OECD Skills Studies

Innovative and Entrepreneurial Universities in Latin America

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Preface

Changes in technology, labour markets, the climate, demography, and, more recently, the COVID-19 pandemic, are having a transformational impact on our societies and ways of life. Because they have a critical role to play in the development of transversal skills and applied knowledge, and can drive, innovation and entrepreneurship, Higher Education Institutions (HEIs) in Latin American countries also have a critical role to play in adjusting to these, and indeed future, transitions.

COVID-19, in particular, highlighted the potential of HEIs to support societies facing dramatic transformations. In the wake of the pandemic, awareness of the role HEIs can, or should, play in their education, research, and collaboration missions, and in particular to address major transformations, has increased significantly, both within HEIs themselves as well as in their broader ecosystems. Many Latin American HEIs are now transitioning to new forms of teaching and learning, connecting their research to the needs of their ecosystems, and playing a more active role in their own communities and networks. Indeed, entrepreneurial and innovative HEIs have become important partners for policy makers and other stakeholders to help achieve a fast and equitable response and recovery.

The eleven HEIs that participated in this study represent a heterogeneous group of institutions that have embraced innovation and entrepreneurship in different ways. These HEIs are developing new approaches to teaching, research, and collaboration, based on partnerships between HEIs and businesses, public authorities, and the civil society. This reflects the increasing importance of opportunity-driven entrepreneurship throughout Latin America.

These institutions display a range of good practices that can inspire many other HEIs in the region, and beyond. Actions range from the delivery of comprehensive and widespread entrepreneurship education to engagement in collaborative activities with external stakeholders, including in teaching and research activities. However, Latin American HEIs can only realise their full potential if they are supported by favourable policy frameworks that enable and encourage the development of entrepreneurship and innovation in higher education. Such policy frameworks should support, in particular, funding and evaluation of knowledge transfer and incubation activities, and the development of intellectual property within HEIs.

This work is the result of a collaboration between the Organisation for Economic Cooperation and Development (OECD), the Inter-American Development Bank (IADB), and Banco Santander. The three organisations recognise that more innovative and entrepreneurial higher education can promote skills at all stages of adults' lives and contribute to the creation of valuable jobs and the development of more sustainable communities.

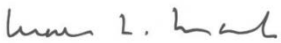
The collaboration was initiated with the organisation of an event at the OECD in Paris in July 2019 to discuss the entrepreneurial and innovation agenda of higher education institutions in Latin America. At this occasion, which gathered representatives from Latin-American and Spanish universities, the OECD, the IADB and Banco Santander presented their analytical work and approaches to entrepreneurship development. This included the HEInnovate framework developed by the OECD and the European Commission, the IADB's research on entrepreneurial and innovation ecosystems in selected Latin

American cities, and the work done by Banco Santander in cooperation with MIT D-Lab, also on urban ecosystems. The event highlighted the complementarity between the three institutions' methodologies, with IADB and Banco Santander studies on ecosystems complementing OECD's work on the entrepreneurial and innovative agenda of HEIs. The event thus laid the ground for this study, which started in September 2020.

The present report is the result of that collaboration, including with the 11 HEIs involved in this study. The report illustrates a large variety of practices adopted by HEIs to promote innovation and entrepreneurship in their own communities. Above all, the report shows that several Latin American HEIs are fully mobilised to develop new functions and activities and offer new opportunities to learners and other stakeholders, in their ecosystems and networks, and reveals the significant potential that can be exploited at the national and regional levels to foster innovation, sustainability, inclusiveness, and entrepreneurship.

Lamia Kamal-Chaoui

Director of the Centre for Entrepreneurship, SMEs, Regions and Cities, OECD



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Foreword

This publication investigates how Higher Education Institutions (HEIs) in Latin America support entrepreneurship and innovation in their ecosystems. It assess strategies and practices of eleven HEIs across six countries: Argentina, Brazil, Chile, Colombia, Mexico and Uruguay. It highlights good practices put forward by Latin-American HEIs to support entrepreneurship development through incubation and acceleration activities, and entrepreneurship education. It also underlines strategies fostering innovation through collaboration with government and business, including in multi-campus institutions.

The review offers suggestions to HEIs on how to strengthen the linkages between entrepreneurial HEIs and their regional ecosystems, including by: increasing the visibility of some forward-looking initiatives; providing more stable funding for knowledge transfer activities; and developing further metrics to assess impact.

The publication is the result of a collaboration between Organisation for Economic Cooperation and Development (OECD), the Inter-American Development Bank (IADB), and Banco Santander, which was initiated in 2019 at a joint event in Paris bringing together Latin-American HEIs to discuss their entrepreneurial and innovative agenda. The event confirmed the interest of Latin-American HEIs in engaging in a review process, and highlighted complementarities between the work streams of the three partner institutions. The review draws on a number of fact-finding processes including a survey to all participant HEIs as well as bilateral interviews with university representatives and local stakeholders (public authorities and firms collaborating with the universities).

Acknowledgements

This review was a collaborative effort between the OECD's Centre for Entrepreneurship, SMEs, Regions and Cities (CFE) led by Lamia Kamal-Chaoui, Director, and the Competitiveness, Technology and Innovation Division of the Inter-American Development Bank (IADB) led by Gonzalo Rivas. It was also undertaken in partnership with Banco Santander.

Maria Sobron Bernal, Policy Analyst, and Raffaele Trapasso, Head of the Entrepreneurship Education and Skills unit in CFE, prepared the report under the supervision of Céline Kauffmann, Head of the Entrepreneurship, SME and Tourism Division, CFE and Lucia Cusmano, Deputy Head of Division. Anne Rimmer and Ashley Noriega, CFE, provided substantive assistance. Juan Carlos Navarro, Senior Advisor, Gabriela Alvarez Borbon, Consultant, and Isabel Vicentini, former Consultant, all of them from the Competitiveness, Technology and Innovation Division at the IADB, provided guidance, detailed comments and inputs to the report. Marcelo Tedesco, Research Affiliate from MIT-D Lab and Edwin Goñi Pacchioni, Economist from IADB also provided input evidence about innovation ecosystems in some of the case-study ecosystems. Professor Pedro Saraiva of the Nova Information Management School of Nova University of Lisbon and Professor Yancy Vaillant of the Toulouse Business School of Barcelona also actively contributed to this report.

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The COVID-19 pandemic required that this report be conducted entirely through virtual meetings. The review team extends its gratitude to the co-ordinators, staff of the selected Higher Education Institutions (HEIs) who provided fundamental input and support for the review. In particular, the team thanks Laura Rosso and Julian Schofer from the University Siglo 21, Argentina, Marcos Martins and Luiz Henrique Catalani from the University of São Paulo, Brazil Rafael Aroca and Fernanda Parolo de Mattos Nogueira from the University of São Carlos, Brazil. Carlos Felipe Jerez Hanckes from the Adolfo Ibáñez University of Chile and Alex Parnas Haussmann from the Pontifical University of Chile are thanked. The OECD also extends its gratitude to Fanny Almario Mayor and Diana Diaz Alvarado from the Pontifical Javerian University, Colombia to Enrique Ramírez and his team from ICESI University Colombia, and Andres Marino Alvarez from the National University of Colombia (Manizales). It also thanks José Manuel Aguirre Guillén from the Tecnológico de Monterrey of Mexico and Elianne Elbaum from the Technological University of Uruguay.

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Executive Summary

Entrepreneurial Latin American higher education institutions (HEIs) have become important local stakeholders, promoting leadership, innovation and sustainability in their own communities. This evolution, shared by all case study HEIs involved in this report, reflects a broader trend in Latin America. More widely, opportunity-driven entrepreneurship has gained traction in the region over the last decade, changing the innovation landscape by bringing new products and services to markets. Technology-driven start-ups in the region have tripled since 2017 and have multiplied their estimated value from USD 7 billion to USD 221 billion over the last decade, according to the IADB. In 2021, the region had twenty-seven unicorns (privately held start-ups valued at more than USD 1 billion). Entrepreneurship has gained importance within national and subnational policy agendas, with several countries establishing public accelerators, or support programmes to help young start-ups and innovative SMEs scale-up their ventures. In some cases, universities in the region have actively connected to these programmes or established their own initiatives. The aim of the review is to identify good practices of entrepreneurship education and knowledge exchange efforts, which can help HEIs, generate economic and societal value for their ecosystems.

However, despite these positive trends, a number of Latin American countries are still characterised by low levels of public and private investment in research and development (R&D) and, in general, low levels of collaboration between universities and businesses. Indeed, investment in R&D in the region grew from a little over 0.5% of GDP in the early 2000s to 0.75% in 2015 before declining again in recent years. This trend contrasts starkly with the average of 2.3% in OECD countries over the last decade. Moreover, the tighter fiscal environment in the wake of COVID-19 has limited the ability of the state to allocate resources to research and innovation. Nevertheless, despite these challenges an increasing number of institutions are actively supporting a new generation of entrepreneurs and providing knowledge-based solutions to partners in their own local ecosystems, including in non-metropolitan areas; solutions that are increasingly oriented to the spatial challenges and opportunities of their ecosystems.

This review assesses the “geography of higher education” in six Latin American countries – Chile, Mexico, Colombia, Argentina, Brazil, and Uruguay – through the examination of eleven case studies. These case studies focus on universities with experience in supporting entrepreneurs. In particular, the review assesses the way in which these institutions contribute to economic growth, inclusion and societal and environmental objectives within their ecosystems, spurring the nascent entrepreneurial and start-up landscape in Latin America.

This review reflects the outcome of a joint collaboration between the IADB, Banco Santander and the OECD, that builds on a 2019 event organised in Paris that brought together several HEIs Latin-American and Spanish HEIs to discuss their entrepreneurial and innovative agenda. The event confirmed the interest of Latin-American HEIs in engaging in a review process, which has culminated in this report.

The methodology used in this review draws on the HEInnovate framework (jointly developed by the OECD and the European Commission) that studies the entrepreneurial and innovation agenda of HEIs. It also draws on IADB and Banco Santander’s work mapping the role of selected HEIs within their own innovation ecosystems (entrepreneurial ecosystems in Mexico City, Montevideo, Santiago de Chile, São Paulo, Buenos Aires, Bogota and Cali). The review also draws on interviews of more than forty Latin American

stakeholders (university representatives, public authorities and firms collaborating with the universities) as well as a survey to all participant HEIs.

Main findings

All case-study universities have developed entrepreneurship activities. These universities have, to varying degrees, embedded entrepreneurship across their educational programmes, their strategies, governance and organisation, in the system of incentives offered to faculty, staff and students, and in the way, they cooperate with external stakeholders, including businesses and local governments.

While largely still nested in business and engineering schools, entrepreneurship education courses are becoming popular across different faculties, with some universities setting mandatory entrepreneurship courses for students across a number of disciplines. Entrepreneurship education is also delivered through extracurricular activities (hackathons, entrepreneurship contests, fairs, festivals) and internships, allowing flexibility and promoting interaction with external stakeholders in particular, with businesses of all sizes and levels of maturity.

There is a variety of approaches to the delivery of entrepreneurship education. In some of the universities studied, courses to help students develop a business idea are prevalent. For example, there are specific courses for science and engineering students, as well as PhD students, as a means to bridge science and research with the business world. In other case studies, entrepreneurship education goes beyond the creation of start-ups and spin-offs and the aim is to empower and stimulate students from all disciplines to acquire a growth-oriented, risk-taking mind-set that prepares them to become leaders of the future. Regardless of their approaches, all case-study universities were able to continue delivering their entrepreneurship education activities (including incubation and acceleration) during the pandemic by digitalising teaching and learning activities.

The review found that most case-study universities are becoming entrepreneurial hubs supporting innovation in their ecosystems. Many are host to accelerators, incubators, centres for entrepreneurship and innovation open to external stakeholders such as entrepreneurs and SMEs. In addition, many universities take advantage of their multi-campus strategy to amplify their impact and engagement. Multi-locality allows them to connect with a broader variety of actors including local governments and business communities. In some of the countries studied, local governments try to attract a campus of an entrepreneurial university as a way to promote innovation and jobs.

Most universities in this report centred their collaboration activities towards their surrounding communities, by building bridges with local entrepreneurs, SMEs, research institutes, and NGOs. HEIs in Brazil and Colombia are intensifying efforts to support innovation, by providing dedicated entrepreneurship training to researchers or conducting cross-disciplinary research to respond to challenges faced by external stakeholders. Multi-campus universities in countries such as Mexico and Uruguay have implemented a “decentralised” system, which allows each campus the flexibility to engage with local constituents. Several universities are collaborating with public authorities and NGOs to address the social challenges of their local communities (particularly prevalent in Chile and Argentina). The review also revealed challenges for case-study universities including unfavourable intellectual property regulations at the university level or at the national level that limit the capacity to patent innovation. Interviews with participants did not; explore however, the degree to which research produced had the potential to be patented, which could be examined in future studies.

Main Recommendations

Based on information collected in interviews and through desk research, the review provides the following recommendations to strengthen linkages between entrepreneurial HEIs and their regional ecosystems.

Increase awareness of good practices and establish continental networks among different HEIs to support mutual learning. Universities should connect with other Latin American universities to share best practices on how they entrepreneurship mainstreaming helps them connect with their communities, including businesses and civil society.

The legal framework to regulate intellectual property should be improved at a national level and at the university level. Technological transfer offices are understaffed and would particularly benefit from legal advice offering support for patent creation and licensing.

Universities should allocate more funding to support entrepreneurial activities and knowledge exchange and collaboration. A sustainable funding stream to maintain incubation or acceleration activities is a necessity in most cases. Sustainability and predictability of resources will also allow the creation of specialised professional skills connected to entrepreneurship (education and support). Improved access to seed funding can help. Venture capital funds, which are relatively more common, tend to offer support to start-ups that already have an effective business model. A larger venture capital system in Latin America could cover the full spectrum of needs of academic entrepreneurs at different stages of the development of their business idea. Concerning knowledge exchange and collaboration, more stable and predictable funding would also allow long-term collaborative projects with stakeholders, including firms of all size and maturity levels.

Develop a system of evaluation of impact, both at the national and regional level. This is an essential learning instrument to understand how to improve the performance of entrepreneurial universities in terms of knowledge exchange, and entrepreneurship support but also serves as a tracker that can unlock access to finance. Most universities are measuring their knowledge exchange activities using knowledge performance output-based indicators, such as number of patents, number of licenses, and number of spin-offs. Yet universities reported that a lack of a national evaluation framework on knowledge exchange hindered their ability to use harmonised indicators at a country level.

Part I Universities as drivers of innovation and entrepreneurship

1 Innovation and higher education ecosystems in Latin America

Opportunity-driven entrepreneurship is gaining traction in selected countries in Latin America (Argentina, Brazil, Chile, Colombia, Mexico and Uruguay). While the innovation system is characterised by low levels of public and private investment in research and development and limited university-business linkages, recent efforts from selected universities are sustaining the nascent entrepreneurial ecosystem and are putting knowledge transfer back on the education agenda. The OECD, the Inter-American Development Bank (IADB) and Banco Santander have joined forces to analyse eleven universities' contribution to innovation and entrepreneurship in selected countries. This study builds on previous work on the topic.

Rationale for this review: Universities as drivers of innovation in their ecosystems

Over the past four decades, universities' role in their communities has changed. The traditional roles of research and teaching are increasingly complemented by the transfer of knowledge, technology to external stakeholders, support for entrepreneurs and the broader community. Universities are increasingly assuming roles of innovators that contribute to regional and national growth. This changing role is due to many factors. Megatrends such as globalisation and technological advancement have altered the way universities teach and conduct research, compelling institutions to compete at the international level, adapt their curriculum and their research to respond to these societal challenges and prepare students for a changing labour market.

In addition, pressures on budgets and economic downturns have led to increased scrutiny of public funding allocated to higher education, putting pressure on institutions (especially public ones) to prove their role in a knowledge-based society. Many of the world's leading higher education institutions (HEIs) are located in economically thriving cities and regions: the geographical proximity between prestigious HEIs and agglomerations of businesses is considered a driver of innovation, productivity and economic growth. The new knowledge generated by these leading research institutions plays an important role in attracting innovative business in regions and is expected to increase university-industry co-operation in the given region. Companies can benefit from the knowledge spill-overs generated by research conducted in local HEIs, especially as knowledge spill-overs are favoured by the geographical proximity of actors.

Universities across the globe have become more "entrepreneurial", adapting teaching and research activities but also increasingly engaging with external partners to transfer knowledge and support entrepreneurs. Etzkowitz defines the entrepreneurial university as one that carries out activities beyond teaching and research, to fulfil its third mission (Etzkowitz, 2013[1]). Gibb, Haskins and Robertson (2013[2]) further argue that entrepreneurial universities are dedicated to "creating public value via a process of open engagement, mutual learning, discovery and exchange with all stakeholders in society – local, national and international". Concretely, third mission activities may refer to continuous education or lifelong learning, innovation, knowledge and technology transfer, social engagement (volunteer work, cultural programmes) and entrepreneurship programmes.

Over the past four decades, entrepreneurial universities have started to engage more with their ecosystem and some universities have turned into key drivers of economic development in their region. They support a new generation of entrepreneurs, by teaching entrepreneurial skills and providing incubation facilities and producing research that has an impact. The University of Stanford in the Silicon Valley or Massachusetts Institute of Technology, United States, are good examples of entrepreneurial university, producing talent, training a new generation of entrepreneurs and liaising with local technological companies to produce pioneering research and technology (Jaffe, 1989[3]).

More recently, the COVID-19 pandemic has also highlighted the capacity of universities to play a fundamental role in providing knowledge-based solutions as well as scientific and technological innovation in their respective ecosystems. For example, many HEIs have mobilised scientific and medical resources to address the health emergency, contributing to research but also to the production of medical equipment (respirators, masks, hand sanitisers). Universities can continue this work and support their regions leading innovative research, offering digital and entrepreneurial skills in their ecosystems. In the post-COVID era, opportunities open up to build on this engagement and strengthen HEIs' role in supporting regional development, such as by leading innovative research and contributing to the development of digital and entrepreneurial skills in their ecosystem.

Within this context, the review analyses entrepreneurship education and knowledge exchange practices in a selected sample of universities and identifies common patterns and lessons learned that could be useful to other universities in the region and across the globe. It takes stock of the best practices and challenges

identified during the fact-finding process of the review. It also benefits from pre-existing work on entrepreneurial ecosystems from the Ecosystem Dynamics Initiative (GED) and the Inter-American Development Bank (IADB), each with their own specific methodological approach (see Box 1.5).

The review aims to understand how universities interact with different actors in entrepreneurial ecosystems and how these HEIs can promote economic growth and prosperity within their ecosystems and support the nascent entrepreneurial and start-up landscape in Latin America. Furthermore, as underscored in the previous section, the region is adapting to global transformations that will shape the way we live, study or work. Understanding the role of universities within this context is important, especially as these institutions are a pillar of democratisation in the region and now have a fundamental role to play in a time where social and digital divides are increasing. The report provides some suggestions and international benchmarks to enhance the role of HEIs as drivers of innovation and sustainability in all territories. The review covers 11 universities in six countries in the Latin American region (Argentina, Brazil, Chile, Colombia, Mexico and Uruguay).

The conceptual framework used to understand HEIs new role

OECD work on entrepreneurial and innovative universities

The OECD has been analysing the role of entrepreneurial universities in regional development for almost two decades. To support higher education systems and institutions in their changing role, the European Commission (EC) and the OECD developed the higher education innovation framework and programme HEInnovate in 2011. This guiding framework includes an online self-assessment tool, which helps HEIs to develop their institutional strategy and related actions to embrace the entrepreneurial and innovation agenda (see Box 1.1 for more information).

Box 1.1. About the HEInnovate guiding framework

HEInnovate is a guiding framework for HEIs wishing to develop their entrepreneurial and innovative potential. The framework, developed by the EC in collaboration with the OECD includes a self-assessment tool, which helps HEIs assess their entrepreneurial and innovative agenda. The interactive tool facilitates discussion within an institution on how to drive forward the entrepreneurial and innovative agenda. Through the continued use of the tool, HEIs can monitor their progress against actions taken, gain inspiration from material available on the HEInnovate webpage and be part of a community of practice. HEInnovate covers eight broad areas, which include statements for self-assessment:

- Leadership and Governance.
- Organisational Capacity, People and Incentives.
- Entrepreneurial Teaching and Learning.
- Preparing and Supporting Entrepreneurs.
- Digital Transformation and Capabilities.
- Knowledge Exchange and Collaboration.
- The Internationalised Institution.
- Measuring Impact.

Source: EC/OECD (2022[4]), *HEInnovate*, https://heinnovate.eu/en., accessed in May 2022

Initial work was followed by country reviews, which examine the implementation of the entrepreneurial and innovation agenda at the country level, by taking into account both the national policy framework and institutional practices. Between 2013 and 2021, 13 country reviews have been undertaken in OECD and European Union member countries.

Box 1.2. Lessons learned from the HEInnovate country reviews

Between 2013 and 2021, the OECD and EC undertook 13 country reviews in Austria, Bulgaria, Croatia, Hungary, Greece, Ireland, Italy, Lithuania, the Netherlands, Poland, Romania, Slovenia and Sweden. These reviews demonstrate that there is no shortage of examples of HEIs driving the entrepreneurship and innovation agenda in their institution and within their regions. In many instances, these practices are at the global forefront of what it means to be an entrepreneurial university. Entrepreneurship education has expanded beyond business and engineering schools and is adopted by different types of universities and faculties, generating innovations in teaching, research activities and the way in which HEIs connect with their stakeholders. Yet the country reviews also found that these entrepreneurial practices are granular, dispersed and under-recognised. The HEInnovate country reports demonstrated that HEIs require effective strategies to collaborate with external stakeholders, which can only be driven by effective governance and institutional settings that favour these arrangements (such as the creation of a technology transfer office, a staff position with a remit to promote innovation, etc.). However, often, institutions lacked the right incentives to reward teachers and researchers engaging in activities with external partners and adequate funding to sustain knowledge transfer activities. At the system level, policies, legislation and funding schemes to support this agenda were still at preliminary stages, with countries like the Netherlands or Sweden leading the way. Further research also illustrated the lack of a national evaluation or accreditation system that would consider the entrepreneurship or knowledge transfer agenda, evidencing a lack of policy support.

Source: Adapted from (OECD, 2022[5]), « Advancing the entrepreneurial university: Lessons learned from 13 HEInnovate country reviews », *OECD SME and Entrepreneurship Papers*, n° 32, Éditions OCDE, Paris, https://doi.org/10.1787/d0ef651f-en.

The HEInnovate framework served as a basis to develop the analysis as it offers a comprehensive understanding of universities' entrepreneurial and innovative agenda and the implementation of this agenda. The present study in particular focuses on two dimensions of the HEInnovate guiding framework: entrepreneurship education and knowledge transfer (Box 1.1). It also looks at incentives and organisational structures put in place to support these activities.

In addition, this review of innovative and entrepreneurial universities in Latin America is the first of a series of regional reports on the theme of the Geography of Higher Education being conducted by the OECD.[1] The reports are part of a policy dialogue that aims to understand better the role of universities in their local ecosystems, and how these can be drivers of growth for their regions. Knowledge transfer needs physical proximity, thus the relevance of the role universities play in supporting regional economies. It will also address a key driver for innovation in higher education policy: the need for policy complementarities or synergies to address a policy that has always turned a blind eye to space. Education policies are often regulated at a national level with disregard for the specific needs of local authorities, even in countries where regional authorities are involved in education policy (such as in Spain or some Latin American countries, especially in federal states). Links between policies are often missed too, as policies are developed in silos. To support innovation, higher education policy needs to be done in co-ordination with other policies such as regional development policies, encouraging foreign direct investment (FDI), or industrial policy (Box 1.3).

Box 1.3. Defining policy complementarities

As noted in HEInnovate reviews, universities that succeed in pushing forward their innovation agenda rely on a solid policy framework. For example, in the Netherlands, higher education policies are designed in co-ordination with other policy areas such as innovation, regional development and attracting FDI.

