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Innovation Management, Knowledge Transfer, and University–Business Linkages in Latin America

Insights from the iN4iN LATAM Chapter 2025

iN4iN intelligence for innovation

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Editorial Note

Innovation Management, Knowledge Transfer, and University–Business Linkages in Latin America: Insights from the iN4iN LATAM Chapter 2025

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The economic, technological, and social transformations unfolding across Latin America are profoundly reshaping expectations for higher education institutions (HEIs). Beyond their traditional roles in teaching and knowledge production, universities are increasingly called upon to serve as strategic actors within innovation ecosystems, territorial development, and engagement with the productive sector. In this setting, the conference Fostering Innovation Management and University–Business Linkages at Higher Education Institutions – iN4iN LATAM Chapter 2025, held in Lima, Peru, served as a key space for academic dialogue and applied reflection, bringing together researchers, university managers, and professionals to critically examine the advances, limitations, and opportunities of innovation management and university–business collaboration models in the region.

The articles collected in this volume reflect this transition across multiple analytical scales— institutional, territorial, organizational, pedagogical, and behavioral. Taken together, they construct a coherent narrative that underscores the need to move beyond linear models of technology transfer toward more complex, collaborative, and impact-oriented approaches which address social, economic, and environmental challenges.

The volume opens with the contribution by Martínez, Rocabado, Cong, Ansari, and Alabarca, discussing sustainability challenges from the perspective of individual decision-making mediated by digital platforms. Through a gamification-based approach applied to airline ticket purchasing, the study highlights the permanent gap between pro-environmental attitudes and actual consumer behavior. This contribution is particularly relevant to the university innovation agenda, as it proves how behavioral design—grounded in cognitive psychology and behavioral economics—can be embedded into concrete technological solutions that encourage more responsible decision-making. The article goes beyond this specific case and offers important implications for education in responsible innovation, and knowledge transfer toward digitally enabled tools with measurable social impact.

Building on this emphasis on applied impact, the article on the knowledge transfer strategy of the National Technical University (UTN) of Costa Rica, authored by Alvarado Barrantes and Sáenz León, provides an in-depth institutional perspective on how a regional public university can structure a comprehensive transfer policy aligned with its social and territorial mission. The study shows that knowledge transfer cannot be reduced to isolated mechanisms, but rather requires clear governance structures, internal capacity building, adequate incentive systems, and consistent evaluation frameworks. This case exemplifies one of the cross-cutting messages of the iN4iN LATAM 2025: without explicit and sustained institutional

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strategies, university–business linkages tend to remain fragmented and lose impact over time.

The pedagogical and formative dimension of innovation is addressed by Ranco Kraaijenbrink, who examines the challenges of human-centered education in the era of artificial intelligence. Drawing on a case study based on experiential learning, the author offers a critical reflection on the growing reliance on automated tools in educational and professional contexts. Within the framework of university–business collaboration, this work offers key insights: sustainable innovation depends not only on technological proficiency, but also on the development of human capabilities such as critical thinking, informed decision-making, and collaborative problem-solving. The article resonates strongly with discussions held in Lima about employability, ethics, and holistic education in digital environments.

From a more structural perspective, the contribution of Pablo Barriga on innovative impact indicators for university–industry collaboration addresses one of the most persistent gaps in innovation ecosystems: impact measurement. The article challenges the dominance of traditional metrics—such as patents and licenses—and proposes a multidimensional framework that integrates inputs, processes, and socioeconomic outcomes. This article is particularly relevant for Latin American contexts, where many linkage initiatives generate social and organizational value that is not adequately captured by conventional indicators. Barriga's framework provides conceptual and methodological tools to strengthen institutional decision-making and accountability toward funders and public policy stakeholders.

The territorial dimension of university–business linkages is further explored by Merlin Patricia Grueso Hinestroza and Aglaya Batz, who analyze the socioeconomic contributions of these collaborations from a territorial perspective, drawing on case studies from Colombia. The article reinforces the notion that collaboration models must be context-sensitive and locally grounded, rather than uncritically rely on frameworks imported from other regions. The evidence presented demonstrates that impact depends on the ability to articulate diverse actors, foster co-creation, and respond to concrete territorial needs. This perspective aligns closely with discussions at the event regarding inclusive innovation and regional development.

In a complementary line of inquiry, the contribution developed in the context of the University of Leipzig on process-oriented Living Labs and technology transfer introduces an advanced approach to university–business collaboration based on structured co-creation. Through the DDI framework (Diagnosis, Design, Implementation), the article demonstrates how collaboration with startups and small and medium-sized enterprises can strengthen real organizational capabilities, moving beyond traditional models of knowledge transfer. This contribution is particularly relevant for Latin America, as it offers a methodology adaptable to different levels of institutional maturity and resource availability.

The volume finds conceptual closure with the critical reflection by Aglaya Batzon on the contemporary role of universities within Latin American innovation systems. Through an analysis of technology transfer offices, patent data, and collaboration dynamics, the article highlights structural tensions between global orientation and responsiveness to local demands. This contribution serves as an integrative framework for the volume, emphasizing that the future legitimacy of higher education institutions will depend not only on their capacity to generate knowledge, but also on their effectiveness in placing that knowledge at the service of social and productive development within their territories.

Taken together, the works presented and discussed during the iN4iN LATAM Chapter 2025 in Lima, Peru, converge on a clear conclusion: innovation management and university–business linkages require systemic, context-aware, and impact-oriented approaches. Overcoming fragmented models, strengthening institutional capacities, rethinking education, and developing more appropriate metrics are not isolated tasks, but interconnected dimensions of a shared challenge. This volume seeks to advance that debate by offering evidence, analytical frameworks, and experiences that support Latin American universities in consolidating a more active, relevant, and strategic role within their innovation ecosystems.

iN4iN LATAM Chapter 2025:
Fostering Innovation Management and University Business Linkages at Higher Education Institutions

Gamifying Sustainability: Incorporating a gamification approach for more responsible decision-making

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Abstract

In response to the growing need for more responsible decision-making in the tourism sector by consumers and the persistent "attitude-behavior gap," this article presents the development of an innovative project designed to include gamification as part of the online flight booking experience with a sustainability approach. Through the application of a structured gamification approach, based on psychological motivators, the solution integrates mechanics and components to motivate users to make responsible decisions, transforming a transactional process into an engaging and meaningful experience.

Keywords: Attitude-behavior gap, Gamification, Innovation, Online Travel Agencies (OTAs), Sustainable tourism.

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1. INTRODUCTION

The tourism, hospitality, and aviation sectors are currently facing an unprecedented challenge. Following a significant phase of post-pandemic recovery, characterized by pent-up demand and the emergence of new consumer behaviors, such as "bleisure" (Puerta et al., 2023), this industry now faces an unprecedented challenge to overcome mere operational efficiency. Sustainability has become a determining component in purchasing decisions for an increasingly growing segment of customers, who increasingly demand transparency and tangible actions from companies (Gössling, 2023; PriceWaterhouseCoopers [PwC], 2023). In this context, Online Travel Agencies (OTAs) are one of the main digital links in the ecosystem and hold a privileged position to shape traveler behavior. However, OTAs' current efforts to integrate sustainability are often fragmented and insufficient to bring about real change (absence of integration of sustainability elements in the booking process, absence of filtering options in the booking process with flight sustainability information, among others).

It seems that the main challenge currently facing the sector is not the lack of environmental awareness, but the persistent difference between consumers' intentions and their effective actions, a widely studied behavior known as the "attitude-behavior gap" (Colombo et al., 2023; Juvan & Dolnicar, 2014). Many organizations focus on presenting data as CO_2 emissions, which, while it may be a necessary step, this mere reporting approach has proven insufficient to close the behavioral gap. Consequently, an innovation process is necessary to go beyond information and focus on motivation. This approach translates not only into showcasing the sustainable option but also developing it to be the most attractive, rewarding, and easy to choose, applying principles of behavioral economics to "nudge" consumers toward more responsible choices (Thaler & Sunstein, 2021).

This article presents the development of a project aimed at addressing this gap by designing and developing a gamified online flight booking experience with a focus on sustainability. It details how the integration of dynamics, mechanics, and components of gamification can transform a merely transactional process into an interactive and purposeful experience. The intended result is a conceptual solution, validated through visual prototypes (mockups), which not only aims to educate travelers but also intrinsically motivates them to make more conscious decisions. The article includes a theoretical framework that underpins the proposal and the solution, the analysis of the context and existing practices, the design, development, and visual validation of the gamified solution, and reflections on the implications for the Company and the tourism industry in general.

2. THEORETICAL FRAMEWORK

2.1. Sustainability, gamification, and innovation

The business demands of this century have defined a new imperative that seems inescapable: the incorporation and integration of sustainability as a fundamental part of business strategies. The declaration of the 2030 Agenda and its 17 Sustainable Development Goals (SDGs) (United Nations, 2015) has gone beyond the context of public policies in countries to be a reference framework for innovation processes and long-term value creation in the private sector (Sachs et al., 2019). Today, companies are no longer only evaluated on their financial performance, but also on their environmental, social, and governance (ESG) impact, integral components that can determine their legitimacy, resilience, and sustainability in the eyes of their stakeholders (including customers) in the long term. In economic sectors and industries such as tourism and aviation, this challenge is particularly complex. In particular, SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action) demand a substantial change that can go far beyond operational efficiency, requiring consumer participation in reducing environmental impact with negative consequences (Scott et al., 2016).

However, a gap has been identified between consumers' environmental awareness and their actual purchasing attitudes and behaviors; this gap is known as "the attitude-behavior gap" (Colombo et al., 2023; Fu, 2025; Juvan & Dolnicar, 2014). For companies in this sector, overcoming this inertia requires developing strategies that are not only limited to informing,

but that motivate and, even more importantly, facilitate responsible decision-making. At a point where customer experience becomes fundamental with the intervention of innovation, the architecture of decisions, influenced by behavioral economics, establishes that it is possible to "nudge" consumers towards choices without limiting their freedom, by adequately designing the environment and context in which these decisions are made (Thaler & Sunstein, 2021). In this sense, innovation must be aimed at creating a digital ecosystem that makes more responsible decision-making an attractive and rewarding option.

Gamification, understood as the application of game elements and mechanics in non-playful environments (Hamari & Tuunanen, 2014; Werbach & Hunter, 2012; Wood & Reiners, 2014), emerges as a method and tool of behavioral innovation with enormous potential (Deterding et al., 2011). These types of strategies base their effectiveness on solid psychological constructs, particularly the application of the Self-Determination Theory, which determines that when the needs for autonomy, competence, and social relationships are satisfied, intrinsic motivation is boosted (Ryan & Deci, 2017). For example, by integrating game mechanics and components such as point systems, badges for responsible decisions, progress boards, comparison, and community building, the shopping experience is transformed into a more interactive and meaningful process. Such an approach takes the fundamental human motivators to incentivize more responsible (pro-environmental) behavior changes voluntarily and persistently (Mora et al., 2015).

The success of applying gamification in business and non-recreational environments to influence specific behaviors has been demonstrated. For example, in education, platforms such as Duolingo make use of badges, streaks, leagues, among other components and mechanisms to promote daily learning. In other areas, such as health and wellness, applications such as Nike Run or Fitbit use challenges and rewards to motivate physical activity and changes in healthy behaviors (Hamari et al., 2016). Other specific examples in the field of sustainability include the gamified social comparison of energy consumption in homes with other neighboring households (Opower Utility Company), to generate consumption reductions (Allcott, 2011). These, like other success stories in different sectors, support the hypothesis that gamification can become an innovative tool to transform sustainability from an abstract and complex concept to an individual, tangible purpose with a certain social status.

2.2. Related work on sustainability apps

The benchmarking of gamified sustainability-focused Apps conducted for this project provided valuable insights into gamification strategies that effectively create long-term user engagement and behavior change. Elements studied on this benchmarking were adapted to the solution for this project.

For example, according to our research, AWorld, developed with the United Nations, incorporates quizzes, e-learning, daily missions, and an impact dashboard to encourage continuous interaction.

Other features, such as streak tracking, leaderboards, badges, and educational content, give a sense of accomplishment, rewarding both knowledge acquisition and sustainable actions. The next one, GreenApes, created in collaboration with Greenpeace, underlines community-building through a social feed where users share sustainable practices. The platform integrates avatar creation, levels as progress journeys, and a rewards system allowing point redemption for discounts, eco-friendly products, and intrinsic rewards (such as collaboration on initiatives). The combination of personalization, social influence, and tangible benefits demonstrates how digital environments can motivate repeated sustainable behaviors. JouleBug focuses on habit formation, combining interactive leaderboards, environmental impact dashboards, and community posts. Its visual summaries of users' environmental impact make progress tangible, while the social interaction fosters peer encouragement. FairTrip, meanwhile, promotes responsible tourism by providing information on ethical businesses and destinations, supported by interactive maps and transparent sustainability criteria.

A cross-analysis of these apps reveals common success factors: clear goal-oriented focus, measurable progress indicators, community engagement, progressive learning, and a balance between extrinsic rewards (discounts, products) and intrinsic motivation (social recognition, personal impact tracking, support to sustainable initiatives) (Koivisto & Hamari, 2019).

3. CONTEXT OF THE DESCRIBED RESEARCH/ PRACTICE

3.1. Current online travel agencies' sustainability practices

To identify an effective solution for gamifying sustainability, a three-step process was followed. Benchmarking was approved to be an effective way for an organization to improve its performance by comparing its services and processes with its competitors in the market (Camp, 1989; Min & Min, 2015). First, a benchmarking analysis of major flight booking platforms was conducted to understand the level of integration of sustainability into the booking process. A MacBook Air was used to perform simulations (logged out) on Google Chrome from June 17 until July 16, 2025, with a simulated short-distance one-way flight from Berlin (BER) to Vienna (VIE) and a long-distance one-way flight from Berlin (BER) to Hongkong (HKG), both with the travel date of November 1, 2025. Platforms were assessed against a rubric that featured emissions visible, CO_2 filter/sort, Eco-labels, Tooltips/explanations, Incentives/feedback, and Educational content. The language of the websites was mostly in English, except for Fluege.de in German, since the website is only available in German. Second, climate action applications were examined to understand how features and mechanisms keep users engaged and motivated when they use the applications. Finally, a gamified engagement loop for Online Travel Agencies (OTAs) was proposed to raise awareness about sustainability for users during the flight booking process.

Table 1. *OTA Sustainability Features*

OTA	Emissions visible	CO_2 filter/ sort	Eco-labels/ badges	Tooltips/ explanations	Incentives/ feedback	Educational content
Google Flights	✓	✓	✓	✓	✗	✗
Skyscanner	✓	✓	✓ (low visibility)	✗	✗	✗
Expedia	✓ (details only)	✗	✓ (limited)	✗	✗	✓ (newsletter)
Booking.com	✗ (flights)	✗	✗	✗	✗	✓ (accommodation)
Check24	✗	✗	✗	✗	✗	✗

Notes. ✓: present; ✗: absent.

The benchmarking indicated that sustainability integration in OTAs is fragmented, with notable gaps between corporate climate commitments and features of the booking process to sustainability. OTAs' websites and mobile applications function as user interfaces during the process of booking travel-related products such as flights, cruises, holiday packages, hotel rooms, and so on (Talwar et al., 2020). These OTAs represent common digital spaces for the implementation of nudges (Adkisson, 2008; Stüben & Cantoni, 2024). Green nudges on OTAs proved to motivate people to be more aware of sustainability (Enste & Potthoff, 2021). As of June 2025, when the investigation was conducted, Google Flights and Skyscanner were the best at showing these features: Emissions visible CO_2, filter/sort, Eco-labels/badges. (see Table 1). Other major platforms, including Booking.com and Expedia Group, had introduced emissions data or "Below Average CO_2" labels, yet the lack of filtering options prevented users from being fully informed about the sustainability options when they made the flight purchase.

3.2. The company and the service

The tourism and aviation industry has experienced a complex crisis following the COVID-19 pandemic and transitioned to a robust recovery phase. Known for a phenomenon known as "revenge tourism," especially airlines, which racked up historic losses, have now returned to an unprecedented level of profitability driven by pent-up demand (International Air Transport Association [IATA], 2023). However, this recovery is fragile and generally uneven. While leisure levels are surpassing 2019 levels in many regions, in particular, the recovery of business travel continues to show slower behavior, with airlines facing challenges related to high fuel costs, high debt, and labor shortages (Deloitte Development LLC, 2025; Siriphot et al., 2023; Tufft et al., 2024; UN Tourism, 2024).

In parallel to the financial recovery and the transformation in consumer behavior and expectations, companies in the industry have been forced to innovate in an agile manner. Sustainability is no longer just a differential approach or a niche to exploit, to now become a purchasing decision factor for an increasingly large segment of consumers (Gössling, 2023; PwC, 2023). The sector is undergoing intensive digitalization, with user preferences towards seamless travel experiences, with less contact and managed almost entirely through mobile devices, which has driven the adoption of new technologies such as artificial intelligence for the hyper-personalization of the offers of companies in the sector (Sigala, 2020; Skift & Amazon Web Services (AWS), 2023). In response to this, new travel patterns have emerged such as "bleisure", which is defined as the combination of business and leisure and a greater demand for flexibility in bookings (Puerta et al., 2023), and companies in the sector are adjusting their value proposition, not only as transport or accommodation providers, but as integrators of memorable, personalized and increasingly responsible travel experiences (Capgemini ESG policy, 2025).

In this sense, the Company faced both a challenge and a significant opportunity: how to address the paradigm of the gap between what consumers say and their real behaviors (Colombo et al., 2023; Fu, 2025; Juvan & Dolnicar, 2014), by guiding consumers toward more responsible choices, considering the Triple Bottom Line (TBL) approach defined by the organization. After extensive research, analysis, and work from the Company, a potential solution seemed to emerge: gamification of the user experience, including sustainability mechanics. Gamification seemed to respond to the needs, expectations, and concerns of the organization and seemed to cover, from various approaches, what the organization was looking for in terms of its sustainability strategy and current trends. From this point, three approaches were defined to guide the development of the gamification project: gamification of the experience with a sustainability approach, an impact calculator, and Twins destinations. The approaches that would later be integrated into the same solution.

4. MAIN RESULTS AND REFLECTIONS

4.1. Results regarding achievement of project objectives

The project solution demonstrates a clear alignment with the Company's strategic objectives of increasing

sustainability awareness, influencing booking behavior to more responsible and conscious choices. These objectives are based on the company's Triple Bottom Line (TBL) approach, which balances environmental ("Planet"), social ("People"), and economic ("Profit") impact. The project pursues transforming complicated indicators into tangible, motivating actions for travelers.

From an environmental perspective, the solution introduces indicators such as booking flights with fewer CO_2 emissions than the average for a route or traveling during off-peak seasons. Social objectives are addressed by rewarding travel choices that support local communities or preserve cultural heritage, while the economic impact is supported by incentives for booking destinations with high small-business participation or lower tourism seasonality. The solution's success lies in combining dynamics, mechanics, and components already mentioned in the theoretical framework, with the TBL indicators.

The gamification design for this project is based on a structural framework of three interconnected levels: dynamics, mechanics, and components (Deterding et al., 2011; Werbach & Hunter, 2012; Wood & Reiners, 2014). At the most abstract level, dynamics act as the motivational drivers — such as intrinsic motivation to make a positive impact, curiosity, and social competence — that set the emotional context to foster sustainable behavior. In turn, mechanics are the rules and processes that materialize these dynamics into concrete actions, through achievements (badges for low-emission reserves), challenges, and feedback systems that transform abstract sustainability goals into tangible and achievable steps (Werbach & Hunter, 2012). Finally, the components constitute the interface and the elements with which the user interacts directly (Deterding et al., 2011; Werbach & Hunter, 2012; Wood & Reiners, 2014), including a points system, a "Digital Passport" to collect achievements, both extrinsic (discounts) and purpose (donations) rewards, and an interactive map to promote alternative destinations with positive impact.

A key aspect of the project's development was the creation of interactive mockups using a digital design platform. This tool enabled the project team to visually prototype the gamified components and integrate them into the Company's existing booking interface. The mockups illustrated, for example, how the CO_2 comparison tool could appear alongside flight options, how badges would be displayed in the user's account dashboard as a "passport", and how leaderboards could be integrated. They also visualized the "Passport" concept, with the points and stamps collector, which could then be redeemed for extrinsic rewards (discounts, all-inclusive trips, or eco-friendly products) or intrinsic rewards (donations to aligned causes). These prototypes were essential for demonstrating that sustainability features could be seamlessly incorporated into the platform without interfering with the user experience.

Table 2. *Components of Self-Determination Theory (SDT) and specific TBL results*

Component	SDT Need(s)	Linked TBL Indicator(s)
Points & Badges	Competence	CO_2 below the route average (environmental)
Leaderboard/ Community	Relatedness	Support for local communities (social)
"Digital Passport"	Autonomy & Competence	Off-peak travel, reduction of seasonality (economic)

Transitioning from concept to evidence requires validation beyond mockups. A proposed A/B testing plan would evaluate booking flows with and without gamified sustainability features. Metrics such as task completion, booking time, and percentage of low-emission choices would provide empirical evidence of whether gamification increases responsible decisions without harming usability.

