

University-Industry Collaboration: Exploring Partnership Approach Models in EELISA Universities

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Abstract. *This study delves into the dynamic landscape of university-industry collaboration, with a particular focus on the long-term impact of the Senior Learning Facilitator (SLF) role within the innovative framework of EELISA (European Engineering Learning Innovation and Science Alliance) universities. Our research objectives revolve around evaluating the influence of the SLF, extracting best practices emerging from their involvement, and conducting a comparative analysis.*

Employing a robust methodology that encompasses detailed case studies, this study uncovers valuable insights specific to the EELISA alliance. As our aim is to unravel how such ecosystems can consolidate and evolve, and how value is co-created within them, the paper's conclusions carry significance for institutions, industry, and policymakers.

This research, therefore, offers a blueprint for more sustainable and productive collaboration, underscoring the pivotal role of university- industry partnerships within EELISA universities in driving innovation, cultivating talent, fueling economic growth, and co-creating Industry 4.0 solutions.

Keywords: EELISA universities, Senior Learning Facilitator (SLF), university-industry collaboration.

Introduction

This research study is dedicated to examining the substantial impact of the Senior Learning Facilitator (SLF) role within the domain of university-industry collaboration and aims to reveal best practices that can be employed to enhance and sustain this aspect. In today's rapidly evolving landscape of higher education and research, universities are undergoing a profound transformation. They are shifting from their conventional roles as centers of academic excellence to dynamic hubs for research and innovation, industry engagement, and societal impact. Also, the SLF role is shifting from the traditional professional profile, integrating various collateral roles and attributes that serve the larger development strategy of the institution.

At the core of this transformation is the exploration of "partnership approach models." These models represent a continuum of collaboration that has its roots in the industrial revolution and has since adapted to meet the requirements of modern society. In this era of constant change

and digital transformation, cultivating a resilient and enduring partnership between academia and industry is not merely advantageous but a vital necessity. All these transformations led to the need of developing robust strategic development plans to harness the benefits of adapting to the dynamic ecosystem they are part of.

In this paper, our objective is to unveil the intricate world of research and development models within the framework of EELISA universities. EELISA is a European Alliance of technical universities focused on promoting innovation, partnership, and knowledge exchange in the fields of engineering and sciences (EELISA, 2023). These models delineate the dynamic relationship between academia and industry, each characterized by distinct objectives, strategies, needs, and methodologies. Our aim is to identify commonalities and differences between the different entities that take on the role of SLF as builders and facilitators of cooperation, innovation, knowledge transfer and co-creation and display initiatives that can play a pivotal role in shaping the collaborative future of higher education.

Literature review

European Universities Initiative and the EELISA Alliance

One important policy support-action of the European Council and implemented by the European Higher Education Area (EHEA) was the European Universities Initiative (European Universities Initiative | European Education Area, n.d.). The European University alliances represent a cornerstone of the European university strategy funded mainly through ERASMUS+ grants and aimed at establishing alliances between higher education institutions across Europe to advance the international competitiveness and promote European values. This initiative aims to achieve the goal of scaling up to include 60 European University alliances, encompassing over 500 higher education institutions by mid-2024.

EELISA: A European Engineering Learning Innovation and Science Alliance

European Engineering Learning Innovation and Science Alliance (EELISA) is the first alliance of world renown Higher Education Institutions (HEI) (graduate engineering schools, technology universities, and full-spectrum universities) from different countries in Europe meant to define and implement a common model of European engineer rooted in society with the motto "Unity in Diversity." Partner HEIs are: Budapesti Műszaki és Gazdaságtudományi Egyetem, École des Ponts ParisTech, Friedrich-Alexander-Universität Erlangen-Nürnberg, İstanbul Teknik Üniversitesi, Scuola Normale Superiore, Scuola Superiore Sant'Anna, Universitatea Națională de Știință și Tehnologie Politehnica București, Université Paris Sciences et Lettres, Universidad Politécnica de Madrid and Zürcher Hochschule für Angewandte Wissenschaften (EELISA, 2023).

EELISA's Mission for Transforming Higher Education

Ultimately, EELISA's mission is to transform the entire European Higher Education Area (EHEA) to address societal challenges and raise students' awareness of their civic role by democratizing engineering education, promoting interdisciplinary learning, encouraging knowledge and technology transfer, and fostering inclusivity.

EELISA INNOvation and COMmon REsearch Strategy (InnoCORE)

EELISA is structured around communities that share a common interest and offer or participate in learning, research, innovation, and third mission activities. EELISA INNOvation and COMmon REsearch Strategy is the research and innovation department of EELISA. InnoCORE is intended

to delve deeper into the institutional transformation initiated by the Alliance, by focusing on its R+I dimension. EELISA InnoCORE is also working on cross-cutting issues of research: defining a common open science strategy and analyzing the cost-benefits and barriers hampering cooperation (EELISA InnoCORE - R&I, n.d.).

Industry 4.0: A Transformative Force

The term "Industry 4.0," often referred to as the Fourth Industrial Revolution, signifies a profound transformation in the realms of manufacturing and technology. This concept has garnered considerable attention in both academic and industrial circles. Researchers have emphasized the potential advantages of Industry 4.0, including heightened efficiency, cost reduction, and improved product quality (Directorate-General for Education et al., 2018).

Collaboration Between Industry and Higher Education

Industry and businesses are beginning to recognize the advantages of collaborating with higher education institutions to tap into forward-looking innovation and talent development, which can confer a competitive edge. Scholars have delved into the economic implications of Industry 4.0, emphasizing its potential to stimulate economic growth, engender new business models, and reshape the competitive landscape (Awasthy et al., 2020). This transformation can have far-reaching consequences across diverse industries. University-industry partnership is deemed the driving force behind knowledge-based societies and economies.