The concept of policy complementarity refers to the mutually reinforcing impact of different actions on a given policy outcome. Policies can be complementary because they support the achievement of a given target from different angles. For example, production development policy, innovation policy and trade policy all support the competitiveness of national or regional industry. Alternatively, a policy in one domain can reinforce the impact of another policy. Policy makers should take into account these policy complementarities when they design and implement policy reforms to avoid poor performance of policies and optimise the use of scarce resources.

Policy synergies are also relevant to higher education policy. For instance, a country that invests in the development of higher education should also be concerned with policies, which create job opportunities for individuals holding a degree, to avoid skills mismatch, or brain drain (qualified workers migrating abroad). In addition, higher education policy should be linked to regional innovation policies. HEIs can act as innovation powerhouses for their regions. Depending on the level of development of their region, HEIs can promote the diffusion of innovation, by creating “competence centres” or “digital hubs”, for example, or collaborating with regional firms to enhance their innovation capacity, through industrial PhD programmes or other forms of joint research activities. In the same vein, through their teaching and learning activities, HEIs can generate human capital to promote sustainable and inclusive development.

The IADB and Santander-sponsored Ecosystem Dynamics Initiative (GED) work on entrepreneurial ecosystems

The study benefits from the IADB’s and Banco Santander exhaustive work on entrepreneurial ecosystems in Bogotá (Colombia), Buenos Aires (Argentina), Mexico City (Mexico), Montevideo (Uruguay), Santiago de Chile (Chile) and São Paulo (Brazil).

The quantitative analysis from the GED and IADB’s entrepreneurial ecosystems assesses the role of HEIs in their surrounding communities, taking into account the characteristics of the different ecosystems. It focuses on the role universities play in supporting research, innovation development and the creation of cutting-edge start-ups. Usually, the innovative edge of start-ups relies on the high content of science and technology in the solutions they bring to the market. For that reason, the process of scouting, incubation, acceleration, investment and exit of this type of start-up requires the confluence of different types of specialised institutions providing specific services and inputs at each stage of this process (hence the importance of knowledge-based institutions such as universities).

The Santander-sponsored Ecosystem Dynamics Initiative (GED) has developed a methodology and metrics to understand the social dynamics of economic ecosystems. GED defines economic ecosystems as a community of actors and individuals who interact with each other and with their environment in a delimited region, which is determined by its social and dynamics, in which resources are exchanged with the function and/or purpose of creating economic value (Tedesco, 2022[6]). In this definition, actors in an ecosystem are united by a common goal. It draws its inspiration from the Complex Systems Theory that studies the dynamics of economic ecosystems such as other forms of complex systems (traffic, epidemics) where the relations between actors are not always sequentially arranged and/or straight-forward (Thurner,

Klimek and Hanel, 2018[7]; Farmer, 2012[8]). The OECD uses an analogue definition, which emphasises the connections of the actors in the ecosystem (Box 1.4).

Box 1.4. Definition of entrepreneurial ecosystems

A key concept for understanding regional entrepreneurial ecosystems is that they are networks and places at the same time. These places host interactions among actors that influence each other. Within regional entrepreneurial ecosystems, the connections (and connectors) within the network are as important as the parts that make up the network. The more connectors in a network (and the more connections they have), the more information and resources flow throughout the network. A healthy regional entrepreneurial ecosystem will find many ways to create and nurture connectors and especially "super-connectors", which proactively connect the connectors. Effective entrepreneurial ecosystems "connect the connectors" and reward participants for stewardship, not ownership.

Four elements that sustain entrepreneurial ecosystems are:

1. They grow from the bottom up.
2. They are inclusive of different types of businesses and support entities located in a given place.
3. They are one or more rallying points for the community.
4. They are sustainable over the long term.

Source: Adapted from OECD/EU (2018[9]), *Supporting Entrepreneurship and Innovation in Higher Education in The Netherlands*, https://doi.org/10.1787/9789264292048-en.

Over 2019-22, GED has analysed more than 5 200 links between 2 500 actors in 12 different economic ecosystems from Latin America and Europe.[2] This review includes Santander GED's analysis of the entrepreneurial economic ecosystems of Bogotá, Buenos Aires, Mexico City, Montevideo, Santiago de Chile and São Paulo, with a focus on the role and positioning of the universities. The ecosystem analysis presented in Part II of this review is presented in the form of a visual diagram the universities' role in the ecosystem, depending on connections these establish with other actors.

In addition, the review also builds on part of the IADB's work (Goñi Pacchioni and Gonzales, 2022[10]) on innovation-driven economic ecosystems in Colombia, and the role that universities and other actors provide to cater for the needs of local start-ups. The analysis is also included in Chapter 4 (in graph form) and details how universities help different types of start-ups (innovation-driven, traditional opportunity-driven, social-environmental impact and necessity-driven) at different stages of development (ideation and start-up, acceleration and scale-up, as well as general business-oriented services and financing services) (Box 1.5).

Box 1.5. Methodology used for the ecosystem network analysis

GED's methodology

This review includes Santander GED's analysis of the entrepreneurial economic ecosystems of Bogotá, Buenos Aires, Mexico City, Montevideo, Santiago de Chile and São Paulo, with a focus on the role and positioning of the universities (see Part II). Data collection for each ecosystem was conducted by firstly identifying as many actors as possible through desk research, which were in turn invited to attend a workshop on strengthening innovation-driven entrepreneurial economic ecosystems and fill out an

online survey regarding their social dynamics with other actors. The workshops and surveys were designed based on lean research principles with four goals in mind:

1. Gather quantitative and qualitative data concerning the relationships between actors.
2. Gather statistical data directly related to the results of collaborations between actors, regardless of the success of the outcomes, the nature of the agreements or other characteristics corresponding to the social capital of each city.
3. Help actors define their ecosystem's purpose, which is a fundamental component for complex systems as described by (Meadows, 2008[11])
4. Inform the participants of the theoretical method to study economic ecosystems as well as important lessons learned for the strengthening and development of their own ecosystems.

At the core of the research instrument, participants were asked to mention up to 25 of their most relevant collaborations with other actors in the last 3 years and provide additional information concerning their nature and outcome.

IADB's methodological approach

Part II of this review features the IADB analysis of the Colombian ecosystems to understand the role, centrality and specific services provided by a subset of universities (ICESI University and Pontificia Universidad Javeriana [hereinafter Javeriana University], Bogotá and Cali Campuses).

For this analysis, the authors conducted in-depth interviews with a selection of actors in each ecosystem. These interviews explored in detail the business model of each actor, their specific interactions with the ecosystem, their opinion of the ecosystem's development and their perception of what opportunities exist for public interventions to further dynamise their ecosystems. Among the universities selected for this report, ICESI was the only institution interviewed.

Source: Tedesco, M. and T. Serrano (2019[12]), "Roles, values, and social dynamics: A new model to describe and understand economic ecosystems", MIT D-Lab, Massachusetts Institute of Technology, Cambridge. Hoffecker, E., K. Leith and K. Wilson (2015[13]), "The lean research framework: Principles for human-centred field research", MIT D-Lab, Massachusetts Institute of Technology, Cambridge. Goñi Pacchioni, E. and S. Reyes (2022[14]), "¿Cómo mapear y medir ecosistemas de emprendimiento? Metodología y aplicación para el ecosistema de emprendimiento innovador de Lima", Nota Técnica, Banco Interamericano de Desarrollo; Goñi Pacchioni, E. and A. Gonzales, (Meadows, 2008[11]) (2022[15]), "Ecosistemas innovadores de emprendimiento en América Latina", Banco Interamericano de Desarrollo.

The methodology to select the case study universities

A selection of universities from Argentina, Brazil, Chile, Colombia, Mexico and Uruguay is studied in this review. The team co-ordinating the study has selected the institutions based on the following criteria:

- The type of entrepreneurial ecosystems in which universities operate, drawing on IADB and Santander analysis of different ecosystems in the region, and how different actors interact in these ecosystems.
- The type of universities: In order to have a varied sample, these institutions were selected taking into consideration their size, geographical location and curriculum. The universities' entrepreneurial trajectory was also considered: selected institutions had already been developing their entrepreneurial agenda for some time.

As a starting point, 22 universities participated in the initial stages of the review process. The OECD surveyed these universities to gain an understanding of the institutions' entrepreneurial and innovative activities. The survey also enquired about governance, funding and institutional arrangements that

universities put in place to support the development of such activities. The survey was addressed to the university leadership.

A workshop was also conducted with these 22 universities to introduce the HEInnovate self-assessment tool and enable the universities to get acquainted with this new digital tool. It was created by the EC and used by universities throughout the world that wish to self-assess their capabilities for entrepreneurship and innovation. The self-assessment tool is useful for universities wishing to prioritise and plan actions for the entrepreneurship and innovation agenda. HEInnovate also identifies areas of strengths and weaknesses, and opens up debate and discussion on the innovative and entrepreneurial nature of each HEI.

After this exercise, 11 universities volunteered to participate in the process as case studies within this review. As noted in Table 1.1, the sample includes universities of different sizes, with some large public universities such as the University of São Paulo, and others more specialised but equally big such as the Tecnológico de Monterrey or the Technological University of Uruguay. The sample also includes Siglo 21 Business University (hereafter Siglo 21) in Argentina and ICESI University in Colombia, which are more business-oriented. With the exception of two universities in Colombia that have one campus (ICESI, National University of Colombia at Manizales or UNAL Manizales), all other universities are multi-campus, with campuses located in different cities within a given country(or regions) which multiplies the impact of universities in different places. Chapter 3 of this review offers in-depth analysis of the kinds of organisational capacity universities are putting in place to support knowledge transfer in a multi-campus setting.

Table 1.1. The selection of 11 case studies

Country	University	General characteristics
Argentina	Siglo 21 Business University (Siglo 21)	Private university, 67 000 students, 4 campuses in Cordoba, 200 research teams, 45 graduate and 30 post-graduate programmes.
Brazil	University of São Paulo (USP)	Public university, 90 000 students, 335 undergraduate and 264 graduate programmes, 42 schools, 4 incubators and 1 technology park. Campuses in seven municipalities in the state of São Paulo.
Brazil	Federal University of São Carlos (UFSCar)	Public university, 20 000 students, 20 disciplines related to the areas of innovation and entrepreneurship. Four campuses in the state of São Paulo.
Chile	Adolfo Ibáñez University (UAI)	Private university, 7 661 students enrolled in 12 undergraduate degree programmes and 3 365 graduate students enrolled in 50 master's and 7 PhD programmes. Three campuses in Chile and an additional site in Lima, Peru.
Chile	Pontifical Catholic University of Chile (PUC)	Private university, 5 campuses, 18 faculties. The university focuses on innovation, digitalisation and service to the community.
Colombia	Pontifical Xavierian University (Javeriana)	Private university, 22 516 students, 2 campuses in Bogotá and Cali, 2 000 professors.
Colombia	National University of Colombia at Manizales (UNAL)	Public university with 9 campuses, 58 000 students (11 440 on Manizales Campus), 953 research groups.
Colombia	ICESI University	Private university created by the business community. Started as a business school, but now includes programmes in health social science, medium-sized university with 7 000 students.
Mexico	Tecnológico de Monterrey (TEC de Monterrey)	Private non-profit university, 26 campuses throughout the country, 92 645 students, 11 entrepreneurship and innovation parks.
Mexico	Universidad Anáhuac México (Anahuac University)	Private university with two campuses in the state of Mexico, with five faculties and eight other campuses throughout the country.
Uruguay	Technological University of Uruguay (UTEC)	Public university with a technological profile. There are campuses or "regional technological institutes" located across the 4 main regions of the country and 8 000 students. Careers in engineering, arts and applied sciences.

The fact-finding process

The COVID-19 pandemic limited travel possibilities so the review team was not able to visit the participating institutions. The fact-finding process was conducted virtually, through 22 online bilateral interviews (or 2 interviews with each institution on the topics addressed in the review). The interviews focused on entrepreneurship education and how these practices enabled HEIs to interact with their ecosystems.[3]

The interviews focused on the following topics:

- Entrepreneurial curricular and extracurricular teaching and learning activities.
- Entrepreneurship promotion within the existing innovation and entrepreneurship ecosystem.
- Current challenges and future opportunities for the university in terms of further entrepreneurship and innovation development.

The second round of bilateral interviews focused on the topic of knowledge exchange and collaboration practices that the universities are developing and implementing to support economic growth in their territories.[4] The interviews centred on incentives, strategies for knowledge transfer, channels for innovation diffusion, to account for the nature of the exchanges between the universities and their external partners and the strategies, and means that each institution is putting in place to support knowledge transfer. The interviewees were asked to report on:

- Institutional approaches to knowledge exchange (how knowledge exchange is engrained in strategic documents, the university's mission, what form it takes and its allocated budget).
- Incentives for knowledge exchange and collaboration (funding, incentives for staff to engage in such activities, evaluation of such activities).
- The university's place in the ecosystem (main partners, form of engagement, underlying challenges and barriers to collaboration).

Framework conditions in the Latin American region: Education, economy and innovation trends

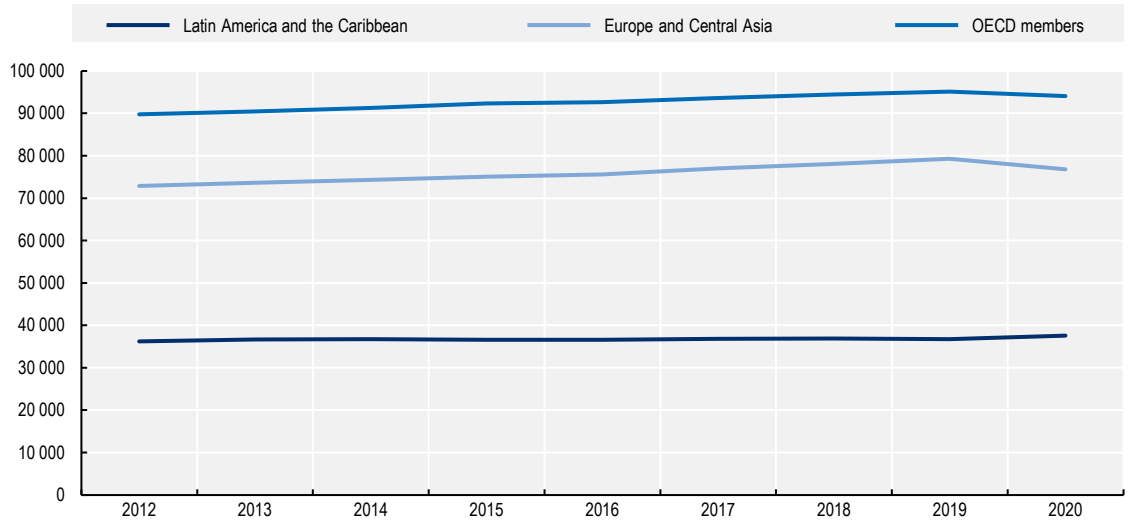
On average, the performance of a given university in terms of entrepreneurship and innovation reflects the framework conditions of its own ecosystem. Innovative regions are also home to entrepreneurial HEIs. In other words, it is difficult to separate HEI contributions from regional innovation; vice-versa, it is hard to understand if a given university performs particularly well due to its location. For this reason, it is important to provide some information about the socio-economic context in which universities operate. Because this study is implemented at the subcontinental scale, the next section illustrates the main economic trends in Latin America, including the impact of COVID-19, which affected the implementation of this study.

A moderated innovation system that affects the economy and universities' ability to transfer knowledge

Since 2014, the Latin American region has exhibited a drop in gross domestic product (GDP) growth rates, with the highest average increase recorded in 2017 at 1.24% (with some disparities, Central American countries performing better) (see Figure 1.3). Labour productivity remains low compared to other regions and has stagnated over the past 20 years and the region is stuck in a productivity trap (Figure 1.1). Other indicators such as per capita GDP, GPD per hour worked or multifactor productivity also show that the region is lagging in terms of competitiveness and productivity[5] (Vesga, 2015[16]).

Figure 1.1. The region exhibits low productivity rates compared to other regions

GDP per person employed, constant 2017 Purchasing power parity (PPP) USD

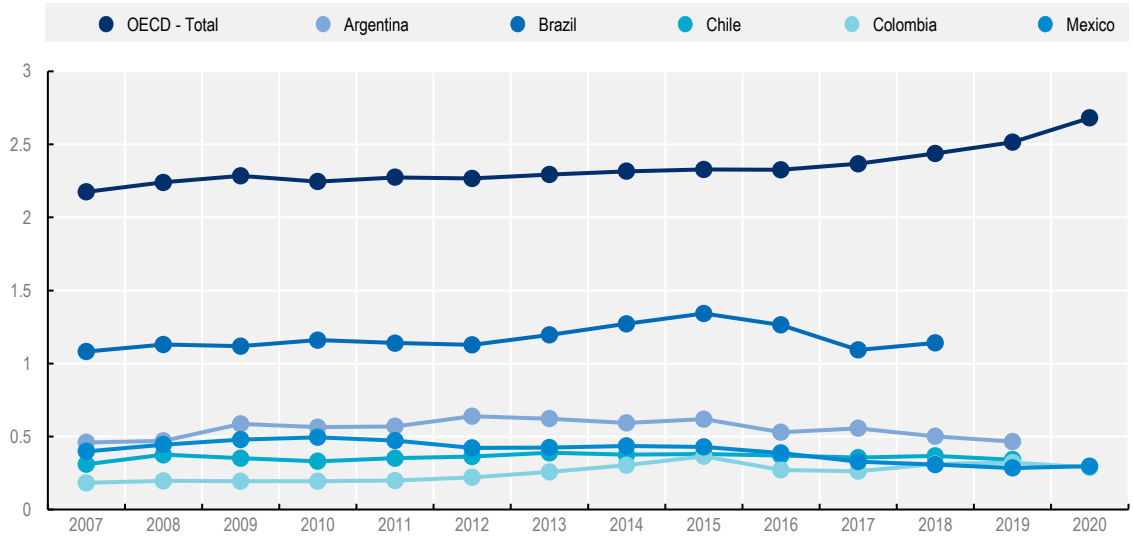


Source: Author's elaboration based on World Bank (2022[17]), *World Bank Open Data*, https://data.worldbank.org/indicator.

The Latin American region, on average, suffers from a lack of public and private investment in research and development (R&D), which hinders innovation-driven growth. Gross domestic expenditure in R&D in the region grew from a little over 0.5% of GDP in the early 2000s to 0.75% in 2015 before declining again in the past years. This trend contrasts starkly with OECD countries, whose R&D intensity stood on average over 2.3% of their GDP in the past decade and increased over the last years (World Bank, 2022[17]; OECD, 2016[18]) (Figure 1.2). In addition, R&D intensity varies within the region: Argentina and Brazil are leading the way compared to other countries such as Colombia and Mexico (Figure 1.2).

Figure 1.2. Research and development intensity in selected countries

Gross domestic expenditure on R&D as a percentage of GDP



Note: Gross domestic expenditure on R&D (GERD), totals all expenditure on inputs used in performing R&D, in a given territory.
Source: Author's elaboration extracted from the OECD, 2022[18], Science, Technology and Innovation Scoreboard accessed in May 2022

The number of researchers employed per thousand inhabitants stands below the OECD countries' median in almost all the countries in the region (OECD/EC, 2022[19]). Higher education expenditure in R&D financed by industry is below OECD countries' median expenditure with the exception of Colombia, in which the industry's contribution to the higher education expenditure in R&D represents 5% of total expenditure (OECD/EC, 2022[19]). As in many other developing countries, the countries of the region are limited by the limited involvement of the industry in research and innovation, with low levels of investments and many firms without a dedicated R&D department (especially small- and medium-sized enterprises [SMEs]). There is also a reduced number of people and institutions dedicated to activities of R&D or innovation.

The research funding system for public and private HEIs, usually under the care of national governments has also diminished its institutional grant allocations in support of joint university-business collaboration. The economic vulnerability of the region has dried out financial resources entailing a decrease in the offer of research grants, which hindered the ability of HEIs to collaborate with external stakeholders to develop research.

These obstacles are also found at the local level, where regions are affected by the low engagement of the private sector, although the most prosperous regions have a more developed innovation system whereby HEIs and firms are more involved in R&D. For instance, technology transfer and innovation activities are very developed in regions such as the state of São Paulo in Brazil or the state of Mexico in Mexico, where universities such as the State University of Campinas (Unicamp) or the University of São Paulo (USP) in Brazil, or the National Autonomous University of Mexico (UNAM) find firms to collaborate with (Serra, Rolim and Bastos, 2018[20]).

In sum, the underdevelopment of the innovation system is an important factor to consider as universities do not operate in an isolated manner. The absorption capacity of firms and the state support for R&D affects the ability of universities to collaborate and transfer knowledge (Serra, Rolim and Bastos, 2018[20]). The absorption capacity of firms is unequal, with prosperous regions benefitting from and contributing to more mature innovation systems but overall university-business collaboration in Latin America is lower than in other regions.

Promoting start-ups and entrepreneurship to counter-balance the negative economic outlook

Since the early 2010s, a specific type of opportunity-driven entrepreneurship has started to gain traction in several LAC countries.[6] Start-ups started emerging and growing in several countries in the region, changing the innovation landscape by bringing in new products and services to the market, competing with established firms or offering innovative solutions (OECD, 2016[18]). Investable innovative start-ups or start-ups whose value proposition can potentially generate high returns to investments have started to attract an increasing amount of public support as well as more private venture investments in several countries of the region.

Following investment trends of more developed markets and a pioneering pilot public programme established in 2010 to accelerate technology-based start-ups in Chile (Start-up Chile), Argentina, Brazil, Colombia, Mexico, Peru and Uruguay have created similar programmes to support start-ups. Entrepreneurship and SMEs have been a policy focus in LAC over the past decade. Start-up Chile is the first public accelerator established in the region for technology-based entrepreneurs and has this year a portfolio of more than 2 200 start-ups from all over the world and over 5 000 alumni from 85 countries (CORFO, 2022[21]). It has programmes to help start-ups scale up from very early stages (pre-acceleration programmes) to programmes for start-ups with a functional product or service, or start-ups seeking to enter new markets. Start-up Chile counts over 200 mentors and connects entrepreneurs to a large network of venture capital funds, local and global business angels, investors as well as governmental and industry partners. Start-up Chile is attached to Chile's established innovation agency Production Development

Corporation (*Corporación de Fomento de la Producción de Chile*, CORFO) in charge of the country's economic development agenda since 1939. Both CORFO and Start-up Chile have important connections with universities in the country.

Colombia followed in the footsteps of Chile and created INNpulsa in 2012, an agency attached to the Ministry of Commerce, Industry and Tourism in charge of entrepreneurship and innovation promotion. INNpulsa is the culmination of public policies to support entrepreneurship which began in the early 2000s with the first fund dedicated to financing student entrepreneurial ventures in universities and technical institutes (*Fondo Emprender*) (Vesga, 2015[16]). The agency connects entrepreneurs and SMEs to existing accelerator incubators, firms and investors all over the country. INNpulsa also offers programmes for entrepreneurs or firms looking to scale up their innovative ventures (but does not offer incubation programmes for early-stage ventures). It offers targeted programmes such as ALDEA for ventures in creative and cultural industries (INNpulsa Colombia, 2022[22]). The agency has created a culture of entrepreneurship and innovation in the country and has connected several entrepreneurs to key actors in cities and regions such as universities, chambers of commerce, incubators and policy-makers. It has anchored high-impact entrepreneurship and firm-based innovation as a fundamental leaver to entrepreneurship policy. It promotes entrepreneurship in regions and regularly organises events throughout the country to connect and galvanise actors in different regions and cities (Vesga, 2015[16]).

Mexico has also started supporting entrepreneurship through the establishment of the National Institute of the Entrepreneur (INADEM) in 2013, attached to the government's Secretariat of Economy. It offers programmes to connect entrepreneurs and SMEs to the private sector and public institutions. Linked to this institute, the government has created a National Entrepreneurship Fund, which funds entrepreneurial ventures. The fund has created a new digital platform where entrepreneurs and SMEs can access a wide variety of government-funded support programmes (incubation, acceleration activities and entrepreneurial mind-set courses) (Fondo Nacional Emprendedor, 2022[23]).