The design includes three levels: dynamics (intrinsic motivation to make a positive impact), mechanics (challenges, feedback, achievements), and components (points, badges, leaderboards, and a "Digital Passport"). These elements transform abstract sustainability goals into clear, rewarding actions for users. Table 2 illustrates the connections between components of Self-Determination Theory (SDT) and specific TBL results related to psychological requirements.

Overall, the results show that the proposed gamification strategy not only meets the predefined objectives

but also offers a scalable and adaptable model. The use of mockups proved an accomplishment in connecting conceptual ideas and practical implementation, giving both the project team and the Company a visual understanding of how the gamified experience could function in real-world applications. By combining evidence-based design principles with visually validated prototypes, the project lays a strong foundation for a future implementation phase that aligns user motivation with corporate sustainability commitments.

4.2. Implications for the industry and the company

Adopting the proposed gamification strategy could place the Company in a stronger position within the highly competitive online travel agency market. In a place where most platforms compete mainly on price and scheduling, offering interactive features that surround sustainability in the booking process creates a clear point of differentiation. This approach can appeal not only to travelers who are motivated by environmental concerns but also to users who value engaging and personalized experiences. In addition, according to the research carried out and the information obtained from the benchmarking process, this strategy could be a pioneer for the OTA sector.

For the Company, the strategy provides a way to bring its Triple Bottom Line sustainability commitments and combine its three objectives directly into one solution implemented in the booking journey. It also opens the door to partnerships with eco-certified airlines, new and less crowded destinations, and NGOs, strengthening brand credibility. Linking rewards to verifiable outcomes, such as measurable CO_2 reductions or tangible contributions to local communities, could help build user trust while minimizing the risk of greenwashing. At an industry level, this type of initiative reflects a shift from simple transparency toward design approaches that actively influence travel decisions.

4.3. Reflections, challenges, and opportunities

The project offers clear potential, but its success will depend on how it is implemented and maintained over time. One of the main reflections from the project is that integrating sustainability into the booking journey requires more than simply providing information; it demands tools, technical infrastructure, and a dedicated team that actively guides and motivates users without disrupting their booking experience. Ensuring the accuracy and credibility of sustainability data is essential. Any indicators used, such as CO_2 emissions or local communities' support, must be assisted by independent verification to avoid greenwashing and maintain user trust. Another challenge lies in balancing extrinsic rewards, like discounts or marketplace products, with intrinsic rewards, such as personal satisfaction or community recognition. Without this balance, user engagement could drop once external incentives are removed.

Privacy and ethics are required considerations: only necessary data (e.g., emissions-related choices) should be tracked, and carbon assessments must be provided with clear methodological transparency. Engagement in social features such as leaderboards must be exclusively opt-in, ensuring that users retain control over their data and visibility.

On the other hand, the opportunity lies in the modular design of the solution. The Company could start with core features and basic badges, then expand to community challenges, leaderboards, and suggestions for alternative destinations. In the long term, the model could be extended beyond flights to include sustainable accommodation and low-impact transportation options, creating a holistic travel ecosystem. An important aspect is related to the measurement of the performance of the experience at the time of its launch, where metrics based on the TBL approach can include KPIs such as the Adoption Rate of Gamified Functionalities, Engagement with Specific Speakers, Challenge Completion Rate, and Responsible Choice Rate OR Interaction and Booking Rate of "Twin Destinations".

5. CONCLUSION

The development of this project demonstrates that gamification, understood as a behavioral innovation tool, can offer a viable and scalable solution to address the "attitude-behavior gap" in the tourism and

hospitality sector (Colombo et al., 2023; Juvan & Dolnicar, 2014). Transforming the complexes of sustainability indicators of the TBL approach into a strategy and structure of dynamics, mechanics, and interactive components, the gamification solution converts consumer decision-making from a passive act to a more active and rewarding experience. This scheme transcends the simple provision of basic information, which has so far proven to be insufficient, to become a kind of responsible decision-making mechanism that actively encourages environmental behaviors through the satisfaction of intrinsic motivations (Ryan & Deci, 2017).

On the other hand, the development of the project highlights the importance of developing this type of collaborative process between industry and academia. The combination of these two groups of knowledge, on the one hand, the Company (real context, technical infrastructure, business objectives) and, on the other hand, academia (methodology, theoretical frameworks), increases the probability of developing successful projects and mitigating potential risks. This co-creation model, framed within the scheme of the Triple Helix of Innovation (Etzkowitz & Leydesdorff, 2000), is central to developing initiatives that can become commercially viable and scientifically sound.

The project offers both a conceptual framework and clear pathways for execution enabling the transformation from design into actionable measures necessary to convert the gamification concept into quantifiable outcomes. The following recommendations highlight the priority goals for OTAs aiming to implement sustainability aspects in their booking process:

Establish CO_2 sorting and filtering as default-visible options in the booking process for promoting sustainable decisions.

Develop a Minimum Viable Product "Digital Passport" featuring points and badges to evaluate user engagement. These MVPs should include interesting and recognizable landmarks, such as the Brandenburg Gate in Berlin.

Partner with trusted and certified third parties for emissions verification to ensure credibility, transparency, and user confidence.

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iN4iN LATAM Chapter 2025:
Fostering Innovation Management and University Business Linkages at Higher Education Institutions

Knowledge Transfer Strategy in a Regional University: The Case of UTN, Costa Rica 2025

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Abstract

This paper outlines the institutional knowledge transfer strategy of the National Technical University (UTN) of Costa Rica, a young public university with a clear regional and social mission. Developed by the Vice-Rectorate for Research and Knowledge Transfer, the strategy reflects a participatory process aimed at strengthening the university's capacity to engage with external socio-productive sectors. Grounded in innovation systems theory and guided by open science principles, the strategy is built around five pillars, including governance, capacity building, external engagement, innovation culture, and evaluation. A 2025 institutional survey informed its design, revealing both existing strengths and key gaps—such as limited knowledge of intellectual property frameworks, weak incentive structures, and low levels of commercial transfer.

Keywords: university; innovation; knowledge transfer; technology.

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1. INTRODUCTION

In recent years, knowledge transfer has become an essential part of how universities contribute to society. No longer confined to teaching and research alone, higher education institutions are increasingly expected to engage with the world around them—building bridges across disciplines, sectors, and communities. This role is especially meaningful in places where universities are not just centers of knowledge, but also active players in promoting inclusive development and social progress. The National Technical University (UTN) of Costa Rica was founded with a deep territorial and social mission: to respond to regional needs and to expand access to education and technology in a fair and meaningful way. Within this vision, developing a strategy for knowledge transfer is not merely about ticking boxes; it is about making a commitment to ensure that what happens inside classrooms and labs does not stay there but reaches beyond the university walls to make a real difference. This paper tells the story of that effort: how UTN built its strategy through a collaborative and reflective process, grounded in dialogue with both its own community and external partners. It's a strategy rooted in Costa Rica's unique context, shaped by national policy goals, and inspired by international conversations on the future of innovation and education.

2. THEORETICAL FRAMEWORK

2.1. Innovation and the knowledge-based economy as a starting point

Innovation, knowledge, and connection to various sectors have long been studied in an integrated manner. Key conceptual frameworks include the Sabato Triangle (Sábato & Botana, 1970) and the Triple Helix model (Etzkowitz, 1996). These frameworks emphasize the importance of interactions among universities, industry, and government to foster stability and strengthen the innovation system. They align with more complex models that seek to explain the innovation process, such as the one proposed by Kline and Rosenberg (1986).

The Sabato Triangle and Triple Helix approaches are complemented by more recent and systemic models, such as the concept of National Innovation Systems (INS). This theoretical development goes beyond merely describing the existing capacities for innovation. Instead, it explores the interactions among the many actors within this complex system (Lundvall, 1992). These actors are typically grouped into two broad categories: knowledge producers and knowledge users. Crucially, they operate within an institutional framework that either facilitates or hinders innovation by shaping these relationships.

Within this framework, universities play a central role as key actors in the knowledge infrastructure (Campos et al., 2023). According to Chesbrough (2003), National Innovation Systems and a shift toward more collaborative knowledge transfer models between academia and socio-productive sectors have sparked the emergence of new trends. These trends encourage business strategies in which firms actively engage with research groups or scientific communities. This dynamic is captured under a new conceptual approach: *open innovation* (Chesbrough, 2003).

This perspective is particularly relevant in certain fields. For instance, as Pisano (2006) notes, biotechnology—an area that demands significant capital investment—has advanced largely due to strong educational–private sector partnerships.

At this point, it is worth pausing to clarify the relationship between innovation, technology transfer, and knowledge-based economies. Innovation is a broad concept, but there is widespread agreement that it represents one phase in the broader knowledge cycle. In essence, it occurs when an invention is brought to market, generating added value in the form of goods and services (Drucker, 1985; Schumpeter, 1934; Rogers, 2003; Tidd & Bessant, 2013; OECD, 2005).

2.2. Technology transfer and knowledge exchange

According to López, Mejía y Schmal (2006), in its broadest sense, *technology transfer* refers to the dissemination or movement of a technology or product from its original creation—*the initial invention*—into a different context, often economic or social. This

definition implies that technology transfer originates either in the market or society itself and can take many forms, such as patents, licensing agreements, or contractual arrangements.

Technology transfer encompasses a range of activities aimed at enabling the adoption of new techniques or knowledge. These may include dissemination, demonstrations, training sessions, and other efforts that lead to innovation or the effective appropriation of knowledge. Often, such transfers involve a formal agreement, some form of payment for usage rights, or financial returns for the original inventor or knowledge producer (López et al., 2006).

A key challenge for those responsible for managing technology transfer lies in identifying and measuring knowledge as it moves from basic scientific research into applied technology or experimental development. This challenge becomes especially critical when defining and managing institutional policies within universities or public R&D centers, as they seek to capitalize on the knowledge and innovations developed within their institutions (Codner et al., 2012).

In Latin America, many universities generate substantial knowledge with real potential for industrial application. However, the local appropriation of that knowledge remains limited. In this regard, and with a view to promoting innovation through effective knowledge transfer, Upstill and Symington (2002) propose three basic modes of university-to-business technology transfer:

Non-commercial or open transfer, which includes academic seminars, workshops, public courses, professional training, and published research.

Commercial transfer, encompassing commissioned research, consulting services, licensing agreements, patents, intellectual property sales, and paid technical services (Wright et al., 2004; Lockett et al., 2005).

Business creation and spin-offs, referring to the formation of new companies—either direct or indirect spin-offs—or technology-based enterprises specifically designed to commercialize university-generated technologies (Upstill & Symington, 2002).

This last approach—creating new ventures—is increasingly seen as a vital mechanism for transferring technology (Mustar et al., 2008; Wright et al., 2004). Today, universities are deeply embedded in networks of economic and community actors, engaging in multiple forms of interaction. This leads to a broader understanding of transfer types. For example, López et al. (2006), Siegel et al. (2004), Leydesdorff & Etzkowitz (1998), Henderson et al. (1998), and Cohen et al. (2002) distinguish between different models of transfer.

One of them is the linear model, also referred to as the *traditional model*, which conceptualizes technology transfer as a sequential process flowing from the university to industry in a step-by-step fashion.

In contrast, the dynamic model, as proposed by Siegel et al. (2004), rethinks this approach. It acknowledges the blend of formal and informal mechanisms

involved in transferring knowledge. Under this model, universities that actively encourage faculty participation tend to produce more patents and licenses. To support this approach, they often allocate more resources to their Technology Transfer Offices (TTOs), intensifying efforts to market their innovations.

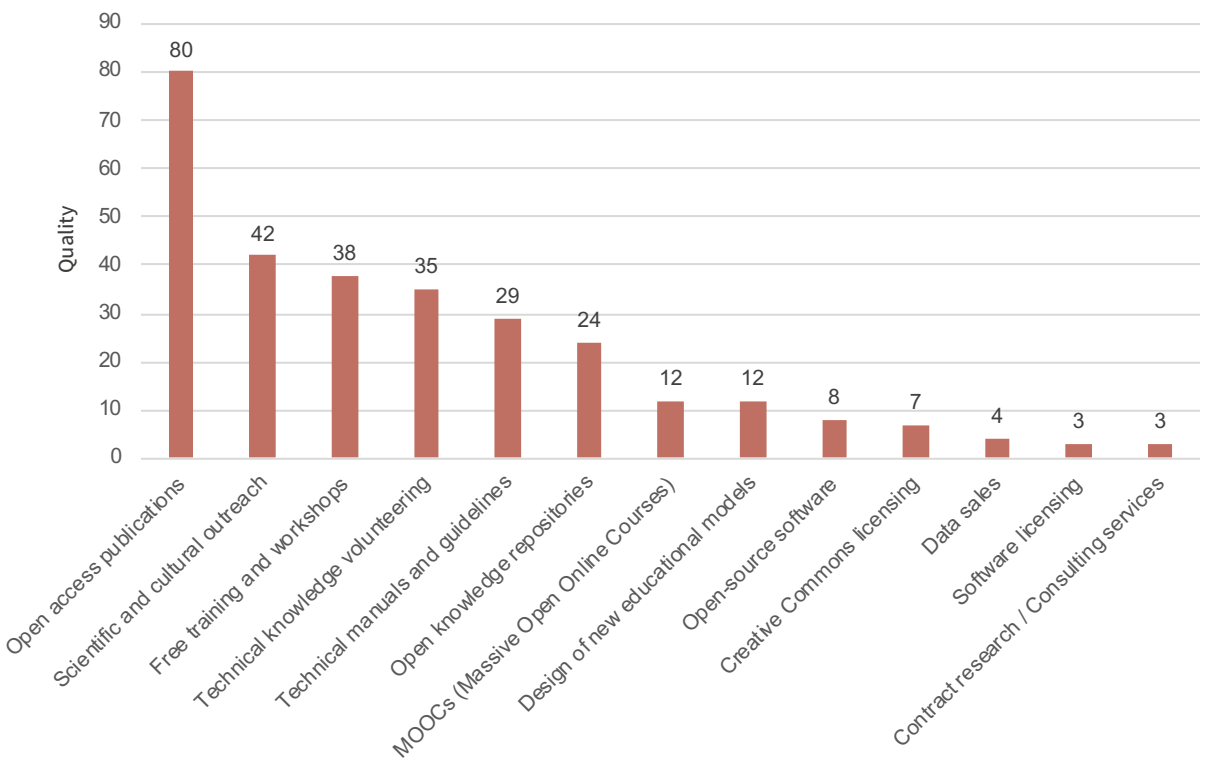
Collaboration between universities and industry can be powerful, but it is not always smooth. These sectors often operate with different mindsets—businesses move fast and focus on market needs, whereas universities work on longer research timelines and emphasize open knowledge. This mismatch can lead to tension around issues like intellectual property, licensing, and how to share results. In response to such challenges, alternative models like the "Catch-Up" approach have gained attention, especially in countries aiming to close the innovation gap. Rather than starting from scratch, this model focuses on absorbing and adapting existing technologies—a strategy that has helped nations like South Korea and Japan drive rapid development by learning from others and tailoring innovations to their own needs.

3. CONTEXT OF THE DESCRIBED RESEARCH/ PRACTICE

At the National Technical University (UTN) of Costa Rica, a survey was carried out among staff members identified by the Vice-Rector's Office for Research and Knowledge Transfer as being potentially involved in knowledge transfer—whether through commercial, non-commercial, or entrepreneurial activities. The effort aimed to include all regional campuses and provide a broad institutional perspective. With a 52% response rate, the survey offered valuable insights into the state of knowledge transfer at UTN, highlighting current practices, perceptions, and institutional challenges as seen by those actively engaged.

Building on this diagnostic process, several strategic pillars of the institutional framework were defined and further developed through participatory work sessions. The strategy was enriched not only by internal collaboration but also by the incorporation of good practices from other public universities and the contributions of the NEXO sub-commission of CONARE,

Figure 1. *Number of knowledge transfer mechanisms*

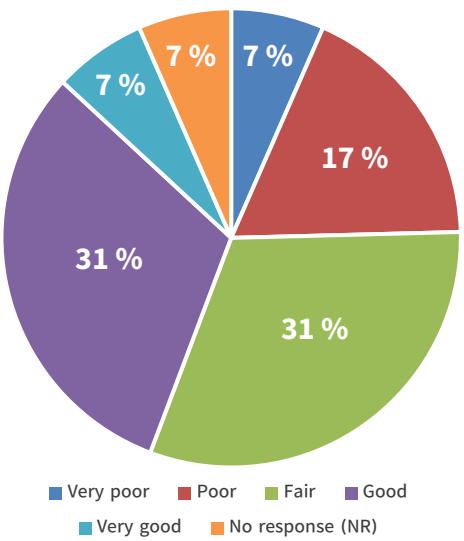


fostering an approach aligned with national coordination and shared learning across institutions.

4. MAIN RESULTS/REFLECTIONS

According to the results of the survey, 84% of respondents at the Technical University reported engaging in knowledge transfer activities. There is a clear predominance of non-commercial modalities of transfer, such as open-access publications, scientific and cultural outreach, and free workshops (see Figure 1). In contrast, commercial modalities—such as licensing and patents—remain underdeveloped. Only 7% of respondents rated the visibility of their works as "very good", while 31% considered it "good" and another 31% described it as "fair" (see Figure 2).

Figure 2. *Perceived effectiveness of knowledge transfer activity dissemination*



In terms of external linkages, the majority (54 mentions) indicated that primary partnerships for knowledge transfer were with external academic institutions. Communities were cited 52 times, followed by central government institutions (43 mentions), and private companies (38 mentions). Fewer respondents reported linkages with professional associations, local governments, entrepreneurs, and other stakeholders. Regarding intellectual property (IP) frameworks, only 19% of those surveyed reported being familiar with national and international regulations in this area.

When asked about the main barriers to knowledge transfer within the university, the most frequently cited challenge (96 mentions) was the lack of institutional incentives. Other significant barriers included limited training in IP-related matters (71 mentions), the absence of an institutional structure or technical support (68 mentions), regulatory constraints (24 mentions), lack of advisory services (18), and weak entrepreneurial capacity (9 mentions).

Drawing from the diagnostic process, five core pillars were defined to shape UTN's knowledge transfer strategy, in line with its regional mandate. The first pillar focuses on governance and institutional structure, establishing a clear framework led by the Vice-Rector's Office for Research and Knowledge Transfer (VIT) and a team of legal and technical experts. This structure supports intellectual property protection, inventor rights, and transparent agreements, aiming to ensure that all transfer activities are coherent, mission-driven, and socially responsive.

The second pillar addresses one of the most evident gaps identified in the diagnostic: a limited level of training and awareness regarding knowledge transfer and intellectual property. In response, dedicated training programs were developed and implemented, targeting various groups within the university community. These initiatives aim to build internal capacity, promote a better understanding of the legal and strategic dimensions of knowledge transfer, and foster a culture of protection and responsible use of intellectual property across the institution.

The third pillar centers on a recognition and incentive scheme, which had also been identified as one of the key institutional weaknesses. This component proposes various support mechanisms, ranging from seed funding for prototype development to institutional awards, mentoring opportunities, and participation in the financial benefits arising from licenses or technological assets.

The fourth pillar focuses on building stronger links with external socio-productive sectors. As part of this

effort, dissemination is also framed as an essential dimension—not only to strengthen partnerships, but also to increase the visibility of ongoing actions. The strategy, therefore, includes initiatives aimed at showcasing knowledge transfer efforts, creating spaces for co-creation, promoting scientific and technological outreach, and fostering a culture of innovation across all campuses. Visibility, in this sense, is not merely about highlighting achievements—it is about inspiring new vocations and reinforcing a shared sense of purpose.

Finally, no strategy can be sustained without monitoring and evaluation. A set of indicators has been defined to assess progress—not only in terms of the number of technologies transferred, but also in relation to their social or economic impact. Here, monitoring is conceived not as a mechanism of control, but as a way of learning, adjusting, and demonstrating the public value of the university. Evaluation, in this case, is an act of care: a commitment to ensuring that knowledge truly reaches those who need it.

5. CONCLUSION

The development of UTN's institutional strategy for knowledge transfer reveals a university that is not only aware of its regional mission, but also committed to translating that mission into tangible, responsive action. Rather than replicating external models, the strategy draws from its own diagnosis, its people, and its context to shape an approach that feels both grounded and aspirational.

The findings of the internal survey show a strong commitment from academic staff to engage in knowledge transfer—primarily through non-commercial modalities such as open publications, workshops, and community outreach. This reflects a university culture that values accessibility and public service. However, the same findings also highlight persistent structural challenges: limited awareness of intellectual property frameworks, a lack of institutional incentives, and scarce visibility for research outputs. These are not minor issues—they affect the university's capacity to connect its knowledge production with real-world needs and opportunities.