Crafting a collaboration strategy with higher education institutions stands as the most prevalent mechanism among European businesses, with 37% of them engaging in this practice. Senior management employed in university-business collaboration is a close second, with 36% participation (Directorate-General for Education et al., 2018).

Exploring Best Practices in Industry Collaboration

As the EELISA Alliance has such a strong component dedicated to research and innovation, our paper focuses on the best practices that derive from the case study of the partner members in terms of industry partnerships and tools implemented in supporting this activity. It is a strategic approach to maximize the collective potential and knowledge base of the alliance. It allows for continuous improvement, resource efficiency, and the development of innovative strategies that can benefit not only the alliance but also the broader ecosystem of industry-academia collaboration.

Each member institution likely has unique experiences and approaches in collaborating with industry. By studying their best practices, not only outside institutions but also the alliance partners can tap into a wealth of collective knowledge, gaining insights that may not be readily available within their institution. Novel strategies can inspire the alliance to think outside the box and explore new avenues for engagement with the industry and the world of business.

Best practices often come with insights on adaptability and scalability. Learning from partner institutions can help the alliance understand how certain practices can be tailored to specific contexts and expanded to benefit a broader range of industries and regions. When partner members have success stories to share, it can support the alliance's advocacy for policies that promote and support industry-academia collaboration at regional, national, and international levels.

The Concept the Senior Learning Facilitator (SLF)

The concept of the Senior Learning Facilitator (SLF) and the issues that this professional role could help address, by amalgamating identified skills and competencies, aims to enhance cooperation

between educational systems, vocational education and training, the business world, the industry, and broader productive and economic systems (SEAL_report_def.Pdf, n.d.). Cooperation is about fostering connections between groups, building networks, and expanding relationships.

According to the same report, (SEAL_report_def.Pdf, n.d.) the SLF should act as:

- a “knowledge hub” among different stakeholders and be able to generate a system view and systemic benefits.
- a learning innovator, a knowledge steward and community builder, i.e. an organizational innovator.
- a player in the academia-industry relationship.
- a requalification path addressed to professional profiles operating in the HR area, a kind of *evolution of the HR professional*.

Thus, the SLF role could be played by several actors engaged in different departments inside a Higher Education Institutions (HEIs), having among their goals the achievement of strong partnerships with the industry, knowledge transfer, and community building. It is crucial for universities to establish specialized departments or individuals as SLFs to implement, guide, and cultivate university- industry cooperation. This action should be an integral part of the strategic management planning of all HEIs. A strategic plan is vital to enable universities to allocate resources efficiently, focusing on partnerships and collaborations that align with their mission and expertise, for the optimizing of funds, faculty, and facilities use.

Role of Senior Learning Facilitators (SLFs) in University-Industry Collaboration

Drawing from existing literature, it's evident that the dynamic landscape of university- industry collaboration highlights the crucial function of SLFs. As intermediaries bridging academia and industry, these professionals offer rich insights for enhancing partnership.

The literature underscores the significance of nurturing resilient, long-lasting partnerships between academia and industry, often associating it with Industry 4.0's transformative potential (Santoro & Bierly, 2006). Industry representatives increasingly realize the benefits of partnering with higher education institutions to harness innovation and talent development.

Previous research has accentuated the pivotal role of SLFs in facilitating knowledge exchange and collaboration within the university- industry nexus.

However, despite the growing recognition of SLFs in enhancing university-industry collaboration, the current body of research offers valuable insights into the broader context of collaboration and the importance of resilient partnerships between academia and industry. Nevertheless, there is a clear gap in understanding how SLFs operate within this landscape, which strategies prove most effective, and how these facilitators contribute to long-lasting partnerships.

This study aims to address these significant gaps by conducting an in-depth exploration of the approaches employed by the EELISA Alliance in nurturing and exploiting the benefits of collaborating with the industry. Our research sheds light on the ways that EELISA SLFs robust strategies can help the higher education sector in strengthening their position as a transformative force for the evolution and well-being of the knowledge-based society.

To achieve these research objectives, we define the following research questions: What are the best practices arising from SLFs' involvement under the general umbrella of the concept of university-industry collaboration in EELISA Alliance? What is the current status of SLFs in the EELISA Alliance?

Research Methodology

Research design

In our research design we employed a mixed-method approach, utilizing participant observation during EELISA events and work package meetings, as well as document analysis of internal and external materials to comprehensively examine existing models and SLFs within the case studies. To explore the different university-industry cooperation models present in EELISA, this study employed a qualitative investigation utilizing multiple case studies. Specifically, we analyze the existing collaborative partnership approach models and dedicated SLFs roles in the universities forming the EELISA Alliance.

This approach enabled us to gather detailed, rich data allowing for a comprehensive understanding of nuanced dynamics and aspects of the university-industry collaboration in EELISA Alliance.

Case selection

EELISA is an innovative academic model that aims to transform the European higher education system while strengthening the links between engineering and society, bringing together academic and industrial actors to solve real world problems, and producing a large body of research and innovation that fuel economic growth in their regions.

All ten universities included in the study are leading research and innovation hubs, thus the need to implement the SLF role within their structure to help build strong links with the industry, to host specialized departments dedicated to inter-institutional collaboration, and develop resources and collaborative frameworks for promoting innovation in technical and scientific education.

Data collection

Several techniques of data collection were used to identify the different approaches, such as: participant observation (during EELISA events and work package meeting between September 2021 and November 2023), and study of internal and external documents (meeting minutes, internal memos, white papers, research strategies, university charters and public information).