Brazil supports its entrepreneurs and SMEs through public agencies that offers SMEs courses in entrepreneurship education, webinars and training. In 2013, the government also created the Brazilian Company of Research and Industrial Innovation (EMBRAPII), a public organisation to strengthen Brazil's innovation capacity. The Ministry of Science, Technology, Innovation and Communications and the Ministry of Education fund this public body. It aims to connect technical research institutions with the industry through established innovation centres (EMBRAPII units and hubs) located within universities and research institutes (EMBRAPII, 2022[24]).

In a similar way, Uruguay created in 2007 the National Research and Innovation Agency (ANII), a public body whose mandate is to promote research and innovation by funding research projects, national and international scholarships and entrepreneurship programmes. It has a specific programme for innovative entrepreneurs with courses and organises annual public calls to tender to help innovative entrepreneurs scale up their ventures. The National Development Agency of Uruguay also accompanies entrepreneurs and SMEs throughout the country. It has delocalised offices that function as one-stop-shops to attend to the needs of entrepreneurs and SMEs (respectively Venture Support Institutions and Centres for SMEs).

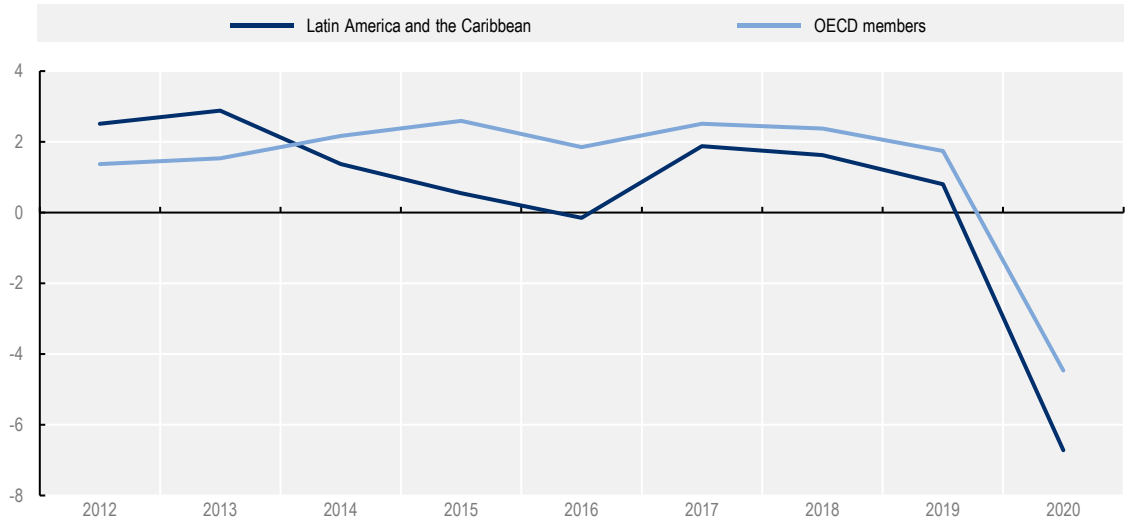
This new landscape has contributed to the emergence of a boom in technology-driven businesses and innovative start-ups thriving on digital technologies. Examples include digital lender Nubank in Brazil, fin-tech Ualá, e-commerce leader Aleph Solutions and *Mercado Libre in Argentina,* used-car platform Kavak in Mexico and Chilean food producer Notco. Such a boom is accompanied by venture capital growth in the region, mainly from foreign investment funds.

As detailed in Chapter 3, universities are collaborating with these institutions that support entrepreneurial development. As reported by universities during the interview process, many start-ups and unicorns[7] are born within a university incubator or were created by alumni.

The COVID-19 pandemic has exacerbated social divides and increased the productivity trap

The region was the hardest hit by the pandemic with a GDP drop of 7% in 2020 and 6% in 2021 compared to OECD countries (-4.7% in 2020 and -5.3% in 2021) (Figure 1.3) (OECD et al., 2021[25]). Recovery is expected to be slow, particularly for economies in the region that depend on services and the tourism sector, which suffered from mobility and health restrictions (such as the Caribbean region). Disruptions in global value chains and a drop in imported inputs for industry (originating from China) have greatly impacted the region's manufacturing industry and the automobile industry in particular.

Figure 1.3. Annual GDP percentage growth in and OECD countries, 2012-20



Source: Author's elaboration based on World Bank (2022[17]), *World Bank Open Data*, https://data.worldbank.org/indicator.

The COVID-19 socio-economic crisis exacerbated social challenges, which lingered against the backdrop of stagnating growth. While there was a growing share of the population considering themselves part of a new "middle class", at the start of the pandemic, the region was facing increasing inequalities and informalities.

As in many other emerging markets, at the outbreak of the pandemic, the region suffered declines in employment, with more than 20 million people leaving the workforce, and a sharp decline in the employment rate which reached a historic minimum value (falling from 57, 4% in 2019 to 51,7%in 2020) (ILO, 2021[26]). The poverty rate reached an average of 33% in the LAC region, its highest level over the past 20 years (OECD, 2021[27]). In addition, high rates of informality (on average 45%) left most workers without access to social protection measures.[8] During periods of confinement, informal workers were not protected against job loss. People earning a lower-middle income decreased by 7 million and those with a middle income decreased by 13 million (OECD et al., 2021[25]).

Inequalities were further accentuated as access to education was challenged by the pandemic, drawing a clear line between those with access to digital technologies and those left behind (see Box 1.6).

Box 1.6. The digital divide in the LAC region

At odds with these trends, the region has made progress in adapting to digitalisation. The digital uptake in the region has steadily increased. The population with Internet access doubled between 2010 and 2018, reaching almost 70% of the total population in 2018. Mobile broadband penetration reached 65% in 2017. Yet penetration of fixed broadband remains low (12%), less than half of the OECD country average (30%). Furthermore, broadband access remains challenging in rural remote regions, as networks are located in large, high-population density areas. The Internet usage gap between the wealthiest and the poorest is estimated at 40 percentage points and the gap between urban and rural households is 25 percentage points

Source: OECD/EU (2021[28]), *Supporting Entrepreneurship and Innovation in Higher Education in Slovenia*, https://www.oecd.org/cfe/smes/HEInnovate-Slovenia.pdf.

University closures also amplified existing inequalities in access to primary and secondary education, with more than 40 weeks of university lost between March 2020 and October 2021, one of the highest across the globe (UNESCO, 2022[29]). Students with no resources to connect to or follow online courses were at a disadvantage compared to students who had the means to follow courses remotely (around 15% of students from a disadvantaged socio-economic background did not have Internet access at home compared to the 2% average in OECD countries). Inequalities also have a strong territorial dimension. In countries like Colombia and Mexico, universities act as Internet providers for more than 20% of rural students who do not have Internet access in their homes but can use it in universities (OECD, 2020[30]).

Universities were also challenged by the lack of digital skills of students and teachers and connectivity issues. Many HEIs were forced to reorganise their activities, teaching has been moved online in a very short timeframe and a strong link between basic and applied research has emerged due to the pressing need to respond to the health crisis. The transition to online teaching has widened the divide between universities with experience in online education and those with little to no experience in such processes, which had difficulties in adopting an effective technological platform to continue teaching activities, although a 2020 survey shows that most universities in the region had a suitable digital platform to continue their teaching online. The survey also shows that teachers were not prepared and some had little experience in online teaching, which directly affected the way in which they could interact with students and evaluate student knowledge in a virtual setting. Many students in the region had difficulties accessing computers or had connectivity issues: the survey shows that more than half of students had limited access to the Internet at home (58%).

The exacerbation of the social inequalities and the challenges faced by the education system is challenging the efforts led by the government and HEIs to democratise access to education over the past decades and expand education to reduce inequalities and not just benefit an elite (Pitton and Britez, 2009[31]). The degree to which universities are equipped to adapt to these megatrends will also define their involvement in the region. Within such a context, this report also looks at how the pandemic has affected universities' activities and how can universities support their ecosystems in the current challenging context.

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Notes

[1] To promote a stronger connection between higher education leaders, policymakers and firms, the OECD launched the Entrepreneurship Education, Collaboration and Engagement (EECOLE) network in June 2021. EECOLE and its partners will build on the findings of the HEInnovate reviews, to deepen understanding in key network areas. In particular, it will develop a full work programme on the geography of higher education to explore more in-depth the connection between universities and their communities.

[2] The term "actor" refers to all the organisations or organization initiatives that exist for the benefit of the economic ecosystem to which the actor belongs (Tedesco and Serrano, 2019[12])

[3] For these encounters, which took place between June and September 2021, each of the 11 universities studied were represented by their project contact point representatives from top management (vice-rectors, deans, directors), professors of entrepreneurship as well as staff co-ordinating incubation or acceleration initiatives. The interviews were conducted by the OECD-IADB team as well as an expert in entrepreneurship education.

[4] The interviews took place between February and March 2022. The 11 universities were again represented by the top management as well as contact points in research departments, innovation agencies and technology transfer offices. To prepare the interviews, the OECD-IADB circulated a questionnaire on knowledge exchange practices for university representatives to answer. On the basis of each institution's answers to the questionnaire, follow-up questions were asked during the bilateral interviews.

[5] Multifactor productivity is calculated by dividing the output by the number of combined inputs used to produce that output.

[6] As opposed to necessity-driven entrepreneurship, which is the prevalent form of entrepreneurship in LAC (Global Entrepreneurship Research Association (GERA), 2018[33])

[7] Unicorn is a start-up valued over 1 billion USD

[8] Informality rates vary across the region. The share of informal workers in Chile and Uruguay represents less than 20% of the total workforce whereas in Colombia more than half of the workers are informal (OECD et al., 2021[25]).

2 Entrepreneurship education

The teaching of entrepreneurship is embedded in selected higher education institutions with formal and informal learning opportunities for students, researchers and alumni. Several universities have developed novel pedagogies to cultivate student's entrepreneurial mind-set. To continue with these practices HEIs should look to increase incentives for staff teaching entrepreneurial activities and to mainstream entrepreneurship education across curriculums.

What is entrepreneurship education?

The entrepreneurial mind-set is often considered a personal feature, which depends on personal and contextual factors. However, evidence and practice show that entrepreneurship is ultimately a skill that can be taught and learned (Saraiva, 2016[1]). Therefore, if exposed to good practices and pedagogies, individuals can acquire entrepreneurial mind-sets. This can happen at a very early age and throughout lifelong training. Based on this perspective, many countries have introduced entrepreneurship teaching activities that range from primary school courses to lifelong learning activities (Gomes, 2020[2]). However, it is at the level of tertiary education that entrepreneurship practices and pedagogies are blossoming internationally. Entrepreneurial education provides academic communities (i.e. teachers, staff and students) with a set of cognitive and transversal skills that are associated with starting and running a business, including cognitive skills such as finance, business plan development, accounting and human resources for example. The most important part, however, concerns transversal and non-cognitive skills. Entrepreneurship education is practical education that empowers students' mind-set. Entrepreneurship pedagogies and practices are designed to improve leadership, creativity, self-insight, self-efficacy or attitudes such as perseverance, risk-taking, pro-activeness and uncertainty tolerance, often understood as the entrepreneurial mind-set (Bacigalupo et al., 2016[3]).

The large majority of individuals that engaged with entrepreneurship education in their tertiary studies will not create or run a business. Nonetheless, the entrepreneurial skills they have acquired during their studies will help them transition to the labour market after graduation. The transversal skills that characterise entrepreneurs can be useful in any career path, including in small- and medium-sized enterprises (SMEs), family firms and large companies where intrapreneurial individuals can generate innovation in businesses they did not create or run. In Slovenia for instance, entrepreneurship education has helped students integrate family-owned businesses (Box 2.1). In addition, entrepreneurship can also play a role in solving societal challenge and creating value for the public good (OECD/EC, 2015[4]). Therefore, the outcomes of entrepreneurship teaching go much beyond start-up creation or science-based high-tech companies (Saraiva, 2016[1]; OECD/EC, 2015[4]).

Box 2.1. Entrepreneurship education in Slovenia prepares students to integrate the local labour market and family-owned businesses

In Slovenia, entrepreneurship education responds to different needs. While generating start-ups is always a popular objective, entrepreneurship training is also delivered in lifelong learning activities (such as GEA College, a private higher education institution that has a Centre for Vocational School, which delivers entrepreneurship courses). In addition, entrepreneurship education is tailored to prepare individuals who will work in local SMEs and/or take over a family business. Entrepreneurship education is also connected to digital research and teaching. For example, the University of Primorska's HICUP (Humans Interacting with Computers) Lab hosts a group of international researchers working on making digital resources more interactive and profitable for users.

Source: OECD/EU (2021[5]), *Supporting Entrepreneurship and Innovation in Higher Education in Slovenia*, https://www.oecd.org/cfe/smes/HEInnovate-Slovenia.pdf.

Higher education institutions (HEIs) are playing a major role in entrepreneurship education adopting different approaches, contents and goals, depending on the audiences reached, their motivations, nature or stage of maturity for entrepreneurial ambitions or ideas (Bischoff, Volkmann and Audretsch, 2017[6]). Entrepreneurship education has seen worldwide growth in HEIs for the past 20 years (OECD/EC, 2015[4]). To support HEIs in all countries and regions to experiment with entrepreneurship pedagogies and

practices, the European Commission (EC) and the OECD have used the HEInnovate framework (more information in Chapter 1). According to the framework, entrepreneurial teaching and learning involve exploring innovative teaching methods and finding ways to stimulate an entrepreneurial mind-set. It is not just learning about entrepreneurship; it is also about being exposed to entrepreneurial experiences and acquiring the skills and competencies to develop an entrepreneurial mind-set.

Different approaches to entrepreneurship education

Entrepreneurship education can be very flexible and adapt to the different conditions of HEIs and their ecosystems. For this reason, there are many different pedagogical approaches. Students can be asked to create a business venture, brainstorm ideas about a potential venture and simulate the creation of a company during courses or extracurricular activities such as competitions or hackathons. It can also include courses during which students listen to an entrepreneur sharing success stories and challenges to venture creation (for more information, see Box 2.2) (Lackéus, 2020[7]).

Box 2.2. Examples of different approaches to entrepreneurship education

There are different pedagogical approaches to entrepreneurship education used by universities. Lackéus (2020[7]) has classified these into three different categories:

- Idea and opportunity creation pedagogy aimed at teaching students how to develop and seek new opportunities to act on new ideas.
- Venture creation pedagogy focused on the creation of a venture or new organisation. Universities using this approach focus on accompanying students in the creation of a venture, through mentoring, courses, accelerations and incubation programmes.
- Value creation pedagogy focused on the creation of value, which exceeds the scope of venture creation as it is a broader activity meant to create societal value in whichever form it can take (physical, economic, social or ecological).

Source: Lackéus, M. (2020[7]), "Comparing the impact of three different experiential approaches to entrepreneurship in education", https://doi.org/10.1108/ijebr-04-2018-0236.

Entrepreneurship education in Latin American universities

There are many entrepreneurial universities in Latin America. These universities have built curricular coverage of entrepreneurship topics in formal education programmes, at the Bachelor of Science (BSc), Master of Science (MSc) or Doctor of Philosophy (PhD) levels, through mandatory or elective courses. The curricular coverage is often combined with a number of extracurricular learning opportunities, such as seminars, workshops, boot camps, summer courses, festivals or business idea competitions.

As discussed above, the regional trend reflects a global movement. Entrepreneurial universities worldwide have implemented dedicated resources and structures, such as entrepreneurship units, incubators or accelerators. These units, especially the accelerators, are a doorway for universities to connect with external players to build further innovation and entrepreneurship. This was also found to be the case in Latin American universities, which engaged in the current project. The 11 case study universities are - diverse. They operate in different ecosystems (predominantly urban areas but with differences in terms of size and accessibility) and their practices have different scopes and a different level of maturity (there are pioneers as well as relatively newcomers), different scopes, ambitions and goals. This section describes

experiences collected from our sample of HEIs dealing with entrepreneurship teaching and learning, both from a curricular and extracurricular perspective, together with mechanisms and infrastructures in place to support entrepreneurial projects.

This chapter analyses entrepreneurship education in selected Latin American universities and the different pedagogical approaches used. Such education includes courses covered in the curriculum but also extracurricular ideas designed to support the entrepreneurial mind-set. The chapter also provides an analysis on how entrepreneurial activities help connect universities with other players. Additional information will be included in Part II.

Entrepreneurship education is in the curriculum of case study universities

Case study universities consider entrepreneurship a core value. The concepts of entrepreneurship and innovation are part of their strategic mission along with sustainability and inclusion. These universities discussed their activities to be designed to promote leadership through entrepreneurship education.

Most institutions view themselves as entrepreneurial universities looking to train the leaders of tomorrow. The University of São Paulo, Brazil (USP) for instance, is investing in entrepreneurship education so that academics can become leaders, whether they operate in their own start-ups or work in SMEs or large companies. Some universities have gone even further by creating mandatory entrepreneurship courses for all of their students regardless of their choice of curriculum. For instance, Anahuac University in Mexico aims at training all students to become “leaders of positive action” and has reinforced its connections with multiple institutions and firms so that the courses offered to students and professionals enable a practical hands-on mind-set. The university offers leadership programmes for students to develop their entrepreneurial skills. More specifically, it runs a large-scale mandatory course on entrepreneurship for all of its undergraduate students, lasting 1 semester for approximately 1 500 students. Given the success of this particular course, the university plans to reinforce this mandatory part of the curriculum with two parallel courses in entrepreneurship, one dealing mostly with entrepreneurial skills and the other addressing topics such as “lean start-up” or design thinking. This example shows the inclusive commitment of the university to create positive action leaders, ensuring 100% of undergraduate students get curricular exposure to entrepreneurship, leaving no student out of this learning opportunity.

In the same vein, ICESI University in Colombia has entrepreneurship programmes to train the next generation of “leaders of the Pacific”, to support territorial cohesion in an important yet relatively impoverished region of Colombia. Entrepreneurship education courses aim to empower and stimulate students from all disciplines grow and acquire a risk-taking mind-set that would prepare them for the future. At ICESI, its business school Entrepreneurship Development Centre (*Centro de Desarrollo Del Espíritu Empresarial*, CDEE) has been offering entrepreneurship courses to all students of the university since 1985. The CDEE is the first such dedicated unit in Latin America created by a visionary dean who was also a Babson College alumnus inspired by Babson’s focus on entrepreneurial education. A diversity of pedagogical approaches is applied, including hands-on experience and real-life challenges. ICESI runs a Master of Science in Entrepreneurship since 2017, which lasts for three semesters and includes an integrating project conducted by students, which includes the training activities specifically focused on the Pacific region, mentioned above.

All case studies have a comprehensive approach to entrepreneurship education

Besides the focus on leadership, all 11 case study universities have a rather comprehensive curricular coverage of entrepreneurship, which provides them with national and international visibility. For instance, the Princeton Review lists the Tecnológico de Monterrey entrepreneurship undergraduate course top of its annual ranking, along with a very selective group of American universities.[1] This illustrates the long-

standing efforts of the institution, which started providing curricular coverage of entrepreneurship as early as 1978. Nowadays, the Tecnológico de Monterrey counts 200 professors of entrepreneurship, 30 of which hold a PhD degree in entrepreneurship. It offers a mandatory entrepreneurship course, which lasts for 1 semester, counts around 12 000 students and adopts an experiential-teaching approach, the development of prototypes and testing of business models, together with the preparation of business pitch presentations.

Siglo 21 Business University (Siglo 21) in Argentina runs entrepreneurship courses since 2014, with the possibility of obtaining specific credits in this area. The university also offers a Certificate in Entrepreneurial Skills, which are issued since 2017, and such courses attract about 3 000 individuals. Some of the dedicated courses, which in some cases are compulsory, include topics such as entrepreneurship development, university entrepreneurship, creativity and entrepreneurship, and digital tools for entrepreneurship, offering students a multidimensional approach to entrepreneurship. Furthermore, students are exposed to innovation and entrepreneurship through practical experiences, project-based learning, prototyping and addressing different sorts of challenges. All of these efforts provide them with an overall innovation- and entrepreneurial-focused learning experience, also shared in their final projects. To capitalise on its legacy and reinforce its ongoing initiatives as an entrepreneurial university, Siglo 21 is planning to launch a new entrepreneurship bachelor's programme in 2022.

Some case study universities have even created their own entrepreneurial competency model. At ICESI, in Colombia, all entrepreneurial teaching and learning activities, including curricular programmes and courses, are designed and implemented according to its own entrepreneurial competencies model. This model relies on a set of 13 dimensions that are considered critical for entrepreneurs and entrepreneurship. Inspired by the EntreComp Framework as developed by Bacigalupo et al. (2016[3]), these dimensions are: vision of entrepreneurial career; self-confidence; flexibility; perception amplitude; decision-making; company management; goal orientation; action orientation; social sensitivity; conceptual thinking; empathy; entrepreneurial networking; and market orientation.

Box 2.3. The European Commission EntreComp Framework

The EC developed EntreComp, the European Entrepreneurship Competence Framework, in 2016 as a reference framework to explain what is meant by an entrepreneurial mind-set.

EntreComp offers a comprehensive description of the knowledge, skills and attitudes that people need to be entrepreneurial and create financial, cultural or social value for others.

EntreComp is a common reference framework that identifies 15 competencies in 3 key areas that describe what it means to be entrepreneurial.

The 3 areas and related 15 competencies are the following:

- *Ideas and opportunities*
  - Spotting opportunities.
  - Creativity.
  - Vision.
  - Valuing ideas.
  - Ethical and sustainable thinking.
- *Resources*
  - Self-awareness and self-efficacy.
  - Motivation and perseverance.

- Mobilising resources.
- Financial and economic literacy.
- Mobilising others.

- *Into action*
  - Taking the initiative.
  - Planning and management.
  - Coping with ambiguity uncertainty and risk.
  - Working with others.
  - Learning through experience.

Source: EC (2016[8]), *EntreComp Europe - About*, https://entrecompeurope.eu/about/.

A focus on science-based entrepreneurship

Among case study HEIs, those with faculties in economics, engineering and science have developed a specific approach to entrepreneurship to bridge science and business. For instance, Adolfo Ibáñez University in Chile runs tailored programmes for its business and engineering school graduates such as an MSc in Innovation from the business school, an MSc in Technology Entrepreneurship from the science and engineering school or an MSc in Sustainable Entrepreneurship. The Federal University of São Carlos (UFSCar) offers some Master of Business Administration (MBA) programmes with a focus on innovation and entrepreneurship, such as is the case of the Master in Business Innovation (MBI or MBA in Innovation) or the ITI Master in Business Administration (MBA in Information, Technology and Innovation for Business, with strong digital entrepreneurial contents). The science and engineering school offers technology-based entrepreneurship programmes. In addition, the university has a Start-up School for undergraduate students in engineering. The Start-up School offers classes in project-based learning, lean start-up or design thinking, with high levels of flexibility. Active learning and flipped classroom approaches are the most commonly used pedagogical approaches.[2] Students can complete their degrees by engaging in a practical entrepreneurial experience, which is recognised as an internship. University representatives consider this as the most promising and popular option for students and they estimate that, in the future, over 30% of students will opt for this choice giving them the possibility to start their own business (or attempt to start it) full time in one semester or part time in two semesters.

The Pontifical Catholic University of Chile (PUC) offers mandatory training in innovation and entrepreneurship to all students of their engineering school. Several other elective courses aim at teaching students about entrepreneurship and innovation such as an MSc in Innovation for professionals, or a minor or major programme in innovation. It is also common to find entrepreneurship courses that are taught jointly by a PUC faculty member and a guest entrepreneur.

Recognising the need to bridge research and innovation, case study universities offer entrepreneurship education to faculty members, researchers and PhD students, as observed in other international cases, such as I-Corps (Box 2.4). Entrepreneurship education in these cases aims to help researchers bring their scientific results closer to the markets and value creation. Researchers should achieve a better understanding of business opportunities as drivers for research activities, projects and outcomes. However, these curricular coverage efforts seem to be in general at an earlier stage of development, less structured and less able to be mainstreamed across different PhD programmes and students.