The five strategic pillars proposed—ranging from governance and capacity-building to external engagement and monitoring—offer a comprehensive, realistic roadmap. But more than that, they reflect a desire to strengthen the institutional ecosystem where knowledge flows not as a product, but as a shared process. The inclusion of incentives, the commitment to training, and the recognition of dissemination and evaluation as core dimensions all speak to a strategy that understands knowledge transfer as a long-term investment in trust, relevance, and collective capacity.

Ultimately, this experience affirms that knowledge transfer is not a mechanical function—it is a human one. It depends on relationships, understanding, and the ability of institutions to create spaces where innovation is not only possible, but welcome. The UTN's approach is an invitation to rethink how universities can accompany society—not only through technological outputs, but through values, engagement, and responsibility.

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iN4iN LATAM Chapter 2025:
Fostering Innovation Management and University Business Linkages at Higher Education Institutions

AI and the future of human-centered education

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Abstract

This case study investigates pedagogical innovation to re-emphasize human capabilities within AI's disruption, aiming to avoid the "AI trap." It focuses on a redesigned Leadership and Sustainability course for business students (typically 20-25 students per cohort) at Del Rosario University, Bogota, Colombia. The methodology uses an experiential learning model around the "Conscious Capitalism carbon fiber bikes" business simulator as an ongoing case study. This approach integrates David A. Kolb's Experiential Learning Theory, brain-based learning principles, and aspects of the flipped classroom model, redefining the teacher's role as a coach of the learning process. Main findings demonstrate that this immersive "learn-by-doing" approach fosters teamwork, strategic decision-making, and impact analysis—skills that are difficult to acquire through traditional methods. For instance, balanced scorecard data consistently showed improved market share and reputation metrics, e.g., average market share increasing by 15%, across most teams by the final rounds, alongside qualitative evidence from reflections detailing enhanced collaborative problem-solving. The simulator, by using tension and emotions, improves retention in line with brain-based learning. This student-driven environment promotes self-paced learning, mindfulness, and high engagement, while also promoting critical thinking, self-management, and problem-solving. It shows a human-centered integration of technology, where the simulator facilitates active experimentation without replacing core cognitive functions. To summarize, this teaching strategy effectively prevents the "AI trap," training students to handle complexity by developing unique human capacities.

Keywords: AI in education; experiential learning; business simulation.

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1. INTRODUCTION

AI and the future of human-centered education: How do we bring humanity back into teaching? In this fast-changing world of AI, education must integrate new AI tools and reinvent the way we educate to emphasize unique human capabilities (Unceta et al., 2021). Kolb (2015) recommends an integrated approach that recognizes that neither traditional nor modern teaching methods are obsolete; rather, finding the optimal configuration is key. There are many advantages for educators to use AI for increasing productivity and creating new learning experiences, but we also need to understand the risks of the AI trap, where we outsource our thinking to a robot (Alam, 2021). However, the decision on how to integrate AI into education is a choice that involves institutional values, judgment, and ethical considerations.

Our modern environment, characterized by constant change and rapid growth of knowledge, forces education to focus on developing critical and analytical thinking individuals (Ramírez-Narváez et al., 2024). Therefore, we need to proactively reinvent our pedagogical methods that emphasize the unique added value of human capabilities. While much of the current academic research heavily focuses on integrating AI tools into education, this paper specifically addresses a critical, yet less explored, area: demonstrating pedagogical innovation that cultivates unique human capabilities without direct reliance on AI tools. This approach fills a gap by focusing on strengthening core human cognitive and social functions to counteract the 'AI trap' (Alam, 2021; Faria et al., 2009).

This paper claims that the unique fusion of experiential learning, brain-based learning principles, and a flipped classroom structure creates a uniquely robust learning ecosystem that fully develops the specific match of human cognitive and emotional capabilities, such as complex strategic decision-making and emotional resilience under pressure, essential for thriving beyond AI automation. The experiential learning model is selected for the basic idea of the learning-by-doing principle. The flipped classroom is selected since it encourages students to take ownership of their learning process. Brain-based learning principles are selected since they are a valuable source to identify how we learn and stimulate the learning process. Other human-centered pedagogical approaches, such as Freire's problem-posing education or Dewey's emphasis on learning by doing, similarly promote active student engagement and the development of critical skills.

We will examine the following literature for this paper: experiential learning, a method focused on 'learning by doing' and acquiring knowledge through direct experience rather than memorization; flipped classrooms, a model where core content is delivered outside of class to enable interactive, applied learning during class time; and brain-based learning principles, an approach that aligns teaching methods with cognitive neuroscience findings.

This unique fusion of human-centered pedagogies, which also implicitly redefines the teacher's role as a facilitator, is precisely how this paper proposes to cultivate the critical human capabilities necessary to avoid the 'AI trap' and empower students for continuous self-creation and purpose-driven action (Alam, 2021; Faria et al., 2009). We will then analyze a best-practice example, namely the course on Leadership and Sustainability, to illustrate how this works.

The Leadership and Sustainability course uses the Conscious Capitalism bike simulator, where teams make six rounds of strategic decisions starting at $1.5 million. Tasks include defining roles, targeting markets, setting up production, designing brands, pricing, and conducting financial planning. Later rounds allow raising $2.5 million via investor pitches and global expansion (e.g., Bangalore, New York). Teams justify decisions post-round and receive feedback. Performance is evaluated via a balanced scorecard (market share, reputation, HR management), emphasizing teamwork reflection.

We know that AI can automate some tasks, but education's core remains a profoundly social and human process. We need to proactively reinvent our pedagogical methods that emphasize the unique added value of human capabilities to stay relevant. This article aims to demonstrate a unique way of teaching without AI, using the online business simulation to create a

new teaching experience for the course on Leadership & Sustainability for bachelor business students at Del Rosario University in Bogota, Colombia.

2. THEORETICAL FRAMEWORK

This pedagogical strategy for teaching leadership and sustainability is a unique fusion of experiential learning theory, brain-based learning, and the flipped classroom model. This unique combination fosters a synergistic learning ecosystem, where, for instance, the competitive emotional engagement of the simulator (brain-based principle) uniquely intensifies the 'Active Experimentation' within Kolb's cycle, driving deeper cognitive processing. These frameworks all show human-centered learning and the development of higher-order thinking skills, addressing the issue of avoiding the "AI trap."

2.1. Experiential learning as the foundational pedagogy

The entire design of the Leadership and Sustainability course is an example of Experiential Learning Theory (ELT) (Kolb, 2015), which claims that knowledge is continuously gained through personal and environmental experiences and is fundamentally a process of creating knowledge through the transformation of experience (McFarland, 2017). ELT is deeply rooted in the work of influential 20th-century scholars such as John Dewey, Kurt Lewin, Jean Piaget, and Paulo Freire.

The course explicitly orchestrates the four stages of Kolb's Experiential Learning Cycle (ELC) (Kolb, 2015):

- Concrete Experience (CE): Students are fully involved in new experiences through the business simulator decision rounds. This hands-on engagement in a 'safe environment' to mimic future situations directly applies to CE. The personality test provides concrete experiences.
- Reflective Observation (RO): The requirement for students to articulate the logic behind their decisions, analyze balanced scorecard results, and engage in structured reflection on their learning journey— using tools like the eco-cycle planning canvas and the start, stop, continue framework—directly represents critical observation (Kolb, 2015).
- Abstract Conceptualization (AC): Initial theoretical readings, developing team strategies and business plans, and adapting those strategies based on simulator feedback and market information represent the process of creating concepts and integrating observations into theory (Kolb, 2015). The insights from industry leaders also contribute to abstract conceptualization.
- Active Experimentation (AE): Submitting decisions in the simulator, making pitches to venture capitalists, and implementing strategic choices like international expansion are clear examples of actively testing theories and making decisions to solve problems (Kolb, 2015).

This dynamic and repeating cycle ensures that learners "touch all the bases," allowing for new understanding

upon returning to an experience. The emphasis on problem-solving, risk-taking, and self-correction within the simulator builds confidence and motivation for acquiring new knowledge, aligning with core ELT principles (Kolb, 2015).

2.2. Redefining the teacher's role in the AI age

The course design shows the redefined role of the teacher in current education, shifting from a "dispenser of information" to a coach of the learning process (Kolb, 2015). The professor in this course provides feedback, offers coaching tips based on simulations, and evaluates strategic pitches. This supports the idea that teachers should use scaffolding, adapted to each student's needs, to effectively engage learners and strengthen or transform their interaction behaviors.

While AI may automate routine jobs, it cannot reproduce the key human attributes such as creating personal connections, encouraging social relationships, and engaging in spontaneous insights (Alam, 2021). The professor's direct feedback sessions and personal assessment of team pitches underscore the irreplaceable human element in teaching (Ramírez-Narváez et al., 2024). This approach aligns with a "pedagogy of responsiveness" and "pedagogy of engagement," where teachers adjust instruction based on student input and capabilities (Black & Wiliam, 2018). For example, this involves gathering evidence of all students' understanding of the concept in class, rather than relying solely on those who are confident enough to share their views.

2.3. Flipped classrooms promote human independence, metacognition, and self-regulation

The pedagogical strategy actively promotes human agency and experience by rejecting the "banking concept of education" (McFarland, 2017), where knowledge is passively deposited. Instead, students are active participants, taking responsibility for their learning through team roles, decision-making, and presentations (Ramírez-Narváez et al., 2024). This creates problem-posing education, encouraging students to critically reflect on positive change (McFarland, 2017). The course promotes the development of metacognition and self-regulation. Students are taught planning and self-monitoring through setting team roles and strategies, and self-evaluation through analyzing balanced scorecard results and engaging in structured reflection. The role of the educator is to gain evidence about the students' capabilities to mitigate the accountability trap with the flipped classroom model.

The requirement to articulate the logic behind decisions further enhances metacognitive awareness. While AI tools (like learning analytics from the simulator) can provide data for this, the ultimate interpretation and strategic planning for improvement remain with the human learner (Alam, 2021). By requiring students to engage with material independently before class and make complex decisions, the flipped classroom principles also implicitly encourage metacognitive skills and self-direction (Ramírez-Narváez et al., 2024). While a common challenge for flipped classrooms can be ensuring consistent student engagement with pre-class content, the immersive and competitive nature of the business simulator, coupled with the necessity for team decision-making and immediate feedback, inherently incentivizes this independent preparation. This structure transforms passive preclass consumption into a direct prerequisite for effective active experimentation and reflective observation within the experiential learning cycle.

2.4. Integration with brain-based learning principles

The course's emphasis on active, engaging, and iterative learning also resonates strongly with brain-based learning pedagogical principles, which apply findings from cognitive neuroscience to educational practices (Arun & Singaravelu, 2018).

- Neuroplasticity and Growth Mindset: Carol S. Dweck's (2016) research on mindsets highlights brain neuroplasticity, emphasizing that the brain changes and strengthens with use. The continuous decision-making, feedback loops, and strategic adjustments within the simulator naturally promote this "brain as a muscle" concept.

The course design encourages a "growth mindset" where abilities are developed through effort rather than being fixed.

- Engagement and Meaning: Brain-based learning promotes student engagement, active involvement, and teaching meaning and understanding rather than memorization (Arun & Singaravelu, 2018). The immersive business simulator, the competitive element, and real-world connections through guest speakers create a highly engaging and meaningful learning environment. Winters (2001) and Caine & Caine (1991) underscore that learning engages the entire physiology and involves a search for meaning. The "emotionality of an experience influences retention" (Arun & Singaravelu, 2018), and the high-stakes decisions and pitches in the simulator would certainly trigger emotional responses, increasing retention.

Cognitive Processes: James Zull's work, which directly parallels (Kolb, 2015) ELT with brain functioning, suggests that concrete experiences engage the sensory cortex; reflective observation involves the back integrative cortex; the creation of new abstract concepts occurs in the frontal integrative cortex; and active testing utilizes the motor brain (Ramírez-Narváez et al., 2024). So, the structured format of the reflection and simulation exercises would be consistent with using these various parts of the brain during the learning process.

2.5. Guiding AI integration and avoiding the "AI Trap"

The best practices example is designed to avoid the "AI trap" of outsourcing human thinking. This aligns perfectly with the comprehensive framework for AI's influence on pedagogy, which centers on human-centered learning and a critical, values-driven integration of technology (Alam, 2021). The framework claims that AI should enhance, broaden, and genuinely improve education rather than directly substitute human teachers or human cognitive functions.

The business simulator, while a technological tool, is not presented as a replacement for human interaction or critical thought. Instead, it serves as a sophisticated environment for active experimentation (Faria et al., 2009), allowing for the practice of complex skills in a controlled setting. According to Alam (2021), this is an example of exploring non-human AI-driven technologies for educational aims rather than replicating traditional human teaching techniques. As noted by this author, technology can help the teacher to focus on more meaningful interactions like coaching and complex feedback, rather than automating their professional judgment or pushing them to work "more like robots." The simulator is used in class as an ongoing case study to assess students' performance in leading a sustainable business venture. Every class has different dynamics and results, which makes it a powerful tool to mimic real-world situations and prepare students as future leaders.

The pedagogical strategy presented for teaching leadership and sustainability serves as an excellent model for modern education. It effectively uses the principles of experiential learning to promote deep understanding, critical thinking, and self-direction. Using brain-based learning principles, it reflects how the brain naturally learns by mixing active 'doing' with reflection using the business simulator. Moreover, its design integrates elements of the flipped classroom by providing students with theoretical knowledge prior to in-class application. This strategy integrates technology in a human-centered way, using the simulator to assist learning (Faria et al., 2009).

3. CONTEXT OF THE DESCRIBED PRACTICE

This section discusses the experiential learning in the Leadership and Sustainability course for bachelor students (about 20-25 students per cohort) at Universidad del Rosario (Del Rosario University), Bogota, Colombia. It teaches critical thinking and problem-solving using a business simulator.

The teaching approach is a fusion of experiential learning theory, brain-based learning principles, and flipped classroom elements, with the teacher acting as a coach. The human-centered combination promotes basic human capabilities, such as critical thinking,

self-direction, and problem-solving. In this AI world, students are being prepared for success by promoting personal development and focusing on purpose.

Part 1: Setting the stage and initial strategy (weeks 1-6)

Students learn fundamental knowledge through readings and discussions, with teams presenting keynotes and facilitating Q&A via Slido. Using a tool like Slido allows all students to contribute to the discussion and show their level of understanding of the topic that they had to prepare before class. They complete a personality test and reflect on becoming sustainable leaders. Following the introduction to the "Conscious Capitalism carbon fiber bikes" business simulator, teams define roles and values using a Team Charter Canvas and then present an initial business plan. The first decision round involves gathering market data and making initial strategic choices regarding store location, production, and product design within a $1.5 million budget.

Part 2: Operational decisions and initial feedback (weeks 7-10)

In Decision Rounds 2 & 3, teams make operational decisions regarding compensation, marketing, production, and pricing, with an additional $1 million investment. Following each round, teams privately present their decisions and underlying logic to the instructor, and receive individualized feedback and coaching based on simulation data. After Decision Round 3, teams review their results on a balanced scorecard, which assesses market share, reputation, and human resource management, reflecting teamwork and contributing to their grades.

Part 3: strategic expansion and final reflection (weeks 11-15)

In Decision Round 4, teams pitch their business vision to a venture capitalist to raise an additional $2.5 million, with pitch quality impacting their share price. Rounds 5 & 6 focus on strategic expansion, including international markets and R&D investments. In the final round, teams present their final decisions and reflect on their learning journey using tools like the eco-cycle planning canvas and the 'start, stop, continue' framework. Using those frameworks enhances the learning experience by reflecting on their personal and group experiences. Throughout the course, industry leaders share their perspectives on leadership and sustainability-related topics to connect experiences with real-world examples.

Materials Needed. Key materials include the "Conscious Capitalism carbon fiber bikes" business simulator, academic articles, Slido, personality tests, the Team Charter Canvas, the balanced scorecard, the eco-cycle planning canvas, and the "start, stop, continue" framework.

Instructor Preparation. The instructor must become familiar with the business simulator and its coaching tips. This preparation involves organizing reading materials, managing digital tools such as Slido and personality tests, and preparing individual team presentations and feedback rubrics. It also includes understanding balanced scorecard metrics, inviting industry guest speakers, and developing facilitation skills to guide sessions using the Team Charter Canvas and the eco-cycling planning framework.

Debriefing Exercise. Debriefing is crucial for connecting experience to theory. This involves teams reflecting on balanced scorecard outcomes, discussing decision impacts on market share, reputation, and HR management, and reviewing teamwork dynamics. Students also reflect on their learning journey as future leaders using tools like the eco-cycle planning canvas and the 'start, stop, continue' framework. Finally, they connect experiential insights to course articles and theories, deepening conceptual understanding.

Assessment and Reflection. Student learning is assessed through quantitative and qualitative measures. Simulation performance, based on normalized balanced scorecard results, contributes to team grades. Individual assignments, including in-simulator micro-simulations, enhance specific knowledge. Quizzes and learning assessments assess understanding of business simulation concepts. Written reflections (personality test, eco-cycle, start-stop-continue) offer

insights into self-awareness and learning progression. For this case study, qualitative data from reflections and debriefing sessions were thematically analyzed to identify patterns in learning progression, and findings were triangulated across simulator performance, student presentations, and instructor observations to enhance validity. Presentations, including keynotes and the venture capitalist pitch, assess articulation and strategic thinking. Participation in Slido discussions and classroom contributions is also evaluated, with quiz and assessment scores often determining failure.

4. DISCUSSION OF PEDAGOGICAL IMPACT

The pedagogical shift in the Leadership and Sustainability course addresses the crucial question of bringing humanity back into education amidst AI disruption, directly countering the "AI trap" of outsourced thinking. This is achieved through a fusion of experiential learning theory, brain-based learning principles, and flipped classroom elements, with the educator redefined as a coach of the learning process.

Central to this approach is the "Conscious Capitalism carbon fiber bikes" business simulator, which transforms learning into an immersive "learn-by-doing" experience. This real-world simulation environment allows students to practice Kolb's ELT cycle, which promotes strategic decision-making, teamwork, and impact analysis abilities. Most are not fully developed using traditional teaching methods. The simulator's competitive, challenging nature also uses brain-based learning principles, introducing tension and emotions that boost retention and promote a "growth mindset."

On top of that, flipped classroom principles promote self-paced learning, with in-class time dedicated to interactive discussion rather than content delivery. This holistic model develops essential human capabilities, including critical thinking, self-direction, and problem-solving. Importantly, the simulator functions as a sophisticated instrument for active explorations, boosting learning without replacing basic human cognitive capabilities.

5. CONCLUSION

In an era increasingly shaped by AI, the primary issue for education is how to reinforce essential human capabilities while effectively avoiding the "AI trap" of outsourced thinking. This study presents a unique pedagogical fusion of experiential learning, brain-based learning principles, and flipped classroom elements, where the educator is redefined as a coach.

Students actively develop strategic decision-making, resilience, critical thinking, and problem-solving skills through the simulator. These uniquely human skills are essential for success beyond AI automation.

This human-centered approach guarantees that technology, such as the simulator, promotes active experimentation without reducing core human cognitive and social functions. By going beyond traditional content delivery, we encourage self-creation, purpose-driven action, and metacognition, preparing students not just for automated tasks but also for dealing with complexity and creating new understanding. This model provides a strong answer to bringing humanity back into teaching, so education remains a truly social and transformative activity that develops unique human potential.

While this case study provides compelling insights, the findings are context-specific; future research should investigate similar pedagogies in a number of situations and using comparative techniques.

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iN4iN LATAM Chapter 2025:
Fostering Innovation Management and University Business Linkages at Higher Education Institutions

Innovative impact indicators for university-industry collaboration

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Abstract

University-Industry Collaboration (UIC) is increasingly vital for innovation, yet its success is often measured by narrow, traditional metrics like patent counts and licensing income. This approach fails to capture the full spectrum of value generated, including process efficiencies, human capital development, and broader societal benefits. This paper addresses this gap by proposing a holistic, multi-dimensional framework of innovative impact indicators. Synthesizing key findings from systematic literature reviews, the paper structures indicators into three critical domains: Input Indicators that measure the potential for success, Process Indicators that assess the health and management of collaboration, and Output and Impact Indicators that evaluate the full range of economic, institutional, and socio-environmental outcomes. The framework is grounded in the practical need for better measurement tools, as highlighted by feedback from international funding programs. It offers a practical and robust tool for universities, industry partners, and policymakers to more accurately evaluate and enhance the true value of their collaborative ventures.

***Keywords*:** university-industry collaboration; impact indicators; innovation management.

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1. INTRODUCTION

University-Industry Collaboration (UIC) is widely recognized as a cornerstone of modern innovation ecosystems, serving as a critical engine for economic growth and technological advancement (Ankrah and Al-Tabbaa, 2015; Rybnicek and Königsgruber, 2019). Policymakers, academic leaders, and corporate executives increasingly look to these partnerships to solve complex societal challenges and maintain a competitive edge in a globalized, knowledge-based economy (Borges et al., 2022). Despite their strategic importance, evaluating the success of these collaborations remains a significant challenge. The methods generally used may not keep pace with the evolving complexity of these relationships, creating a critical measurement gap.

