-industry relationships*: Blumenthal, Gluck, and Louis (1996) identify factors that encourage engagement between faculty members and industry partners. Positive relationships between academia and industry, such as trust and mutual understanding, serve as drivers for collaboration.
- *Sustainability of collaboration*: Lee (2000) focuses on the long-term engagement and successful outcomes of university-industry research collaboration. The sustainability of collaboration depends on various drivers, including shared goals, continuous funding, and effective communication.

- *Relationship dynamics*: Santoro and Gopalakrishnan (2000) explore the relationship dynamics between university research centers and industrial firms. Drivers that facilitate effective technology transfer activities include clear communication channels, joint problem-solving, and alignment of interests.
- *Collaborative R&D projects*: Barnes, Pashby, and Gibbons (2002) evaluate collaborative R&D projects and identify drivers that lead to effective industry-academia interaction. These drivers include open communication, shared resources, complementary expertise, and a supportive organizational culture.
- *Firm size and technology centrality*: Santoro and Chakrabarti (2002) discuss the impact of firm size and technology centrality on industry-university collaborations. Drivers that facilitate successful partnerships include a balance between firms' size and technological capabilities, as well as the willingness to collaborate and share resources.
- *Information technology and knowledge transfer*: Lovrek, Novak, and Skala (2003) highlight the role of information technology in knowledge transfer strategies. Drivers that promote effective integration of IT include infrastructure development, data sharing mechanisms, and the use of collaborative platforms.
- *Science and technology policies*: Azagra-Caro, Consoli, and Navarro (2006) examine science and technology policies related to university-industry linkages. They identify drivers such as supportive policies, funding mechanisms, and incentives that encourage collaboration between academia and industry.
- *Entrepreneurial paradigm and individual motivations*: Dooley and Kirk (2007) address the drivers behind academics' engagement in industry collaborations. They emphasize the entrepreneurial paradigm and individual motivations, including the desire for commercialization, professional development, and financial incentives.
- *Nature of collaboration*: Azagra-Caro (2007) investigates the factors influencing faculty members' interactions with different types of firms. Drivers that determine the nature of collaboration include factors such as academic reputation, industry reputation, research alignment, and intellectual property considerations.

Benefits of IAC

Industry-academia collaboration offers numerous benefits, as highlighted in the research articles mentioned above. Lee (1996) emphasizes the potential benefits of technology transfer through university-industry collaboration, including knowledge exchange, commercialization opportunities, and economic growth. Blumenthal, Gluck, and Louis (1996) discuss the benefits of faculty-industry relationships, such as enhanced research opportunities, access to resources, and industry relevance. Lee (2000) identifies the benefits of sustainability in university-industry research collaboration, including increased innovation, improved research quality, and enhanced competitiveness. Santoro and Gopalakrishnan (2000) explore the positive impacts of relationship dynamics between university research centers and industrial firms, such as improved technology transfer activities and enhanced collaborative outcomes. Barnes, Pashby, and Gibbons (2002) evaluate collaborative R&D projects and highlight the benefits, including shared knowledge, joint problem-solving, and mutual learning. Santoro and Chakrabarti (2002) discuss the benefits of industry-university interactions, such as access to knowledge resources, technology development, and increased competitiveness. Lovrek, Novak, and Skala (2003) examine the benefits of integrating information technology into knowledge transfer strategies, including efficient communication, enhanced collaboration, and accelerated innovation. Azagra-Caro, Consoli, and Navarro (2006) explore the benefits of science and technology policies in promoting university-industry linkages, such as knowledge spillovers, technology transfer, and industry growth. Dooley and Kirk (2007) address the benefits of academic engagement in industry collaborations, including practical application of research, professional development, and societal impact. Azagra-Caro (2007) investigates the benefits of faculty members interacting with different types of firms, such as enhanced research opportunities, increased funding, and career advancement. These studies collectively emphasize the diverse range of benefits associated with industry-academia

collaboration, including knowledge transfer, innovation, research quality, commercialization, access to resources, and economic growth.

Sustainability of IAC:

The sustainability of industry-academia collaboration is a key focus in the research articles mentioned above. Lee (1996) examines the boundaries of university-industry collaboration and highlights the need for sustainable partnerships that go beyond short-term interactions. Lee (2000) specifically assesses the sustainability of university-industry research collaboration, emphasizing the importance of long-term engagement and successful outcomes. The study by Barnes, Pashby, and Gibbons (2002) evaluates the effectiveness of collaborative R&D projects, shedding light on factors that contribute to sustainable industry-academia interaction. Azagra-Caro (2007) explores the reasons for the delocalization of university-industry interaction and discusses the implications for sustainability. Berbegal-Mirabent, García, and Ribeiro-Soriano (2015) investigate university-industry partnerships for the provision of R&D services, highlighting the sustainability of such collaborations in delivering valuable outcomes. Hemmert, Bstieler, and Okamuro (2014) examine the formation of mutual trust in university-industry research collaborations and its impact on sustainability. Freitas, Marques, and e Silva (2013) explore university-industry collaboration and innovation in emergent and mature industries, examining the sustainability of these partnerships across different contexts. These studies collectively contribute to the understanding of sustainability in industry-academia collaboration, emphasizing the need for long-term engagement, effective project management, mutual trust, and favorable policies to foster sustainable partnerships.