Box 2.4. Supporting entrepreneurs: The I-Corps programme

To transform a scientist into a scientist-entrepreneur, there is a need for appropriate education and training. There are many examples of start-ups producing services or products that fail to meet market demand. In some cases, a better definition of the service/product and some market research would have helped transform a failure into a success.

Based on this assumption, the National Science Foundation (NSF) launched the I-Corps programme in 2012. The programme awards principal investigators (PIs) a USD 50 000 NSF grant. Together with an entrepreneurial lead, generally a PhD student or a business mentor, students attend a seven-week course in which they are taught to identify business opportunities for their research and ways to exploit these opportunities. Academics (students and teachers) who develop a business idea may lack information about the way in which they should successfully implement it.

Through I-Corps, NSF grantees learn to identify valuable product opportunities that can emerge from academic research and gain skills in entrepreneurship through training in customer discovery and guidance from established entrepreneurs.

Source: Huang-Saad, A., J. Fay and L. Sheridan (2017[9]), "Closing the divide: Accelerating technology commercialization by catalyzing the university entrepreneurial ecosystem with I-Corps™", https://doi.org/10.1007/s10961-016-9531-2; US NSF (n.d.[10]), *NSF Innovation Corps (I-Corps™)*, https://www.nsf.gov/news/special_reports/i-corps/.

Extracurricular activities to support the entrepreneurial mind-set

Mirroring an international trend, case study universities offer a large number and variety of extracurricular activities related to entrepreneurship education. These practices contribute to fostering an entrepreneurial mind-set in students. Extracurricular entrepreneurship education can take different forms: Lectures from alumni and guest speakers, seminars, workshops, roundtables, challenges, competitions, business idea contests, boot camps, hackathons, festivals, summer courses and online activities. Such initiatives are often open to all students from the university but also other national and international participants.

Dedicated entrepreneurship units, such as university incubators, accelerators or other bodies, play a critical role in the design and implementation of extracurricular activities. For instance, each semester, around 200 undergraduate students make use of the "design factories" of Pontifical Xavierian University (Javeriana). These factories aim to help test and prototype new products. The design factories have been involved in activities related to the COVID-19 response, such as new ventilator designs, solution prototyping or even patents, all originating from 16 different 'factory" projects.

PhD students at the National University of Colombia (UNAL) at Manizales have the possibility to work with the Business Innovation Park *Parque de Inovacion Empresarial*, focusing their research on innovation and entrepreneurship. PhD students can also connect with the Knowledge Transfer Office of the university and several extracurricular learning opportunities. Additionally, local companies can share their challenges with PhD students and research groups, who are required to come up with a solution within three to four months.

The Javeriana organises the ZUMO+ incubation programme for creative and cultural industries. ZUMO+ is a twelve-week programme that accepts six teams for each edition and counts international mentors, namely from Canada and the United Kingdom. It helps creative and cultural entrepreneurs find appropriate business models and validate market opportunities.

Extracurricular activities offering access to entrepreneurial education can also be short term, taking place over a few days or a week. Short-term activities aim to raise awareness about entrepreneurship or generate new contacts and opportunities for visibility and fundraising to start-uppers. For example, the Technological University of Uruguay (UTEC) organises every year the so-called "Innovation Week", which rotates across different cities. This event brings together students and local communities, addressing topics that are also adjusted to the specific context of each territory where the Innovation Week takes place.

The UTEC Innovation Week is a good example of an extracurricular activity that reaches out beyond the academic community and involves other HEIs and external stakeholders, including primary and secondary school students, women entrepreneurs, SMEs and family businesses.

For instance, *Universidad en tu Colegio* is a programme run by the UNAL Manizales Campus, through which entrepreneurs go to primary or secondary schools to tell their success stories and provide young students with new career perspectives. This initiative is already covering five sub-regions with ongoing pilot initiatives that include ideation and prototyping activities, reaching around 40 different schools.

Anahuac University has put in place several initiatives to promote entrepreneurial mind-sets and awareness for youth, involving primary and secondary education students, with specific content developed to address entrepreneurship for the millennial generation. This includes online content as well as a one-day workshop "Money to invest", in which students can involve their families and engage in practical challenges.

The digitalisation of extracurricular activities supporting entrepreneurship

Extracurricular entrepreneurship education is also offered online. Since 2007, the University of São Paulo (USP) organises i"NN", an online new-business programme. Over 15 years, the i"NN" programme has involved hundreds of students and spurred the creation of 90 new start-up companies. The USP offers other online courses in entrepreneurship, for instance on the Coursera platform, showing the potential of remote learning also in the field of entrepreneurship.

As in other domains, the COVID-19 pandemic catalysed the digitalisation of entrepreneurship education and many programmes have been converted into online sessions. Among the advantages of digital transformation, there is the possibility of involving international contributors and participants. Case study universities discussed the possibility of some of the innovations brought about by the pandemic becoming permanent in the future, possibly combining face-to-face and remote contents or components.

Feria 21, a large pre-incubation and networking opportunity organised by Siglo 21 since 2017, represents another example of swift digital transformation. Feria 21 brings together investors, start-ups, companies and local and regional government entities, also counting on the collaboration of university alumni (Club Emprendedores 21 with more than 3 000 members). Rather than discontinuing the event because of the pandemic, the university organised it online involving more than 800 participants.

Entrepreneurship education as a bridge to the university's ecosystem

Case study universities have created a variety of infrastructures dedicated to providing entrepreneurship support to relevant stakeholders in their ecosystem. These include entrepreneurship centres, pre-incubation and incubation facilities, acceleration activities, technology parks, co-working environments, as well as partnerships with other players from the surrounding entrepreneurship ecosystems.

The strategic mission of universities defines their engagement

Several of the case study universities rank entrepreneurship very high in their strategic agenda. A good example of this is the Tecnológico de Monterrey. An impact evaluation, conducted in 2019 in connection

with the university's 75th anniversary celebrations, illustrates the institute's positive impact on its ecosystem. According to the evaluation, about 41% of the institute's alumni are entrepreneurs. They contributed to the creation of 2.8 million jobs. More recently, and showing the importance of "collaboration and engagement" for this university, the Tecnológico de Monterrey created and implemented an SOS Programme for SMEs during the COVID-19 pandemic. The programme helped 800 companies digitalise their business. The SOS programme involved students and professors of the institute who volunteered to mentor participating SMEs.

Another example of how central "entrepreneurship" can be in institutional strategies and activities is the Javeriana in Bogotá, Colombia. This university expresses a clear vision of its entrepreneurial role, with well-defined concepts, roadmaps, structured approaches and a strong organisational structure supporting these activities. This includes the Centre for Entrepreneurship *Centro Javeriano de Emprendimento* and the Department of Innovation *Dirección de Innovación*, which together provide comprehensive support to all stages of entrepreneurial projects regardless of their level of maturity.

Universities as entrepreneurship hubs

Case study Latin American universities play tangible roles in the entrepreneurship ecosystems in which they operate. These universities are active in connecting their research to venture creation. For example, the USP in Brazil is connected to its ecosystem through different bodies and organisations. These include an innovation agency (AUSPIN), four incubators (one of them dedicated to social innovation), a technology park hosting 75 companies, a number of maker and co-working spaces and the INNOVA.USP space for innovation and entrepreneurship. INNOVA.USP alone has incubated around 600 companies, among which 7 unicorns (start-ups that achieve a capitalisation of USD 1 billion without being listed on the stock market) creating over 30 000 jobs.

ICESI in Cali, Colombia, has been playing an important role in stimulating research activities in the field of entrepreneurship through its entrepreneurship centre (CDEE). The CDEE interacts with the Global Entrepreneurship Monitor and the Colombian Ministry of Science, Technology and Innovation and has organised the Latin American Congress on Entrepreneurial Mind-sets since 1987.

The PUC, in Santiago, has an innovation centre that provides services to local and national companies to help them build an innovation culture. Leveraging this network of companies, the centre promotes knowledge transfer and entrepreneurship activities of the university. It is located in a building dedicated to innovation and entrepreneurship and designed by a Pritzker Architecture Prize laureate. This iconic building is right at the main entrance of the university campus, thus conveying a message both of the importance of entrepreneurship and accessibility to those from outside the academic community. The innovation centre allows interactions to take place between students, faculty members, companies and entrepreneurs, which should lead to new ideas and projects. The PUC received a large private donation to create the facilities that host the centre. The aim was to bring together students from all of the PUC's faculties and schools. The centre is governed by an innovation centre advisory board involving representatives from the local business community. The board's primary concern is that the activities of the innovation centre reflect the innovation needs of local stakeholders.

Universities take advantage of their multi-campus strategy to maximise their impact

Many universities take advantage of their multi-campus strategy to amplify their impact and engagement strategy. In different localities, they have the opportunity to connect with different actors, including local governments and business communities. In some cases, the localisation of a university campus explicitly relates to a regional development policy. For instance, the Tecnológico de Monterrey, which operates on 31 campuses located in 25 cities, is considered a key partner for local and regional governments.

Another example is UTEC which has well-established connections namely with chambers of commerce, SMEs, government and public agencies, as well as innovation and entrepreneurship networks established in the territories in which is located. UTEC operates “open laboratories” on three different campuses. These open laboratories are a sort of “fab labs”, places where local actors, including businesses, can create and test new ideas, and experiment with new digital machinery that allows for quick prototyping. UTEC has even developed a mobile version of open laboratories, inspired by a student ideas competition. The mobile version of open laboratories is a mobile home equipped with a variety of devices, such as 3D printers and drones. The mobile home travels across different locations and in doing so allows UTEC’s entrepreneurship education activities to reach different places, people and entrepreneurs of all ages and from a variety of communities, thus making a very positive contribution to inclusive entrepreneurship and territorial cohesion.

UTEC also focuses on social aspects of entrepreneurship. For instance, it promotes on its campuses programmes of entrepreneurship for co-operatives, a social innovation laboratory and co-operates with the social entrepreneurship platform ASHOKA. Among other initiatives, UTEC campuses have put in place *Arena Emprendedora*, a project aimed at dealing with gender balance by stimulating women’s entrepreneurial skills.

Universities as components of a dynamic ecosystem

In general, there is a symbiotic relationship between universities and their own ecosystems. This feature has been observed also in case study Latin American universities. Some universities are embedded in very dynamic ecosystems supporting high-end research, cutting-edge start-ups and technology development. The Federal University of São Carlos (UFSCar) in Brazil is based in the city of São Carlos, in the central eastern region of the state of São Paulo. São Carlos is Brazil’s National Capital of Technology, due to its high ratio of doctors per resident (1 per 180), while the rest of the country averages 1 per 5 423 (UFSCar, n.d.[11]). The location of the very first incubator in Latin America, the city of São Carlos is active in research, innovation activities, patents and intellectual property. UFSCar is one of three important universities that belong to this São Carlos innovation ecosystem, which organises a number of science-related events on a periodical basis. Some of the key components of the São Carlos innovation and entrepreneurship ecosystem include three technological parks: FabLabs, Maker Spaces and Co-Working Facilities. Detailed progress reports show the outcomes achieved by both UFSCar and the surrounding ecosystem regarding entrepreneurial activities. Yet another example of being open to the outside world, the UFSCar library also operates as a community library and is seen as a meeting space.

The São Carlos ecosystem has developed some governance arrangements, without creating a central management authority, to avoid excessive planning and remain open to stakeholders. This governance generates an annual plan and events that offer many opportunities to involve new players (Report Sanca Hub, 2022[12])

Also due to its vibrant technological ecosystem, the UFSCar has accumulated a portfolio with over 200 patents, 20 of them with active licensing agreements that generate relevant income for the institution. Some of the patents have high societal impacts, namely those related to agriculture. The UFSCar innovation portfolio has leveraged several start-ups and some of them scaled up into global companies (e.g. NANOX, which provides nanotechnology surface materials with antimicrobial properties).

The pandemic did not break the linkages between universities and their ecosystems

All case-study universities were able to adapt their activities to the new context generated by the COVID-19 pandemic. Universities were forced to move entrepreneurship education online, sometimes providing teachers with specific training, on the use of online platforms and digital methodologies. In addition, universities focused their efforts on helping their local communities as well as companies, SMEs and

entrepreneurs in their networks face new problems raised by the pandemic. As already discussed above, several universities engaged with SMEs to help them develop digital tools to manage business activities. Overall, the pandemic somehow broadened the networks of universities concerning entrepreneurship and entrepreneurial activities, engaging more people, including international experts, through online platforms. Anahuac University in Mexico provides a relevant example of the "silver lining" impact of the pandemic. During the COVID-19 pandemic and under the sponsorship of Santander, the university organised a series of webinars, which provided training to over 3 000 SMEs, helping them overcome the business difficulties and challenges raised by COVID-19.

Capitalising on the expertise accumulated during the pandemic, several case study universities plan to move towards blended entrepreneurial approaches and activities, where face-to-face interactions are used when relevant and are complemented with online solutions and experiences. Blended approaches to entrepreneurship education and activities will allow the creation of larger networks (new ecosystems) involving regional, national and international partners.

The way forward: Some considerations to push entrepreneurship education to the next level

The 11 Latin American universities that contributed to this study provide the opportunity to discuss what the entrepreneurial and innovative university looks like in the context of Latin American countries. These examples prove that "entrepreneurship" has become an important domain for teaching, learning and engaging in Latin America. Institutional practices mirror this international trend. Entrepreneurship spurs innovation in pedagogies and practices, which are more flexible and open to different communities, including those outside the universities.

In the sample of case study universities, entrepreneurship education is central to the institutional strategy. Most case study universities offer entrepreneurship courses to stimulate an entrepreneurial mind-set and train students with skills and aptitudes that will help them become the leaders of tomorrow. Many of the universities involved in the study offer tailored courses in their faculties of economics, science and engineering designed to help students create new ventures. More rarely, entrepreneurship courses are more transversal and designed to help all students, regardless of their field of study, acquire an entrepreneurial mind-set (e.g. Siglo 21 and Anahuac University).

Many universities are also conducting interesting extracurricular activities such as festivals, hackathons and competitions, which offer an opportunity for students to stimulate their entrepreneurial mind-set while connecting to other local players such as mentors, companies and local authorities. Many of these activities are not only open to students but also to local entrepreneurs who wish to take advantage of the opportunities offered by the university.

Case study universities play important roles in their own ecosystems by providing incubation, acceleration services and collaborating with local institutions and established firms. Many of the case study universities have local innovation hubs such as the Tecnológico de Monterrey or UFSCar. Some are more focused on connecting impactful research to entrepreneurial abilities and training researchers to push their ideas to the market (e.g. PUC and ICESI in Chile).

Overall, the variety of approaches to entrepreneurship education and activities that were observed in case study Latin American universities mirrors an international trend. For example, similar institutional efforts can be found in European countries, which hosted HEInnovate national reviews (EC/OECD, 2022[13]). These converging international practices offer the possibility of identifying some benchmarks and then some suggestions for case study universities, should they consider scaling up their efforts to promote entrepreneurship.

Curricular coverage of entrepreneurship

Based on information gathered in online interviews and interactions, case study universities and universities looking to strengthen their entrepreneurial agenda in the Latin-American region could consider a series of insights to improve curricular and extracurricular entrepreneurship education, as well as external activities connected with entrepreneurship. These include:

- **Increasing the number and outreach of mandatory courses in entrepreneurship**, to assure that all students, and not only those in business or engineering schools, get some curricular coverage of entrepreneurship-related topics and develop entrepreneurial mind-sets.
- **Promoting entrepreneurship and innovation education for PhD students** as a complement to their scientific skills. Most PhD students will develop a career outside academia and entrepreneurial skills may be useful to empower them *vis-à-vis* alternative career choices, including starting their own business or becoming innovators in existing organisations.
- **Connecting the different institutional experiences** would help promote curricular entrepreneurship education in Latin America. Collaboration among HEIs can make entrepreneurial teaching and learning both more efficient and more inclusive, going beyond the boundaries of business and engineering schools.

Extracurricular activities

Collaboration and specialisation could also feature extracurricular activities, which have the advantage of being more flexible and more accessible for motivated students.

- **Reducing fragmentation of extracurricular teaching and learning opportunities**. Case study universities presented a large, yet often fragmented list of extracurricular entrepreneurial initiatives. There is scope to improve the co-ordination and exchange of students across Latin America. In addition, the optimisation of activities may also allow further specialisation to more advanced topics and customised extracurricular activities to sectors or other specific needs.
- **Benchmarking extracurricular initiatives**. Taking into account the speed of evolution connected with the nature of entrepreneurial extracurricular activities, Latin American universities would benefit from sharing best practices and continuous benchmarking with ongoing international initiatives, assuring that the most innovative and effective approaches are identified and present in their portfolios.
- **Promoting outreach by hybridisation of their extracurricular activities**. Capitalising on the expertise developed during the COVID-19 pandemic, case study universities should be able to find a good mix between face-to-face and online interactions for entrepreneurial extracurricular activities. This would allow a broader outreach of entrepreneurship education and the possibility to involve contributions and content from experts, speakers or entrepreneurs located anywhere in the world.

Entrepreneurship education to connect to the needs of the ecosystem

By engaging with entrepreneurship, HEIs become more porous and accessible to external stakeholders. Hence, promoting entrepreneurship is also a way to promote collaboration.

- **Creating incentives for faculty and staff to engage in entrepreneurial activities**. Case study universities have been putting in place incentives for staff to engage in entrepreneurial activities and they should continue the implementation of these. More generally, universities across the region could consider generating incentives to stimulate the engagement of faculty members in entrepreneurship activities. These “incentives” could take the form of financial rewards, profit

sharing, spinoff or patent-related matters but, also, how the contributions made to such activities are considered when decisions are made in the recruitment or promotion of academic staff.

- **Connecting with other Latin American universities to share best practices about the way in which entrepreneurship helps universities connect with their communities**. The variety of initiatives put in place by case study universities to connect with their stakeholders shows the possibility of "federating" different experiences across universities and collecting good practices. This could improve learning from good practices and pave the way for joint efforts conducted by groups of Latin American universities supporting each other in promoting entrepreneurship in the sub-continent.
- **Generating additional resources through entrepreneurship and collaboration**. Entrepreneurial universities diversify funding solutions. A larger venture system could be able to respond to customised priorities and services. Such a funding mechanism should be able to cover the full spectrum of needs coming from entrepreneurs connected with universities in Latin America.
- **Increasing predictability and sustainability of funds allocated to entrepreneurial activities in the university**. As in other parts of the world, in Latin American case study universities, there is a need for sustainable allocations of resources supporting entrepreneurship activities. Sustainable and predictable funding would help to operate incubation or acceleration activities.
- **Improving intellectual property services**. The need for better intellectual property services was mentioned by different case study universities that do not have enough funding to hire legal services specialised in intellectual property development. Also in Latin America, entrepreneurial universities are confronted with bureaucratic obstacles when trying to develop intellectual property (patents, licenses and spin-offs). The administrative procedures required are lengthy and costly for universities that do not have dedicated staff.

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Notes

[1] The Princeton Review is an education service company that produces a multidimensional ranking of HEIs to orient and support students in selecting undergraduate programmes (www.princetonreview.com).

[2] “Flipped classroom” refers to a pedagogical approach used to let students learn about a new subject at home to be followed by classroom discussion.

3 Knowledge exchange and collaboration

Collaborating with external stakeholders to support innovation is gaining momentum in selected universities. Many HEIs have adopted a comprehensive knowledge transfer strategy ranging from consulting services for companies, applied research to life-long learning activities or services to surrounding communities. Next universities should look to build capacity to scale-up these activities.

Across OECD economies, higher education institutions (HEIs) are experiencing a shift in their knowledge exchange activities from a narrow technology transfer perspective towards a much wider one that includes different forms of knowledge exchange. European and North American HEIs have been promoting and implementing a somewhat standardised model of technology transfer, resulting from years of common benchmarking and catering to international standards. With the consolidation of the knowledge economy, many of these are now revisiting their view of the role of HEIs in society and embarking on a transition. HEIs become agents of change beyond that of human capital formation and technology transfer, evolving into promoters of human interaction, social guidance and key facilitators of knowledge exchange and applied knowledge optimisation throughout society (Harrison and Turok, 2017[1]).

To guide such a transition, many OECD-based HEIs can benefit from the experiences of their Latin American counterparts. The wide variety of institutional contexts, including academic, legislative, historic and cultural differences across Latin American HEIs, together with the lesser weight of international standardisation, has led to the implementation of a rich diversity of knowledge exchange trajectories across HEIs in Latin America. As compared to many other OECD contexts that have chosen to standardise HEI knowledge exchange around similar notions and methods, the richness in the diversity of knowledge exchange in Latin America offers many alternatives and experiences that can inspire future development. In addition, many universities in the region have to deal with a less mature innovation system (with less public and private spending on research and development [R&D]) that directly influences their ability to patent or license technology.

This chapter presents the variety of knowledge exchange in Latin America, highlights the experiences, obstacles and alternative approaches to knowledge exchange and comments on the lessons to be learnt from the study of 11 Latin American HEIs.

Beyond technology transfer: Universities in the region have adopted a comprehensive knowledge exchange strategy

With the consolidation of knowledge over the last half-century as a primary factor of production (Romer, 1986[2]) and key aspects of social and economic development, the role of HEIs as generators and disseminators of knowledge has placed them at the forefront of many development strategies.

Although consensus is building around the principles of wider knowledge exchange for HEIs, the specifics of how HEIs can transition and implement measures in support of this new way of knowledge exchange are still undefined. As such, the richness of experiences coming from the Latin American HEIs analysed as part of this study offers many clues as to the multiplicity of approaches that can be used but also the obstacles that can hamper such efforts. Most institutions in this study generally implement the same general knowledge exchange axis that can also be found in HEIs throughout OECD countries: licensing, extension and entrepreneurship. However, the knowledge that is exchanged, the motivation stimulating this exchange, the partners involved in the exchange and the methods used to exchange this knowledge are varied and rich in lessons to be learnt. From Chile's Pontifical Catholic University of Chile (PUC), which has a relatively orthodox but effective technology transfer structure and method; to Argentina's Siglo 21 Business University (Siglo 21), where knowledge generation is strictly contextualised to include and cater to local specificities so that the HEI is the bridge between technology and the people; to Mexico's Anahuac University, which has become a key player in the local "social transformation" of the economy as a result of the long-standing humanistic character present in all aspects of the university; to the Technological University of Uruguay (UTEC) that is dedicated to playing a role in changing the technology averse culture of the local ecosystem and convincing policy makers of the importance of investing in technological capacity building. The HEI cases under study all have different dominant approaches to knowledge exchange that differentiates them from the rest. Some of this differentiation will be highlighted in the remaining pages of this chapter.

Understanding knowledge exchange practices in selected case studies

Extension services

Most traditional knowledge exchange efforts undertaken by HEIs are unidirectional and are meant to get knowledge generated within the HEI out to society. As such, research publications are a method of transferring knowledge that is mostly unidirectional and typically only accessible to other academic practitioners. Teaching is also unidirectional in nature and, although it may have a somewhat wider potential audience of students, it remains limited in its transfer to core knowledge for undergraduate studies and rarely includes cutting-edge knowledge except in specialised or graduate pedagogy.

As explained in the first section of this chapter, greater volumes of advanced knowledge must reach society if the economic benefits of a Romer-style knowledge-based economy are to take hold (Romer, 1986[2]). This is one of the motivations that have led HEI institutions, encouraged by policy makers, to give much more priority to the promotion of technology transfer. The objective then became to push technology out of the HEI's labs and off researchers' desks into the economy.

Contrary to what happens in many OECD countries, the patenting and licensing of technologies produced by HEI labs are the exception rather than the norm in many of the Latin American universities studied. The institutional frameworks, formal rules and informal norms, that influence many Latin American universities, especially public ones, place significant constraints on the effective transfer of knowledge through patents and licensing agreements. This has made the entrepreneurial path a much more attractive alternative for "pushing" university-produced technologies and knowledge into the economy. Although knowledge transfer is happening through licensing agreements, with such licensing helping to diversify the revenue stream of much larger private HEIs such as the Tecnológico de Monterrey and Adolfo Ibáñez University (UAI), this is viewed as a much more complicated method of transfer than through university-backed start-ups. Additionally, whereas existing businesses need to adapt themselves to be able to incorporate effectively new knowledge and technology, the clean slate that entrepreneurial ventures offer makes them well suited to exploit commercially university-produced knowledge and innovations.