In the past, assessments of university–industry collaborations (UIC) have often focused on a limited range of outcomes that are straightforward to measure and largely centered on economic gains. Typical ways to measure collaboration include looking at how many patents are created, how much money comes from licensing deals, or how many research papers are published together (Perkmann et al., 2013). While valuable, these metrics provide an incomplete and often misleading picture of a partnership's true value. This narrow view fails to account for three critical dimensions of success. First, it neglects the foundational "input factors"—such as institutional stability and human capital—that are the essential predictors of successful outcomes (Ćudić et al., 2022). Second, it overlooks the quality of the collaborative process itself, including the relational dynamics of trust, communication, and strategic alignment that are vital for translating potential into results (Rybnicek and Königsgruber, 2019). Finally, and perhaps most importantly, such assessments fail to capture the broader and often intangible social and environmental impacts, including contributions to public health, the development of sustainable technologies, and the creation of human capital (Ervits, 2024).

This measurement gap creates a critical problem: it leads to an undervaluation of partnerships whose primary benefits are institutional or societal, and it provides managers and policymakers with limited actionable insights for improving collaboration design. The specific objective of this paper is to address this gap by proposing a holistic and multi-dimensional framework of innovative impact indicators for UIC. This framework is developed by synthesizing the findings from a comprehensive review of key academic literature to construct a model that is both theoretically robust and practically applicable, enabling stakeholders to more accurately assess, manage, and articulate the full value of their collaborative efforts.

2. THEORETICAL FRAMEWORK

The evaluation of UIC is a complex, multi-faceted challenge that has evolved significantly in academic literature. A robust theoretical framework for developing innovative impact indicators must therefore synthesize several distinct but complementary streams of research. This review consolidates four primary perspectives that collectively form the foundation for the holistic model proposed in this paper: the Input-Output model, the Process and Success Factor model, the Socio-Environmental Impact model, and the overarching Bibliometric Landscape.

The most foundational approach to understanding UIC performance is the Input-Output model. This perspective treats collaboration as a system in which specific enabling conditions directly influence measurable results. Ćudić et al. (2022) proposed a model, validated through statistical analysis, demonstrating that investments in specific input areas are key to achieving successful outcomes in university–industry collaborations. They highlight four main types of inputs. Institutional factors include organizational and national support, such as R&D spending and a stable political environment. Human factors refer to the availability of skilled researchers who can actively contribute to projects. Linkage factors capture the intensity of interactions between universities and industry, such as joint funding arrangements and collaborative research initiatives. Finally, framework factors involve the underlying infrastructure, including digital and information technology systems, that facilitate effective cooperation. Together, these inputs help explain why some collaborations produce stronger results than others. These inputs, in turn, produce tangible outputs like new products and intangible outputs

such as patents and new business models. This model establishes a critical baseline: to understand impact, one must first measure the foundational resources and conditions that make it possible.

Nevertheless, the link between inputs and outputs is not automatic; it is mediated by the quality of the partnership itself. This brings us to the Process and Success Factor model, which focuses on the relational and managerial dynamics *within* the collaboration. After reviewing over a hundred studies, Rybnicek and Königsgruber (2019) emphasize that the strength of partnerships is a key driver of successful university–industry collaborations. Factors such as trust, clear communication, and shared commitment form the foundation of these strong relationships. Their analysis brings together a wide range of research into a detailed model of success, highlighting how the quality of interactions between partners can determine the effectiveness of collaborative efforts.

As Barnes et al. (2002) found in their classic case studies, effective interaction is the bedrock of successful R&D projects. Furthermore, Rybnicek and Königsgruber (2019) highlight the importance of institutional factors like flexibility and clear governance, and output factors like the clarity and alignment of objectives. This perspective is reinforced by Ankrah and Al-Tabbaa (2015), whose review concludes that most successful UICs are treated as a "*rational process*" (p.396), requiring deliberate management, clear roles, and strong governance to navigate the inherent barriers, such as the cultural divides and bureaucratic hurdles identified by Muscio and Vallanti (2014). While the first two models explain *what* is needed and *how* it should be managed, the third perspective addresses the crucial question of *what constitutes true impact*.

The Socio-Environmental Impact model argues for expanding the definition of success beyond purely economic metrics. The research by Ervits (2024) is central to this view, demonstrating that the most impactful collaborations are often "*communities of shared values*" (Ervits, 2024, p.2) that aim to solve societal problems. This perspective shifts the focus to outcomes that benefit the public good, proposing four core categories of social benefits: improvements in health and quality of life, the creation of environmental solutions, knowledge creation for social good, and human capital development through training and job creation. This aligns with the broader push to evaluate university "third mission" activities (Molas-Gallart et al., 2002) and recognizes that the development of human capital is one of the most unique and valuable outputs of the UICs (Schofield, 2013).

Finally, the Bibliometric Landscape provides a meta-analysis that validates the centrality of these themes. The review by Borges et al. (2022) maps the entire research field, confirming that Innovation, Cooperation, and Knowledge Transfer are the most dominant concepts in the literature. Their analysis also reveals an evolving focus on contemporary outcomes like "*Academic Entrepreneurship*" (p.12) and "*Commercialization*," (p.12), reinforcing the need for forward-looking indicators. This broad view confirms that a comprehensive framework must account for the foundational inputs, the relational process, and a

multi-dimensional definition of impact that includes economic, institutional, and societal outcomes. While each of these theoretical streams offers valuable insights, they have often been explored in isolation. The primary contribution of the framework proposed in this paper is to synthesize these distinct perspectives into a single, integrated, and practical tool for the holistic evaluation of UIC.

3. CONTEXT OF THE DESCRIBED RESEARCH

The development of this framework is driven by a dual context: on one hand, the fragmented state of academic research on UIC measurement and, on the other hand, a clear and pressing demand from the field for more effective evaluation tools. It is not merely an academic exercise but a direct response to this evident need for practical and robust approaches.

The academic landscape has produced several invaluable systematic reviews that map the field. For instance, the work of Ankrah and Al-Tabbaa (2015) provides a comprehensive end-to-end process model, breaking down UIC into five core themes: motivations, forms, formation, facilitators/barriers, and outcomes. Similarly, the review by Rybnicek and Königsgruber (2019) extracts the critical success factors that determine the health of the partnership itself, emphasizing relational dynamics like trust, communication, and mutual commitment. Other research has focused on specific aspects, such as the motivations for academic engagement (Perkmann et al., 2013), the common barriers and obstacles to success (Muscio and Vallanti, 2014), or the unique social and environmental benefits that collaborations can generate (Ervits, 2024).

While each of these research streams provides deep insights, their specialization has resulted in a patchwork of disparate models and concepts. For a university manager, industry partner, or policymaker seeking guidance, there is no single, unified framework that connects the foundational inputs (Ćudić et al., 2022) with the collaborative process (Rybnicek and Königsgruber, 2019) and the full spectrum of multi-dimensional outcomes (Ankrah and Al-Tabbaa, 2015; Ervits, 2024). This fragmentation leaves practitioners with a theoretical toolbox of individual parts but no clear instructions on how to assemble them into a functioning engine for evaluation.

This academic context is mirrored by a pressing practical demand. The need for an integrated framework was starkly illustrated by the feedback received on a recent Erasmus+ Capacity Building project proposal. The project, designed by a consortium of European and Latin American partners to enhance student employability through an Internet Work-Based Learning (IWBL) model, was praised for its high relevance. However, the evaluators identified a critical, overarching weakness. Their feedback stated that the proposal *"lacks a robust framework for measuring impact"* and *"does not present an appropriate set of indicators or baseline data."* This real-world example is not an isolated case; it is representative of a broader shift in expectations from funding bodies and stakeholders. There is a clear demand to move beyond narratives of activity and simple output counts toward a sophisticated, evidence-based demonstration of value.

Therefore, the framework presented in this paper was developed to bridge this critical gap. It directly responds to the practical need for better measurement tools by synthesizing the fragmented academic knowledge into a single, coherent, and actionable model. Its context is one of translation: transforming the rich but disjointed insights from the literature into a practical solution for the field.

4. MAIN RESULTS

The primary result of this research is a comprehensive, three-part framework of innovative indicators designed to provide a holistic and evidence-based assessment of UIC. This framework synthesizes the different streams of academic literature into a single, practical tool. It is structured to evaluate a collaboration across its entire lifecycle: the foundational conditions that enable it, the health of the collaborative process itself, and the full spectrum of its multi-dimensional impact.

Part 1: Input indicators (the foundation for success)

The success of any collaboration is fundamentally dependent on the quality of its foundational elements. Merely initiating a partnership is no guarantee of a valuable outcome; the right enabling conditions must be in place. This section outlines the critical input indicators, adapted from the statistically validated model of Ćudić et al. (2022), which measure the potential for success.

Institutional factors: Indicators like these offer a baseline understanding of the conditions necessary for successful partnerships. These indicators give a sense of how supportive a country's economic and policy environment is for research and innovation. Among them, the Gross Expenditure on R&D (GERD) stands out as a particularly useful measure, showing the level of resources a country dedicates to developing its research capabilities. At the organizational level, this translates into the clarity and consistency of university policies regarding Intellectual Property (IP), overhead, and contracting. As Muscio and Vallanti (2014) have shown, bureaucratic and administrative hurdles are among the most significant perceived obstacles to successful collaboration. Therefore, measuring process efficiency, such as the time taken to approve a research contract or a Non-Disclosure Agreement (NDA), serves as a practical indicator of a supportive institutional environment. The presence of dedicated support structures, like a well-resourced Technology Transfer Office (TTO), is another critical measure of an institution's readiness for effective engagement (Ankrah and Al-Tabbaa, 2015).

Human factors: This category focuses on the quantity and, more importantly, the quality of the available human capital. The most significant indicator identified by Ćudić et al. (2022) is the density of Researchers in R&D. For a specific collaboration, this can be measured by the number of PhDs and postdocs involved in industry-funded projects. Furthermore, the quality of these researchers is paramount. An innovative indicator is the percentage of faculty with prior industry experience, as this suggests a greater understanding of commercial contexts and timelines. Equally important is the involvement of the next generation of talent, measured by the number of student internships and co-supervised theses, which serves as a leading indicator of future knowledge transfer and talent pipeline development (Ankrah and Al-Tabbaa, 2015).

Linkage factors: These indicators measure the intensity and nature of the direct interaction between the university and industry partners. The strongest predictors of success, according to Ćudić et al. (2022), are GERD performed and financed by a business enterprise. At the project level, this translates into the percentage of R&D budget provided by industry sources, including the estimated value of in-kind contributions such as equipment, materials, or staff time. The number of active projects and the volume of joint publications serve as straightforward measures of the intensity of collaboration. A more nuanced indicator is personnel exchange, measured in person-days, where staff move between organizations, as this facilitates the transfer of tacit knowledge, which is often more valuable than formal deliverables (Schofield, 2013).

Part 2: Process and success factor indicators (the health of the partnership)

Strong inputs are necessary but not sufficient for success. The bridge between potential and impact is the collaborative process itself. This section outlines indicators derived from the extensive systematic review of Rybnicek and Königsgruber (2019), which measure the health, quality, and management of the partnership.

Relationship quality: This is arguably the most critical set of process factors, focusing on the interpersonal and inter-organizational dynamics. Effective communication plays a crucial role in successful collaboration. It can be tracked in simple ways, such as the frequency with which partners hold formal or informal meetings to stay in touch. Instead of only tracking the number of meetings, a better way to see if communication works is to check whether partners begin using a common language, indicating they have overcome the differences between academic and industry terminology. Mutual trust is another universally cited success factor (Ankrah and Al-Tabbaa, 2015). It can be measured by the track record of partners delivering on their promises and, qualitatively, by the perceived

openness in discussing challenges and failures. Finally, mutual commitment is a leading indicator of a partnership's longevity and can be measured by the level of visible support from senior leadership and a demonstrated willingness to plan for future collaborations beyond the current project's scope.

Management and governance: A healthy relationship must be supported by effective management structures. The presence of a 'collaboration champion'—a key individual who drives the partnership forward—is a well-documented facilitator (Ankrah and Al-Tabbaa, 2015). The effectiveness of governance can be measured by the existence of a joint steering committee and the clarity of a shared strategy document that outlines roles, responsibilities, and milestones. The degree of cultural compatibility between the open, long-term orientation of academia and the proprietary, short-term focus of industry is a critical success factor that, while challenging to quantify, can be assessed through periodic partner surveys.

Framework and legal alignment: This concerns the formal structures that govern the collaboration. A key indicator is IPR policy flexibility, measuring the university's ability to adapt its standard procedures to meet the needs of an industry partner. The clarity of legal contracts—defining deliverables, confidentiality, and ownership—is essential for preventing the kinds of disputes that frequently derail collaborations (Muscio and Vallanti, 2014). Furthermore, the partnership's ability to operate within the broader external environment can be measured by its success in leveraging public funding or tax incentives.

Part 3: Output and impact indicators (the full spectrum of results)

This is the state-of-the-art component of the framework, moving beyond a single definition of success to capture the multi-dimensional value created. As illustrated in Figure 1, impact is divided into three distinct but interconnected domains: Economic and Innovation, Institutional, and Social and Environmental.

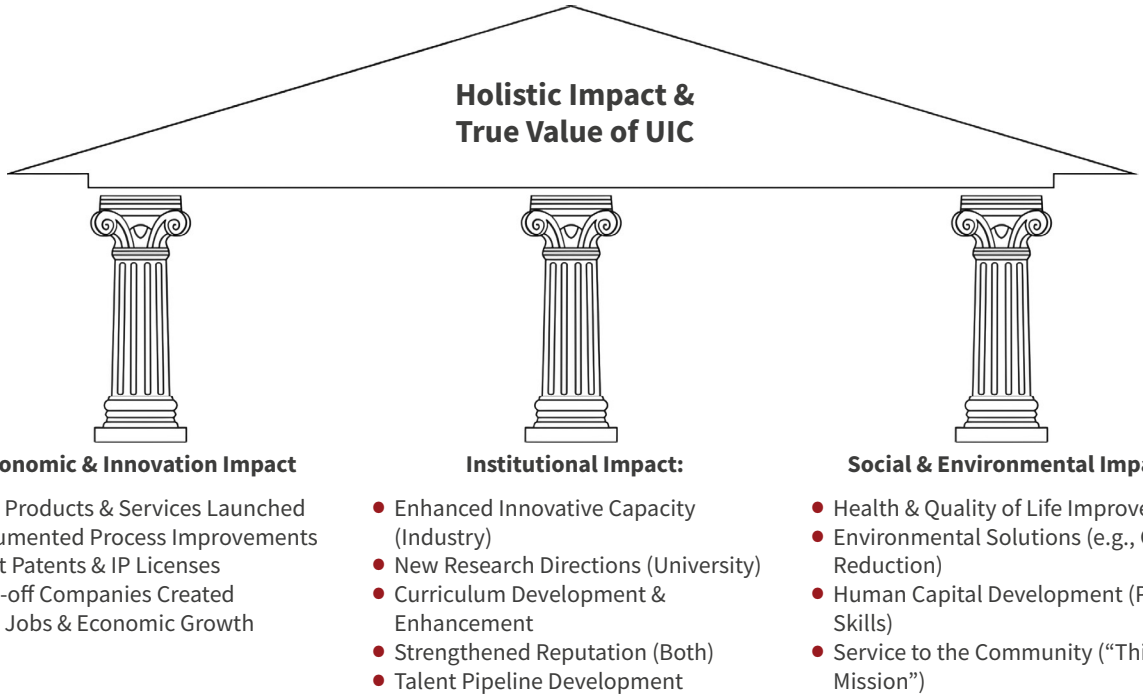
The specific indicators within these domains are as follows:

Economic and innovation impact: These are the direct commercial and technological outputs, often considered the traditional markers of success. Key indicators include the number of joint patents filed and granted, and the number of new products or services launched based on the collaboration's research. Beyond simple creation, impact can be measured by documented process improvements implemented by the industry partner (e.g., a 15% reduction in manufacturing costs). The entrepreneurial impact, a theme of growing importance (Borges et al., 2022), is measured by the number of spin-off companies created and the amount of follow-on funding secured. Finally, direct economic contribution is measured by new jobs created and the revenue generated from licensing the IP.

Institutional impact: These indicators measure the often-overlooked benefits to the partners' internal capabilities and knowledge base. For universities, a key impact is the development of new or updated curricula informed by real-world problems, and the generation of new research directions that would not have emerged without industry insight. For the industry, a critical indicator is enhanced innovative capacity, reflecting the absorption of new knowledge and skills, and the accelerated commercialization of technologies (Ankrah and Al-Tabbaa, 2015). For both partners, an important but intangible outcome is an enhanced reputation within their respective fields.

Social and environmental impact: This dimension captures the contribution to the public good, drawing heavily on the framework proposed by Ervits (2024). These indicators measure a collaboration's success in acting as a "*community of shared values*"(p.2). Indicators for Health and Quality of Life include the number of new medical treatments or diagnostic tools advanced into clinical trials. Environmental Impact is measured by quantifiable outcomes such as the reduction in CO2 emissions or the development of cleaner manufacturing processes. Finally, Human Capital Development represents a unique societal contribution of UICs and is measured by the number of Master's and PhD degrees facilitated for students and employees, and the number of post-doctoral researchers trained with skills relevant to both academia and industry.

Figure 1. *A multi-dimensional framework of UIC impact*



Note: Adapted from Ankrah and Al-Tabbaa (2015), Ervits (2024), and Ćudić et al. (2022).

The primary strength and innovation of this three-part framework is its integrated and diagnostic nature. It moves beyond a simple, static checklist of outputs to provide a dynamic tool for management and evaluation. By simultaneously measuring the foundational inputs, the health of the collaborative process, and a multi-dimensional set of impacts, stakeholders can develop a nuanced understanding of a partnership's performance. This framework allows for a shift from asking "Was this collaboration successful?" to asking the more insightful question, "Why was this collaboration successful (or not), and how can we improve?" It provides a structured methodology to identify the root causes of success or failure, offering clear, actionable insights for university leaders, industry managers, and policymakers aiming to foster more effective and truly impactful collaborations.

5. CONCLUSION

This paper set out to address a critical and persistent gap in the evaluation of UICs. While the strategic importance of these partnerships is undisputed, the frameworks used to measure their success have remained narrowly focused on traditional, economic-centric metrics, providing an incomplete and often misleading picture of their true value. By synthesizing a wide body of systematic literature, this research has constructed a holistic, multi-dimensional framework of innovative impact indicators designed to bridge this measurement gap.

The primary result of this work is the proposed three-part framework, which provides a comprehensive lens for assessment. It begins by establishing the Input Indicators—the foundational institutional, human, and linkage factors that create the potential for success, as validated by the work of Ćudić et al. (2022). It then moves to evaluate the Process and Success Factor Indicators, which assess the health and management of the partnership itself, focusing on the critical relational dynamics of trust, communication, and governance identified by Rybnicek and Königsgruber (2019). Finally, and most innovatively, the framework redefines success through its multi-dimensional Output and

Impact Indicators. This final component moves beyond a singular focus on economic returns to provide a balanced view that includes Institutional Impact—such as enhanced innovative capacity and curriculum development—and the vital Social and Environmental Impact, including contributions to public health and human capital development, as highlighted by Ervits (2024) and Ankrah and Al-Tabbaa (2015).

The central contribution of this paper is not the invention of new metrics from scratch, but the synthesis of fragmented academic knowledge into a single, coherent, and practical tool. It transforms a collection of disaggregated concepts into an integrated 'balanced scorecard' that stakeholders can actively use. The implications of this are significant. For university and industry managers, the framework serves as a diagnostic tool, enabling them to identify weaknesses not just in the outcomes, but in the foundational inputs or the collaborative process itself. This provides actionable insights for designing and managing more effective partnerships. For policymakers and funding agencies, it offers a more sophisticated and defensible methodology for evaluating proposals and assessing the return on public investment. It allows them to justify support for collaborations based on a broader and more accurate definition of value, including long-term institutional and societal returns.

While this framework provides a robust model, it is not without limitations. As a conceptual model derived from a literature synthesis, its primary limitation is that it has not yet been empirically validated on a large scale in this integrated form. The relative weighting and importance of each indicator will likely vary depending on the specific context, such as the industry sector, the national innovation system, or the maturity of the collaboration.

These limitations, however, illuminate clear directions for future research. The most critical next step is the empirical validation of the proposed framework through case studies and large-scale surveys across diverse UICs. Longitudinal studies are also needed to understand how the relevance of these indicators evolves over the different phases of a partnership's lifecycle. Finally, further research could focus on adapting and tailoring the framework for specific contexts, such as collaborations in the social sciences and humanities, where impact is often even less tangible.