Table 1. Data sources

Data Type	Quantity	Data Source
Participant observation	7 events	Kick-off meeting of EELISA InnoCore (EELISA INNOvation and COMmon REsearch Strategy) Sept 30 th , 2021, “EELISA Research-Based Learning Symposium” May 17 th 2022, EELISA UNFOLDS, the Innovation and Entrepreneurship dimension of EELISA July 5 th 2022, “EELISA celebration event” September 1 st 2022, EELISA External Stakeholder Meeting, May 16 th 2023, 1st EELISA International Conference: Uniting 400 Participants and 100+ Global Speakers, October 4 th , 2023, EELISA days, November 1 st 2023
Internal documents	368 pages	EELISA INNOvation and COMmon REsearch Strategy, Summary Symposia with Representatives of R&I Structures, meeting minutes, white papers, memos
External documents and sources	11 webpages, 176 pages	The EELISA website (interviews, articles), universities’ websites, universities’ research strategies

Source: Authors’ elaboration.

The research employed descriptive analysis to summarize and present the characteristics of the data collected from each case, aiming to gain an in-depth understanding of individual cases and their unique attributes. Through cross-case comparison, similarities, differences, and key patterns

were identified, enabling the generalization of findings and the formulation of broader conclusions about the researched phenomenon.

Research Results

The research results section delves into the outcomes derived from the in-depth case studies conducted within the scope of this study. These case studies offer valuable insights into various university-industry partnership models and the pivotal role played by SLFs within the EELISA Alliance. Through meticulous analysis and examination, the following section elucidates the findings gleaned from the exploration of collaborative dynamics, shedding light on the nuances of university-industry collaboration and the impact of SLFs on fostering such collaborations.

Table 2. SLF entities in EELISA universities

UNIVERSITY I: BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS (BME) https://www.bme.hu/kutatas-fejlesztes-es-innovacio-a-bme-n	
Coordinating Inter-Institutional Collaboration	BME utilizes the Center for Innovation Management and Cooperation (FIEK) to facilitate efficient collaboration and innovation among researchers and lecturers. FIEK aims to establish laboratories that cater to industry needs, ensuring the swift transfer of research and development results to the industrial sector. This fosters long-term cooperation between industry and universities. FIEK also oversees the Industry 4.0 Technology Center and the R&D Office (Research, Development, Innovation), providing technology and knowledge transfer services at the university level.
Connecting with Industry	To strengthen relationships between academia and industry, BME, in 2017, formed a consortium with Siemens, Richter Gedeon, Nokia Solutions and Networks, and MVM (Hungarian Electrical). The Center for University-Industry Cooperation supervises, coordinates, and strengthens the university's innovation-related activities, including research and development, knowledge transfer, intellectual property management, business incubation, partner network development, and international relations.
Developing Resources and Collaborative Framework	To promote the innovation ecosystem, BME establishes competence centers, enhances research infrastructure, and creates a competence center. The R&D Office (Research, Development, Innovation) of BME plays a crucial role in this initiative by ensuring the efficient operation of the university's result-oriented innovation ecosystem. Additionally, it fosters an entrepreneurial mindset among educators, researchers, and students.
Promoting Innovation in Technical and Scientific Education	BME's Industry 4.0 Technology Center (TK) serves as a gateway for small and medium-sized enterprises (SMEs), offering demonstration and development services, professionally established industry knowledge related to Industry 4.0, and guidance on digitalization capabilities. TK facilitates decision-making in development and creates an up-to-date map of industrial challenges. It generates projects involving the entire community, addressing the project needs of SMEs, including industrial companies, SMEs, university labs, research groups, and students, and implementing these opportunities. This encourages knowledge sharing and contributes to the entire community's development.
UNIVERSITY II: ÉCOLE DES PONTS PARISTECH https://ecoledesponts.fr/en	
Coordinating Inter-Institutional Collaboration	The Research Directorate's Central Department at École des Ponts ParisTech supports research activities in various ways. It offers expertise in preparing and managing contracts, cost accounting for individual projects, scientist recruitment, and the safeguarding and promotion of research outcomes. The School nurtures research partnerships through 14 industrial chairs. These long-term partnerships with companies aim to create both scientific and educational value for the School and foster innovative competitiveness for these businesses.