Although the entrepreneurial path for the transfer of technology is a valid method for HEIs to use when they prioritise new start-ups, they are excluding existing businesses as recipients of HEI-produced knowledge. Existing businesses must adapt to integrate new knowledge but are often better equipped in terms of market penetration, resources and capabilities to be able to optimise the implementation of the transferred knowledge. There is, then, a balance to be struck between reaping the potential social benefits of preserving employment and market stability through improving the competitiveness of existing businesses because of university-supplied technology transfers and capturing the efficiency of start-up-based transfers. Especially since new venture creation will tend to add output capacity and, therefore, competitive intensity in the market.

Hence, HEIs favouring the entrepreneurial path for the transfer of their technology should also develop an active extension service that connects and exchanges knowledge with the existing business community. For instance, although Colombia's ICESI University is renowned for its entrepreneurship support, it has also developed very good connections with the local business community, which it uses to transfer research results and university-produced knowledge. The key is to attempt to unify both existing businesses and new ventures within the same networks and promotion efforts.

Entrepreneurship education as a means to support technology transfer

Not all entrepreneurship promotion done by HEIs is carried out with the purpose of knowledge and technology transfer. In fact, as set out in the previous chapter, much of entrepreneurship education and promotion by universities is based on capacity building and skills development. HEIs, such as Anahuac University, promote the entrepreneurial initiatives of students with internal and external business

incubators and accelerators, but these initiatives are not necessarily exploiting university-developed technologies as the basis of their ventures. It can be argued in these cases that the knowledge transferred mostly comes from the entrepreneurship support technicians offer and therefore transfer their expertise over to these novice entrepreneurs. Colombia's ICESI has developed a good reputation for its expertise in entrepreneurship support, which it offers to both the university's students and faculty who want to initiate their own entrepreneurial ventures, irrespective of whether these ventures are based on opportunities from research results or not.

In order to increase the technology transfer outcome of their entrepreneurship support, some HEIs are specifically aiming their entrepreneurship promotion toward their faculty members and researchers. This often takes the form of training in business and entrepreneurship skills offered to faculty. ICESI has offered business and entrepreneurial training for its researchers but these courses are not always popular as researchers are not always attracted to entrepreneurial careers. Nevertheless, increasing business and entrepreneurial knowledge has been observed by HEIs such as Argentina's S21 to go a long way in helping researchers to better understand and adapt their outputs to business needs, further facilitating its potential for transfer (more on this in the following section). Researchers at Anahuac University were originally found to have little interest in promoting entrepreneurial initiatives. This was in large part the vestige of past stereotypes existing in many OECD countries when it was once ill-viewed to personally benefit from the fruits of institutional research. However, a change in attitude at Anahuac University came about when researchers were put in charge of the incubation activities and entrepreneurship promotion. Greater involvement led to greater understanding and, subsequently, more interest.

An HEI that has been orienting part of its entrepreneurship promotion towards its faculty is USFCar. They observed how the conventional wisdom that academics are entrepreneurially averse is largely false in their case by witnessing increasing interest on the part of their faculty for the many training and venturing opportunities offered to their faculty members. The younger generations of researchers were especially likely to take advantage of these measures.

Another technique historically used to increase the technology transferred through the entrepreneurship support measures promoted by the HEIs is to focus these measures on populations and academic disciplines that are more likely to generate applied and transferable knowledge. For example, the PUC in Chile has developed and implemented a very entrepreneurship-oriented technology transfer strategy largely focused on its engineering school. The many innovations coming out of this school are commercialised through entrepreneurial ventures promoted by students and faculty, but also by external entrepreneurs.

Leveraging on interdisciplinary approaches

The interdisciplinary nature of technology and knowledge exchanges enriches the quality of its impact (Feng, Liu and Wang, 2022[3]). A more holistic involvement of all knowledge-generating departments of HEIs is a way to ensure not only that a greater proportion of the generated knowledge will reach society but also that a wider spectrum of knowledge and greater scope of beneficiaries from this knowledge can be reached. Historically, innovation and knowledge transfer efforts at the UAI were concentrated on the faculty of engineering. However, recent and ongoing reforms are working to spread these efforts across all areas of the university.

However, the key factor is not so much getting all departments individually involved in technology transfer activities. Rather the cross-disciplinary nature of the transfer efforts is what is often likely to have the greatest impact, as many sources of conceptual knowledge on their own carry very little commercial applicability warranting any transfer demand. Yet, when different disciplines and sources of knowledge are fused together around a coherent theme, their full potential and applicability can be realised. This cross-disciplinary collaboration, however, goes against the structure and culture of most HEIs.

In order to apply a more multidisciplinary technology transfer strategy, many HEIs have had to break down countless cultural "walls" within their organisation. Efforts taken by ICESI to try to introduce greater cross-disciplinarity within knowledge exchange initiatives have proven very difficult to implement and are not very popular amongst their own research community. Similar efforts carried out by the UFSCar, however, showed that despite initially being very difficult to get the different academic areas to communicate, with time, students and younger researchers took over the informal lead of these efforts, which made collaboration and exchange across disciplines at the university much easier.

A knowledge transfer strategy for multi-campus universities

Over recent decades the missions and activities of HEIs have become more complex and diversified. This is a general trend observed both in OECD countries and worldwide. The scope of higher education has become increasingly globalised, in both its influence and its markets. Many HEIs, both public and private, have seen significant changes in their sources of funding, often within a pressured budgetary context, leading many to search for improved economic performance. Simultaneously, HEIs have experienced greater levels of autonomy. As a result, HEIs across the world have been developing new organisational structures and formats, leading many smaller institutions to fuse and merge in attempts to gain greater market coverage, offer more diversified study options, reach critical masses and greater efficiency. Many others have internationalised by establishing satellite campuses in new countries, either on their own or through collaboration agreements, in order both to gain access to new promising student markets and be able to offer their existing students a differentiated offer of international study destinations.

The result is an often complex multi-campus structure which can be challenging from an administrative perspective. The novelty of this phenomenon in many OECD member countries means that there is a lack of clear guidelines and benchmarks upon which HEI administrations can adapt and build upon. This is especially apparent within the knowledge exchange strategies and policies of multi-campus HEIs. Indeed HEIs face the paradox between the proximity benefits of implementing a decentralised knowledge exchange strategy with a strong smart specialisation focus in each one of the individual campuses or the efficiency and control benefits of implementing a centralised knowledge exchange strategy that follows systematic procedures that offer a more holistic overview of the entire internal HEI system.

The study of Latin American HEIs and the many different approaches that they have turned to in the face of this multi-campus knowledge exchange policy paradox can offer important lessons for OECD HEIs. An exemplar that has had to confront this paradox much before it became an issue for most OECD HEIs is the Tecnológico de Monterrey (TEC). The institute is a huge university system that serves over 94 000 students across 29 different campuses in Mexico and 18 international branches and offices (TEC, n.d.[4]). There once was a much greater level of independence and intercampus competition. Now the culture has shifted to an organisational philosophy that "there is only one TEC". In terms of structure for knowledge transfer, TEC implements a hybrid structure, which blends centralisation approaches in areas requiring consistency, and local differentiation, particularly in terms of relational capital building and adaptation. The university has a centralised offer throughout the TEC system, with the same general programmes. Programme design and administration are centralised but with a degree of local adaptation, that takes advantage of regional experts and capabilities. The knowledge exchange officers on each campus are encouraged to actively network with local players and agents such as local chambers of commerce, technological parks, incubators and accelerators to create proximity and establish a working relationship at the campus level. This way, TEC aims to better exploit the "potentialities" of each region. Notably, the talent management functions remain centralised mainly to maintain greater consistency and control.

The University of São Paulo (USP) is another of the largest HEI systems in Latin America (over 99 000 students) with one of the largest number of doctoral graduates in the world.[1] It has a main campus but also counts on a network of 11 different satellite campuses. The USP is largely decentralised across

campuses, with the exception of a number of unified official agreements and legal elements. Official technology transfer offices have recently been opened in all the USP's academic departments. Prior to that, the centralised transfer agency which existed was not an active internal actor within the USP. The expectation is that the creation of the network of transfer offices will not only decentralise the universities' knowledge exchange functions but will also facilitate engagement. From industry's point of view, the decentralisation of the USP's transfer offices facilitates accessibility and finding a local contact point to engage with. For its part, although the UFSCar agrees that greater decentralisation of its knowledge exchange function may be preferable, it stresses that the complexity of regulations and legal red tape forces it to maintain the centralisation of administrative function within its multi-campus system.

In contrast, the management of knowledge exchange at the PUC is centrally co-ordinated for all faculties. All rules and procedures are unified. The structures of the knowledge transfer "units" are sometimes different across faculties but they connect in terms of policies. Each faculty has an innovation centre that acts as an umbrella organisation overseeing all transfer activities, which are centrally controlled. The Pontifical Xavierian University (Javeriana) in Colombia takes a different approach, whereby the internal knowledge exchange dynamics across campuses are centred on collaboration and balance, with some healthy competition over resources. Because of the strong smart specialisation focus implemented, which aims to focus resources on areas of competitive advantage, certain faculties sometimes feel left out. However, there is an increasing number of transversal cross-campus projects; the competition is therefore not across campuses but rather across researchers.

An interesting approach to multi-campus knowledge exchange policy and structure is implemented at UTEC. UTEC has 11 campuses that are geographically spread across Uruguay. They are a relatively small university system with just under 4 000 full-time students but are experiencing strong growth (UTEC, n.d.[5]). It has a central council with multi-campus participation; however, the management of each campus is decentralised. The UTEC system is not centralised, nor is it localised: it is networked. Intercampus collaborations are often required due to a need for critical mass. The advantage of such a networked structure is that there is a constant flow of resources and capabilities across the intercampus network. The disadvantage is that it is often difficult for actors to access and retain the added value generated by such a structure. The university has very strong links to the private sector leading them to be able to capitalise on the significant intercampus differences in order to capture the contrasts across the territory and ecosystem of each campus. Despite this independence, there are common indicators and goals set to help control and monitor the system. UTEC's networked model, however, is not easily scalable. There is increasing use of digital platforms for cross-campus co-ordination. These platforms help to align the actions of each campus. Uruguay has good digital connection capabilities, which contribute to the effectiveness of these platforms. These digital platforms were developed by the Centre for Digital Transformation with the assistance of the Massachusetts Institute of Technology (MIT)'s Data Science Department.

Incentives systems implemented by case study universities to support knowledge transfer

Together with the bottom-up forces motivating institutional change, HEIs can also stimulate greater participation and collaboration of staff and faculty in technology transfer initiatives by reforming their evaluation and incentive policies. When the UAI embarked on reforms to transition toward transferable applied research, they triggered internal change by remodelling their academic evaluation criteria, in an effort to move from being "teaching-focused" to "research-focused". The new evaluation criteria for professors/researchers at the university include extension services, which compensate and incentivise the consultancy and applied research contracts that professors can generate for the HEI. Professors then have a choice between which tracks they prefer to be evaluated upon research, teaching, extension or a mix.

However, in many instances, internal policy or external regulation inhibits HEI researchers from retaining property rights over the knowledge and technologies that they help generate. This tends to act as an important disincentive to the generation of transferable knowledge. In universities such as Anahuac University and ICESI, researchers are found to have little incentive for technology transfer activities and, as a result, are not necessarily oriented towards the business applications of their research.

To help to counter this, researchers at the Javeriana are incentivised based on three factors: publications, spin-offs and created intellectual property (patents). The university has found that establishing patent-based incentives based on a percentage of the revenues generated from the commercialisation of their innovations has been effective in aligning academic production with business needs. Bonuses on patents therefore depend not only on whether these are registered but on whether private demand emerges and effective transfer takes place. To facilitate this, researchers at the Javeriana are incentivised to be involved and participate in the entire transfer process.

The perspective adopted by Tecnológico de Monterrey in order to cater to the multiple roles of professors at the university was to develop four different faculty types: teaching, research, entrepreneurial and extension professors. Whereas the evaluation of teaching professors is mostly based on class hours and teaching evaluations, they are encouraged to be active in external “in-company” training. Research professors are evaluated according to their publications and production of intellectual property (IP). The utility of the patents created is taken into consideration with patents having commercial potential being prioritised. The entrepreneurial professor is a new figure at Tecnológico de Monterrey, meant to cater to those professors who want to exploit institute-generated knowledge through entrepreneurship. This category of professorship, however, is proving complicated to set up for both normative and conceptual reasons, resulting in very few Tecnológico de Monterrey members of faculty having yet adopted this path. Finally, extension professors are tasked as experts and consultants, engaging directly with organisations and corporations. Evaluation indicators for extension professors are based on the number of programmes initiated and the revenues that these programmes generate for the HEI. As an incentive, extension professors earn a monetary complement above their regular wages. As is the case in most HEIs with similar multi-path faculty trajectories, professors are left to choose the path they would like to adopt (being an entrepreneurial professor or following a more traditional path).

Universities like Tecnológico de Monterrey that are implementing greater extension services directed towards responding to corporate needs have seen this line of transfer activity generate significant revenues. For Tecnológico de Monterrey, the revenues generated by the extension activities have made their extension professors the university’s most “profitable” faculty members. The UFSCar is increasingly counting on extension revenues as a source of supplementary income. This HEI is using extension revenues to complement royalties from licensing to foster further innovation from its research departments.

However, consultancy-based extension is mostly focused on large companies and corporations, and public organisations. As a result, many academic disciplines as well as the wider business community and society may be left out from the extension most of the time. This is why universities such as Uruguay’s UTEC have adopted social indicators within the evaluation process of the collaboration activities of their faculty. At Anahuac University, social criteria are present in all aspects of the university including as an integral part of academic evaluations.

Adapting knowledge transfer to the needs of the ecosystem

Although HEIs are taking ever-greater steps to “push” into the economy the knowledge and technologies generated within their departments and research labs, the target markets may not be able or willing to absorb this knowledge. In general, researchers tend to engage in relatively time-consuming lines of research, with the aim of advancing the frontier of knowledge in specific areas, often disconnected from the market in an immediate or obvious way. Companies, on the other hand, are generally interested in the

development of short-term marketable solutions, or the incremental but not radical improvement of their internal processes (OECD, 2021[6])

In response, some HEIs are adopting knowledge development strategies that are much more demand-driven to generate appropriate technologies that better fit the markets' needs. In this way, HEI technologies are more likely to be "pulled" by businesses, which better ensures the proper transfer of this knowledge into the economy. Several HEIs in Latin America have been historically implementing such a "pull" strategy.[2] UFSCar prides itself on the ability to adapt very rapidly teachings and programmes to match the changing needs of the industry and its demands. In the case of Siglo 21, knowledge generation is strictly contextualised to include and cater to local specificities and demands. Because it is not a research university, this Argentinian HEI has focused on practical knowledge with greater local applicability. Most knowledge transfer in their case is demand-based and done through pedagogy in the classrooms or in-company, as well as through the publications of specialised reports and publications. Siglo 21-generated knowledge is also disseminated through events organised by the university and by having an active presence within the popular media and press.

Similarly, developing greater extension services on the part of HEIs is often very useful for building relational capital with the business community. In this way, universities get to understand better market needs in terms of knowledge and technology demands. For Tecnológico de Monterrey, extension services have allowed it to detect needs and be proactive as to the design of new programmes and training, especially those related to training linked to new technologies that are often unavailable in certain regions. The proximity and close exchanges that the HEI is nurturing with the business community are fundamental to being able to design and offer the very best services. They are at the origin of many (applied) innovations and research projects undertaken by Monterrey researchers. The multi-service extension strategy has become very successful for the HEI and is largely the consequence of the reinforcing loop created by the relational proximity derived from its extension services.

The relational capital of universities facilitates knowledge exchange

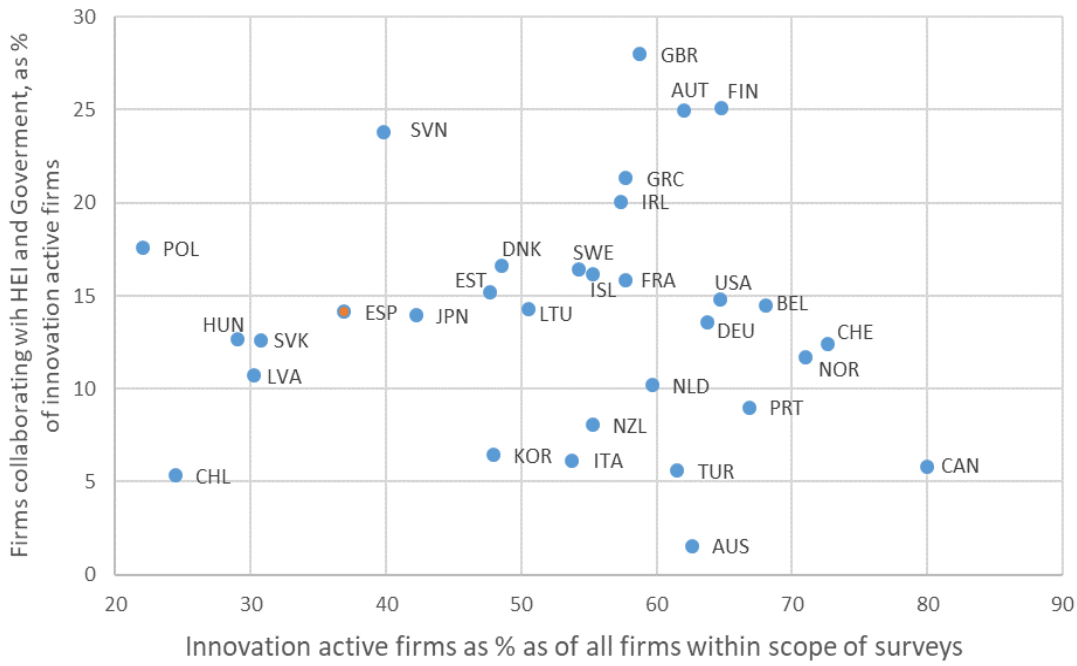
The relationship between universities and business is challenging, many Latin American ecosystems reflecting an international trend. Case study universities flagged that in many of their communities; businesses do not perceive universities as credible partners. However, this is not exclusive to Latin America and is a trait common across most OECD countries. Innovation surveys indicate that on average, OECD countries face low rates of collaboration between firms and HEIs in terms of knowledge transfers leading to innovation (Figure 3.1). Most firms manifest a lack of appreciation of the strategic importance of such transfers but also report other obstacles to collaboration with HEIs, including the lack of perceived openness and accessibility of universities. This is often both the cause and result, of a general lack of awareness and exchange across both these communities.

In relative terms, there has not been a historical tradition of collaboration between research and business in many OECD member countries. Lack of trust between the actors, due to lack of prior interaction, knowledge of each other's activities and the use of different "languages" represent obvious barriers to transfer and collaboration (OECD, 2021[6]). From the perspective of the UAI, the innovation readiness of universities and businesses is not the same. Moreover, according to this university and as noted in the literature in this area, the incentives, agendas and timing of the different actors in the system are often not aligned (Bruneel, D'Este and Salter, 2010[7]). According to the Javeriana, the business community does not understand HEIs and HEIs often do not have sufficient time and resources to be able to cater adequately to local businesses.

The lack of mutual awareness contributes to the foregoing of numerous opportunities that could broaden horizons and strengthen knowledge exchange efforts and the innovation performance of firms. This in turn could increase the impacts of research carried out by HEIs. Siglo 21 tackles this lack of mutual awareness through a "constant interaction strategy" which involves nurturing connections with non-governmental

organisations (NGOs), business associations and industry and responding to the specificities of local business communities through the development of partnerships.

Figure 3.1. Firms collaborating with HEIs and government in OECD countries



Source: OECD (2021[8]), *OECD Business Innovation Statistics*, https://oe.cd/innostats, accessed in May 2022.

Therefore, close ties with the community can become a source of strategic advantage guiding the HEIs' research and knowledge transfer efforts. HEIs like Siglo 21, which have developed close relationships with local business communities, are positioned better to connect and contribute to updating local business knowledge, introducing them to new topics and new methods. Ultimately, this allows Siglo 21 to be more proactive and detect and introduce innovative issues to the local community. Frequent interactions and interrelations help to build trust and bridge the academic and business communities together. ICESI, for example, is capitalising on its business orientation and prioritising trust building with the local business community, which is fundamental for proper collaboration and connections to take hold. ICESI has reinforced these ties by naming the ex-president of the chambers of commerce as their new provost. For this HEI, close ties not only help transfers but are serving as a means of exchange that is making the university a much closer partner for businesses and a go-to outlet for solutions.

The road ahead from knowledge exchange to collaboration

The notion of knowledge exchange, as opposed to mere transfer, refers to relationships between HEIs and their ecosystem that are not unidirectional (neither "push" nor "pull") or linear but rather interactive and collaborative. In such knowledge exchange relationships, it is not only universities that are relevant to the ecosystem but also the community that is an important source of knowledge for the HEIs. What is more, the co-creation of knowledge, where mixed teams of researchers from HEIs and industry engage in joint knowledge creation, is increasingly recognised as important for strong innovation performance (OECD, 2021[9]).

Connecting HEIs with their local ecosystem potentially benefits the promotion of mutual understanding about what is possible, or impossible, to achieve. Universities need to exchange with their local communities to achieve a place-responsive strategy and a tailored approach to respond to the specific needs of the local communities and avoid replicating models and "best practices", in a spatially blind way (OECD, 2020[10]).[3] A frequent practice within Latin American HEIs is to involve members of industry and representatives from the community to participate in joint orientation committees. Furthermore, the industry is often involved as a participant in curricular programming. More entrepreneurial-oriented HEIs tend to bring entrepreneurs into classes, whilst at the same time; professors in these HEIs are encouraged to get involved in entrepreneurship promotion activities.

Similarly, several HEIs in Latin America, as in many parts of the OECD, have been developing close ties with the private sector by establishing co-operative education programmes. These programmes are based on pedagogy alternating between academic classes and in-company student apprenticeships. Such programmes support the exchange of knowledge between the private sector and academia. Participating organisations benefit by having access to highly skilled labour, the opportunity to learn about the R&D being developed at the university and how this R&D could potentially be applied in their organisation. When a co-operative education student returns to their academic studies, they bring back an understanding of what is of interest to the industry. Professors and faculty hear discussions amongst students and during their courses. In many cases, professors and faculty apply the experience of co-operative education students to their courses and research (OECD, 2017[11]).

Tecnológico de Monterrey, UFSCar and ICESI encourage bidirectional learning and knowledge exchange through their extension services. These HEIs have observed significant research benefits from extension services, which give their researchers direct access to industry. As a result, improved empirical data and observations can be obtained for research whilst, at the same time, research topics tend to better capture and reflect business reality, needs and concerns. For ICESI, the close collaboration with its local ecosystem is helping to develop a needs-based research focus that is delivering more applicable knowledge outputs to local industry and businesses.

In the case of bidirectional knowledge exchange based on research collaboration and technology co-creation between HEIs and private industry, Latin American examples exist but are still scarce. In the absence of strong collaboration, the innovations that come out of HEI labs usually need significant fine-tuning to make them market-ready. The UFSCar sees significant differences between the level of preparedness of the technologies developed at the university and the level needed in order to be effectively commercialised and implemented by industry. Collaboration with industry and private businesses is necessary to mould HEI technologies into tradeable goods and services. However, dealing with the associated legal constraints and confidentiality restrictions is very time-consuming. Establishing a partnership agreement and abiding by the strict compliance norms imposed discourage collaboration with HEIs. This is found to be especially true of small- and medium-sized enterprises (SMEs) and smaller entrepreneurial ventures. The very complicated legislation and internal bureaucracy needed to co-create with HEIs disincentivises SMEs since the process is often more expensive for them than the entire project budget. As a result, collaboration is often accessible only to large corporate groups with the time and resources to deal with the necessary due diligence and red tape. The incubators and accelerators however represent an alternative to connect with start-ups and SMEs to some degree. These facilities provide programmes for start-ups and SMEs, a form of partnership that has fewer legal constraints and confidentiality restrictions.