In summary, by moving beyond traditional metrics and embracing a more holistic perspective, this framework offers a path toward a more meaningful and accurate valuation of UIC. By measuring what truly matters, we can better understand, manage, and ultimately enhance the capacity of these vital partnerships to generate lasting value for both the organizations involved and for society as a whole.

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iN4iN LATAM Chapter 2025:
Fostering Innovation Management and University Business Linkages at Higher Education Institutions

University–business linkages: contributions to socioeconomic development from a territorial perspective

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Abstract

This study analyzes the strategic role of University–Business Linkages (UBLs) in addressing socioeconomic challenges in Colombia from a territorial perspective. Using a multiple-case study design, we examine two organizations that promote social innovation, multisectoral collaboration, and territorial development. Findings highlight the importance of academia in applied research, co-creation processes, and social impact measurement, while also identifying persistent barriers such as difficulties in locating appropriate interlocutors within universities and aligning objectives among partners. The study reveals that these alliances are vital for fostering sustainable solutions and applied knowledge that contributes to local development. Furthermore, the article contributes to debates on UBLs in developing countries by emphasizing that lessons from the Global North cannot be automatically transferred to the Global South. Future research should develop robust methodologies to measure social impact, explore co-creation models tailored to specific territorial contexts, and examine public policies strengthening social innovation ecosystems in developing countries. Longitudinal and comparative studies are also recommended to deepen understanding of the transfer and adaptation of best practices across diverse territorial settings.

Keywords: university business linkages; case study; socioeconomic development.

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1. INTRODUCTION

Universities-Business Linkages (UBLs) have become a topic of growing interest in the academic literature (Garcia et al., 2014), as they are recognized as collaborative associations that strengthen the survival, relevance, and competitiveness of both sectors (Zavale & Langa, 2018). In knowledge-based economies, UBLs are essential not only for innovation and technology transfer but also for addressing broader socioeconomic challenges through collaborative problem-solving.

The academic literature on UBL identifies four main thematic streams. The first focuses on the characteristics of universities, companies, and scientists, and how these factors favor or hinder alliances between universities and companies. The second stream of research on UBL is oriented to the study of knowledge transfer channels, the type of knowledge transferred, and the breadth and depth of university-business alliances. The third stream of studies on University-Business Linkages develops technology policies, and the fourth group focuses on the development of spin-offs (Zavale & Langa, 2018). However, most of this evidence originates from developed countries, where institutional frameworks, innovation policies, and research capacities differ significantly from those in the Global South. As highlighted by Güemes-Castorena and Ponce-Jaramillo (2019), good practices and lessons derived from the Global North are not necessarily transferable to developing contexts, where structural inequalities, fragmented institutions, and resource constraints shape UBL dynamics.

UBLs are widely recognized as a key component within the 2030 Agenda and sustainability efforts; however, the way in which these collaborations contribute to socioeconomic development from a regional perspective remains insufficiently structured and warrants further scientific research (Olphin et al., 2024). Additionally, there is a research gap regarding the role of Higher Education Institutions (HIEs) in socio-economic development (Renault et al., 2016).

This research raises the need for context-sensitive research that examines how UBLs function in Latin American territories, where socioeconomic challenges are intertwined with structural issues such as inequality, informality, and limited state capacity. Colombia offers a particularly relevant setting given its regional disparities, the diversity of its local innovation ecosystems, and the increasing policy emphasis on fostering university–industry–society collaboration. Based on the above context, the present study addresses the following research question: How do University–Business Linkages contribute to socioeconomic development from a territorial perspective?

2. THEORETICAL FRAMEWORK

2.1. University business linkages

UBLs have become increasingly important in recent years (Orlando et al., 2025). UBLs are based on systematic connections between universities and companies to promote innovation and socio-economic development (Güemes-Castorena & Ponce-Jaramillo, 2019). Various authors have studied the determining factors and strategies to strengthen this type of bond, as well as the frequent barriers and mechanisms of success (Hoc & Trong, 2019; Hou et al., 2021).

UBL strategies include joint research and development (R+D) projects, student and academic staff mobility, technology extension services, training and joint updating of curricula, incubation and support for spin-offs, shared access to infrastructures, and technology transfer seminars or workshops (Hoc & Trong, 2019).

2.2. UBL and social/territorial development

UBLs extend the role of Higher Education Institutions (HEIs) beyond teaching and research to perform generative and developmental functions within regional innovation systems (Gunasekara, 2006). These alliances are a fundamental part of regional development processes, especially when they are designed as platforms for the co-creation of knowledge and intersectoral learning (Olphin et al., 2024).

According to scientific literature, the contribution of UBLs to regional sustainability and competitiveness depends on the ability to adapt these collaborations to the needs of the territory, generating contextualized

solutions to social, economic, and environmental challenges (Olphin et al., 2024).

3. CONTEXT OF THE DESCRIBED RESEARCH/PRACTICE

To generate empirical evidence on the role of universities in socioeconomic development projects in alliance with the private sector, this study adopted a qualitative exploratory approach through the design of a multiple case study. The choice of this method responds to the need to analyze complex phenomena in depth and within their real-life context, especially when the boundaries between the phenomenon and its context are not evident (Edmonds & Kennedy, 2017).

3.1. Research method and design

The study followed a descriptive multiple-case design, which allows comparison between cases to identify common patterns and context-specific particularities. Case Studies are considered a research method rather than being limited to a single approach or perspective within qualitative research. Case Studies usually focus on developing a narrative or on revealing a phenomenon in depth, often retrospectively (Edmonds & Kennedy, 2017).

3.2. Unit of observation

The units of analysis were two private organizations operating in Colombia, selected based on their trajectory and explicit orientation toward social impact, multisectoral collaboration, and territorial development. One organization is headquartered in Cartagena (Case 1) and the other in Medellin (Case 2). The cases were chosen because they exemplify different yet complementary approaches to UBLs in two heterogeneous territorial contexts of Colombia: the Caribbean region and the Antioquia region.

3.3. Participants

The study included two senior executives from each organization, who were directly involved in the design and management of projects linked with academia and other stakeholders. Their perspectives provide insights into both strategic decision-making and operational experiences in building UBLs.

3.4. Data collection

Data were collected through a semi-structured interview protocol, structured around four thematic dimensions: (1) Information about the participant and the organization, (2) Context of the Organization, (3)

Alliances with other actors, and (4) Lessons learned and recommendations.

3.5. Data analysis

The information was examined using the Directed Thematic Content Analysis Technique, which combines deductive coding based on the interview protocol with inductive identification of emerging categories. Triangulation was achieved through researcher discussion and systematic comparison across cases, strengthening the credibility of findings.

4. MAIN RESULTS/REFLECTIONS

The analysis yielded insights across the four thematic dimensions of the study, complemented by transversal themes that illuminate broader patterns in University–Business Linkages (UBLs) in Colombia. The following discussion synthesizes the findings, highlighting convergences, contrasts, and their implications for the design and practice of UBLs in territorial contexts. A comparative overview of both cases is presented in Table 1, which consolidates the main results and facilitates the identification of commonalities and divergences across the two organizations.

4.1. Participants and organizational information

Both organizations are characterized by strong leadership committed to social transformation. Case 1, a civil, multi-business foundation with over fifty years of experience, embodies an institutional trajectory rooted in the promotion of long-term territorial development. Case 2, by contrast, represents a younger social enterprise with eleven years of activity, explicitly designed to convert financial resources into measurable

Table 1. *Comparative summary of University–Business Linkages in two Colombian organizations*

Dimension	Case 1 – Cartagena	Case 2 – Medellin
Participants & Organization	Senior Executive; multi-business civil foundation with 50+ years of experience; focus on social and territorial transformation.	Senior Executive; social enterprise with 11 years of experience; converts income into sustainable social impact, with human-centered approach.
Organizational Context	Purpose: sustainable territorial development in Cartagena and Bolivar. Strategic lines: education, sustainable citizenship, poverty reduction. Positioning: convener of multisectoral efforts in a highly unequal region.	Purpose: transforming social realities through sustainability capacities. Strategic lines: training and human development, corporate volunteering, sustainability consultancy, territorial development. Positioning: bridge between social needs and business opportunities.
Alliances with Universities & Other Actors	Multisectoral alliances with private sector, public sector, civil society, and universities. Academia contributes research, innovation, and programs (e.g., Early Childhood Center of Excellence, Boomerang Scholarships). Success factors: complementarity of knowledge, applied research, sustained collaboration.	Collaboration with universities for impact measurement and knowledge management. Active in Medellin's innovation ecosystem (university–business–state). Barriers: difficulties identifying interlocutors within universities. Facilitators: clear communication, institutional participation in networks.
Lessons Learned & Recommendations	Barriers: minimal; fluid work with universities. Recommendations: align organizational and academic purposes; maintain openness to diverse approaches; recognize expertise for national development.	Barriers: weak interlocution channels with universities. Recommendations: promote open innovation spaces; strengthen academia–business collaboration to create sustainable solutions.

social impact while placing human wellbeing at the center of its operations. Despite their different institutional forms and histories, both cases converge in the prioritization of social value creation and the recognition of alliances as a strategic mechanism to achieve organizational goals. This suggests that committed leadership acts as a decisive factor in articulating university partnerships and ensuring the sustainability of collaborative agendas.

4.2. Organizational context

The cases also reveal distinct territorial orientations. Case 1 focuses on Cartagena and Bolivar, working to address structural challenges of inequality through strategic lines in education, citizenship, and poverty alleviation. Its positioning as a convener of multisectoral initiatives underscores its role as an institutional intermediary in contexts of high social fragmentation. Conversely, Case 2 is embedded in Medellin, emphasizing capacity-building and sustainability through initiatives such as corporate volunteering, consultancy, and human development programs. Its role as a bridge between social needs and business opportunities reflects a model of intermediation that is more market-oriented, yet socially driven. Although the geographic and thematic emphases differ, both organizations regard territorial challenges as opportunities for innovation and adapt their models to local socioeconomic realities.

4.3. Partnerships with other actors

Collaboration with academia emerges as a defining feature of both organizations, though with varying levels of institutional maturity. Case 1 demonstrates fluid interaction with universities, evidenced by joint research projects, academic participation in governance bodies, and initiatives such as the Center of Excellence for Early Childhood. These partnerships are facilitated by the complementarity of knowledge and a shared orientation toward applied research. Case 2, in contrast, illustrates the opportunities and limitations of UBLs in emerging ecosystems. Its engagement with universities focuses primarily on methodologies for social impact measurement and knowledge management, yet it faces persistent barriers in identifying appropriate interlocutors. These difficulties reveal the importance of institutionalized communication channels and highlight how coordination deficits within universities can constrain the scalability of alliances.

4.4. Lessons learned and recommendations

The lessons drawn from the two cases underscore heterogeneous institutional experiences with UBLs. For Case 1, alliances with academia have evolved organically, with few barriers and relatively seamless collaboration. Its recommendations stress the alignment of organizational and academic purposes, the need for openness to diverse approaches, and the recognition of mutual expertise as a foundation for national development. Case 2, by contrast, underscores the fragility of partnerships when interlocution mechanisms are weak, recommending the creation of open innovation spaces and multisectoral dialogues as deliberate facilitation strategies. The contrast between the two cases thus reflects the coexistence of both fluid and frictional models of UBLs, shaped by organizational context and institutional readiness.

4.5. Emerging themes

Three transversal themes emerged that transcend case-specific dynamics. First, social innovation appears as a cross-cutting axis, serving not only as a conceptual framework but also as a practical orientation for linking academic knowledge with business and social needs. Second, the importance of measurement and systematization is emphasized, with both organizations recognizing the limitations of traditional indicators and calling for context-sensitive methodologies to capture the real impact of alliances. Third, the territorial embeddedness of UBLs is highlighted, as both organizations adapt their strategies to the socioeconomic and cultural particularities of Cartagena, Bolivar, and Medellin, underscoring the non-transferability of generic models.

Together, these findings suggest that UBLs in Colombia are shaped by a logic of social innovation,

constrained by the methodological challenges of impact measurement, and deeply embedded in territorial realities. This combination of factors not only differentiates the Colombian experience from that of developed countries but also points to the need for flexible, context-driven approaches to alliance building in the Global South.

5. CONCLUSION

This multiple case study on university–business partnerships in Colombia demonstrates that such alliances constitute a crucial driver of sustainable territorial development. Although the two organizations analyzed differ in institutional form, scope, and trajectory, both converge in their commitment to social transformation, privileging multisectoral collaboration and the articulation of diverse actors to address pressing socioeconomic challenges. In this process, the role of academia is fundamental, providing not only research and innovation but also applied programs that strengthen local ecosystems, as also noted by Arza and Carattoli (2017) in their analysis of university–industry interactions in Latin America.

Nonetheless, the cases reveal persistent challenges. Among these are the challenges in identifying suitable interlocutors within universities and the need to better align purposes and expectations between academic and business partners. These barriers limit the scalability and sustainability of alliances, as also noted by Güemes-Castorena and Ponce-Jaramillo (2019), who emphasize the institutional and relational gaps that complicate the transfer of best practices in developing contexts.

The lessons learned highlight the importance of openness to diverse approaches, recognition of mutual capacities, and the promotion of open innovation spaces as enablers of effective collaboration. Emerging themes such as the centrality of social innovation, the systematization and measurement of social impact, and the territorial embeddedness of alliances underscore that UBLs in Colombia are shaped by logics distinct from those documented in the Global North. While research in developed economies often emphasizes technology transfer and commercialization (Garcia et al., 2014; Zavale & Langa, 2018), the Colombian cases illustrate a different orientation, privileging the co-creation of socially relevant solutions—an approach increasingly recognized as vital for inclusive development in the Global South.

Future research should expand on these insights by examining co-creation processes between academia and the productive sector in diverse territorial contexts and by analyzing how regional specificities shape the effectiveness of alliances. Longitudinal and comparative studies could enrich our understanding of how best practices are transferred, or fail to transfer, across territories, as highlighted by Zavale and Langa (2018) in their systematic review of UBLs in Sub-Saharan Africa. In parallel, it is essential to investigate the design of public policies that strengthen social innovation ecosystems, thereby providing the institutional frameworks that enable UBLs to contribute more effectively to inclusive and sustainable development, as also emphasized by Arza and Carattoli (2017).

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iN4iN LATAM Chapter 2025:
Fostering Innovation Management and University Business Linkages at Higher Education Institutions

From living lab to scalable startup: a process design methodology for innovation

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Abstract

The paper introduces the DDI (Diagnosis, Design, Implementation) framework, a novel approach to help early-stage companies integrate data-driven process design. The framework was developed using a two-layer action research methodology involving direct intervention through workshops with three German startups. It connects process design to the business model, integrates the Voice of the Customer (VOC), and is flexible with various digital tools. Quantitative analysis confirmed significant waste reduction and improved performance indicators. Qualitative analysis of participant interviews demonstrated the framework's high perceived utility. The DDI framework provides a flexible methodology for startups to build scalable, customer-centric processes, closing the critical gap between traditional optimization techniques and the needs of new ventures. The paper shows how its application strengthens university–business linkages and enhances process design capabilities in early-stage startups.

Keywords: process design; methodology development; startups.

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1. INTRODUCTION

Nowadays, companies are experiencing turbulent times, from supply chain disruptions and rising costs to environmental regulations and rapid changes in the market and customer needs. Traditional companies struggle to survive in this challenging environment. Startups however must face additional difficulties, such as finding the product market fit, accessing resources, and scaling their business quickly (Mueller & Thoring, 2012; Ries, 2011). To succeed, startups must build their business on a foundation of solid processes from the very beginning. This approach supports resource efficiency and scalability by creating efficient workflows designed to prevent future bottlenecks and operational waste.

Universities can play an essential role, matching Startups with resource networks, coaching, knowledge and tech supporting companies to design business models and operations to address a real-world challenge. Unfortunately, such connections often prove inadequate. Startups accelerators and coaching tend to concentrate on product and market strategy, without the operational processes to create a scalable company. As a result, a serious gap emerges: founders become product specialists but remain inexperienced in operations. Consequently, when rapid growth occurs, companies unfortunately end up suffering workflow problems, operational bottlenecks, and various forms of waste.

To address this gap, Leipzig University established the Process Living Lab. Its purpose is to strengthen university–business linkages (UBL) by expanding the traditional triple helix model of technology transfer (university–government–industry) (Leydesdorff & Etzkowitz, 1998) into a fourth helix model. In this approach, customers are actively involved in the process, moving from passive recipients to engaged participants who test prototypes, provide feedback, and contribute to solution development (Leminen et al., 2012). The Process Living Lab not only researches processes but also co-develops solutions with SMEs and startups. Using a data-driven approach and digital tools, it designs, refines, and improves methods for process analysis, improvement, and design in collaboration with end users. This paper introduces an innovative University–Business Linkage (UBL) model and a process design methodology developed through collaboration between academia and industry, transforming technology transfer from a simple exchange of knowledge into a co-creation process that enhances firms' capabilities. The framework offers a practical and replicable approach, particularly suited to the Latin American context. It presents the model's validation in the German setting, outlines the process design methodology and its core principles, and reports on both the validation results and the current stage of the technology.

2. THEORETICAL FRAMEWORK

Academic-industry collaboration has been studied for decades. Initially, technology transfer models and innovation were viewed as linear processes, and university-industry links were weak. However, several authors proposed different technology transfer models, ranging from Rogers et al.'s (2014) theory of the diffusion of innovations to Teece's (1986) explanation of why some companies achieve innovation but are unable to profit from it. These models paved the way for Leydesdorff & Etzkowitz (1998), the architects of the triple helix model. However, described technology transfer models are insufficient and must evolve to transfer technology faster to industry, especially in times where data, globalization, connectivity, and fast-changing customer needs create the need to strengthen the linkages between universities and industry. This motivates the creation of living labs that extend the triple helix model into a new four helix model, where the user becomes critical in technology transfer (Leminen et al., 2012). Now, universities can test prototypes with real customers outside of university facilities, and prototypes are tested in real settings, where they gather real data from customers; this model enables rapid iteration with the customer and timely feedback, ultimately reducing market risk during technology transfer.

Companies place a high value on their know-how. This term refers to the structured and organized knowledge that is integrated into a company's operations. This knowledge can give a company a competitive advantage, leading to success and sustainability (Tahat, 2021). It facilitates the sharing of information

and expertise, which in turn accelerates new product development (NPD) and enhances innovation. Several companies have documented success by using structured methodologies to innovate and improve their processes. Methodologies such Lean, to eliminate waste (Spear & Bowen, 1999), Six Sigma, to achieve higher quality standards (Pande et al., 2007), and Agile Scrum (Ismayilova, 2023), to support fast iterations to improve processes and outcomes, are cases to mention in this regard.

The structured framework used to develop the methodology follows an action research model. This model integrates the researcher as part of the subject of research itself, considering every interaction as data collected (Lewin, 1946). Using this framework allows for the development of an iterative methodology that is continuously enhanced and refined based on continuous feedback. In this case, theory meets practice.

3. CONTEXT OF THE DESCRIBED RESEARCH/PRACTICE

Knowledge-intensive and technology-driven startups play a vital role in the German economy by driving innovation, opening new markets, and contributing to economic growth. The Saxony government recognizes this, and the actors within the triple helix model collaborate to promote and develop these firms. As part of these efforts, the government of Saxony has established several alliances to strengthen entrepreneurship and startup culture in the region. The primary objective of these alliances, initiated through government-supported universities, is to strategically build networks across institutions and leverage their individual strengths, thereby creating meaningful synergies.

Thus, the Protosax program was created as part of the Startup Campus Alliance. Its primary goal is to provide spaces for creating, prototyping, and testing products and services. The program specifically supports students in testing and developing business ideas. Each participating university contributes by offering coaching services, access to labs and workshops programs focused on key areas for early-stage entrepreneurs, equipping students with knowledge and tools that ultimately foster technology transfer from academia to industry. On the other hand, students provide valuable feedback to universities, helping them improve their methods, frameworks, and technology.

The Process Living Lab at Leipzig University plays a key role in technology transfer. It researches data-based methods for process improvement, using digital tools like sensors and eye tracking to collect data. The lab then provides these services to SMEs and startups. It also fosters student research through projects that connect academia and industry. Additionally, the lab uses government resources to create international networks and promote other technology transfer models, such as hackathons and industry-academy conferences. Specifically for the Startup Campus Alliance, the Process Living Lab developed a framework (DDI) focused on process design for startups and SMEs. This methodology was developed in

response to Germany's current economic situation, particularly the shortage of skilled labor (ifo Institute, 2024). Therefore, companies are striving to make their operations more efficient and increase their output with the same resources.