Connecting with Industry	École des Ponts ParisTech has been actively developing long-term partnerships with companies for over a decade, primarily through industrial chairs. These chairs, organized around themes of strategic importance to the School, aim to generate scientific and educational value for the institution and promote competitive innovation for the companies involved. Currently, there are 14 active chairs, with 9 exclusively partnered with the School, and these chairs represent a diverse range of enterprises.
Developing Resources and Collaborative Framework	ParisTech has devised a research strategy in alignment with the School's 2025 strategic plan. This strategy, a collaborative effort involving laboratories and coordinated by the Research Directorate, centers on interdisciplinary research to address four socio-economic challenges: City and Mobility Systems, Management of Risks, Resources, and Milieus, Industry of the Future, Economy, Practices, and Society. The action plan linked to these priorities involves strengthening scientific policy, fostering innovation, developing partnership-based research, and attracting research talent to support these goals.
Promoting Innovation in Technical and Scientific Education	The Scientific Council (CS) guides the School in its scientific and innovation policy. It focuses on research activities in relation to national and European priorities, sustainable growth models, and methodologies for innovation and competitiveness. The CS enhances closeness to researchers by working directly with them in themed seminars, fostering synergy between the CS, the Research Directorate, and laboratory researchers. This collaboration stimulates research, vision-sharing, and the development of prospects for the School.
UNIVERSITY III: FRIEDRICH-ALEXANDER-UNIVERSITÄT ERLANGEN-NÜRNBERG (FAU) https://www.fau.de/	
Coordinating Inter-Institutional Collaboration	FAU has a robust network that transcends institutional and geographical boundaries, benefiting students and researchers alike. They collaborate with prestigious international companies, including Siemens, Schaeffler, and adidas. Partnerships extend to other universities, federal authorities, and museums, along with external research institutions like the Max Planck Institute for the Science of Light, Helmholtz Institute for Renewable Energies Erlangen-Nürnberg, Fraunhofer IIS, and IISB. These collaborations foster innovation, rapidly translating concepts into practical solutions.
Connecting with Industry	FAU actively participates in various EU research projects with international partners from academia, industry, and society. Most funding for these EU collaborative projects comes from Horizon 2020 and Horizon Europe. These projects leverage partner expertise, skills, and infrastructure. Examples include I-BAT, NeutroCure, Quromorphic, Precode, and ATOPLLOT.
Developing Resources and Collaborative Framework	FAU's objective is to generate and share knowledge openly, responsibly, and for the benefit of society. The FAU Development Plan, known as "Moving Knowledge," solidifies this commitment. In EDUCATION, the focus is on teaching and learning innovation, exemplified by #FAUdigital. In RESEARCH, FAU seeks to identify compelling research areas, attract exceptional researchers, and shape science and innovation policy through #FAUconnect. For OUTREACH, FAU emphasizes opportunities for patenting, licensing, and innovation, exemplified by #FAUinnovate.
Promoting Innovation in Technical and Scientific Education	FAU values an international perspective and collaborative knowledge sharing. Collaboration is nurtured both within the University and with researchers at national and international institutions. Collaborative research is a mutual and beneficial process. FAU supports this approach through initiatives such as identifying joint research topics, start-up funding, and access to central institutes. In U-Multirank's university ranking, FAU receives an excellent rating in research, knowledge transfer, and international focus.

UNIVERSITY IV: ISTANBUL TECHNICAL UNIVERSITY (ITU) https://www.itu.edu.tr	
Coordinating Inter-Institutional Collaboration	Istanbul Technical University (ITU) is committed to contributing to humanity on a global scale. Its internationalization policy aims to: Emphasize international collaborations and develop strategies to promote and support these collaborations; Enhance the international experiences of its students and academics, including attracting qualified international students and academics; Elevate the international academic competitiveness of ITU and increase its global visibility. ITU is a member of more than 15 international higher education and research associations. With over 500 laboratories and 35 research centers, ITU plays a pivotal role in driving innovation in Turkey. It actively engages with industry through more than 2,500 R&D projects carried out in ARI Teknokent.
Connecting with Industry	ITU's Academy-Industry Cooperation Division is the driving force behind connecting ongoing R&D efforts with industry needs. It facilitates project planning, offers legal counsel, manages contracts, and fosters collaboration between industrial organizations and academics. It also analyzes the capacity and needs of both the university and industry to maximize the efficient use of academic resources.
Developing Resources and Collaborative Framework	ITU, with its rich scientific background, dynamic students, expert faculty, and research infrastructure, is a significant R&D institution in Turkey. The Dean's Office of Research (ARDEK) provides a structured approach to all research activities at ITU, helping push the boundaries of the university's performance. ARDEK is responsible for setting and announcing new research policies and supports various academic topics beyond research.
Promoting Innovation in Technical and Scientific Education	ITU, as a research university, focuses on strengthening its technical and technological presence. It boasts numerous education and research centers, as well as over 400 laboratories to facilitate scientific studies. ITÜNOVA Technology Transfer Office (TTO) connects knowledge and industry for commercialization, transferring academic studies and new technologies for the benefit of both industry and Turkey. ITÜNOVA TTO, established as part of ITU Foundation and ITU ARI Teknokent, aims to increase ITU's scientific and technological knowledge production capacity on an international level and enhance society's benefit through academy-industry collaboration and technology transfer.
UNIVERSITY V: SCUOLA NORMALE SUPERIORE (SNS) https://www.sns.it/it	
Coordinating Inter-Institutional Collaboration	The Scuola Normale Superiore (SNS) plays a pivotal role in local, national, and international development by actively participating in the "Third Mission" even before this concept was formally established. It focuses on the transfer and application of knowledge generated within the academic context. This mission comprises two main facets: the enhancement of research and the production of public goods. In terms of research enhancement and knowledge utilization, SNS operates JoTTO in collaboration with other prestigious institutions, such as the Scuola Superiore Sant'Anna, Scuola IMT Alti Studi Lucca, and Scuola IUSS of Pavia. JoTTO leverages technological transfer experiences and scientific expertise to promote research outcomes, protect intellectual property, foster startups, and initiate collaborations with companies.
Connecting with Industry	In 2018, SNS, in conjunction with the Scuola Superiore Sant'Anna, applied for participation in HEInnovate, an initiative by the European Commission and the OECD's LEED Forum. HEInnovate offers a self-assessment tool for higher education institutions to explore their potential for innovation concerning business and industry interactions.
Developing Resources and Collaborative Framework	SNS's Programmatic Development Plan outlines strategic guidelines for 2024. It emphasizes collaboration with companies as a means of fostering innovation, primarily through collaborative research contracts, technological and advisory services, scholarship funding, joint laboratories, and participation in spin-offs. SNS is also committed to technology transfer, offering support in protecting, managing, and enhancing intellectual property.