Co-creation efforts are also often marred in property rights issues. Private businesses that collaborated in technology development or those that develop the applicability of technologies in co-operation with HEIs will require property rights over the technologies that they are adding value. However, the legal obstacles and bureaucracy required for this are often very complicated for private companies to face. According to the USP, business partners view the distribution of intellectual property on the results of potential research collaborations as a deterrent for research collaboration. New rules are therefore being implemented at this

HEI that will attempt to bring clearer and more transparent terms regulating the intellectual property distribution when co-creation of innovation through university-industry research collaborations takes place.

Governmental organisations and public administrations also represent attractive knowledge collaborators for many Latin American HEIs. Despite its strong ties with the business community, ICESI admits that its favoured knowledge co-creation partners are public institutions, both from the local and national levels. For example, the university has developed a close relationship with a local hospital, which they report has contributed to the creation and dissemination of knowledge within the community. The disadvantage, however, highlighted by several HEIs collaborating with public administrations on R&D, is that these relationships are habitually affected by political issues.

In some cases, public sector collaborations can take place when there is a lack of demand for innovation transfer coming from the private sector. HEIs need to establish dynamic relationships between researchers and the external community for such research collaborations to take hold and this is very difficult. Both sides need help to get adequate contacts that will complement themselves and form synergies in their knowledge co-creation efforts. Too often, research collaborations with industry depend more on personal relationships between professors and industry partners, than systemised synergic matching. Many HEIs, such as Javeriana University, comment on the significant time and financial resources necessary to invest in suitably establishing the connections required for appropriate research-based knowledge exchange activities to take hold. There is a need for matchmaking, which creates an improved marketplace where both socio-economic problems and HEI-generated technology solutions can meet, but also where the agents from both sides can connect to work towards co-designing and developing new applied knowledge solutions. At Anahuac University, this has been largely solved by the establishment of networking associations that act as intermediates and facilitate matchmaking between research and industry.

Exchange intermediaries and lateral transfers

Case studies that have developed internal intermediaries of innovation

In an innovation environment in which business and research actors pursue seemingly different and often conflicting paradigms and goals, intermediaries play a crucial role in connecting actors and facilitating mutually beneficial knowledge exchange processes (Box 3.1) (OECD, 2021[9]).

Box 3.1. Knowledge intermediaries

In an innovation landscape characterised by low levels of collaboration between universities and firms, knowledge intermediaries play a crucial role in connecting these actors and facilitating knowledge exchange.

These intermediaries can take the form of:

- Technology transfer offices, mainly attached to universities, created to facilitate the transfer of technology and knowledge from a university to the productive sector.
- A consortium of technology transfer offices, with some technology transfer offices joining forces and mutualising their offer to the market.
- Sciences parks, usually under the management of a public or private entity (whether the university, government or firms), with the goal of generating innovative knowledge to transfer to the market. In many countries such as Brazil, Mexico and Spain, science parks were created by public authorities as a tool to diversify the local economy and promote innovation.

Many of these parks are located within the premises of the university campuses, provide support services, and dedicated spaces to host innovative start-ups.

- Clusters or geographic concentrations of interconnected companies and institutions (such as universities and researcher centres), linked by common technologies and skills.
- Technological centres for R&D centres that provide research and technology services to companies and often collaborate with universities to translate research into practical application in professional settings.

Other intermediaries may exist: in Chile, for instance there is a non-for-profit organisation, the Integrated Piloting Centre of Mining Technologies (CIPTEMIN), which collaborates with universities to bring new research into the market. The centre provides a space to mature and test technologies developed by universities, and make them market ready.

Source: Adapted from OECD (2021[6]), "Improving knowledge transfer and collaboration between science and business in Spain", http://dx.doi.org/10.1787/4d787b35-en.

In order to facilitate and even instigate proper knowledge exchange and fruitful research collaborations between HEIs and their ecosystems, there need to be appropriate linkage and engagement networks. Knowledge intermediaries play very important roles in these networks. Technology centres, clusters, incubators, science and technology parks and specialised providers of professional services around the law, finance and intellectual property rights all represent likely examples of organisations that, under different settings and legal arrangements, help connect different actors and functions in the knowledge exchange system (OECD, 2021[6]).

In the case of much larger Latin American HEIs, these knowledge intermediation functions are often carried out in-house. Specific units within these universities are set up to carry out intermediary roles that help connect supply and demand for different types of knowledge. They also co-ordinate the processes and bureaucracy associated with such exchange. Internal intermediary "centres" are a key presence at the UAI, as a connexion hub for external partners. Being distributed internally within each faculty, these centres are largely mono-disciplinary in nature and have developed into extension offices rather than true knowledge exchange intermediaries. As such, these centres act as a specialised consultancy that mainly push technology out of the UAI labs and facilitates the establishment of "spin-outs" based on UAI-developed technologies. Recent reforms, however, have been implemented to encourage more multidisciplinary collaborations and to make these centres more active facilitators of bidirectional exchange between the university's researchers and external partners.

At the UFSCar, the points of connection between professors/researchers and external partners mostly originate out of the already existing relational capital of the people involved. Once the intention to collaborate is highlighted, the university's internal knowledge intermediary agency must then be contacted to process the many required legal and administrative issues, such as confidentiality and property rights agreements. Each campus has its own innovation leader trying to link faculty members with the university's centralised intermediary agency. Only on occasions when businesses do not have pre-established relationships with a professor will the HEI's intermediation agency or innovation leaders act as a matchmaker. This is usually limited to larger corporate entities.

There are challenges facing internal intermediaries. Most often, there is a considerable gap between the state of the technology as developed by the HEI's research labs and the level required to fit the needs of external partners. For legal reasons, a separate area at the UFSCar works with external partners on commercial adaptations. This area is legally and structurally separate from the departments where the technologies originated. As a result, true solution-based co-creation is unlikely and an internal intermediation figure is required to make the link between the different entities involved.

In contrast, the USP's internal intermediary unit is much more active in bridging the university with its ecosystem. The role of their intermediaries across the university's decentralised multi-campus network facilitates accessibility and provides multiple local points of contact for businesses to engage better with the university. As with most HEIs, these internal efforts are combined usually with external independent intermediaries under a wide range of configurations and services provided to both HEIs and businesses.

Case study universities collaborating with external intermediaries of innovation

External intermediaries come in many different forms and are likely to offer different types of services (Box 3.1). Some provide space to bring physically HEI researchers and their counterparts from the private sector together to co-work on joint innovation projects, whilst others rely more on their specialised staff to link both these parts together and offer assistance to help strengthen their exchanges. External intermediaries can have a generalist perspective (such as the Fraunhofer Institutes, see Box 3.2) or be limited in scope to only one specific sector of technology. In the same way, some offer a wide menu of services to both HEIs and the private sector, while others are more functionally specialised in aspects such as law, IP or finance and offer this expertise for the benefit of knowledge exchange initiatives.

Box 3.2. The Fraunhofer Institutes

The Fraunhofer-Gessellschaft based in Germany is one of the biggest applied research organisations. Founded in 1949, the organisation has 76 institutes throughout the country. The organisation turns scientific research and technologies into commercial products ready to be used by companies. It operates in key technology areas such as artificial intelligence and cybersecurity medicine. The institutes work closely with universities, with university professors being appointed as Fraunhofer institute directors to create ties and make sure that the results of university research are applied. The institutes also collaborate with universities for different acceleration and incubation programmes. For example, Fraunhofer has collaborated with UnternehmerTUM, the innovation centre of the Technical University of Munich, to provide support to spin-offs within the context of their FDays 12-week acceleration programme that acts as a stress test for market, team and technology. At the request of the federal government, the institute is working with a pool of companies and universities to push forward interdisciplinary research and transform it into application-oriented technology developments.

Source: Fraunhofer-Gesellschaft (2022[12]), *Cooperation with Universities*, https://www.fraunhofer.de/en/about-fraunhofer/profile-structure/structure-organization.html; OECD (2021[6]), "Improving knowledge transfer and collaboration between science and business in Spain", http://dx.doi.org/10.1787/4d787b35-en.

Some of the benefits of being external and set up as independent organisations – either for-profit private initiatives or non-profit associations and foundations – come from the added operational flexibility relative to the HEI's internally governed intermediaries. External intermediaries also tend to act in greater proximity with the private sector, allowing them to better appreciate local concerns and capture the ecosystem's knowledge needs. As a result, external intermediaries understand the level of adaptation required for the effective implementation of HEI-generated knowledge. This can potentially allow them to act as effective "translators" helping researchers and businesses to connect and reach common goals. External intermediaries also tend to sustain a number of simultaneous connections with different research entities, not being limited to a single HEI. This allows some of them to reach a critical mass that permits greater functional or disciplinary specialisation. Depending on their structure, external intermediaries are usually not aiming to "push" any existing HEI technologies onto the market, nor are they looking to simply solve business problems. Rather, they are in the business of setting connections and offering the services that will make these connections transform into impactful knowledge exchange.

In several OECD countries, however, the (over)abundance of these external intermediaries has generated calls for greater co-ordination in order to avoid frequent overlaps in the provision of services and the engendered confusion on the part of intended beneficiaries as to where to turn to for adequate assistance (OECD, 2021[6]). Co-ordinating the operations of diverse knowledge intermediation agents – including knowledge transfer services within universities as well as independent knowledge intermediaries such as technology centres, science and technology parks and clusters – has become a priority for effective knowledge exchange.

However, this phenomenon was not detected during the analysis of the Latin American knowledge exchange ecosystems. In fact, several ecosystems lacked the presence of external intermediaries or have intermediaries that suffered from insufficient resources and professional expertise to be able to reach satisfactorily the knowledge exchange goals that they set for themselves. On the other hand, some external intermediaries found in Latin America are very effective in their tasks and have become key players in orchestrating their entire knowledge exchange ecosystem.

Brazil's ONOVOLAB is one of these transcendent external intermediaries that has become an essential knowledge exchange player in many parts of the country. As a private entity, ONOVOLAB is the largest independent innovation intermediary based in Brazil, promoting innovation, science, technology and entrepreneurship. They offer physical spaces for innovation and co-creation, as well as a range of professional services including venture capital intermediation, helping link technology spin-off projects to funding. They also host networking and dissemination events that serve to place ONOVOLAB as the critical hub connecting most parts of the knowledge exchange ecosystem to each other.

As a result of ONOVOLAB's effectiveness, HEIs such as UFSCar have been outsourcing their matchmaking intermediary services. As noted in the previous section, the UFSCar internal intermediary agency mostly offers administrative support and facilitates internal connections but external bridging tasks are mostly delegated to external intermediaries. ONOVOLAB has developed a methodology for better matchmaking external needs with UFSCar knowledge creation. In general, businesses in UFSCar's ecosystem are not prepared and oriented towards innovation. ONOVOLAB works to break down knowledge barriers limiting businesses and match them to knowledge. The intermediary is implementing a novel approach to innovation in an ecosystem with multiple players. This is helping to break down cultural innovation barriers and facilitate the effective exchange of knowledge between HEIs and their ecosystem.

Connect Bogotá is another significant external intermediary at the root of an effective knowledge exchange ecosystem. Connect Bogotá is a mission-based association of over 60 private, public, academic and government sector organisations aiming to develop, support and implement projects that promote science, technology, innovation and entrepreneurship in the region so as to support its socio-economic transformation. The Javeriana, together with other public and private organisations, is a member of this network. As such, they gain access to a set of benefits and services that can help the university enhance its innovation output, generate valuable connections and exchange with the business community, and strengthen its capacity to exercise collective leadership.

Despite the significant presence of Connect Bogotá within Javeriana University's knowledge exchange ecosystem, interviews highlight that the HEI still believes that there remains a mismatch between external needs and HEI-supplied technologies, requiring a marketplace where both social/business problems and HEI-generated solutions can meet. External brokers are needed to help bring these parties together. To complement the actions of Connect Bogotá, the university is working on elaborating an inventory of external intermediaries and experts that could give visibility to these actors and help tie some problem-solution knots together.

In this vein, Anahuac University relies heavily on external networking associations to facilitate matchmaking. These associations "walk around" the local economic/industrial community to understand them better and predict the knowledge and recruitment needs of industries for the future. As such, through their prospective use of these external intermediaries, the university has developed a more proactive

attitude towards knowledge exchange, with the intermediaries facilitating the bidirectional flow of knowledge that allows this forward-thinking exchange to happen.

In the case of Siglo 21, its “local” rather than “technological” knowledge exchange focus has meant that many external intermediaries present in its ecosystem did not align with the university’s output. Because technology is seldom understood by most in its targeted communities, the university has adopted a leadership role within its ecosystem and has emphasised the importance of vulgarising and adapting HEI-produced knowledge to optimise its value for local industry and the population. In this quest, Siglo 21 has teamed up with several community-based NGOs and business associations to promote knowledge exchange with its local ecosystem. The university has signed several collaboration agreements with these indirect local intermediaries. The close connection with these intermediaries is helping the HEI’s faculty members and students to better adapt themselves to the “language” and needs of local businesses and civil society.

Lateral exchange and co-operation among Latin America and the Caribbean (LAC) HEIs

Engagement and collaboration offer opportunities for networking among Latin American universities, helping reduce the fragmentation in higher education systems. A characteristic of the Latin American knowledge exchange system that stands out is the importance of lateral knowledge transfers. Although the phenomenon is also found in other OECD countries, the occurrence of collaborations across different HEIs as part of their knowledge exchange efforts was notable in the analysed Latin American innovation ecosystems. These collaborations go further than simple networking and the exchange of best practices. Often, they are partnerships aimed to either share resources and/or reach greater critical mass to be able to develop further services and establish more effective knowledge exchange ecosystems.

Many of these collaborations originated from resource or service deficiencies within their knowledge exchange ecosystem that HEIs compensated for by joining forces. In this way, when significant public support was removed in Mexico because of the federal administration’s change in priorities, Anahuac University merged its entrepreneurship promotion programmes with those of other HEIs in order not to lose the effectiveness of its outreach.

The Connect Bogotá platform highlights a different approach to lateral knowledge. It brings together a consortium of as many as 25 different HEIs joining forces in order to create synergies and generate a collective impact that could hardly be attained without such collaboration. As mentioned in the previous section, the consortium of HEIs works together with private and governmental representatives in order to “transform Bogotá into the most innovative and entrepreneurial region in Latin America” (Connect Bogota, 2022[13]).

Apart from the impact of the collective goals of such coalitions, there are benefits for each individual participating HEI. The Javeriana has been able to share both experiences and resources across other HEIs, efforts that have been reciprocated to the benefit of the university’s entrepreneurship promotion programmes and outreach. According to the Javeriana, the different universities that are part of Connect Bogotá tend to complement each other. This happens in an atmosphere of “co-opetition”. Whereas the original stance across the different HEIs was one of competition within the region, through Connect Bogotá, it has evolved to set the stage for the collaboration, taking place today for the greater goal of the entire ecosystem. As such, the coalition has helped the Javeriana to establish conversations and facilitated both vertical and lateral connections.

Another common form of lateral collaboration and knowledge exchange among case study Latin American HEIs comes from bridging social capital with international HEIs. The innovation model developed by the Javeriana comes from the University of San Diego, which provided representatives of the Javeriana with insights into the workings behind the method that has been successful for the Californian HEI. The

Javeriana not only implemented this method within its own campuses but it shared this knowledge with the other Connect Bogotá HEI members.

A similar dynamic is seen at Anahuac University, which helps public universities with fewer resources to set up knowledge exchange projects. The university uses its international relations and its capacity to develop international networks to tap into new sources of knowledge and bridge these back into the local ecosystem in the form of resources, techniques and methods that they then share with local public universities. A similar practice is found at Siglo 21, which describes itself as an importer and distributor of knowledge coming from afar, into the region. Tecnológico de Monterrey also has a policy of looking outwards and collaborating with other international universities in order to capture new knowledge from abroad that can then be shared nationally. At its origins, the Monterrey model was inspired by MIT and brought to Mexico. Over its history, Tecnológico de Monterrey has then duplicated this model across its different regional campuses spread out throughout the country.

Public policies and vehicles to foster knowledge exchange

Although the objective of the study presented in this report was not aimed specifically toward the analysis of public knowledge exchange support policy, HEI views of such policy were nevertheless captured. In this regard, there are important country-level, and sometimes regional, distinctions throughout Latin America that prevent any clear generalisation. Yet, there is a common perspective expressed by HEIs across Latin America that, often, public administrations (national and regional governments alike) are not the principal leaders of knowledge exchange efforts within ecosystems. This contrasts with many other public administrations throughout OECD member countries that are increasingly prioritising and emphasising the importance of knowledge exchange, not only through words but also through actions and leadership[4] . It is true that it may sometimes be difficult for HEI to appreciate the impacts of public policy and measures whose scope may stretch further than the limited interests of the HEI. However, rarely did the HEIs under analysis identify local, regional or national public departments as prominent figures within their knowledge exchange ecosystem. More often than not, policy was perceived as a source of constraint rather than facilitation.

One clear and noteworthy exception to this, however, is Colombia's General Royalties system *Sistema General de Regalías* (SGR) programme. The SGR is primarily a financial support programme, which originally served to compensate territories for the exploitation of non-renewable resources but has since taken on much wider social knowledge appropriation goals. The objectives of the most recent version of the programme[5] are to:

- Create conditions of equity in income distribution through saving for times of scarcity.
- Distribute resources to the poorest population, generating greater social equity.
- Promote regional development and competitiveness.
- Incentivise mining and energy projects (both for small and medium industries and for artisanal mining).
- Promote the integration of territorial entities in common projects.
- Promote investment in the social and economic restoration of territories where exploration and exploitation activities are carried out.

This SGR programme complements existing financial transfers directed to research in Colombia. The SGR's knowledge exchange impact is derived from its efforts to better link the knowledge and innovation created in HEIs with the socio-economic needs of the local ecosystem. On a practical level, regional development plans are developed through civic discussions and participation. HEIs and their research faculty then formulate research proposals that are evaluated and financed according to their contributions to the SGR objectives and the regional priorities as set in their development plan. Because of the amounts

of transfers involved and the close co-ordination of national policy, community priorities and HEI research efforts; this programme has had a noteworthy impact on steering the focus of HEI research and knowledge exchange towards applied topics of local importance. The resulting multidisciplinary knowledge output of HEIs has consequently become much more place-based and socially appropriable. Both ICESI and the Javeriana acknowledge that the SGR programme is in part responsible for influencing the greater social orientation of their institutional strategies.

In contrast to this, where access to public funding for HEIs and their researchers has become more constrained, innovation policy has largely shifted away from local social issues towards more revenue-generating corporate extension service delivery. This has been the experience of Tecnológico de Monterrey, which stated that because public funding for the HEI was disappearing, most of its financial resources now came from the private sector.

A public sector programme that was identified as having a positive contribution towards HEI knowledge exchange is Chile's Production Development Corporation (CORFO) initiative called Engineering 2030, which sees particular engineering schools receive support to align their education and learning environment with societal grand challenges. This programme was identified as having a significant impact on the country's engineering faculties in terms of both pedagogy and research. From the teaching aspect, the UAI took advantage of the programme to reform significantly its engineering curriculum. With the objective of modernising and transitioning from fundamentals to a more applied curriculum, greater innovation and entrepreneurial training was included in their engineering programmes. They also shortened the length of the HEI's engineering programmes and developed greater co-operation with external businesses for internships and practice. Executive programmes were added to complement their existing academic-oriented postgraduate engineering courses.

The UAI also took advantage of this programme to transition its engineering research focus by offering greater support for applied research. The PUC also benefitted from the Engineering 2030 support, which they used to team up with Federico Santa María Technical University to instigate internationally recognised research whilst ensuring that the HEI contributes to the social, environmental, political, and economic development of the country.[6]

The impact of the Engineering 2030 initiative was significant but limited to schools of engineering. Similar reform could amplify the knowledge exchange impact of HEIs by holistically making all disciplines and faculties include incentives to stimulate a more applied approach to higher education and research. Without abandoning fundamental research, introducing greater incentives and strategic orientation for applied research where they do not currently exist has been demonstrated to be an effective policy to stimulate greater knowledge exchange. This is a path that public policies should explore to assist HEIs in their knowledge exchange efforts.

Box 3.3. The Sexenium for Knowledge Transfer and Innovation in Spain: An effective economic incentive for researchers

The Sexenium for Knowledge Transfer and Innovation was introduced in Spain by the national public administration as a pilot in 2018, replicating the success model of the existing Sexenium for research. These are accredited merit recognitions (based on six-year contribution intervals) that encourage transfer activities between teaching and research staff in universities and public research centres. These lead to economic incentives and offer added recognition for career advancements and promotions. The number of applications in the first call far exceeded expectations, reflecting both the interest of the Spanish scientific community in this instrument and the fact that a broad definition of the

concept of transfer was considered. This instrument, which has no international equivalent, is contributing to progressively promoting a greater transfer culture among researchers in Spain.

Source: OECD (2021[6]), "Improving knowledge transfer and collaboration between science and business in Spain", http://dx.doi.org/10.1787/4d787b35-en.

From the perspective of many case study HEIs in Latin America, there is a lack of incentives to adapt and transfer knowledge and connect research to innovation. The main constraints to technology transfer at the USP, from the researchers' point of view, come from regulatory problems linked to contracts that demand exclusivity over property rights on generated knowledge. This means that much of the knowledge created within the HEI cannot be commercialised or "spun off" through entrepreneurial initiatives or collaborations. From the businesses' point of view, the imposed distribution of intellectual property on the results of potential research collaborations detracts industry involvement. The big problem for innovation at the USP, therefore, is structure and incentives that are very academic-oriented; the same can be said for many public HEIs in Latin America.

Public legislation is not as much of a limiting factor as the institutionalised constraints implemented by many HEI administrations and regulatory bodies. The law is permissive according to the USFCar but it is very hard to internalise and change the institutional framework and norms to make things more agile and compatible with HEI-business collaborations and exchanges. Internal policy restraints and audits are counter-productive when it comes to promoting innovation, knowledge transfer and commercialisation. At the USP, significant effort and resources are dedicated to legal proofing all initiatives, which slows down procedures, diminishes motivation and disincentivises proactivity and innovation. Nevertheless, many USP faculty are involved in innovation even though no formal incentives are in place.

New policy, however, being brought in by the new management of the USP, is attempting to bring clearer and more transparent terms regulating intellectual property distribution when innovation co-creation through university-industry research collaborations take place. It is hoped that this will significantly change the attitudes towards knowledge exchange and transfer and remove some of the bureaucratic obstacles to HEI-business collaboration. As it stands, many HEI administrations in Latin America are not incentivised to stimulate change that could promote greater knowledge exchange. Internal resistance to change and the need for significant normative reforms means that they often run the strong risk of reprimand if they do not meet established expectations.

In Brazil, innovation legislation put in place in 2016 legally opened up the path for change. However, a larger factor in stimulating change in internal attitudes towards collaboration with industry and establishing a more agile technology transfer system at the USP has been the change in leadership. In response to pressure from students and faculty members pushing for change towards more innovation-adapted governance, the university's new administration has made innovation its main priority. A new adjunct rector of innovation has been named and this position has been "constitutionalised" to assure permanence and resistance to political shift. Such senior backing is necessary to change and surmount the culturally embedded institutional obstacles to innovation that have set in over a long period. New leadership was required to direct the institution down a more knowledge exchange-friendly path. The USP administration is working to spread an innovation-compatible mentality to all departments. Similar scenarios are playing out throughout the Latin American HEI community.

Greater involvement from public administrations through cross-disciplinary initiatives such as Chile's Engineering 2030, in conjunction with the HEI administrations, could have a significant impact on encouraging the transition of HEI to more exchange-compatible applied pedagogy and research in Latin America. This could help set clearer objectives and guidelines that would contribute to overcoming existing resistance still present in the internal culture and norms of many HEIs.