3.1. Research gap

Process design is critical for organizations of all sizes. It defines the workflows, tasks, responsibilities, and resources for any given process. However, traditional techniques like Lean and Six Sigma are built for established companies with defined processes, not for startups that lack organized structures. These traditional methods typically rely on observation and non-computational analysis. But today's world of new technology, connectivity, and globalization has prompted the development of new frameworks. Modern design techniques now include computational methods, AI, and computer engineering to deliver more accurate and reliable results (Leff, 2021). Nevertheless, integrating these advanced tools creates new difficulties. Companies face challenges with specialized knowledge, data integration, security, and infrastructure (Neuer et al., 2020). These barriers make it difficult for small enterprises and early-stage startups to adopt these modern techniques. Startups face a significant gap when integrating data and digitalization into their process design. They also deal with unique challenges, such as limited resources, market volatility, and the pressure to rapidly meet customer needs (Abrantes & Furtado, 2021). Therefore, the Process Living Lab developed a new framework to close this gap. It provides early-stage startups with a set of tools to integrate digital technologies, recognizing that they often lack the infrastructure, knowledge, or resources for complex data analysis. Moreover, the developed framework is a toolset for entrepreneurs that ensures process design is directly connected to their business model. Finally, because startups prioritize innovative products and fast growth, the framework integrates the voice of the customer from the very first stage. This approach provides a deep understanding of the problem, ensuring the final processes are truly designed to meet customer needs.

The framework was developed by the Process Living Lab using an action research methodology. This approach enabled the collection of data through direct intervention with three startups in Germany. The method facilitated the measurement of how this interaction improved the initial process design and supported continuous improvement via the canonical *plan-act-observe-reflect cycle* (Lewin, 1946). The research was structured in two distinct layers: an upper layer dedicated to the development of the framework through action research, and a lower layer for its subsequent testing. This dual-layer design was implemented to address the central research question: *how can startups integrate digital tools into their process design, and what challenges emerge during implementation?*

The stages of the action research cycle were executed as follows:

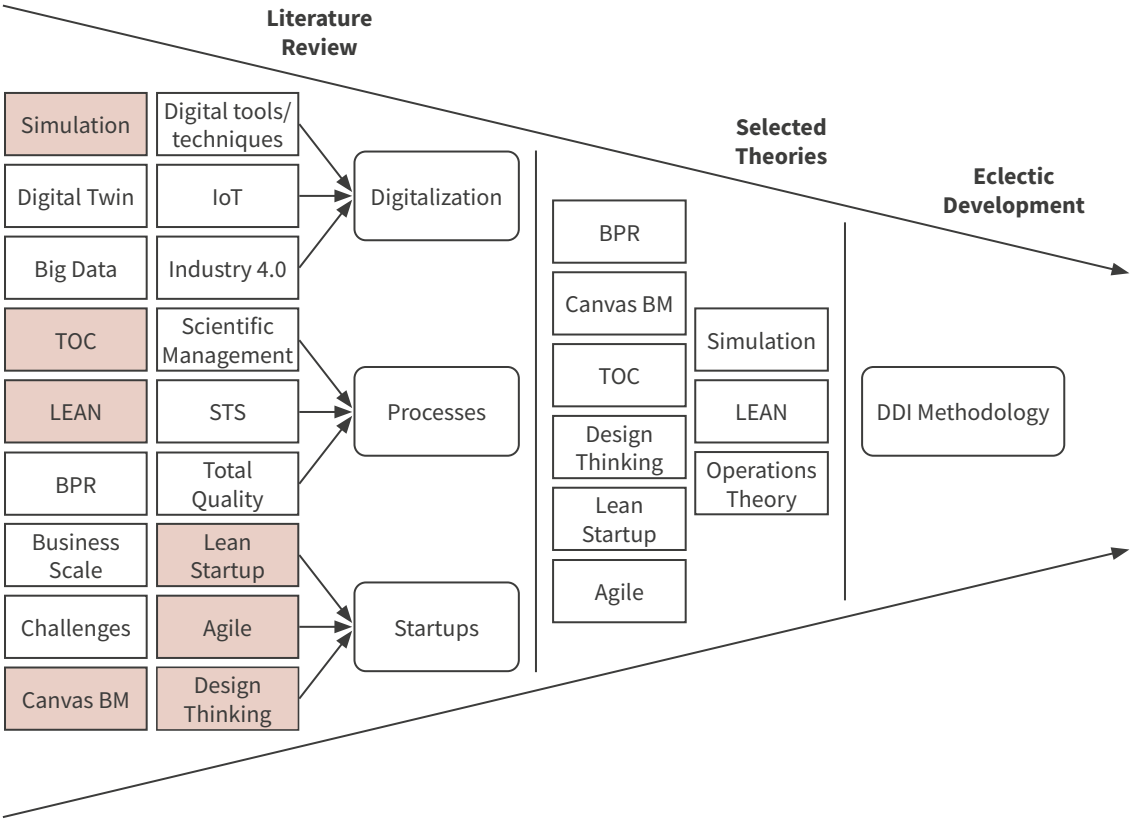
- *The Plan* stage focused on the development of the research methodology.
- *The Act* stage involved the implementation of the framework within the three participating startups.
- *The Observe* stage consisted of measuring the process outputs.
- *The Reflect* stage involved a detailed evaluation, where the designed process was compared against a final participant survey to assess the framework's perceived utility.

3.2. DDI methodology development

To develop the methodology, we started with a thorough literature review focused on three foundational areas: process improvement, common startup problems, and the role of digitalization in established methods. These topics were chosen because they directly address the core gap identified. Next, we used a "theory funnel" to select the most relevant theories relevant to the problem (Figure 1). Each step and activity in the methodology was then built upon a chosen theory. The result is a unique, eclectic framework called DDI: Diagnosis, Design, and Implementation.

The methodology has a strong focus on business strategy, starting with the Business Model Canvas (Osterwalder & Pigneur, 2010) to understand the startup's core activities, resources, and overall strategy. From there, we narrow the focus to a single block of the

Figure 1. *Theory funnel for the development of the DDI methodology for process design*



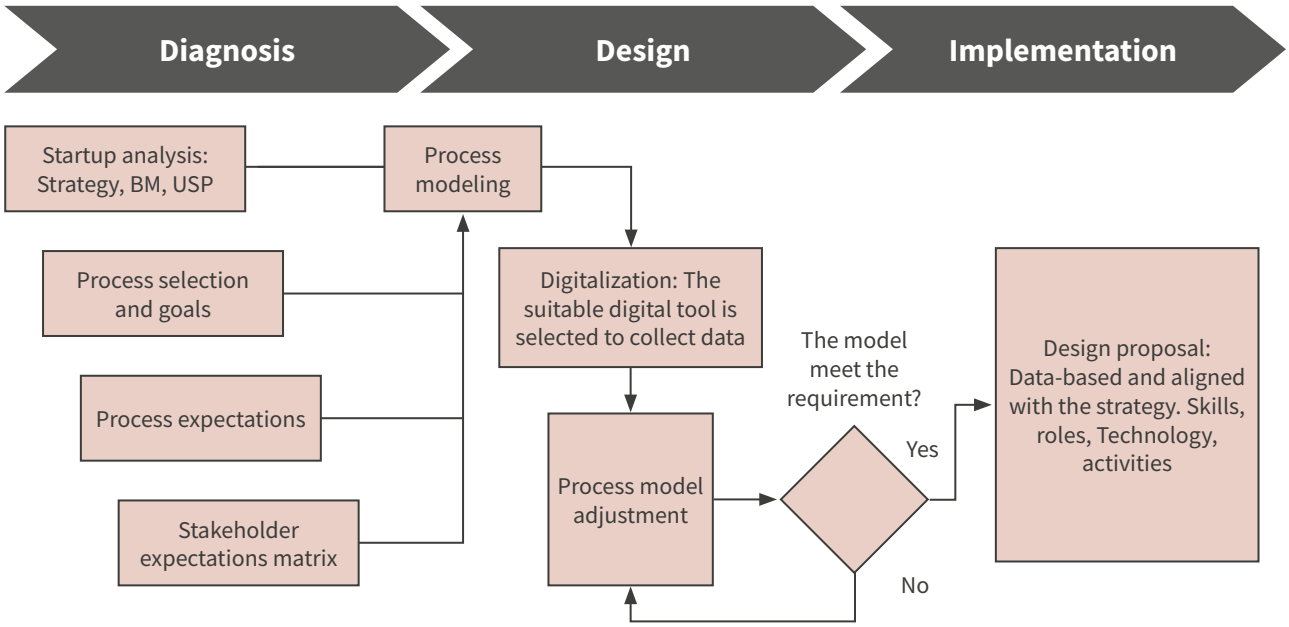
canvas to select a specific process for design, defining its boundaries, triggers, outputs, stakeholders, and the process owner. The diagnosis phase then integrates the Voice of the Customer (VOC), using a key tool we call the "matrix of expectations" to identify critical quality requirements from the customer's perspective. Based on this analysis, we prioritize the most important criteria to ensure the final process is designed to meet customer needs (Ries, 2011). Finally, the design phase kicks off with creating a process map to serve as a blueprint, using standard tools like VSM or BPMN (Madison, 2005), depending on the process type.

4. MAIN RESULTS/REFLECTIONS

The schematic steps of this methodology are shown in Figure 2, while the relationships and outputs of each task are detailed in Table 1. The activities were applied to three selected startups, with data collected through workshops where the researcher guided the entrepreneurs using specific questions to reach the expected outcomes. Each element was also documented to capture data that could later be used to refine and improve the methodology.

For each participating firm, two approaches to analysis were applied. First, a quantitative assessment was carried out for each process. After the process design stage, improvements were made using performance indicators such as process time and lead time, along with the identification of non-value-added (NVA) activities. Overall, waste reduction was achieved by applying the methodology. In addition, a process map was created for each case. The second level of analysis focused on qualitative data, based on final interviews with participants. These interviews were examined using qualitative content analysis to assess the perceived usefulness of the methodology. Coding categories were linked to the digital tools used in the research, and insights on perceived utility were derived from the interviews.

Figure 2. *Methodology workflow*



Note: Details of the order and tasks performed in designing the process using the DDI methodology.

Participants identified significant value in the DDI methodology, highlighting two main areas: a clearer understanding of their processes and actionable paths for improvement.

4.1. Key benefits

Improved Process Understanding: The most frequently cited benefit was workflow visualization. Participants consistently noted how the methodology helped them map out their current processes, making them more objective and aware. As one participant stated, *"…I believe it made me more conscious of time and movements…"* Another added, *"…Seeing the workflow visualized in diagrams made it easier to understand..."*

Structured Guidance for Improvement: The diagnostic phase was seen as a critical first step. Participants also valued the inductive questioning and expert facilitation during the workshops. This was summarized by one participant who said, *"The guidance provided helped identify points for improvement that would have been overlooked otherwise."*

4.2. Challenges identified

Despite the benefits, participants also noted several challenges:

- *Dependency on Experts*: A primary concern was the reliance on expert intervention to guide tool usage and interpret data, which some felt could slow down implementation and make it harder to sustain improvements independently.
- *Complexity of Digital Tools*: Experiences with digital tools were mixed. Key issues included a lack of familiarity and technical limitations in virtual settings that affected collaboration.
- *Online Workshop Limitations*: Conducting workshops entirely online was a notable challenge. As one participant observed, *"Not being able to conduct the process in person made it difficult to identify certain steps.*

5. CONCLUSION

This research presents a successful model for technology transfer, initiated and driven by a university lab. First, the Process Living Lab at Leipzig University

Table 1. *Structure of the diagnosis, design, and implementation methodology*

Phase	Activity	Outputs
Diagnosis	Understanding the startup	USP Business model Resources: human, finance Business strategy, constraints, Growth stage
Diagnosis	Process selection and goal definition	Process to be designed Inputs and expected output of the process Responsible (process owner)
Diagnosis	Define goals and expectations	List of expectations Identify common interest
Diagnosis	Expectation Matrix	Prioritize expectations Expectative matrix
Design	Quantify expectations	Feasible expectations
Design	Process modeling	Process model workflow Parameters for simulation
Design	Digitalization: data collection and transformation	Data results from model simulation. Data visualization. Insights from the data (bottlenecks, process times, total output)
Implementation	Process design proposal	A compilation of information collected from the workshops, containing a simulated process, a list of resources, and activities.

Note: This table shows the detailed tasks and outputs of each activity in the methodology. These tasks were applied via structured workshops.

used academic research to identify a real-world problem and develop a tailored framework for startups. Second, it transferred this technology by applying the methodology directly, enhancing the capabilities of three selected startups. This approach strengthens university-business linkages by developing solutions tested with real customers, effectively extending the triple helix to a four-helix model that also incorporates citizens.

The model's success is amplified by another critical element: the government's active participation. Thanks to resources from the Alliance for Enhancing Entrepreneurship, Innovation, and Startups, the framework is currently being tested in six additional deep-tech startups in Saxony. This proves that university-government partnerships can effectively integrate with industry, in the form of startups, to enhance business capabilities across the region.

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iN4iN LATAM Chapter 2025:
Fostering Innovation Management and University Business Linkages at Higher Education Institutions

Repositioning universities for inclusive innovation in Latin America

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Abstract

This chapter examines the evolving role of universities in Latin America within innovation ecosystems, guided by the central question: Who do universities serve? The analysis combines a review of Technology Transfer Offices (TTOs), patent data from Colombia and Peru, and research group classifications from the Ministry of Science, Technology, and Innovation of Colombia. Results reveal three persistent challenges: dependence on multinational corporations, bureaucratic inefficiencies, and weak engagement with local ecosystems. Patent landscapes in both Colombia and Peru are dominated by foreign corporations, whereas domestic universities and firms remain marginal actors. At the same time, excessive bureaucracy within TTOs erodes timeliness, undermining universities' ability to meet the demands of industry and society. Evidence from research group classifications further shows that enterprises are gaining ground in high-quality knowledge production, while regional asymmetries persist.

Keywords: Technology Transfer Offices (TTOs); innovation ecosystems; knowledge transfer; Latin American research ecosystem.

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1. INTRODUCTION

Universities have historically been instruments of knowledge creation and innovation. Their contributions have transformed societies, from the discovery of penicillin to the development of the internet, and more recently, the foundations of artificial intelligence (AI). Academic institutions have long occupied a privileged position at the frontier of scientific discovery, shaping not only the stock of human knowledge but also the institutions and norms through which innovation emerges (Mowery et al., 2001). This trajectory reflects the core mission of academia: advancing knowledge across disciplines and addressing human challenges.

Yet, this paradigm is undergoing a profound transformation. Over the past decades, firms have increasingly assumed roles once monopolized by universities, emerging as central actors in knowledge generation and technological breakthroughs. The case of AI exemplifies this shift. Although its conceptual and technical foundations were developed within academia, from Turing's (1950) seminal reflections to the Dartmouth Conference of 1956, current advances in generative AI are driven primarily by firms such as Google, OpenAI, and DeepMind (Haenlein & Kaplan, 2019). This transition reflects a broader recognition that sustainable advantage depends on cultivating unique assets, with knowledge being the rarest and most strategic among them (Hamel, 1998). As a result, firms have restructured into knowledge – creating organizations, positioning themselves at the forefront of technological development (Barnard & Merwe, 2016).

This transition does not diminish the relevance of universities but redefines their role within a more complex landscape. Institutions of higher education remain critical to fundamental discovery, talent formation, and fostering spaces of intellectual exchange. However, their central challenge increasingly lies not in producing knowledge but in ensuring its effective transfer into societal and economic value (Agrawal, 2006; Bikard et al., 2019). Weak industry linkages, institutional rigidities, and limited entrepreneurial orientation often constrain this transfer (Sjoo & Hellstrom, 2019).

The evolution from linear technology transfer models to frameworks such as the Triple Helix of university–industry– government collaboration (Etzkowitz & Leydesdorff, 2000) and the Quadruple Helix, which incorporates civil society (Lindberg et al., 2014), illustrates these shifting expectations. Universities are no longer perceived as isolated generators of knowledge but as hubs within broader innovation ecosystems. Their legitimacy increasingly depends on co-producing knowledge with diverse stakeholders, accelerating innovation, and ensuring inclusiveness, particularly in contexts marked by critical social needs.

This reconfiguration is especially relevant in Latin America. The Atlántico Digital Transformation Report (Atlantico, 2023) recognizes that without rapid adaptation, Latin America risks deepening its competitiveness gap in the global knowledge economy. Universities are thus expected to broaden their contributions: aligning research agendas with digital transformation, building stronger ties with industry, and extending the benefits of knowledge to traditionally excluded communities. Within this scenario, we intend to discuss the question: Who do universities serve? especially in the Latin American context.

2. CONTEXT OF THE DESCRIBED RESEARCH

This chapter employs a qualitative and descriptive research design, combining a systematic literature review with secondary data analysis to explore the evolving role of universities in Latin America within the framework of knowledge transfer and innovation ecosystems. The methodological strategy is organized around three interrelated dimensions, each addressing the guiding question of this study: Who do universities serve?

2.1. Literature review on Technology Transfer Offices (TTOs)

The first dimension examines Technology Transfer Offices (TTOs) as institutional mechanisms mediating between academia and industry. A systematic

review of scholarly contributions was conducted to capture theoretical and empirical insights into university–industry collaboration and technology transfer. Emphasis is placed on the organizational structures, functional roles, and limitations of TTOs in Latin American universities. In this regional context, institutional voids, weak intellectual property regimes, and fragmented innovation systems often constrain the effectiveness of knowledge commercialization. This review thus contextualizes the structural and institutional challenges faced by universities in bridging academic research with industrial and societal applications.

2.2. TTOs and local versus global engagement: evidence from Colombia and Peru

The second dimension investigates whether TTOs in Latin America primarily serve multinational corporations or foster local innovation ecosystems. Patent data were retrieved from the Lens database (https://www.lens.org/), which provides information on patent applications by country, applicant type, and institutional affiliation. The analysis compares Colombia and Peru, examining the relative prominence of multinational corporations, local firms, and universities in patent activity. Special attention is given to the role of national universities and public research organizations. This comparison highlights the tension between global integration, often led by multinational R&D strategies, and local anchoring, which strengthens the societal legitimacy and developmental contributions of universities.

2.3. Knowledge generation in Colombia

The third dimension focuses on knowledge production and dissemination within the Colombian research ecosystem. Data was obtained from the Ministry of Science, Technology, and Innovation of Colombia (MinCiencias) (https://minciencias.gov.co/la-ciencia-en-cifras/grupos), which maintains the official registry of recognized research groups. This dataset enables classification by institutional type (e.g., universities, enterprises, government agencies, civil society associations, research centers, and compensation funds) and provides longitudinal data on their evolution. The analysis considers both the quantitative distribution of research groups and their quality classifications, highlighting structural concentration, institutional diversity, and systemic weaknesses such as limited funding and fragmented collaboration.

3. MAIN RESULTS/REFLECTIONS

3.1. International models of TTOs and liaison offices: lessons for Latin America

Technology Transfer Offices (TTOs) and university–industry liaison units have followed diverse organizational trajectories worldwide, shaped by national policy regimes, market conditions, and institutional missions. In the United States, the Bayh–Dole Act institutionalized the pursuit of intellectual property (IP) protection and licensing revenue within universities, triggering the rapid diffusion of TTOs focused on patenting and out-licensing (Trejo, 2017; Florez &

Table 1. *Main TTO studies in Latin America*

Author(s) & Year	Country(ies) studied	Main findings
Florez & Pineda (2019)	Mexico, Colombia	OTRIs/OTT often act as administrative units rather than strategic intermediaries; lack of incentives for researchers, weak demand orientation, and limited management capacity hinder effectiveness.
Berumen (2019)	Mexico, Spain, United States	Mexico's OTTs expanded through public policy but face heterogeneity and sustainability issues; U.S. offices consolidated due to strong systemic conditions; Spain and Mexico display uneven results tied to institutional fragility.
Rojas (2021)	Mexico	Case study of an OTT in a Mexican ICT center that demonstrates its effectiveness in project structuring (including proposal design, project formulation, and the development of new business lines) and underscores the role of specialized technology transfer staff.

Pineda, 2019). Yet, regional studies show that direct transplantation of this model produces uneven results, as scientific capacity, industrial demand, and legal frameworks differ markedly from the U.S. context (Ísmodes, 2015; Rojas, 2021).

European practices have been more heterogeneous. Alongside IP management, universities often emphasize collaborative R&D contracts, sponsored projects, and the creation of spin-offs, frequently supported by public policies to strengthen professional transfer capacity (Ísmodes, 2015; Solís et al., 2020). Latin American policy frameworks inspired by Europe likewise stress organizational models that move beyond transactional IP management toward broader portfolios of engagement (Bonadeo, 2017; Di Meglio, 2024).

Organizationally, three archetypes dominate: (1) internal TTOs embedded within universities, (2) external or shared agencies serving multiple institutions, and (3) hybrids. Regional evidence suggests that internal or tightly coupled designs are preferable when alignment with academic missions, responsiveness, and researcher engagement are priorities, whereas shared models are better suited for pooling scarce capabilities (Bonzón & Terezano, 2023; Galvez & Herrera, 2020). Colombia's national OTRI program, for example, underscores both the limits of small, isolated offices and the value of coordinated services, standardized procedures, and common performance metrics.