Promoting Innovation in Technical and Scientific Education	The Normale is recognized for its valuable basic research at both national and international levels, reflected in international rankings and research quality assessments. Enhanced visibility of research results will be achieved through open access publications and data dissemination, aligning with the Normale's mission of promoting merit, culture, and the dissemination of knowledge for the benefit of all.
UNIVERSITY VI: SCUOLA SUPERIORE SANT'ANNA http://www.santannapisa.it/it/homepage-0	
Coordinating Inter-Institutional Collaboration	The Sant'Anna School belongs to important regional, national, and international networks dealing with research exploitation and entrepreneurial culture promotion issues. Sant'Anna School actively participates in national and international networks established together with other universities, companies, and research centers on issues of training, research and Third Mission. Strategic partnerships are medium/long-term agreements between entities and universities on topics of common interest in the areas of: research and development, innovation, human capital, social responsibility.
Connecting with Industry	The University Office for Research Valorization (U.O. Valorizzazione Ricerca) supports the establishment of collaborations between the School and companies. It pays specific attention to matters related to Intellectual Property management and offers initial meetings and further information. The School's laboratories and research centers have given rise to numerous spin-off companies and an extensive patent portfolio with national and international titles, including shared rights with other institutions and licensing agreements with companies. It has also been recognized as one of Italy's top universities for the ratio of patents to the number of teachers and researchers, particularly in Science & Technology.
Developing Resources and Collaborative Framework	The University-Industry Technology Transfer Group focuses on two primary areas of research. The first area monitors technology transfer (TT) from academia to industry in Italy and across Europe, investigating TT models adopted by universities and other public research organizations (PROs). Furthermore, the group emphasizes the strategic management of Intellectual Property, particularly in the context of Open Innovation and globalization. They also delve into traditional topics in R&D Management, including the behavior of individual researchers and their lab organization.
Promoting Innovation in Technical and Scientific Education	Scuola Superiore Sant'Anna adheres to the Declaration of Messina in support of open access to academic literature and the dissemination of research results. To achieve this, the School has instituted the Regulation on open access to scientific literature and research data, allowing for open data and the deposit and long-term preservation of documents in its Institutional Research Repository. They also actively engage in continuous training for their members in alignment with European strategies, collaborating with organizations like the Italian Computing and Data Infrastructure (ICDI) and the Agency for the Promotion of European Research (APRE).
UNIVERSITY VII: UNIVERSITATEA NAȚIONALĂ DE ȘTIINȚĂ ȘI TEHNOLOGIE POLITEHNICA BUCUREȘTI (POLITEHNICA Bucharest) https://upb.ro/	
Coordinating Inter-Institutional Collaboration	POLITEHNICA Bucharest is actively engaged with national, European, and global organizations and associations, fostering collaboration with higher education institutions, especially in the technical and engineering fields. It has also established and participates in various research networks, innovation clusters, large research infrastructures, and forums. Through these networks and collaborations, POLITEHNICA Bucharest collaborates with public research institutions and private enterprises to further research outcomes and promote research collaboration.

Connecting with Industry	POLITEHNICA Bucharest maintains close ties with industry partners across various technical fields. Different companies have established laboratories for POLITEHNICA Bucharest students, contribute through lectures, and collaborate with researchers to discover innovative technological solutions. POLITEHNICA Bucharest has also become the headquarters for the European Cybersecurity Competence Centre (ECCC) and established the Digital Innovative Hub "CyberSecurity Hub – CSH" to enhance cybersecurity. Additionally, POLITEHNICA Bucharest is the hub for education and training in Small Modular Reactors (SMRs) in the region.
Developing Resources and Collaborative Framework	The Directorate of Research-Innovation and European Funds oversees research activities and collaborative projects. POLITEHNICA Bucharest has adopted a strategic approach with 11 directions of action. Furthermore, POLITEHNICA Bucharest has established a strategic development framework known as the RUCDI Strategy. It sets out values, principles, and objectives for the university's community to strengthen. It provides guidance to address external changes and emerging opportunities. The RUCDI Strategy has two dimensions: five operational areas (Education and Learning Environment, Research, Innovation, People and Community, Campus, Services, and Institutional Capacity) and four guiding directions (Excellence, Impact, Internationalization, and Openness).
Promoting Innovation in Technical and Scientific Education	POLITEHNICA Bucharest's Innovation and Technology Transfer Services (SITT), operating within the DMACS framework, play a vital role in promoting, developing, and protecting intellectual property and university transfer activities. They assess the commercial potential of Intellectual Property Rights (IPR) from research and development, offer support for protection and commercialization of IPR, and assist in creating strategies and business plans for Spin-Off/Out and Start-Up companies at POLITEHNICA Bucharest.
UNIVERSITY VIII: UNIVERSITE PARIS SCIENCES ET LETTRES (PSL) https://psl.eu/	
Coordinating Inter-Institutional Collaboration	PSL University actively promotes its training and research through international partnerships. These collaborations are diverse, reflecting the multidisciplinary nature of PSL's courses and focusing on access to research and development infrastructures, platforms, and ecosystems. The aim is to drive unique innovations and facilitate access to knowledge on a global scale. The institution has nurtured scientific collaborations with international partners based on shared values. Simultaneously, the creation of an innovation ecosystem, centered on high-quality laboratories and open to the world, actively enhances PSL University's international appeal.
Connecting with Industry	PSL offers a wide range of partnership opportunities, including research contracts, sponsorships, internships, CIFRE PhD Fellowships, and continuing education. Partnering with PSL can involve funding education and research programs, providing merit scholarships for equal opportunities, and supporting forward-looking projects addressing significant challenges. Collaborating with businesses to strengthen the relationship between research and industry is a key strategy for PSL, leveraging its pool of talent, expertise, and innovative technologies. Valorisation and Technology Transfer teams within PSL's schools and institutions serve as the interface with the corporate world.
Developing Resources and Collaborative Framework	PSL has embarked on a collaborative initiative involving its component schools. Drawing on the experience of schools and institutes that have already obtained certification, each school conducts self-assessment and develops an action plan. This collaborative approach fosters the sharing of best practices and the identification of areas for joint action. PSL's ecosystem is characterized by diverse elements, including multiple industrial chairs, partnerships between Institut Curie and the pharmaceutical industry, and the Carnot Institutes/Tremplins (Carnot Curie Cancer, Carnot INRIA, Carnot MINES, Carnot Pasteur MS, Tremplin Carnot IPGG Microfluidics, Tremplin Carnot Cognition), as well as CIFRE PhD Fellowships in humanities and social sciences.