CONCLUSION

In conclusion, the research articles discussed above provide valuable insights into various aspects of industry-academia collaboration. These studies shed light on the trends, barriers, drivers, benefits, and sustainability of such partnerships across the globe. The trend in industry-academia collaboration is evident through extensive research, with scholars exploring the dynamics, limitations, and defining factors of these collaborations. The barriers to collaboration highlight the challenges faced in establishing and maintaining successful partnerships between academia and industry. On the other hand, the drivers of collaboration reveal the motivations and factors that promote engagement between the two sectors. The benefits of industry-academia collaboration encompass knowledge transfer, innovation, enhanced research quality, commercialization opportunities, and economic growth. Lastly, the sustainability of these collaborations is a key focus, emphasizing the importance of long-term engagement, effective project management, mutual trust, and supportive policies. Overall, these studies collectively contribute to our understanding of industry-academia collaboration, offering insights that can inform and shape future partnerships, policies, and practices in this domain.

REFERENCES

1. Abramo G, D'Angelo CA. Evaluating research: from informed peer review to bibliometrics. *Scientometrics*. 2011 Jun 1;87(3):499-514.
2. Arundel A, Geuna A. Proximity and the use of public science by innovative European firms. *Economics of Innovation and new Technology*. 2004 Sep 1;13(6):559-80.
3. Arvanitis S, Kubli U, Woerter M. University-industry knowledge and technology transfer in Switzerland: What university scientists think about co-operation with private enterprises. *Research Policy*. 2008 Dec 1;37(10):1865-83.
4. What type of faculty member interacts with what type of firm? Some reasons for the delocalisation of university-industry interaction [Internet]. Google.com. 2023 [cited 2023 Jul 11]
5. Barnes T, Pashby I, Gibbons A. Effective university-industry interaction: A multi-case evaluation of collaborative r&d projects. *European Management Journal*. 2002 Jun 1;20(3):272-85.
6. Bekkers R, Freitas IM. Analysing knowledge transfer channels between universities and industry: To what degree do sectors also matter?. *Research policy*. 2008 Dec 1;37(10):1837-53.

7. Berbegal-Mirabent, J., García, J. L. S., & Ribeiro-Soriano, D. E. (2015). University–industry partnerships for the provision of R&D services. *Journal of Business Research*, 68(7), 1407-1413.
8. Bjerregaard, T. (2009). Universities-industry collaboration strategies: a micro-level perspective. *European Journal of Innovation Management*, 12(2), 161-176.
9. Blumenthal, D., Gluck, M., & Louis, K. S. (1996). Stalking the elusive "faculty member with industry": A survey of faculty industry relationships at one university. *Journal of Technology Transfer*, 21(3-4), 277-286.
10. Bozeman, B., & Gaughan, M. (2007). Impacts of grants and contracts on academic researchers' interactions with industry. *Research policy*, 36(5), 694-707.
11. Bruneel J, d'Este P, Salter A. Investigating the factors that diminish the barriers to university–industry collaboration. *Research policy*. 2010 Sep 1;39(7):858-68.
12. Bstieler, L., Hemmert, M., & Barczak, G. (2017). The changing bases of mutual trust formation in inter-organizational relationships: A dyadic study of university-industry research collaborations. *Journal of business research*, 74, 47-54.
13. Comacchio, A., Bonesso, S., & Pizzi, C. (2012). Boundary spanning between industry and university: the role of Technology Transfer Centres. *The Journal of Technology Transfer*, 37, 943-966.
14. De Fuentes, C., & Dutrénit, G. (2012). Best channels of academia–industry interaction for long-term benefit. *Research Policy*, 41(9), 1666-1682.
15. Dooley, L., & Kirk, D. (2007). University-industry collaboration: Grafting the entrepreneurial paradigm onto academic structures. *European Journal of Innovation Management*, 10(3), 316-332.
16. Etzkowitz H, Webster A, Gebhardt C, Terra BR. The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. *Research policy*. 2000 Feb 1;29(2):313-30.
17. Franco, M., & Haase, H. (2015). University–industry cooperation: Researchers' motivations and interaction channels. *Journal of Engineering and technology Management*, 36, 41-51.
18. Freitas, I. M. B., Marques, R. A., & e Silva, E. M. D. P. (2013). University–industry collaboration and innovation in emergent and mature industries in new industrialized countries. *Research Policy*, 42(2), 443-453.
19. Gibbons P. *Scaffolding language, scaffolding learning*. Portsmouth, NH: Heinemann; 2002.
20. Hegade, P., Patil, N., & Bidari, I. (2021). Principles of Elective Design with Industry-Institute Collaboration. *Journal of Engineering Education Transformations*, 34, 384-390.
21. Hemmert M, Bstieler L, Okamuro H. Bridging the cultural divide: Trust formation in university–industry research collaborations in the US, Japan, and South Korea. *Technovation*. 2014 Oct 1;34(10):605-16.
22. Lee, Y.-S. (1996). Technology transfer and the research university: A search for the boundaries of university-industry collaboration. *Research Policy*, 25(6), 843-863.
23. Lee, Y.-S. (2000). The sustainability of university-industry research collaboration: An empirical assessment. *Journal of Technology Transfer*, 25(2), 111-133.
24. Marijan, D., & Gotlieb, A. (2021). Industry-Academia research collaboration in software engineering: The Certus model. *Information and software technology*, 132, 106473.
25. Mikkonen, T., Lassenius, C., Männistö, T., Oivo, M., & Järvinen, J. (2018). Continuous and collaborative technology transfer: Software engineering research with real-time industry impact. *Information and Software Technology*, 95, 34-45.
26. Mustar, P., & Wright, M. (2010). Convergence or path dependency in policies to foster the creation of university spin-off firms? A comparison of France and the United Kingdom. *Research Policy*, 39(6), 783-792.
27. Owen-Smith, J., Riccaboni, M., Pammolli, F., Powell, W. W., & Petersen, A. M. (2002). A comparison of U.S. and European university-industry relations in the life sciences. *Management Science*, 48(1), 24-43.
28. Ponds, R., Oort, F. V., & Frenken, K. (2009). Innovation, spillovers and university–industry collaboration: an extended knowledge production function approach. *Journal of Economic Geography*, 10(2), 231-255.