For Latin America, adaptation rather than replication is the most defensible path. Comparative work on Mexico and Colombia highlights that TTOs should act as articulating intermediaries: not only brokering patents but also structuring demand-driven ("market-pull") projects, technical services, and long-term partnerships tailored to regional needs (Di Meglio, 2024; Florez & Pineda, 2019). Lessons from Colombia's OTRI program further emphasize shifting from technology-push to market-pull logics, expanding dissemination and marketing functions, and adopting metrics that capture adoption and societal impact.

Examples of collaborative and multi-institutional models already illustrate this adaptive approach. In Argentina, initiatives such as the VINCTEC–UNER program illustrate the value of SME-oriented liaison centers (Bonzón & Terezano, 2023), whereas in Mexico, BUAP's OTT demonstrates the importance of professional expertise in patent drafting and incentive structures for researchers (Solís et al., 2020). In Peru, case studies point to persistent challenges of professionalization and alignment with industry demand, though national policies continue to encourage broader university–industry linkages (Galvez & Herrera, 2020; Ísmodes, 2015). These experiences converge on two critical enablers: sustained government support to underwrite professionalization and inter-institutional cooperation to reach critical mass.

Evidence from Mexico, Colombia, Peru, and Argentina displayed in Table 1 shows that TTOs remain

emergent, fragmented, and constrained by institutional voids, weak IP regimes, and limited professionalization (Bonadeo, 2017; Galvez & Herrera, 2020; Rojas, 2021). Nevertheless, innovative adaptations are emerging: Mexico's BUAP illustrates how internal professional expertise and researcher incentives can improve patenting outcomes (Solís et al., 2020); Argentina's VINCTEC–UNER demonstrates how liaison offices can strengthen regional SMEs (Bonzón & Terezano, 2023); and Colombia's OTRI program provides a blueprint for coordinated, networked services that address the inefficiencies of isolated offices (Florez & Pineda, 2019). These examples underscore that while Latin America cannot simply replicate U.S. or European models, it can selectively adapt practices to local needs and capacities.

Two insights cut across regions. First, TTOs function most effectively when embedded within systemic frameworks that align incentives, resources, and demand-side conditions. Second, institutional design matters: internal offices facilitate alignment with academic missions, while shared or hybrid models allow for pooling of scarce resources. For Latin America, the policy challenge is therefore twofold: to professionalize and stabilize TTO operations while simultaneously embedding them within broader national and regional innovation ecosystems.

3.2. Refocusing TTOs on the local ecosystem vs. serving multinationals

A persistent challenge for Latin American universities is the tendency of Technology Transfer Offices (TTOs) to orient their strategies toward the logic of large multinational corporations rather than the needs of national firms and local enterprises (Bonzón & Terezano, 2023; Florez & Pineda, 2019). This bias reflects the influence of imported paradigms, particularly the U.S. model, which privileges licensing inventions to actors with the financial and organizational capacity to scale them, typically global corporations with established operations in the region (Mowery et al., 2001). While such strategies may generate international visibility, they risk sidelining context-specific innovations that could yield substantial benefits for local industries and communities (Sjoo & Hellstrom, 2019).

The problem is especially critical given the structure of Latin American economies, where small and medium-sized enterprises (SMEs) dominate. These firms invest little in R&D but could derive significant value from adaptive innovations, consulting, and technical services provided by universities (OECD & European Union, 2017). Yet, patent-centered transfer models often neglect these high-impact but less visible forms of collaboration. In some contexts, academics bypass formal TTOs, engaging directly with local firms or governments, perceiving official offices as misaligned with immediate needs (Ísmodes, 2015; Rojas, 2021). This signals a failure of focus: TTOs should function not only as brokers for international business but also as bridges for community-driven innovation and regional development (Galvez & Herrera, 2020).

Patent data reinforce these concerns. In Colombia, patent registrations are overwhelmingly concentrated among multinational corporations. As shown in Figure 1, the first national applicant is Ecopetrol, while Universidad Nacional de Colombia is the only domestic university among the top filers; other leading applicants include Procter & Gamble, Colgate-Palmolive, and Bayer.

A similar pattern emerges in Peru, where pharmaceutical and industrial multinationals dominate patent filings, leaving domestic universities and firms as marginal actors (See Figure 2). Despite modest growth in patent numbers, both systems reveal weak local participation and strong dependence on foreign corporate agendas.

In both cases, TTO strategies appear to be oriented toward facilitating knowledge appropriation by external actors rather than addressing the technological demands of local industries, governments, and civil society. This evidence highlights the need for a strategic reorientation. Rather than adopting foreign benchmarks as universal indicators of success (patents, licenses, royalties), Latin American TTOs must develop models that balance global integration with local anchoring. Practical steps include:

- Mapping local needs to ensure technology transfer aligns with priority productive sectors such as agriculture, manufacturing, and digital services.

Figure 1. *Colombian patent landscape. (a) Number of patents registered in Colombia by year. (b) Main organizations holding patents in Colombia (Lens database, 2024).*

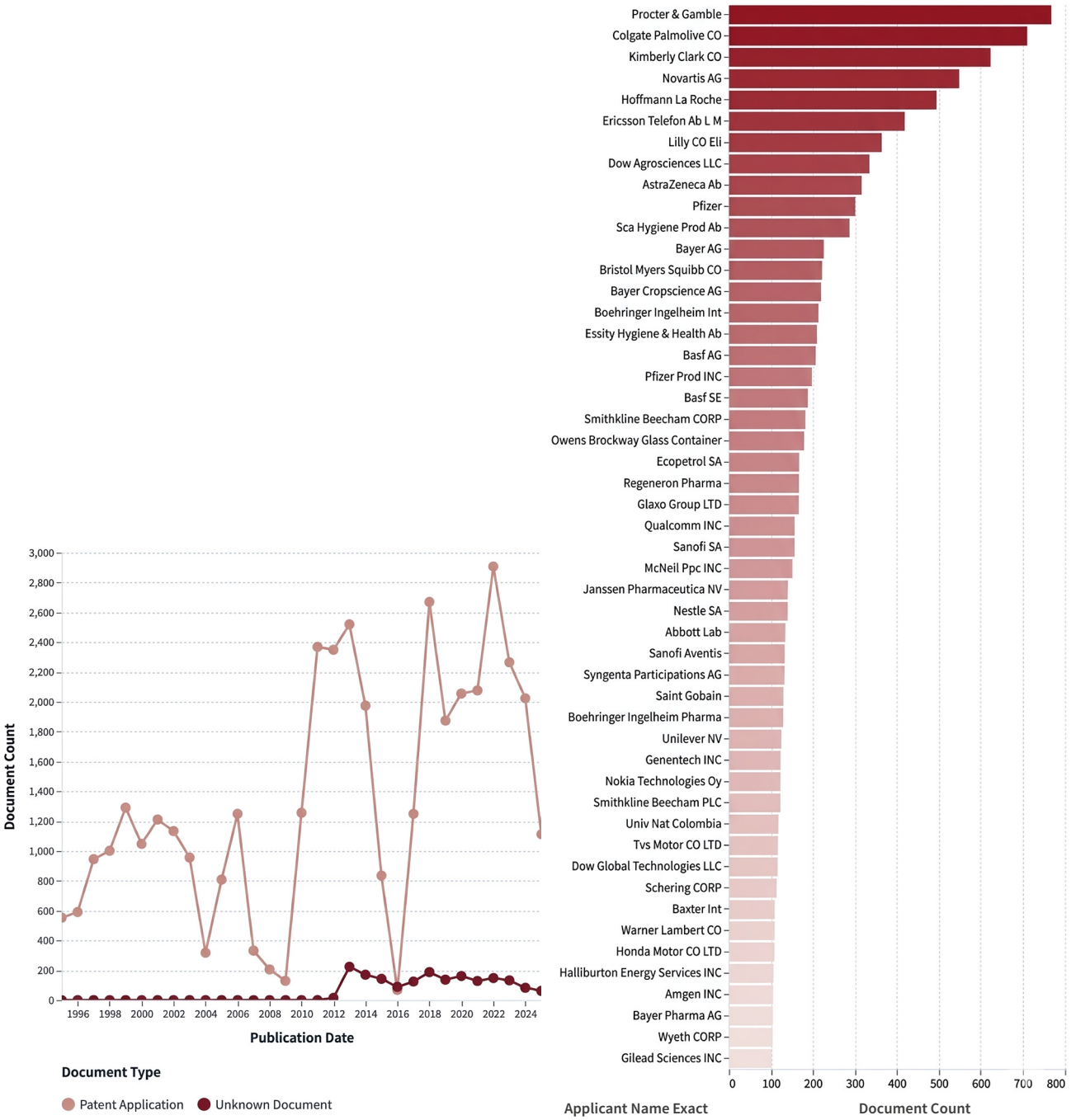
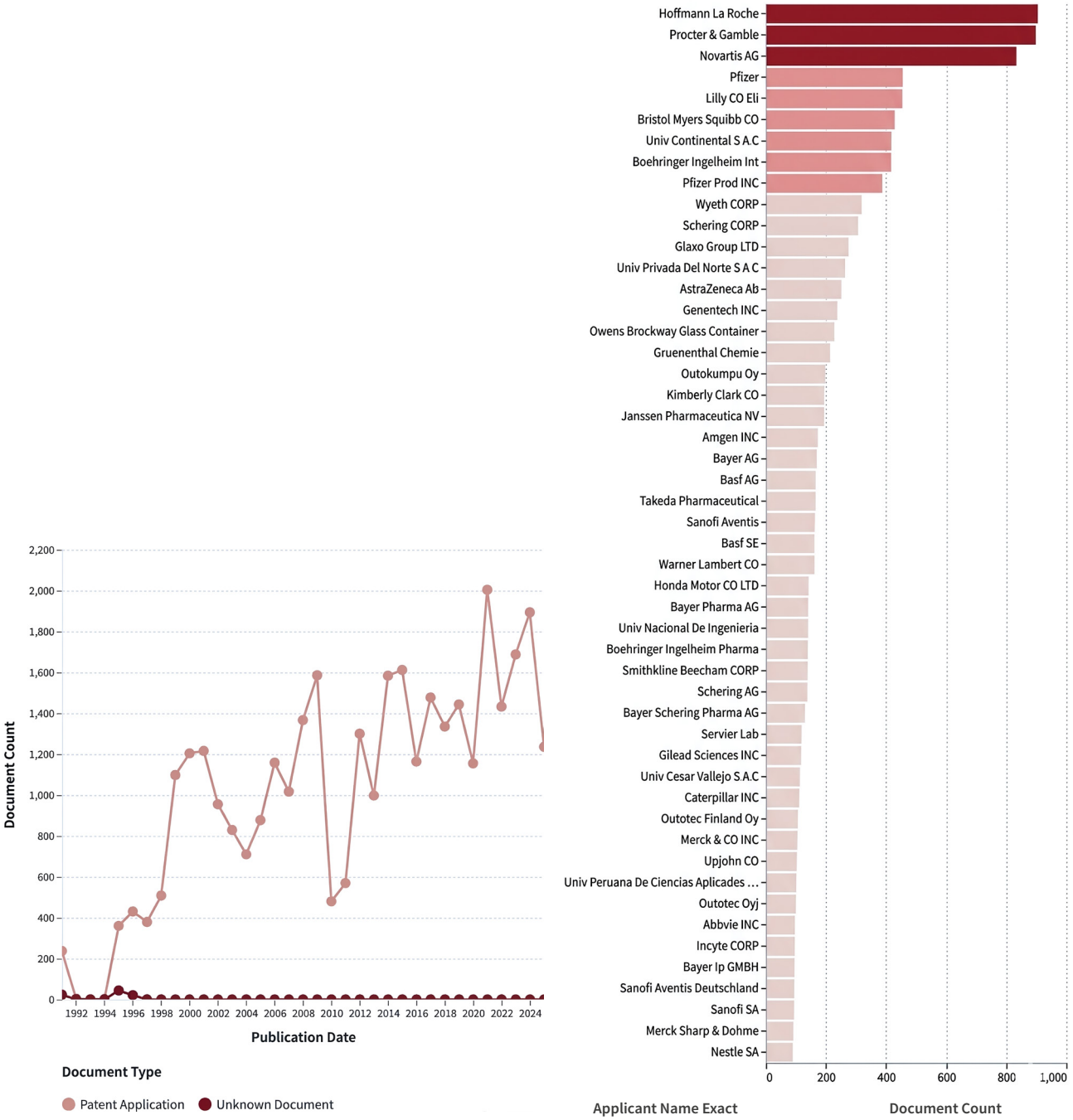


Figure 2. *Peruvian patent landscape. (a) Number of patents registered in Peru by year. (b) Main organizations holding patents in Peru (Lens database, 2024).*



- Developing SME-focused programs, positioning TTOs as extension offices that provide technical services, training, and applied R&D solutions.
- Adjusting academic incentives, rewarding faculty engagement with local challenges as much as international publications or multinational partnerships.

A sustainable TTO model for Latin America must ensure universities act as catalysts of endogenous development. This requires bridging the gap between academic research and local innovation ecosystems while selectively engaging with global corporations to complement, rather than dominate, national agendas (Agrawal, 2006; Bikard et al., 2019). Without this reorientation, TTOs risk becoming peripheral actors in global innovation chains, with limited contributions to the socio-economic development of their countries.

3.3. The university's internal pace vs. the accelerated dynamics of the productive sector

A central challenge for Latin American universities is the persistent misalignment between their internal rhythms and the accelerated dynamics of the productive sector. While industries increasingly operate on short innovation cycles, universities are constrained by rigid governance structures, lengthy approval processes, and inflexible administrative rules. This mismatch generates delays in contract negotiations, intellectual property (IP) management, and collaborative projects, reducing the effectiveness of technology transfer initiatives. Excessive bureaucracy within TTOs has been identified as one of the main barriers to productive university–industry collaboration (Galvez & Herrera, 2020; Rojas, 2021).

The consequences are tangible. Firms often perceive universities as slow or difficult partners, opting instead for private consultants or international collaborators who can respond more quickly. Likewise, researchers frequently bypass TTOs, transferring inventions independently to avoid procedural bottlenecks. Such practices weaken the institutional role of TTOs and risk producing suboptimal agreements that neglect long-term strategic alignment (Bonzón & Terezano, 2023; Flores et al., 2024).

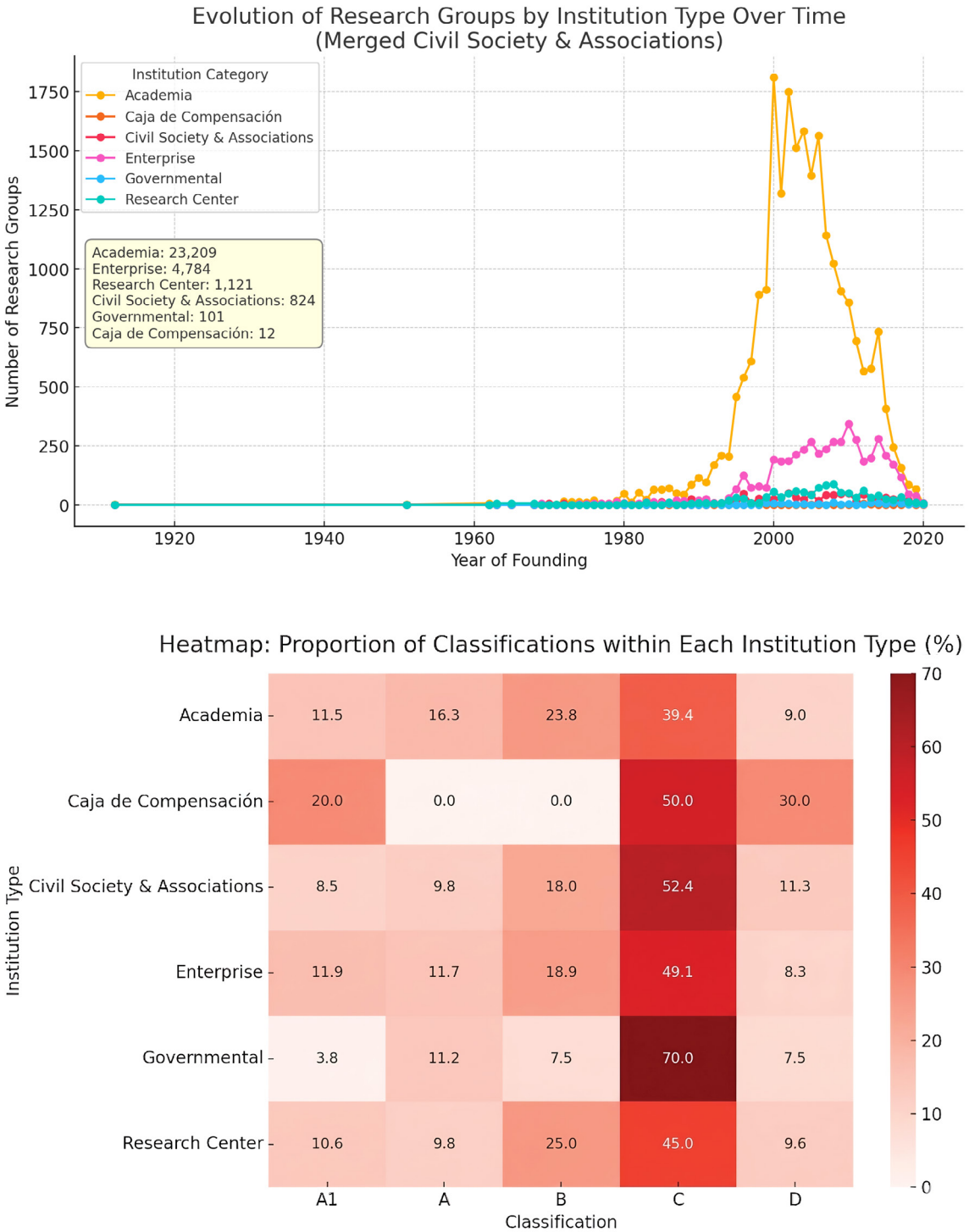
Evidence from Colombia illustrates this tension. Figure 3 shows that companies host a slightly higher share of top-rated (A1) research groups (11.9%) compared to universities (11.5%). While this difference is modest, it signals a rebalancing in which non-academic actors, particularly firms, are gradually consolidating their role in research and development. Universities remain the largest producers of research, but their bureaucratic inertia threatens their capacity to translate scientific outputs into timely innovation.

Figure 4 highlights another systemic challenge: geographical and sectoral asymmetries in research capacity. The Capital District (Bogotá) concentrates nearly 9,000 recognized research groups, while peripheral regions such as Llano or Centro Sur host only a few hundred. This spatial imbalance deepens systemic rigidity, limits inclusive scientific development, and reinforces dependency on knowledge generated in Bogotá or by international partners. Universities in less developed regions often lack the critical mass to adapt to emerging demands, leaving local economies to evolve with minimal scientific support.

These findings underline the urgency of accelerating and decentralizing university engagement. Without reforms that streamline procedures, empower TTOs with greater autonomy, and strengthen regional research ecosystems, universities risk further disconnection from both local needs and industry timelines. Companies and, increasingly, research centers are demonstrating growing capacity to produce high-level research outputs, while universities risk falling behind.

Several reforms are essential to bridge this "speed gap." First, universities should simplify procedures and delegate authority to TTOs, enabling them to approve standard agreements, set technical service fees, and sign nondisclosure agreements without excessive oversight. Comparative experiences show that empowered technology managers respond faster and more effectively (Berumen, 2019; Sun et al., 2025). Second, formalizing IP and commercialization policies is critical. In Peru, for example, fewer than 10% of universities had formal IP frameworks in place by the

Figure 3. *(a) Evolution of research groups recognized by MINCIENCIAS and (b) Group classification by institution type*



Note: A1 accounts for the highest classification recognition given by MINCIENCIAS. Groups classified as A1 usually provide high quality knowledge to the Colombian ecosystem.

mid-2010s, creating inefficiency and legal uncertainty (Ísmodes, 2015).

Another priority is the professionalization of TTO staff. Many offices lack in-house patent lawyers, business negotiators, or specialists capable of operating at the academic–industry interface and instead rely on external consultants for routine processes. Regional networks such as FORTEC in Brazil and Red OTT in Mexico illustrate how continuous training and collective learning can build the dual technical and managerial expertise required for agile technology transfer (Ogarrio & Culebro, 2019; Vargas & Rivera, 2017).