Although universities are seeking to improve and reform their internal regulations and norms to become more innovation-friendly, the fiscal system in many countries is also playing a role in disincentivising innovation. It is perceived by some HEIs that public audits and accounting have a public finance optimisation approach rather than one aimed towards maximising innovation output and exchange. From the HEIs' perspective, both the fiscal legislation and the fiscal inspections and monitoring practices would benefit from public policy reforms that are more compatible with HEIs' knowledge exchange practices.

At UTEC, they have made use of digital platforms to help co-ordinate and homogenise this monitoring process. Despite the independence of its 11 different campuses, there are common indicators and goals set to help control and monitor the system. This allows for objective-based financing across strategic areas and permits UTEC to more easily present indicators that align with the governmental strategy and correspond to public monitoring criteria. This has contributed to diminishing the burden of fiscal audits and inspections and consequently has facilitated the acquisition of public funds.

HEIs' role in promoting place-based capabilities and specialisations (smart specialisation)

The many examples of local adaptation on the part of HEIs to the specificities of their knowledge exchange ecosystem noted in this chapter bear witness to the role that HEIs can have in the promotion of smart specialisation within their territories. Smart specialisation is an approach to regional growth built around existing place-based capabilities. The goal of smart specialisation is not to make the economic structure of regions more specialised (i.e. less diversified) but instead to leverage existing strengths, identify hidden opportunities and generate novel platforms upon which regions can build competitive advantage in high-value-added activities (OECD, 2021[9]). Smart specialisation from the HEIs perspective focuses on building competitive advantage in research domains and sectors where regions possess strengths and leveraging those capabilities through diversification into related activities. A place-based, bottom-up smart specialisation for HEIs would lead it to focus on improving attributes that strengthen desired territorial processes (Capello and Kroll, 2016[14]).

Box 3.4. The Academy for Smart Specialisation in Sweden: Putting an HEI at the heart of a regional smart specialisation strategy

The region of Värmland, Sweden has joined forces with the University of Karlstad to create the Academy for Smart Specialisation in Värmland. The university is located in Karlstad, the main city of the region of Värmland, in North Middle Sweden. This initiative was part of the regional government of Värmland's ambitious smart specialisation strategy to strengthen R&D capacity, support the diversification of the economy in new sectors, create new skills and revive a decaying industry of pulp and paper (Värmland's Research and Innovation Strategy for Smart Specialisation 2015-2020, VRIS3). Karlstad University and Region Värmland jointly run the Academy for Smart Specialisation. The purpose of the academy is to serve as a meeting place and co-operation platform for researchers, companies, and financiers, the public sector and entrepreneurs. The Academy for Smart Specialisation hosts different research groups and projects. Most of these mirror the sectorial priorities as identified by the Värmland smart specialisation strategy (such as forest-based bioeconomy, digitalisation of welfare services, renewable energy, etc.).

Source: OECD (2020[15]), *Evaluation of the Academy for Smart Specialisation*, The Geography of Higher Education, OECD, Paris.

Several Latin American HEIs were deliberately implementing approaches that can be considered smart specialisation strategies, in connection with their knowledge exchange practices, whilst several others

were following very similar models to smart specialisation without necessarily naming it as such. The Javeriana is following the principles of smart specialisation to guide its research and exchange orientations. Proximity is an important part of the Javeriana's smart specialisation strategy. The areas of innovation that are encouraged within the HEI are those that fit the strengths and related capacity-building necessities of the ecosystem. This is reflected in the importance given to being place-based as part of the university's development strategy.

Argentina's Siglo 21 is a university with very a strong local orientation in all its activities. Knowledge generation is strictly contextualised to include and cater to local specificities. The focus at Siglo 21 is a community-based commitment rather than smart specialisation as such: they have developed an organisational culture and mind-set oriented towards the HEI's ecosystem. As a result, the geographic impact of the HEI is widespread in all regions of Argentina where the university is active. Collaborations with community NGOs and the active participation of their students enable the university to reach out to all of the communities in which Siglo 21 students reside.

As part of the USP's innovation orientation, the university is playing a much more influential role within the different local ecosystems where it has a presence. The university is now taking steps to become a much more active part of the place-based innovation processes of each locality. An example of this is InnovCity, which is a government initiative to transform a key part of the city of São Paulo into an innovation-driven community. The USP's main campus is centrally located within this InnovCity and, as such, assumes a leading role in its conceptualisation and development.

For its part, UFSCar has had a clear role historically as part of the spatial development of its ecosystem. This has resulted from 50 years of efforts to "connect the dots" since the establishment of UFSCar. As a result of UFSCar teaching and knowledge exchange activities, a critical mass of qualified human capital and related technology industries were established in the region, creating a positive reinforcement loop which has helped to guide the territory's development path. The demand for qualified human capital in the region has increased because of the profound change in the local ecosystem. The change was gradual and place-specific. The region now has a reputation for technology and not simply one type or source of technology but a mix and variety of knowledge creation and commercialisation. With a high number of technology start-ups being created today, UFSCar is rapidly seeking to adapt teachings and programmes to match the changing needs of the industry and its demands.

Universities in Latin America have an important role to play in helping societies adapt to global shifts

Four major macro-level shifts are influencing HEIs and their knowledge exchange ecosystems globally. These are the social responsibility, digital, environmental and entrepreneurial transitions within HEIs, alongside the economy and society in general. The COVID-19 pandemic has accelerated the pace of these transformations in many ways. HEIs in OECD countries and beyond are not only affected by these changes but are called upon to play key roles in instigating, guiding and assisting their ecosystems through these different transitions. An important component of knowledge exchange between HEIs and external actors is how HEIs in a given territory participate and contribute to local development and regeneration. The way HEIs interact with their communities is part of a broader framework where HEIs are perceived as drivers of local socio-economic development.

Case study HEIs' role in the transition towards greater social responsibility

The first transition, towards greater social responsibility, is one that has been around somewhat longer for HEIs but is also manifesting itself within the business community and society in general. Inclusive of corporate social responsibility, in the case of HEIs, it is often referred to as the "third mission" of higher

education. The third mission of higher education goes beyond the education and research functions of universities to include also HEIs as drivers of economic and social development. Actions related to the third mission are associated with local skill development and capacity building, community engagement and entrepreneurship beyond those associated with students, faculty or staff. The knowledge exchange functions of HEIs are influenced greatly by the adoption of such a social mission. Instead of narrow technology transfers for the economic benefits of corporate entities, the third mission implies a much wider interpretation of the knowledge to be exchanged, the reasons motivating the exchange, the method in which it will be exchanged and the receiver that stands to benefit from this exchange.

Anahuac University is a notable example of an HEI that has placed such a third mission as its dominant purpose dictating both its pedagogical and research strategies. All pedagogy at this university must follow five main humanistic principles. Social criteria are used as an integral part of academic evaluations of faculty members in order to guide and prioritise the university's research output. At the same time, all entrepreneurship initiatives promoted and supported by the university are encouraged to have a significant positive social impact. Social consciousness is therefore at the heart of Anahuac University's organisational culture, structure and processes. It has established itself as an expert in social responsibility and shares this expertise with businesses and with the local economy, through their award-winning corporate social responsibility (CSR) consultancy and extension services. Anahuac University counts among its many academic faculties, one that is specifically oriented to the study and pedagogy of CSR. As a result, the university has become a key player in the local "social transformation" of the economy within its geographical area of influence. This form of knowledge transfer is highly relevant and can have a local impact on the local ecosystem.

UTEC has also embraced their social mission and has made it a point to attempt to have a positive social impact in the communities in which it operates. The HEI implements social indicators within the evaluation process of its academic faculty. Social action and engagement with the local ecosystem are a core part of the job description of professors, not an additional requirement. Professors are remunerated to encourage them to move close to the university's campuses outside the capital city and this way become physically part of the communities that are served by UTEC. The work of faculty members at UTEC is very (local-) demand-oriented. All faculty members at the university are trained to identify social and local needs. As a result, they are much more likely to choose to orient their work towards developing solutions to these challenges.

Another noteworthy example is Siglo 21's focus on humanistic technologies in the promotion of their knowledge development activities. The HEI has given itself the mission of becoming the bridge between technology and the people. One of the outstanding initiatives from the university is the network of social learning centres that the university has set up to reach out to indigenous and remote populations.

Case study HEIs' role in the digital transition

The efficiency-driven industrial paradigm that dominated most of the 20th century has given way to one where knowledge and innovation represent the main source of competitive advantage for businesses. Countless industry-dependent territories across OECD countries have been struggling to adjust to the new capabilities required to be competitive in a digitally transformed economy (OECD, 2021[9]). The situation for many incumbent industrial firms, and, by extension, industrial regions, is complicated further by yet another shift in paradigm, brought upon by the data-driven economy and smart production capabilities. This new phase brings potentially fundamental changes to industry. As such, it is often referred to as the fourth industrial revolution (De Propris and Bailey, 2020[16]). Such change is bound to have its effects beyond manufacturing by affecting the operations of all industrial systems, including many Latin American regional economies. Thus, it is more challenging for incumbent businesses to transition towards the conditions required for competitiveness in today's data-driven context, than it is for new start-ups to adopt these from scratch.

The true challenge in the knowledge and data-driven economy will not come from technology but rather in the ability and skills needed to effectively release the potential of these digital tools (Llinás-Sala, 2020[17]). Even though much attention is given to digital-based advances, human capital will nevertheless be the key to competitiveness. This will increasingly be the case over the coming years in many parts of Latin America as the digital transformation of the entire economy will mean that the demand for such talent will far outweigh its supply (Llinás-Sala, 2020[17]).

In this context, HEIs have a crucial role to play. Not only must universities contribute to the digital transformation of their economy by introducing and developing appropriate technologies and digital tools adapted to the specificities of the local ecosystem, but they must also educate a new generation of digitally savvy graduates who are able to implement and optimise these tools. Similarly, HEIs must be able to provide outreach that will help train or refresh the skillset of workers so that they can better adapt to the consequent change in their work practices. Universities and vocational HEIs should be able to provide advanced digital skills (coding, data analysis) to compete or keep up with other new education providers (such as coding boot camps) that are able to reskill or upskill people in a short amount of time and offer alternative entries to the high technology sector (Navarro and Cathles, 2019[18]). More importantly, HEIs are likely to have a role to play in instigating and driving the digital transition of their ecosystem, as not doing so is likely to contribute to the community being left behind.

Tecnológico de Monterrey has been proactive in this area, as it has been collaborating with community and public administrations to transform perceptions and attitudes towards digitalisation and data technologies. One of the three principal research focuses that Monterrey is pursuing is directly linked to the smart economy and industry 4.0. Tecnológico de Monterrey is also part of an active urban regeneration plan to create the “Distrito TEC” which will become a physical testing ground and pilot base for urban digital development.

Siglo 21 is another HEI in Latin America that has been very proactive in its anticipation of digital changes and its impacts on the locality and its population. The university is active within the community and engages in discussion with many different organisations in relation to technology transition and change, notably the baseline understanding of digitalisation is poor. Siglo 21 sees a role for itself in bringing without everyone’s reach and facilitating access to these technological advancements for industry and the local population. To achieve this, the university works in close collaboration with local chambers of commerce and industrial associations. The goal is to assist the local business community to realise the importance of digitalisation, engage in the adoption of digital tools and improve their digital preparedness.

Case study HEIs’ role in the environmental transition

The third significant macro-level shift that is bound to transform most parts of the economy and society is the environmental transition towards a decarbonised future. Latin America is particularly vulnerable to the effects of climate change, making the region a relevant actor in global mitigation efforts (Climate Transparency, 2019[19]). Many geographical areas of Latin America, important sections of the economy and, consequently, the populations dependent on these industries stand to lose significantly from environmental degradation. The ability of regions to adapt to new environmentally respectful practices and wider changes that are forthcoming because of climate change and resource depletion will be crucial to the competitiveness of many economies throughout Latin America and the livelihoods of many of its inhabitants.

HEIs have an important role to play in this transition. They are often the entry door of knowledge for many regions and as such must become a force for change within their knowledge exchange ecosystem. HEIs have a key role to play in educating their local communities on the threats of climatic change, as well as being an instigator of socio-economic transformation by highlighting and offering opportunities to mitigate and adapt to such change. Not only should HEIs in Latin America be actively prioritising research in their

labs aimed towards facilitating the environmental transition but they should also align their extension and outreach efforts to put the environmental transition at the forefront of their knowledge exchange activities.

Unfortunately, this is still a work in progress in HEIs across OECD member countries and very few HEIs in Latin America are giving significant attention to this transition beyond internal research chairs and labs. This macro-level trend has yet to influence the knowledge exchange efforts of HEIs in Latin America and very little is being done in the way of cross-disciplinary implementation of proactive outreach measures to help prepare the HEIs' local areas of influence. One possible exception comes from the Javeriana, which has set environmental projects as one of three areas of priority in their latest wave of nationally funded (via the General Royalties System, *Sistema General de Regalías*).

HEIs' role in the transition towards an entrepreneurial society

For most of the 20th century, local geographies and their populations played only a marginal role for HEIs. The dominant influences on HEIs operating within their locality, at the time, came from the leading economic perceptions including that of a capital-driven economy (Solow, 1956[20]), economies of agglomeration (Fujita and Thisse, 1996[21]) or knowledge as a factor of production (Romer, 1986[2]). For HEIs, the local community was widely perceived as having only a subordinate contribution to make. This remained the case even with the rise of the entrepreneurial university in recent decades, which added the promotion of knowledge spill-overs to the research and education roles of universities.

However, a form of entrepreneurial society is quickly developing in most OECD economies that offers a new institutional role for HEIs as a leader, promoter and catalyst for this entrepreneurially driven society (Audretsch, 2012[22]). Beyond narrow technology transfer, universities in an entrepreneurial society must make contributing and providing leadership for creating entrepreneurial thinking, actions, institutions and entrepreneurial capital within their local communities a core part of their mandate. This cultural transition, which influences the attitudes and actions of people, organisations and administrations, may be challenged by the traditionalism that often marks communities and their institutions. The scope of action of the university in an entrepreneurial society, therefore, goes beyond its walls and beyond economic considerations, by becoming an active generator of entrepreneurship capital and values, which enhances and celebrates creativity and freedom of inquiry, resourcefulness, the sense of initiative and greater tolerance to ambiguity, innovation and change.

Rather than focused on the creation of new business ventures, the entrepreneurial society is based on a behavioural view of entrepreneurship that can be infused into all aspects of society. From entrepreneurial public administrations, business sectors and civil activism, entrepreneurship then becomes multifunctional and can be oriented to serve better the purpose and vision of the community at large.

As with the other macro-level transitions mentioned, HEIs have an important role to play as facilitators of the transition towards an entrepreneurially driven society. HEI should therefore give themselves the mandate to contribute and provide leadership for creating entrepreneurial thinking, actions, institutions and entrepreneurial capital within their knowledge exchange ecosystems. This mandate can only be effectively carried out with the establishment of a properly adapted and flowing knowledge exchange capacity.

This chapter has already noted many different examples of initiatives and ways in which Latin American HEIs are often using innovative measures that serve to contribute to the entrepreneurial transition of society. Not only are HEIs in Latin America active in entrepreneurial education within and outside its walls (see chapter 2), but universities such as the UFSCar have given themselves the task of training innovative leaders. Many Latin American HEIs, including the Siglo 21, are actively involved in inspiring communities, stimulating entrepreneurial mind-sets and as organisers of entrepreneurial capacity-building events such as Feria 21, bioHakathon and other open innovation events, which spur many new business and social initiatives.

Similarly, UTEC is determined to counter the lack of social initiatives in Uruguay and change the cultural barriers towards innovation. Through education, extension and outreach, the university is aiming to reverse the strong risk aversion amongst the Uruguayan population and include more women in the entrepreneurship and innovation processes. UTEC is leading efforts to lobby the public administration for a long-term political plan to support and promote an entrepreneurial society based on technology and innovation in Uruguay.

In the United States, agriculture and mechanical colleges, often better known as land-grant universities, were provided by the Morrill Act of 1862, which granted land to each state to be used in perpetuity to fund agricultural and mechanical colleges that benefitted local communities in ways that went beyond research and education. Extension services in many instances became intrinsically part of the essence of the communities in the universities' areas of influence. These have evolved over time and many have seen their extension role diluted with greater priorities allocated to economic transfers and spin-offs. However, examples such as the University of Missouri have kept their extension role alive. These in many instances have evolved in order to adopt an increasing orientation towards entrepreneurship capital building and stimulating the values of an entrepreneurial society.

The way forward: Some considerations to enhance knowledge exchange activities in Latin-American universities

In conclusion, the richness of experiences and alternative approaches to knowledge exchange in a selection of Latin America HEIs, as presented in this chapter, offers many lessons to be learnt that can serve to guide HEIs across all OECD member countries. This is especially pertinent as several HEIs are currently transitioning their knowledge exchange objectives and methods to match better the changing values of society. The resulting shift to a wider definition of knowledge transfer for HEIs involves multi-participant exchange and a pluri-directional flow of knowledge and applied innovation. The institutional, academic, legislative, historic and cultural variety across Latin American HEIs has led to the implementation of a rich diversity of different knowledge exchange trajectories.

The analysed Latin American HEIs offer many clues as to the multiplicity of approaches that can be used but also the obstacles that can hamper such efforts. Such experience can eventually inspire future development paths for other HEIs leading them to become greater actors of change and transformation within their knowledge exchange ecosystems, especially at the current time, when the countries are looking for clues to revive economic growth after the pandemic.

Recovery will be underpinned by domestic demand and economic diversification. Disruptions in global value chains caused by the pandemic have impacted many sectors and signal the need for more economic diversification and less dependency on international trade. For Latin America, export dependency for manufacturing and high-technology goods has reached its limits. China, the United States and Europe are decreasing their level of interdependence and openness to international trade. Disruptions in international global value chains during the pandemic also underlined the limits of economic interdependence across the production chain. This has accelerated the creation of trade amongst regional partners, creating different hubs across the globe (North America, East and South-East Asia, Europe) (OECD et al., 2021[23]).

There is an opportunity for HEIs to support affected industries and pave the way for new sectors, by leveraging their knowledge transfer strategies. Latin America can take advantage of this current landscape to move forward with regional integration and a diversified productive strategy whereby large firms and SMEs will need to reinvent their production lines and find more linkages with the local ecosystem. Universities can be important partners for firms, providing them with digital and technology capabilities and innovative solutions.

In addition, efforts to promote entrepreneurship should take into account the need to reduce disparities and generate social cohesion in Latin America and sustainable recovery from COVID-19 will require adopting measures that benefit society as a whole. Universities should also pay attention not to exacerbate the digital and social divides in order to continue providing quality education to everyone and not just the elite.

More specifically, universities across the region could consider the following:

- The legal framework to sustain intellectual property should be improved both at the university level and at the national one. Often, national legislation systems forbid researchers and professors in public to be partners in a start-up, as this would conflict with their status as public employees. Furthermore, based on interviews with representatives from case study universities, technological transfer offices are understaffed and, in particular, would need legal advice to offer support for patent creation and licensing.
- When possible, universities should increase resources dedicated to knowledge transfer and activities, and provide a dedicated funding stream to avoid depending on public funding. This could be accompanied by an increased allocation of stable public funding allocated to universities. Such funding would enable universities to engage in more long-term collaborative projects with different stakeholders, particularly the business sector.
- Develop a system of evaluation of impact, to be used as a learning instrument to understand how to improve the performance of entrepreneurial universities in terms of innovation and inclusion. Most universities are measuring their knowledge transfer activities using knowledge performance indicators and output-based indicators (such as number of patents, licenses and spin-offs). Yet universities reported that a lack of a national evaluation framework on knowledge exchange hindered their ability to use harmonised indicators at a country level.

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Notes

[1] For more information, see https://uspdigital.usp.br/anuario/AnuarioControle.

[2] Adapting to market needs also has its limits: there is an inherent risk of limiting novel lines of research or a risk of replicating technical services that could be offered by other market players.

[3] A place-responsive strategy refers to a strategy that responds to the needs of a local community in a given territory.

[4] See HEInnovate series of national reports from Europe at https://www.oecd.org/cfe/smes/geo-higher-education.htm

[5] For more information, see www.dnp.gov.co.

[6] For more information, see https://www.ing.uc.cl/.

Part II A review of selected universities' entrepreneurial and innovation activities

4 Case studies in Mexico

This chapter analyses initiatives conducted by Tecnológico de Monterrey and University Anahuac to support entrepreneurship education, and knowledge transfer. It also studies the connections that the universities have generated with external stakeholders through these activities in the ecosystem of Mexico City and beyond.

Tecnológico de Monterrey, Mexico

Tecnológico de Monterrey is a private non-profit university with 26 campuses throughout the country. Entrepreneurship education and support are a core part of the university's curriculum, and several programmes are in place to support venture creation (66% of students every year attend an entrepreneurship programme). Through its 21 business incubators and 11 technology parks, the institute is a central actor in the ecosystem attracting local entrepreneurs, small- and medium-sized enterprises (SMEs), public and private investors.

Entrepreneurship education

Tecnológico de Monterrey has comprehensive curricular coverage of entrepreneurship education activities. For undergraduate students, it offers:

- Courses designed to teach entrepreneurial skills (managing uncertainty, fostering resilience) which are open to students on a voluntary basis.
- Mandatory courses on entrepreneurship during the third year of a bachelor's degree for all students through an experimental-based approach with lean start-up methodology[1] (creating a minimum viable product for the market). Many students who take this course are invited to the business incubator.

For graduate/master's students, the university offers:

- A very successful Master of Business Administration (MBA) in Entrepreneurship and Innovation, with many international students.
- For Doctor of Philosophy (PhD) students, there is a programme to link research to the market through courses/workshops.

The university also organises over 300 extracurricular activities such as hackathons that involve alumni, boot camp for the arts, some programmes targeted to a specific region. The university also organises national events such as the IncMonterrey entrepreneurial festival.

Connection with the ecosystem driven by entrepreneurship education

The university is highly connected to the ecosystem. It helps train entrepreneurs and interacts with non-profit organisations, the investor community and the government at both the federal and state levels.

The Eugenio Garza Lagüera Entrepreneurship Institute (*Instituto de Emprendimiento Eugenio Garza Lagüera*) runs the IncMonterrey as a multifaceted initiative, which aims to connect entrepreneurs, leaders, investors, SMEs, students and academics (Tecnológico de Monterrey, 2021[1]). It offers an accelerator programme for start-ups, a prototype-development programme for researchers and entrepreneurs, and launches different challenges for "enthusiasts". The INCmty festival is an event that gathers investors, entrepreneurs, researchers and students who want to network and generate or promote an entrepreneurial project or help their business grow. INCmty also supports over 250 entrepreneurship initiatives per year and receives support from private investors such as Santander Bank.

Tecnológico de Monterrey is also working with the Massachusetts Institute of Technology (MIT) Regional Entrepreneurship Acceleration Program (REAP) in the state of Monterrey. The MIT REAP helps to develop the venture capital industry and increase efforts to support local entrepreneurship. The initiative brings together Tecnológico de Monterrey, the state government and venture capital firms. There are similar incubation programmes present on all campuses, where incubators are brought together, and entrepreneurs benefit from a strong network of mentors throughout the country. One acceleration programme located in Chihuahua is open to start-ups from anywhere in the world.

The university also has entrepreneurship and innovation parks (technology parks). Since 2002, more than 4 000 start-ups have graduated and intake into the parks is made up of companies from incubators and companies from the wider ecosystem. The most successful park is located in Chihuahua. Technology parks attract governments and companies looking to invest in start-ups. From an organisational perspective, the parks are funded by private investors and managed by the university.

Impact of the COVID-19 pandemic on entrepreneurship education

Shifting to virtual delivery was not a problem for the university as it was already conducting a number of activities online. Some of this knowledge could be transferred through the development of a virtual programme to help entrepreneurs, called "SOS programmes", which aimed to help SMEs digitalise their processes. Over the course of six weeks, the university's programme helped SMEs to develop business models to transition online through Zoom courses delivered by expert instructors and faculty, digital marketing consulting and networking sessions between SMEs and with sponsoring companies. This programme was free of charge as students and professors volunteered to help these SMEs, delivering eight-session programmes per cycle. The programme started in Monterrey and has now been expanded across the country helping more than 800 start-ups.