Promoting Innovation in Technical and Scientific Education	PSL aims to be a driving force for technology and knowledge transfer and an accelerator of economic growth. By engaging companies, investors, and public actors in research initiatives, PSL fosters an environment conducive to innovation for the benefit of society and the economy. It offers various opportunities, including PSL's innovation and entrepreneurship services, as well as other technology transfer services within PSL. PSL-Valorisation, a technology transfer department available to all PSL research teams, actively works to cultivate an innovation culture within PSL member institutions, emphasizing principles of proximity, responsiveness, and risk sharing.
UNIVERSITY IX: UNIVERSIDAD POLITÉCNICA DE MADRID (UPM) https://www.upm.es/	
Coordinating Inter-Institutional Collaboration	Established in 2012 at the Technical University of Madrid, itdUPM (Center for Innovation in Technology for Human Development) serves as a notable example of how a dynamic community of both internal and external professionals can collaborate in the pursuit of advancing towards a developed, sustainable society. By applying a multi-actor transdisciplinary approach, this community demonstrates innovation and manages successful sustainability initiatives within the context of a traditional university that typically operates along disciplinary lines. Today, itdUPM has evolved into a collaborative network comprising lecturers, researchers, students, and non-academic professionals.
Connecting with Industry	Within UPM, the Office of Transfer of Research Results (OTRI) is structured into various units. These include the Intellectual and Industrial Property Unit, responsible for managing the protection of university results, and the Scientific Culture Unit, which focuses on disseminating research outcomes to society. Additionally, there is the University-Business Chairs Unit, which manages collaborations between the university and companies, as well as the Public-Private Collaboration Unit, dedicated to promoting knowledge transfer from UPM to the productive sector. Lastly, the REDOTRI-Indicators Unit plays a role in tracking and evaluating the impact of these activities.
Developing Resources and Collaborative Framework	UPM's Governing Council approved the framework for an in-house Research, Development, and Innovation (R&D&I) Program on February 23, 2017. The UPM Scientific and Technological Park (Parque UPM) has emerged as a significant driver of the university's R&D&I activities. It's characterized by the creation of new R&D&I centers, business incubators, and specialized laboratories, often with the participation of public and private institutions.
Promoting Innovation in Technical and Scientific Education	The mission of the International R&D&I Projects Office (OPI) is to promote the participation of the UPM in international R&D&I financing programs. In addition, this office offers its own postgraduate degree in Promotion and Management of Projects and International Actions of I D I. The Technology Transfer Office has the fundamental mission is to provide support in the processing, economic management, and justification of all those agreements and contracts emanating from the teaching and research establishment belonging to the Centers and Departments of the UPM.
UNIVERSITY X: DIE ZHAW ZÜRCHER (ZHAW) https://www.zhaw.ch/de/hochschule/	
Coordinating Inter-Institutional Collaboration	The ZHAW is actively engaged in addressing contemporary societal challenges and global issues such as climate change, energy supply, security, migration, and poverty. Many of these challenges extend beyond disciplinary boundaries and national interests.
Connecting with Industry	The ZHAW's eight schools conduct interdisciplinary research across a wide spectrum of topics in over 60 institutes and centers. These research efforts often involve collaboration with partners, with the goal of developing solutions to current and future challenges. There are primarily four ways in which the ZHAW can collaborate with companies and other organizations: Cooperation, Mandated Research, Services, Sponsorships and Endowments.
Developing Resources and Collaborative Framework	The R&D and Business Services Unit Office coordinates a variety of collaboration models to suit different needs and intentions regarding the use of research results.

Promoting Innovation in Technical and Scientific Education	The ZHAW leverages its market and practice-oriented research areas to provide practical education. The findings from research projects quickly inform and enrich the curriculum, ensuring that students receive hands-on, real-world training. ZHAW supports businesses and other economic entities in developing entrepreneurial initiatives, analyzing, conceiving, and controlling innovation processes, and establishing cross-actor innovation networks through its Institute of Innovation and Entrepreneurship.
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Source: Authors' own research design based on the data collection results.

Discussion

The research findings provide valuable insights and actionable recommendations for universities aiming to enhance their partnership strategies. By adapting and personalizing successful components from these models, universities can revolutionize the way they engage with the ever-evolving research and innovation ecosystem.

In Figure 1 we made a cross-case comparison from all the existing models that the EELISA universities deploy for the SLF entity in the collaboration approach.