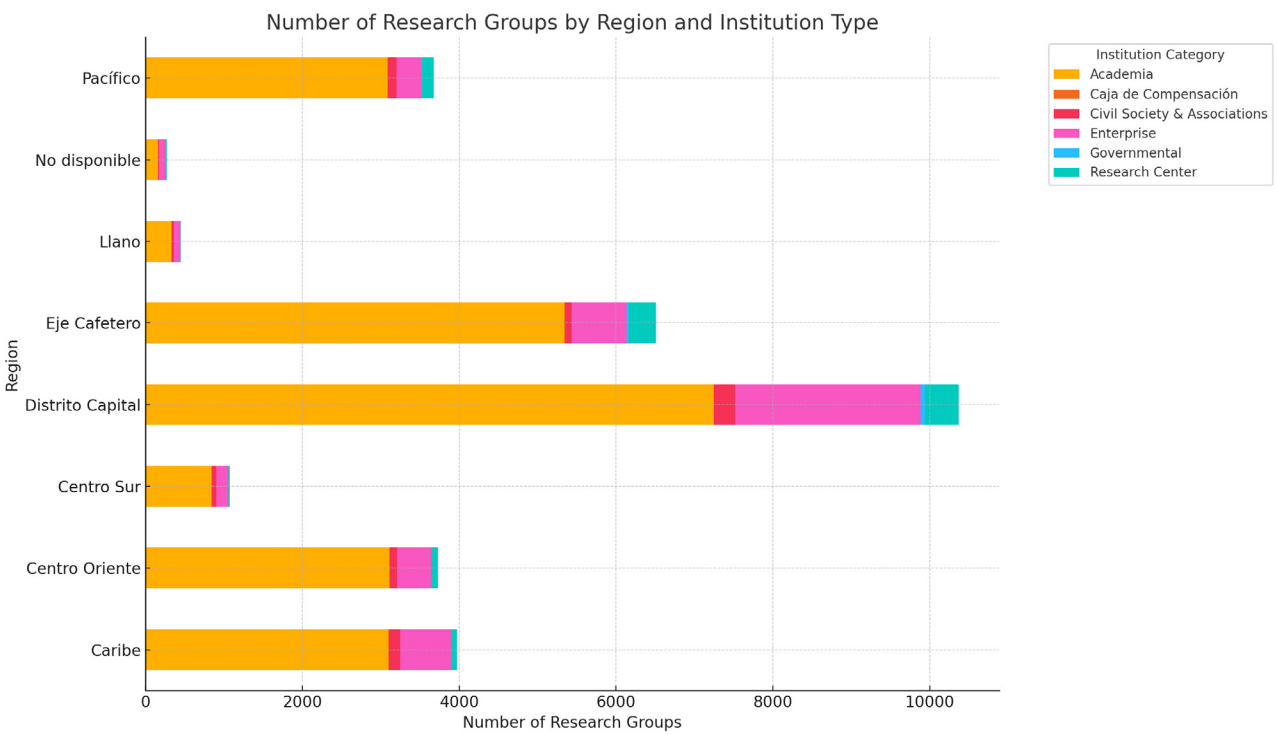
Finally, a cultural shift is necessary. Universities must embrace efficiency and timeliness as central to their role as innovation partners. Service-oriented practices, such as deadlines for invention disclosure evaluations, clear response timelines for industry partners, and satisfaction surveys, can help TTOs strengthen trust and overcome reputational barriers. Strong leadership from university authorities is also indispensable: prioritizing innovation agendas requires removing administrative obstacles, allocating resources, and rewarding faculty who engage in impactful transfer (Rayes, 2023).

Overall, the effectiveness of Latin American TTOs depends not only on resources or legal frameworks but also on institutional agility. As Rojas Arce (2021) observes, cumbersome bureaucratic processes undermine the very purpose of technology transfer, where timeliness is critical to seizing innovation opportunities. Universities that modernize and decentralize their processes will be positioned as central actors in regional innovation ecosystems. Those that fail to adapt risk relegation to peripheral roles, bypassed by more agile partners.

4. CONCLUSIONS

This study has sought to answer the guiding question: Who do universities serve in Latin America? The

Figure 4. *Number of research groups classified by regions (Colombia)*



evidence demonstrates that universities cannot prioritize a single constituency, whether global science, national competitiveness, industrial demand, or societal needs, but must instead act as mediators across the Quadruple Helix. This balancing act is not a normative aspiration but a structural necessity, given the asymmetries and constraints of the region's innovation systems.

The patent landscapes of Colombia and Peru reveal a persistent dependency: *multinational corporations dominate intellectual property filings, while local firms and universities remain peripheral actors*. If universities continue to evaluate success primarily through patent counts, they risk reinforcing reliance on foreign corporations and neglecting the technological and social demands of their own societies. Broader success metrics are therefore essential. Indicators that capture partnerships with SMEs, contributions to regional competitiveness, or impacts on social inclusion would more accurately reflect the developmental role of universities in Latin America's diverse and localized innovation contexts.

A similar shift is visible in research group dynamics. In Colombia, enterprises now host a slightly higher share of top-classified research groups than universities, signaling a rebalancing of knowledge production toward the productive sector. Coupled with the geographical concentration of research capacity in Bogotá, this trend exacerbates territorial inequalities and sidelines peripheral regions. Unless universities adopt decentralization strategies and governments provide targeted investments, higher education institutions risk reproducing the very inequalities they are tasked with mitigating.

Across cases, a recurrent theme emerges: *time as a determinant of impact*. Bureaucratic inefficiencies within Technology Transfer Offices (TTOs) delay negotiations, erode trust with industry, and diminish responsiveness to societal challenges. Process agility is therefore not an administrative detail but a strategic imperative. Achieving it requires institutional reforms to streamline procedures, professionalize transfer staff, and grant TTOs greater autonomy. Equally, it demands cultural change: universities must recognize responsiveness, service orientation, and collaborative problem-solving as integral to their mission.

The risks of inertia are evident. If universities fail to adapt, they risk marginalization within national innovation systems, ceding leadership to multinational corporations and private firms whose agendas may diverge from local needs. Conversely, universities that embrace agility, redefine metrics of success, and strengthen regional engagement can consolidate themselves as central actors in inclusive and sustainable innovation. For Latin America, the challenge is not to replicate foreign models uncritically but to adapt them to local realities, positioning universities as mediators among government, industry, and civil society, and as catalysts of development that is both competitive and socially just.

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iN4iN LATAM Chapter 2025:
Fostering Innovation Management and University Business Linkages at Higher Education Institutions

Connection with the environment (society and companies) – Postgraduate studies

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Abstract

The relationship between universities and their surrounding environment—particularly with the productive sector and civil society—has become a central dimension of contemporary higher education. This paper analyzes the importance of strengthening university engagement with society and companies from the perspective of postgraduate education. First, it examines the conceptual framework of university–industry–society interaction and the so-called "third mission" of universities, highlighting its relevance for innovation, knowledge transfer, and sustainable development. Second, it discusses the Peruvian context, identifying institutional and structural challenges that limit effective collaboration between universities and external actors. Third, the paper presents the experience of Universidad Peruana Cayetano Heredia (UPCH), focusing on institutional initiatives aimed at promoting innovation, social responsibility, and collaboration with public and private organizations. Finally, it proposes strategies and indicators to strengthen engagement from graduate programs, emphasizing co-created academic programs, applied research projects, and partnerships with external stakeholders. The study concludes that consolidating institutional structures, fostering collaborative networks, and promoting inclusive and intercultural communication are essential to enhance the social relevance and impact of universities in Peru.

Keywords: university–environment engagement; technology transfer; graduate education; university–industry collaboration; Peru.

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1. INTRODUCTION

The relationship between the university and its environment—particularly with the productive sector and social organizations—constitutes one of the pillars of contemporary higher-education development. Universities have moved from being institutions focused on professional training and scientific knowledge generation to becoming strategic actors for sustainable development, innovation, and social cohesion (Etzkowitz & Leydesdorff, 2000). In this context, university–industry–society interaction is recognized as an essential dynamic in the construction of knowledge ecosystems, where cooperation drives both economic competitiveness and collective well-being.

The so-called third mission of universities refers precisely to this commitment to the environment, complementing teaching and research with activities oriented toward technology transfer, social innovation, and territorial development (Benneworth & Jongbloed, 2010). In the Latin American context, this mission becomes even more relevant given that universities operate in settings where social inequality, economic informality, and institutional constraints demand a more strategic and transformative engagement (Arocena & Sutz, 2016).

From a business perspective, universities serve as sources of talent, applied research, and technological solutions, while for civil society they represent spaces for dialogue and co-creation of knowledge oriented toward the common good. Collaboration can take multiple forms: internships, open innovation projects, university social responsibility programs, or service-learning initiatives (Vallaeys, 2014). These mechanisms help align the relevance of training with labor-market demands and territorial needs, generating synergies that strengthen both educational quality and the university's social impact.

In sum, engagement with the environment should not be understood as a complementary activity, but rather as a structural dimension of modern university management. It involves building sustainable cooperation networks, developing institutional innovation policies, and strengthening participatory governance. In this way, the university reaffirms its role as a key agent of inclusive and sustainable development, capable of articulating academic knowledge with the economic and social dynamics of its immediate and global environment (OECD, 2019).

2. Context of the presentation

2.1. The university–environment relationship in the Peruvian context

In Peru, the relationship between universities and their environment has evolved in recent years in response to regulatory, economic, and social changes demanding a more relevant and articulated higher education system. University Law No. 30220 (2014) establishes that universities must contribute to sustainable development through scientific research, technological innovation, and social responsibility, recognizing the importance of actively engaging with the productive sector and civil society. This orientation seeks to ensure that universities move beyond traditional professional training to become agents of change in their territories (Superintendencia Nacional de Educación Superior Universitaria [SUNEDU], 2025).

However, university engagement in Peru faces several challenges. Weak articulation with the business sector, limited investment in research and development (R&D), and a fragile innovation culture hinder the consolidation of knowledge ecosystems. According to the Organisation for Economic Co-operation and Development (OECD, 2019), Peru's R&D expenditure does not exceed 0.2% of GDP, far below the Latin American average of 0.7%, limiting the ability of universities to generate applicable and transferable knowledge. Furthermore, many institutions lack robust organizational structures to facilitate cooperation with companies, local governments, or social organizations (Consejo Nacional de Ciencia, Tecnología e Innovación [CONCYTEC], 2023).

Programs such as the Special Science Popularization Initiatives and the Technological Innovation Funds (FINCyT) have fostered collaboration networks

between universities and companies. Yet sustaining these networks requires institutionalizing engagement policies within universities. The triple-helix model proposed by Etzkowitz and Leydesdorff (2000)—university, industry, and government as drivers of innovation—provides a valuable framework for strengthening the role of Peruvian universities in productive and social development.

2.2. The need for offices for engagement and technology transfer

Strengthening university–environment relationships requires specific organizational structures to manage, coordinate, and promote cooperation with external actors. Technology Transfer Offices (TTOs) and Engagement or Outreach Directorates fulfill this role, facilitating interaction between academia and the productive or social sectors. Their creation responds to the need for institutional mechanisms that translate research into innovation and academic training into social development (Benneworth & Jongbloed, 2010).

In Latin America, leading universities in innovation—such as the University of São Paulo, the University of Chile, and the Pontifical Catholic University of Chile—have robust structures for technology transfer, business incubation, and intellectual-property management. These offices act as intermediaries that reduce cultural and bureaucratic barriers between academia and industry, ensuring the sustainability of collaborative initiatives (López et al., 2021).

In Peru, universities have begun to advance in this direction. The Universidad Peruana Cayetano Heredia (UPCH), for instance, has a Directorate for Innovation and Technology Transfer that promotes applied research, scientific entrepreneurship, and collaboration with the productive sector. Furthermore, the Pontifical Catholic University of Peru (PUCP) has a Research Management Office with a dedicated Intellectual Property and Technology Transfer unit. These experiences demonstrate that institutionalizing such structures strengthens research management, innovation culture, and external funding opportunities (Vela et al., 2018).

University Social Responsibility (USR) and Outreach Offices play a parallel role in engagement with civil-society organizations and local governments. According to Vallaeys (2014), USR should not be limited to community extension, but rather understood as a comprehensive management strategy aligning teaching, research, and social projection with community needs. Dedicated social engagement offices allow universities to design service-learning programs, participatory research initiatives, and social innovation projects, strengthening institutional relevance and legitimacy.

These offices support alignment with the Sustainable Development Goals (SDGs) and national science and innovation goals. Modern university management must therefore include specialized units capable of coordinating cooperation with industry, civil society, and government, ensuring that knowledge creation has a real societal impact (UNESCO, 2021).

2.3. The importance of academic programs co-designed with key actors

Academic program design is another critical aspect of university engagement. Program relevance depends largely on responsiveness to labor-market demands, social challenges, and emerging technological opportunities. Thus, involving key actors—industry, professional associations, social organizations, local governments, and alumni—is essential to ensure program quality and relevance (OECD, 2019).

Strategic university planning must incorporate participatory diagnostic and consultation mechanisms, enabling consensus on competencies required for future professionals (Bryson, 2018). In Peru, SUNEDU (2022) promotes evidence-based continuous improvement processes, especially in curriculum design and program accreditation.

Collaboration with external actors also supports competency-based education and the creation of joint graduate programs. These approaches align with global trends toward flexible, interdisciplinary, outcome-oriented higher education (CEPAL, 2020). Jointly designed graduate programs in areas such as innovation, environmental management, or digital transformation can enhance employability and social relevance.

Co-creation also fosters applied research and social innovation. Arocena and Sutz (2016) argue that interactive learning between universities and society drives inclusive innovation, particularly in developing scientific systems. Engaging local communities, civil associations, and subnational governments in academic design fosters contextualized knowledge and sustainable solutions.

Methodologically, building relevant academic offerings requires participatory planning and institutional foresight, applying tools such as stakeholder analysis, curriculum co-design workshops, and labor-market trend studies (Godet, 2007). This results in updated graduate profiles, contextualized competencies, and flexible programs integrating practice and applied research.

Ultimately, co-designed academic offerings strengthen university legitimacy, promote inter-institutional trust, and create broader learning communities. Universities do not merely train professionals—they foster knowledge networks that generate shared value across academia, industry, and civil society.

3. AXES OF ANALYSIS

3.1. The experience of Universidad Peruana Cayetano Heredia in its relationship with the environment

UPCH has, in recent years, built an increasingly solid relationship with its environment, particularly with companies, public institutions, and social organizations. Historically recognized for its excellence in biomedical and public health research, the university has diversified its scope toward areas of innovation, entrepreneurship, and social responsibility, aligning itself with international trends in university management based on the triple helix model (Etzkowitz & Leydesdorff, 2000).

The creation of the Directorate of Innovation and Technology Transfer (DITT) and the Directorate of Social Responsibility and Engagement (DRVS) marked a turning point in the institution's strategy. DITT has promoted applied research projects and partnerships with the productive sector, particularly in biotechnology, digital health, and environmental sustainability. It has also supported professors and researchers in participating in international networks and innovation competitions (UPCH, 2023). These actions have enabled research outcomes to transcend the academic sphere and contribute to solving concrete social and economic problems.

Meanwhile, DRVS has strengthened interaction with communities, municipalities, and nongovernmental organizations through service-learning programs, professional volunteering, and social innovation initiatives. During the COVID-19 pandemic, UPCH stood out for its scientific communication efforts and collaborative community-health projects (Ministerio de Educación del Perú, 2021). This institutionalization of social engagement has helped consolidate a more participatory university culture oriented toward social impact.

However, challenges remain in creating transversal articulation between these directorates, the faculties, and the Graduate School—especially in integrating research, teaching, and outreach under a unified strategic approach.

3.2. Strategies and indicators to strengthen engagement from graduate programs

UPCH's Graduate School can play a central role in strengthening engagement with the environment, given that graduate studies represent the space where research and advanced training converge with innovation and knowledge transfer. In this context, the following strategies and indicators are proposed:

a) Institutional strategies

- *Integrate engagement into curricular design*: incorporate courses and innovation or territorial-intervention projects in master's and doctoral programs, in collaboration with external actors (OECD, 2019).
- *Strengthen university–industry–society agreements*: promote internships, applied research, and co-funded theses aimed at solving sector-specific challenges (Vela et al., 2018).
- *Develop joint or co-created graduate programs*: design master's degrees and diplomas with participation from public, private, and civil-society sectors, ensuring relevance and employability.
- *Encourage scientific and social entrepreneurship*: support incubators and networks of specialized mentors who guide graduate students in developing innovation projects.
- *Promote responsible internationalization*: foster academic cooperation with institutions abroad that value technology transfer and sustainable local development (UNESCO, 2021).

b) Monitoring and evaluation indicators

- Number of active agreements with companies and social organizations linked to graduate programs.
- Percentage of master's and doctoral theses with applied impact or participation from external actors.
- Amount of funding secured through joint university-environment projects.
- Number of students and faculty involved in innovation or social entrepreneurship programs.
- Satisfaction levels of external strategic partners (measured through surveys).
- Applied scientific production (patents, technical reports, innovative products) generated through partnerships.

The systematic use of these indicators would allow UPCH to develop an evaluation culture focused on impact, consolidating a university-management system that connects academic knowledge with national needs.

3.3. Limitations in advancing engagement and the linguistic dimension

- Despite institutional progress, UPCH faces structural and cultural limitations that affect its ability to expand external engagement. Key challenges include:
- *Institutional fragmentation*: lack of articulation between faculties and directorates leads to duplicated efforts and hinders the development of large-scale interdisciplinary projects (SUNEDU, 2022).
- *Limited resources for technology transfer*: many initiatives rely on competitive external funding and lack stable institutional financing (Vela et al., 2018).
- *Limited business-sector participation*: a cultural gap persists between academia and industry, characterized by mistrust and insufficient incentives for cooperation (López et al., 2021).
- *Weak culture of social-impact evaluation*: although outreach projects exist, results are not always systematically measured or communicated to society.

A particularly relevant factor in the Peruvian context is the language barrier. Most engagement initiatives operate in Spanish, limiting the effective participation

of Indigenous and rural communities. Incorporating Quechua and other Indigenous languages into communication, training, and research represents both a challenge and an opportunity to strengthen social relevance.

There are institutional examples in this direction. The National University of San Antonio Abad of Cusco (UNSAAC) has implemented bilingual university-extension programs to train Quechua-speaking communities. In addition, the National University of San Cristóbal de Huamanga promotes research and publication of scientific materials in both Quechua and Spanish (Barrionuevo, 2025). UPCH itself has initiated intercultural-health experiences through its Public Health and Nursing faculties, though they are still in the early stages.

Promoting multilingual communication in university management and social outreach not only guarantees inclusion but also enriches scientific production and cultural exchange. In a multilingual country like Peru, linguistic diversification should be considered an element of educational quality and social relevance (UNESCO, 2021).

In summary, UPCH has taken significant steps in strengthening its relationship with the environment through the creation of new directorates and programs focused on innovation and social responsibility. Nonetheless, consolidating a comprehensive engagement policy will require greater institutional articulation, financial sustainability, and intercultural openness to communicate knowledge in the country's diverse languages. Only then can the university fully fulfill its mission as an agent of scientific, economic, and social development.

4. CONCLUSIONS

4.1. UPCH's experience in its relationship with companies and social organizations

In recent years, UPCH has shown significant progress in its engagement with external stakeholders, especially following the creation of new units focused on innovation, entrepreneurship, and social outreach. These initiatives have enabled the consolidation of joint projects with companies and organizations, promoting technological solutions, community health programs, educational initiatives, and projects with territorial impact.

The creation of the Innovation and Entrepreneurship Directorate and the Social Responsibility and Engagement Directorate was a strategic step. As a result, the university not only strengthened its capacity for knowledge transfer, but it also expanded opportunities for faculty and students to engage directly with social and productive actors. In this way, UPCH has been able to respond more effectively to national challenges such as public health, education, biomedical research, and social innovation, reaffirming its role as a scientific institution committed to the country.

This experience demonstrates that when a university organizes itself institutionally to look outward, opportunities for collaboration multiply, value creation becomes more diverse, and sustainable relationships are built on trust and shared objectives.

4.2. Strategies to strengthen engagement at the graduate level

At the graduate level, there is a tremendous opportunity to deepen university–society relationships. Suggested lines of action include:

- Co-created programs with companies and organizations, where external representatives participate in curricular design and serve as guest lecturers.
- Applied research or innovation projects developed in collaboration with organizations that present real-world challenges.
- Professional internships and research stays in public institutions, NGOs, and private companies.
- Seminars, innovation roundtables, and dialogue forums with actors from the productive sector, the social sector, and local communities.
- A network of external mentors to support thesis projects aimed at solving real problems.

To monitor these initiatives, simple and relevant indicators may be considered, such as the number of active partnerships, joint projects, students involved in engagement activities, participating faculty, and satisfaction of external partners.

4.3. Remaining limitations and challenges: a critical perspective

Despite progress, challenges remain. University culture remains largely focused on traditional research, which at times diminishes the emphasis placed on social engagement and collaboration with the productive sector. There are also operational and administrative barriers that hinder agile execution of projects with external actors. Another critical point is the need to strengthen soft skills, leadership, and communication competencies among academic staff and students to improve dialogue with other sectors.

Finally, an underexplored aspect of engagement is the country's linguistic diversity. Most of our communication and outreach strategies are developed in Spanish—and sometimes in English—leaving aside indigenous languages such as Quechua or Aymara. However, institutional examples already point the way: SUNEDU has released informational materials in Quechua, and universities such as UNSAAC and UNMSM have developed bilingual cultural and educational initiatives. Including these languages is not only a cultural gesture but a necessary step for the university to truly engage with a diverse and multicultural country.

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