29. Rohrbeck, R., & Arnold, H. (2006). Making university-industry collaboration work: A case study on the Deutsche Telekom Laboratories contrasted with findings in literature. *International Journal of Innovation Management*, 10(03), 245-274.
30. Santoro, M. D., & Chakrabarti, A. K. (2002). Firm size and technology centrality in industry-university interactions. *Research Policy*, 31(7), 1163-1180.
31. Santoro, M. D., & Gopalakrishnan, S. (2000). Relationship dynamics between university research centers and industrial firms: Their impact on technology transfer activities. *Journal of Engineering and Technology Management*, 17(3-4), 371-398.
32. Scandura, A. (2016). University-industry collaboration and firms' R&D effort. *Research Policy*, 45(9), 1907-1922.
33. Schwabe, H., & Castellacci, F. (2020). Automation, workers' skills and job satisfaction. *Plos one*, 15(11), e0242929.
34. Soh, P. H., & Subramanian, A. M. (2014). When do firms benefit from university-industry R&D collaborations? The implications of firm R&D focus on scientific research and technological recombination. *Journal of Business Venturing*, 29(6), 807-821.
35. Osorno-Hinojosa R, Korla M, Ramírez-Vázquez DD. Open innovation with value co-creation from university-industry collaboration. *Journal of Open Innovation: Technology, Market, and Complexity*. 2022 Jan 27;8(1):32.
36. Kleiner TM. Denn wir wissen nicht, was sie tun: eine Analyse der Tätigkeiten freiwillig Engagierter in Deutschland auf Basis des Freiwilligensurveys 2014. Thünen Working Paper; 2022.
37. Kwok L. Labor shortage: a critical reflection and a call for industry-academia collaboration. *International Journal of Contemporary Hospitality Management*. 2022 Oct 21;34(11):3929-43.
38. Castellacci F, Consoli D, Santoalha A. The role of e-skills in technological diversification in European regions. *Regional Studies*. 2020 Aug 2;54(8):1123-35.
39. Groot SU. Understanding the extent and nature of academia-industry interactions in Rwanda. *Technological Forecasting and Social Change* [Internet]. 2021 [cited 2023 Jul 13];170(C). Available from: <https://ideas.repec.org/a/eee/tefoso/v170y2021ics0040162521003450.html>
40. Lovrek I, Kos M, Mikac B. Collaboration between academia and industry: Telecommunications and informatics at the University of Zagreb. *Computer communications*. 2003 Mar 20;26(5):451-9.
41. Azagra-Caro JM, Carayol N, Llerena P. Patent production at a European research university: exploratory evidence at the laboratory level. *The Journal of Technology Transfer*. 2006 Mar;31:257-68.
42. Azagra-Caro JM. What type of faculty member interacts with what type of firm? Some reasons for the delocalisation of university-industry interaction. *Technovation*. 2007 Nov 1;27(11):704-15.