University	Coordinating Inter-Institutional Collaboration	Connecting with Industry	Developing Resources and Collaborative Framework	Promoting Innovation in Technical and Scientific Education
Budapesti Műszaki és Gazdaságtudományi Egyetem	Center for Innovation Management and Cooperation (FIEK)	Center for University-Industry Cooperation	R&D Office	Industry 4.0 Technology Center (TK)
École des Ponts ParisTech	Research Directorate's Central Department	14 industrial chairs	School's 2025 strategic plan	Scientific Council (CS)
Friedrich-Alexander Universität	Collaborative Networks	EU research projects	Development Plan	
İstanbul Teknik Üniversitesi	internationalization policy	Academy-Industry Cooperation Division	Dean's Office of Research (ARDEK)	İTÜNOVA Technology Transfer Office
Scuola Normale Superiore	JoTTO Technological Transfer		Programmatic Development Plan	
Scuola Superiore Sant'Anna	Collaborative networks	U.O. Valorizzazione Ricerca	University-Industry Technology Transfer Group	
Universitatea Națională de Știință și Tehnologie Politehnica București	Collaborative networks	Research and Innovation hubs	RUCDI Strategy (Human Resources, Research, Development, and Innovation)	Innovation and Technology Transfer Services
Université Paris Sciences et Lettres	International partnerships	Valorisation and Technology Transfer Teams	Multiple Industrial Chairs	PSL-Valorisation
Universidad Politécnica de Madrid	Collaborative networks	Office of Transfer of Research Results	Research, Development, and Innovation (R&D&I) Program	Technology Transfer Office
Zürcher Hochschule für Angewandte Wissenschaften		Cooperation, Mandated Research, Services, Sponsorships and Endowments	Business Services Unit Office	ZHAW Institute of Innovation and Entrepreneurship

Figure 1. Representation of university-industry cooperation models in EELISA universities

Source: Authors' own research design.

Based on the models employed by the EELISA universities regarding the university-industry collaboration, the following best practices emerge:

Budapesti Műszaki és Gazdaságtudományi Egyetem: These centers symbolize a comprehensive approach to bridging the gap between academia and industry. They create an environment that facilitates the effective translation of research and innovation into practical solutions and economic benefits. The collaboration between these centers fosters knowledge transfer, technology commercialization, and the development of a mutually beneficial relationship.

École des Ponts ParisTech: These departments showcase the institution's commitment to research excellence, efficient resource utilization, and a structured approach to research management. It creates an environment where researchers can focus on their work, knowing that the administrative aspects of research are well-organized and supported.

Friedrich-Alexander-Universität Erlangen-Nürnberg: A strategic plan is an essential tool for sustained growth and continuous improvement. It keeps the institution competitive, responsive to emerging trends, and dedicated to advancing knowledge and innovation. This plan provides a roadmap for research excellence, aligning the efforts of all stakeholders toward a common vision.

İstanbul Teknik Üniversitesi: The presence of these departments reflects a proactive approach to fostering collaboration, innovation, and knowledge transfer between academia and industry. They promote partnership, drive innovation, and serve as vital intermediaries in the journey from research to practical applications in the industry, benefiting both academia and society at large.

Scuola Normale Superiore: These departments develop critical elements for institutions seeking to stay at the forefront of academic and research excellence. They facilitate the transition of knowledge into practical applications, promote innovation, and provide a structured approach to growth and development, ultimately benefiting the institution, its stakeholders, and society as a whole.

Scuola Superiore Sant'Anna: The university's proactive approach to leveraging research outcomes for both academic and economic benefits is evident in these departments. They enable the institution to protect, commercialize, and apply its intellectual property and research findings, resulting in economic and societal impact. These elements are instrumental in strengthening the institution's position as a leader in the region in terms of research, innovation, and knowledge transfer.

Universitatea Națională de Știință și Tehnologie POLITEHNICA București: The university employs a comprehensive and strategic approach to research, innovation, and technology transfer. The combination of these elements creates a holistic approach to research, innovation, and technology transfer. The institution is committed to leveraging its research excellence, securing European funding, and ensuring that research findings have practical applications and economic value. This approach aligns with the broader goals of fostering innovation, driving economic growth, and contributing to the development of knowledge-based societies and economies.

Université Paris Sciences et Lettres: The departments and research activities demonstrate a multi-faceted commitment to global engagement, knowledge transfer, and industrial collaboration. The coexistence of these offices empowers an outward-looking vision and mission, proactive in technology transfer, and deeply engaged with industry. This approach not only enhances the academic environment but also strengthens the institution's role as a driver of innovation, entrepreneurship, and economic development. It exemplifies the importance of collaborative efforts in addressing societal challenges and fostering a dynamic ecosystem for research and innovation.

Universidad Politécnica de Madrid: The coexistence of these departments emphasizes the institution's holistic approach to research, innovation, and societal impact. These entities strengthen the commitment to leveraging research for the betterment of humanity, technology transfer for economic growth, and collaborative efforts between academia and industry. They collectively contribute to fostering innovation, entrepreneurship, and sustainable development, ultimately enhancing the institution's role as a driver of progress and positive change in society.

Zürcher Hochschule für Angewandte Wissenschaften: The university is committed to fostering innovation, entrepreneurship, and collaboration between academia and industry through a comprehensive approach to innovation, entrepreneurship, and partnership. These entities help the institution serve as a catalyst for economic growth and a facilitator of technology transfer. By supporting research and development and nurturing an entrepreneurial ecosystem, the institution actively contributes to the transformation of ideas into impactful solutions, ultimately benefiting both the academic community and broader society.

In summary, the research results underscore the significant impact of specialized departments within a well-defined regulatory framework on the university role to promote collaboration in research and innovation. All universities developed different approaches to the Senior Learning Facilitators (SLFs) multifaceted role to foster connections between institutions, building networks, and expanding relationships. Each model possesses unique traits and varying approaches tailored to their regional strategies and socio-economic paradigms. The findings emphasize the importance of professional enablers of cooperation and a supportive environment, including a coherent strategic development plan and adequate departments and facilities, to enhance and stimulate co-research and co-innovation activities.

Conclusions

This study has provided valuable insights into the potential of the Senior Learning Facilitator (SLF) role within a structured framework for long-term university- industry collaboration in EELISA universities. The findings offer practical and comprehensive guidance for establishing and maintaining effective partnerships derived from the best practices employed by the various SLFs in EELISA Alliance.

The following conclusions emerging from this research present the key patterns observed:

Coordinating Inter-Institutional Collaboration: University-industry collaborations involve complex processes such as agreements, intellectual property rights, and funding. EELISA universities have offices with specialized facilitators who effectively manage these complexities, ensuring clarity of responsibilities and proper handling of legal and contractual aspects. SLFs play a pivotal role in driving and sustaining collaboration, aligning R&D processes with industry standards, business strategies and regulatory requirements.

Connecting with Industry: Every EELISA university in this study has specialized departments overseeing research and innovation collaboration. Sharing research results with industry is crucial for meaningful innovation. The SLF acts as a bridge, aligning the goals and expectations of academia and industry, ensuring purposeful collaboration.

Developing Resources and Collaborative Framework: Most EELISA universities have integrated business units into their research and development departments, responsible for coordinating and facilitating various business-related services. Additionally, they have established collaborative frameworks as part of their strategic development plans to provide a structural backbone for cooperative research, defining terms, resource allocation, and responsibilities, facilitating long-term research partnerships.

Promoting Innovation in Technical and Scientific Education: Many EELISA universities have established Innovation and Technology Transfer Offices. SLFs function as intermediaries, navigating complex legal and administrative processes. They support the commercialization of university-generated intellectual property and advocate for curricular innovation, fostering creativity, cross-disciplinary thinking, and novel problem-solving approaches.

The impact of the SLF role within innovative collaborative frameworks such as EELISA is significant and multi-faceted. Drawing from the experiences of the studied universities, here are keyways in which SLFs contribute to a successful partnership according to the example provided in the figure below:

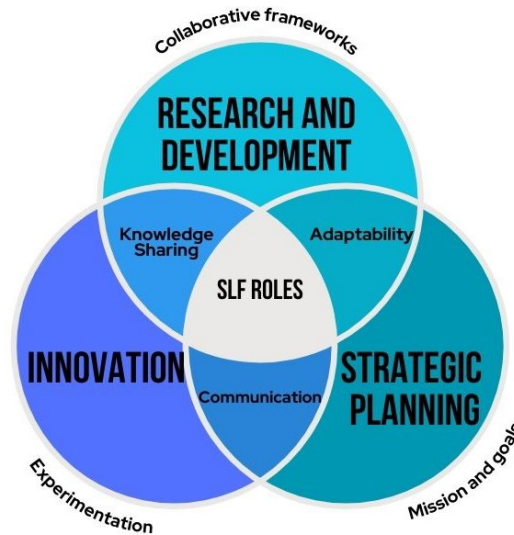


Figure 2. SLF's roles in EELISA universities

Source: Authors' own research design.

SLF's different roles and approaches in EELISA universities:

- Knowledge Sharing: SLFs promote knowledge sharing between academia and industry.
- Adaptation to Changing Needs: SLFs assess evolving industry and framework needs, making necessary adjustments to keep research relevant.
- Innovation and Experimentation: SLFs encourage innovation and experimentation, enhancing framework effectiveness.
- Research and Development: SLFs may engage in R&D to improve collaborative frameworks, staying current with policies and identifying innovative solutions.
- Communication and Reporting: SLFs communicate R&D progress and outcomes to stakeholders, preparing reports and publications.
- Strategic Planning: SLFs develop and implement strategic plans aligning R&D with university missions and long-term growth goals.

The existing literature underscores that without effective facilitation, collaborative efforts can encounter significant challenges and barriers, which may ultimately hinder their success. As highlighted by (Awasthy et al., 2020), personal relationships serve as the primary catalyst for collaboration. Therefore, effective facilitation is paramount for collaborative success and that is the pivotal attribute that needs to be developed within HEIs.

All EELISA partner universities have thoughtfully integrated these principles into their strategic development plans, prioritizing robust connections with the industry or businesses. Given the dynamic shifts in the engineering education landscape, it becomes imperative to embrace fundamental changes to prepare graduates for the ever-evolving demands of the professional world.

Certainly, our outtake on SLFs acting as builders of connections, networks, and relationships and as partnership, knowledge transfer, innovation facilitators does not completely embody all the possibilities that exist. Future work could examine the key facilitators of collaboration from the industrial perspective. Investigations focusing on the existence of SLFs correspondents in the industry and the guiding principle or framework of collaboration, could offer additional insights.

Future work should also incorporate additional indices that tap into a broader and more fine-grained array that could extend our findings and further advance ways industry-university partnerships can be used as a key strategy for creating competitive advantage, fueling economic growth, and co-creating Industry 4.0 solutions.

Limitations

While this research provides valuable insights into the ecosystem of university- industry collaboration, it is important to acknowledge certain limitations that may have influenced the findings.

While we believe our results have broadened the understanding of the vital role played by the various entities embodying the SLF, a key limitation relates to our principal focus on the higher education sector. Since collaborative ventures mean two or more partners, our concentration on one side of the partnership limits the scope of our research.

Also, we have to acknowledge limitations in our data collection methods due to the extensive amount of information and research and innovation activities existing in the Alliance and also our strive to maintain a neutral and impartial stance avoiding personal biases in interpreting the results, since representing a university being part of the Alliance.

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