Remaining challenges related to entrepreneurship education

The university is looking to improve further its entrepreneurship education activities by undertaking more of such activities with the community, ensuring the use of open innovation methodologies for increased impact. Internally, in order to address the challenge of mainstreaming entrepreneurship across all faculties, the university will focus efforts on opening internal conversations around the model of entrepreneurship. Finally, there will be a renewed focus on the part of the university to attract more seed funding to support entrepreneurs.

Knowledge transfer strategy

During the interviews, stakeholders reported that the governance of the university is highly pragmatic and entrepreneurial. Knowledge transfer is mentioned in several strategic documents of the university including the most recent strategic plan for 2025 and the vision for 2030. Knowledge transfer includes three components:

- **Technology transfer and licensing, start-up creation**: The classic knowledge transfer strategy.
- **Entrepreneurship promotion**: Promoting entrepreneurial skills and offering incubation services to young graduates.
- **Continuous education and consulting**: Several professors and experts working at the university are teaching dedicated courses on improving the productivity of companies, providing consulting services or advising companies on research or new market opportunities. The university has created the figure of the "extension professor" who interacts on a frequent basis with companies for education and research activities. The university also provides consulting services to other universities in the Latin-American region on how to develop continuous education.

The institute was founded in 1946, by a group of companies led by MIT alumni, who understood the influence of MIT on the productive apparatus of the country. After 15 years, it has gained success in the region of Monterrey and has seen its campuses multiply since then, with several campuses located throughout the country. The co-ordination of these activities takes place at the central level and is subsequently adapted for every region. At times, the university's management board has taken the initiative to open a campus to take advantage of a local cluster (such as in Mexico City) and in others, the university responds to the demand of local entrepreneurs who offer financial support to open a new campus (Puebla, Querétaro).

The programmes and strategic knowledge transfer priorities are defined centrally within the vice-rectory for continuous education, the vice-rectory for research and knowledge transfer, and then each campus adapts the strategy to the local conditions, to the request of the city or the local companies. Every incubator is tailored to respond to the needs of local companies. For example, the campus located in Mexico City has a technology transfer strategy oriented to the needs of the technological companies. The north of Mexico is very industrial whereas the south is rich in natural resources and the local campuses adapt to the local needs.

Connection with the ecosystem driven by knowledge transfer activities

The university plays a significant role within its surrounding ecosystem. For example, the DistritoTec initiative in Monterrey, led by the Tecnológico de Monterrey– Campus Monterrey, involves the transformation of the 20-kilometre urban radius surrounding the campus as a comprehensive "innovation district", introducing an economic model supported by high technology firms and innovation-based activities, together with infrastructure designed for a high quality of life. The ambition is for this campus to become a source of urban regeneration. The university has also helped the government with the creation of 14 technological parks over the past 14 years. Additionally, the university has undertaken a number of other regional initiatives:

- The campus of Querétaro works closely with the Aerospace Cluster in the state.
- The Mexico City campus works with the health and bio-technology sectors.
- Chihuahua campus' technology park (Orion) is a core element of the state's innovation strategy.

Incentives for staff to engage in knowledge transfer activities

The university has introduced technology transfer indicators, which have greatly contributed to the creation of a culture of transfer. At the end of the 1990s, the intellectual production system was poor but a system to monitor patent development was progressively put in place, culminating with the university having the most patents in Mexico by 2004.

The university has also put in place incentives for professors to carry out knowledge transfer activities through the creation of the "extension professor or consultant" status for professors who conduct activities in knowledge transfer spaces. This role has been designed to be very lucrative. Other professional categories include:

- The entrepreneurial professor, whose workload is to be partially entrepreneurial. This position is more difficult to fill as professors are expected to demonstrate results and successful ventures.
- The research professor focused on carrying out research activities that are financed by the university or by external partners.
- The teaching professor leads mainly on teaching activities with potentially some research alongside these.

Professors at the university are asked to choose one of these career paths and are evaluated according to the metrics attributed to their chosen career path.

Remaining challenges related to knowledge transfer activities

The university reports that government funding for research has fluctuated over recent periods. The previous national government provided strong financial support for research activities carried out by universities. Local states are looking to fill some of this gap by putting in place strategies to increase interaction and co-operation. There are also regulatory procedures in place, which are not favourable to research activities and technology development.

Anahuac University, Mexico

The university is spread across two campuses in the state of Mexico and is made up of five faculties. Entrepreneurship and leadership priorities are set out in strategic documents and the university aims to become a leader in activities in the field of entrepreneurship activities are largely focused within the Faculty of Economics, however other faculties are also engaged in these activities. The Faculty of Economics, through the entrepreneurship centre Centro de Emprendimiento Anahuac has developed two approaches to supporting entrepreneurship:

- Entrepreneurship programmes and extracurricular activities.
- Services to external parties (entrepreneurs, SMEs) through its accelerators and incubator.

Entrepreneurship education

The university places significant emphasis on practice-based learning; as such, courses are heavily focused on learning by doing, encouraging skills such as managing uncertainty and listening to end users. The belief is that these skills and practices will be of use to all students, regardless of whether they pursue careers in entrepreneurship or not.

- All undergraduate students across all faculties are required to take an entrepreneurship innovation course. This practical course encourages students to interact with real customers. In 2022, 2 new core courses for second-year students will be added:
  - Entrepreneurship mind-set development (soft skills, teamwork).
  - Solution-finding (through the lean start-up methodology).
- Graduate engineering schools also offer entrepreneurship courses and training on intellectual property development is being set-up for students pursuing PhDs. They have been working with Mexico's National Autonomous University (UNAM), a large public university, to run a training programme for researchers, which aims to raise awareness of the importance of market validation. The training was developed by US professors and I-Corps trainers, and the joint venture has received funding from the government's science agency.

The university also offers entrepreneurship programmes for secondary and primary school students, including a programme for 6–12-year-olds, focused on age-appropriate problem solving, in alliance with the platform micochinito.com.

In the realm of extracurricular activities, Anahuac University organises competitions in partnership with universities in Canada and encourages students to take part in national competitions such as Premio Santander. Prior to the COVID-19 pandemic, the university's architecture school hosted the FabLabs boot camp, which conducted a competition bringing together students and external partners.

Connection with the ecosystem driven by entrepreneurship education

The university has incubation services that support students with mentors and then provide students with a methodology and business model to implement. This is open to all students. Both the incubator and the accelerator are in the Faculty of Economics and co-ordinate their activities together. The incubator services aim to generate start-ups, but the focus is also on educating students, alumni and professors. Some of the students create start-ups and some do not. Students, alumni and professors who participate in the incubator are offered a scholarship.

The accelerator has an acceleration programme (using the lean start-up methodology) to scale up the process for anyone who may need their services (students, alumni and entrepreneurs). This programme to scale the business proposal is free; however, the training and consulting services for start-ups do incur

a cost. In addition, they organise many webinars/workshops for entrepreneurs. The webinars cover cybersecurity for cloud services and investment studied through a gender lens. Public funding and some other sources finance the accelerator, and they have three big projects with the Inter-American Development Bank (IDB) and an alliance with the Mexican Association of Private Equity and Venture Capital Funds companies that fund the accelerator for specific projects. However, it is not funded by venture capital funds as these usually look for more advanced companies with an effective business model. The accelerator has an alliance with Santander Bank to train 300 SMEs free during the pandemic and through different webinars, and mentorship programmes for entrepreneurship. It also has an alliance with the agency that works with entrepreneurs in the government (bilateral relationship with the government) and local and federal government.

Impact of the COVID-19 pandemic on entrepreneurship education

During the pandemic, the university has trained lecturers on how to use Zoom, to support the smooth transition to remote education. The accelerator has suffered due to less but much more targeted funding, as companies came to them with specific problems.

The pandemic has also been a positive force to think outside the box. For the majority of SMEs, it was a disaster, but some SMEs grew at such a pace that they did not know what to do with their growth. The university reported that it has been very interesting to work with these SMEs because of the completely different challenges they were facing. Courses for SMEs on emotional intelligence and stress management have now been developed by the university because of the effects of the pandemic.

Remaining challenges related to entrepreneurship education

As seen in other Latin American HEIs, intellectual property management continues to be a challenging area as professors are employees and, ultimately, it is down to the university to define who the owner of their invention is. In the area of teaching, professors are required to have PhDs in order to be accredited, with only a certain percentage of external practitioners allowed to teach outside of this process, leaving little room for non-PhD private-sector employees or entrepreneurs to teach.

The university is developing a number of next steps in order to improve its evaluation practices and measurement of entrepreneurship education approaches. First, participating clients and students will evaluate the accelerator. In addition to this, metrics are in development, which will include key performance indicators to assess how many projects come to the accelerator and their outcomes.

- Each semester, around 1 500 students across both campuses attend entrepreneurship courses according to a report evaluating the implementation of entrepreneurship activities.
- An entrepreneurship committee has recently been established. The Faculty of Business and Economics runs it with representation from other faculties including engineering and architecture. The committee produces a report on entrepreneurship in the university, leveraging a number of performance indicators.

Knowledge transfer strategy

The institutional strategic plan states that the university's ambition is to strengthen the research team and the research model through social impact, with one means of achieving it the implementation of a strategy to promote knowledge transfer. It also highlights ambitions to strengthen strategic alliances and work towards becoming a productive, public and social environment organisation (Anahuac University, 2021[2]). The university is looking to consolidate its position in the metropolitan area of Mexico City by providing an education offer to undergraduates and graduates, as well as developing continuous education and collaborating with local businesses.

In terms of organisational structure, the university has a research department, which is awarded a budget against which it plans its knowledge transfer and research activities. This department sets guidelines and incentives for researchers. The business accelerator and the Anahuac Business Development Institute (IDEA) also carry out transfer activities.

Connection with the ecosystem driven by knowledge transfer activities

The Business and Economics School Accelerator, AcelerA, has participated in applied research projects with private institutions. Through these projects, AcelerA and IDEA have contributed to the spread of corporate social responsibility practices, specifically in SMEs, strengthening the crowdfunding ecosystem in Mexico and teaching the lean start-up methodology to trainers and entrepreneurs nationwide, among others.

IDEA also funds projects supporting knowledge transfer activities, such as a special book collection "*Negocios para la paz*" published in collaboration with a local publisher (Edicion Limusa) (Anahuac University, 2020[3]).

Incentives for staff to engage in knowledge transfer activities

Performance evaluation of the university's academics is carried out by the research department and considers patent generation as an indicator. Academics receive financial incentives when engaging in patent-generating and related activities and collaborations.

Remaining challenges related to knowledge transfer activities

University stakeholders reported several challenges related to knowledge transfer activities. In order to develop a research development project with enough financial support for knowledge transfer to occur, most of the time, the university is required to complete collaboration agreements with universities or members of NGOs. These instruments are bureaucratic and time-consuming. In the area of financed projects, there are a number of barriers related to current tax requirements: these impede knowledge transfers into governmental and public environments.

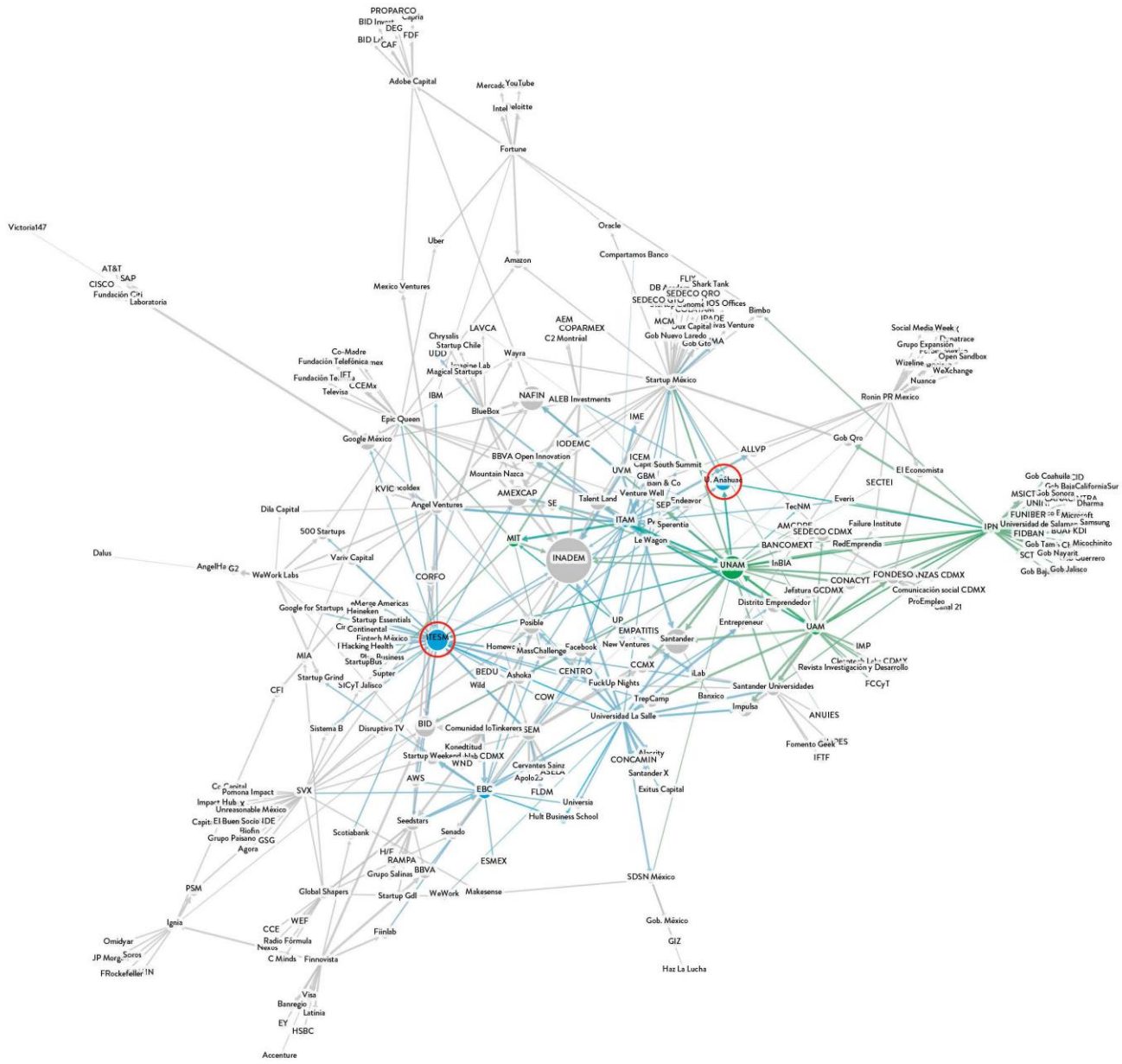
Stakeholders also reported limited government support for research activities in private institutions. The regulatory landscape presents a number of barriers in the form of laws and normative regulations, which affect knowledge activities in the social, business and public sectors. These regulations make it difficult for universities to collaborate, for instance, acceleration and incubation centres within a university face legal and fiscal obstacles due to current outsourcing regulation, which inhibits, in some way, professors' consultancy activities within an enterprise.

Ecosystem analysis of Mexico City and the role of Tecnológico de Monterrey and Anahuac University

As evidenced by the analysis carried out by Global Ecosystem Dynamics, in collaboration with MIT D-Lab and supported by Santander Universidades on the innovation-driven entrepreneurial economic ecosystems of Mexico City, Anahuac University and Tecnológico de Monterrey are important actors within the Mexico City ecosystem (see Figure 4.1).

UNAM and Tecnológico de Monterrey are the universities that show the highest weight in degree and connectivity to other actors. This weight and influence position them as *gravitational centres* greatly contributing to the development of the structure of the economic ecosystem.[2] While not a gravitational centre, Anahuac University was the third most mentioned university in the ecosystem.

Figure 4.1. Ecosystem analysis of Mexico City and the role of the Tecnológico de Monterrey and Anahuac University



Note: This figure provides a visualisation of the collaborations between actors of the economic ecosystem of Mexico City with a node size dependent on the number of mentions by other participants and the strength of said mentions (weighted in degree), highlighting in blue the universities categorised as Enablers, those focusing primarily on education and capacity building, and in green the universities categorised as Knowledge Generators, those focusing primarily on research and the development of new technologies. These visualisations, along with the interpretation of each node's centrality metrics, allow for the analysis of the positioning of universities mentioned within their innovation-driven entrepreneurial economic ecosystem.

There could be a dissonance between what the university sees as its presence in the ecosystem and what this independent mapping exercise finds. Data collection for each ecosystem was conducted by first identifying as many actors as possible through desk research, which were in turn invited to attend a workshop on strengthening innovation-driven entrepreneurial economic ecosystems and fill an online survey regarding their social dynamics with other actors.

Source: Tedesco, M. (2022[4]), "How and why to study collaboration at the level of economic ecosystems", *D-Lab Working Papers: NDIR*, MIT D-Lab.

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Tedesco, M. (2022), "How and why to study collaboration at the level of economic ecosystems", *D-Lab Working Papers: NDIR*, MIT D-Lab. [4]

Notes

[1] It is a methodology to launching a venture creation that draws on rounds of experimentation or user feedback to create a business plan or to develop a new product or service

[2] Gravitational centres refer to the nodes (actors) that, due to their centrality and influence in the ecosystem (quantity and quality of their collaborations), attract a large number of other nodes through their relationships, strengthening the dynamics of collaboration within the same ecosystem.

5 Case studies in Colombia

This chapter analyses efforts conducted by the Pontifical Xavierian University (Javeriana), National University of Colombia (at Manizales), and ICESI University to support entrepreneurship education, and knowledge transfer. It also studies the connections that the universities have generated with external stakeholders through these activities in the ecosystems of Bogotá, Cali and beyond.

The Pontifical Xavierian University (Javeriana), Colombia

Founded in 1632, as the first accredited institution, the university is private and run by the Society of Jesus. The university has two campuses in Bogotá and Cali and has 22 516 students, 2 000 professors, 235 programmes (13 doctoral programmes, 75 master's degrees, 100 research groups accredited by the Ministry of Science, licensing of 5 technologies 10 patents, 82 patents applied). The third mission and service to the community is an extremely important pillar for the university: it is a key player in local and regional development. Entrepreneurship was included as a strategic priority ten years ago; it is now one of the main objectives of the university.

Entrepreneurship education

The Javeriana Center for Entrepreneurship leads all entrepreneurship activities and provides professional development opportunities for all university students. The centre promotes entrepreneurial culture and development of entrepreneurial skills (incubation and pre-incubation programmes), supports programmes across several faculties, develops entrepreneurial skills workshops and supports the integration of entrepreneurs within national and regional entrepreneurship ecosystems (i.e., to continue developing their entrepreneurial ventures). The entrepreneurship centre has an incubator and currently does not rule out the possibility of having an accelerator, noting there are already a few accelerators in the Bogotá ecosystem in addition to governmental support for entrepreneurs through the *Emprender* fund.

Other initiatives include an entrepreneurship and innovation academic programme, which mentors students through entrepreneurship and innovation projects. The university has a Master of Business Administration (MBA) in Business Financing and courses on intellectual property for scientific careers.

The university's Design Factory leads the development of graduate prototypes, supporting students in the development of a project. The Design Factory also provides consultancy services to companies. This is a bi-directional relationship, as companies within the ecosystem assign challenges to the students. Extracurricular activities include Design Week, and the entrepreneurship centre organises the "Fall in love with problems" week (a hackathon).

Connection with the ecosystem driven by entrepreneurship education

The Centre for Entrepreneurship and Design Factory engage with the government, companies and accelerators. The Innovation Directorate is also well connected to the ecosystem and centralises all research processes to be transformed into innovation, deals with financing for the maturation and commercialisation of technologies and proofs of concept, and generates integration mechanisms with other units for knowledge transfer. These activities have culminated in the Innovation Directorate obtaining a license for a phytopharmaceutical for breast cancer, for example.

Impact of the COVID-19 pandemic on entrepreneurship education

The pandemic had a negative impact on teamwork due to the lack of face-to-face interaction between students. To stimulate this interaction, the Design Factory collaborated in designing respirator projects for hospital patients. Shifting to online activities was also beneficial as it allowed students to have access to international tutors as part of the activities of the entrepreneurship centre; however, opportunities for networking were limited.

Remaining challenges related to entrepreneurship education

The university has identified a number of remaining challenges in the area of entrepreneurship education. There are barriers in engaging entrepreneurs from the social sciences and the university aspires to focus

efforts on bringing together different disciplines. The university is also trying to strike a balance between driving technological innovation whilst ensuring social innovation is created alongside. Finally, the university has identified that entrepreneurs involved in pre-incubation stages sometimes did not have basic needs met. In response, it will be focusing on attracting capital for these pre-incubation early stages.

Knowledge transfer strategy

The knowledge transfer strategy of the Javeriana is a transversal activity. According to the Javeriana's mission, the university works to promote the development of the country, contributing to innovation through creativity, knowledge exchange and technology transfer.

To put in place this strategy, a technology transfer office (TTO) was created in 2012 under the umbrella of the vice presidency of research. One of the goals of the technology transfer office is to promote alignment between the industry and the academy to create integrated solutions that address the needs or challenges that enterprises are dealing with today. The TTO has been also very active in house, working to educate the whole university community, and with different units of the university, researchers, students as well as the administrative team.

The university has a budget that is assigned annually to the vice presidency of research and particularly to the TTO. From this budget, it funded the proof-of-concept call for applications, whilst another part of the budget is dedicated to the TTO's knowledge exchange goals.

Connection with the ecosystem driven by knowledge transfer activities

The university has been working with the government on a national smart specialisation strategy that looks to develop capabilities and technologies in specific areas such as education, health, information and communications technologies, cultural industries and others. The partnership has supported the creation of the Internet of things and Big Data centre, comprising large firms, government and other universities.

Furthermore, the university, through the Innovation Directorate, was one of the 25 winners of iNNpulsaTEC 2021, a government programme put in place to help small companies and start-ups develop business growth capabilities. Through the programme, the university supported companies such as Mantel LTDA (a telecommunication company) and CIEL SAS (manufacturing) with the identification of technological needs, development and support in the implementation of action plans focused on strengthening their capabilities.

The university also has a number of professors who work across different industries; this supports a university-wide understanding of the "real world" needs and challenges facing businesses, with the aim of developing tailored solutions. The university also includes students in its transfer activities, for example through the project *link you*, funded by the European Commission (EC), which aims to strengthen the capabilities of students in the fields of innovation, creativity and entrepreneurship.

Incentives for staff to engage in knowledge transfer activities

The university recognises the efforts of researchers through its teacher regulation framework. An intellectual property policy is also in place, which attributes a percentage of royalties to the researcher if the technology transfer process has been successfully completed.

Remaining challenges related to knowledge transfer activities

Collaboration with external stakeholders has proven to be difficult at times because the national innovation system is in the process of development. National legislation and public policies on innovation are still recent, for instance the Science Technology and Innovation National Policy (2021), or the Intellectual Property National Policy (2021). In addition, more legislation or regulation is needed to help HEIs be more

innovative and to push research and development activities. There is also a need for more financial resources for actors within the innovation ecosystem such as TTOs, research innovations centres or universities. Resources are often project-based, and it is sometimes difficult to keep a continuous stream of projects to support the cost of running the TTO.

National University of Colombia (UNAL) at Manizales

This public university was established 150 years ago and has nine campuses. The Manizales campus hosts a number of different faculties including the science, engineering, architecture and industrial doctorates and has 4 250 students. Each of the nine campuses has incorporated a strategy for entrepreneurship.

Entrepreneurship education

Entrepreneurship and innovation courses are optional for students; however, the undergraduate Faculty of Economics has a compulsory module on “cultural entrepreneurship”. Furthermore, the Faculty of Engineering offers courses on intellectual property, patents and licenses, which are compulsory. Other faculties offer electives and entrepreneurship courses. There is no central co-ordination of the aforementioned courses; each faculty develops its curriculum. However, a project is in the pipeline to set up a unique “chair of entrepreneurship” role. Finally, students are offered workshops on setting up a business, which include negotiation training and business identification.

Connection with the ecosystem driven by entrepreneurship education

The university plays an active role in supporting the ecosystem by, for instance, acting as a host for a support programme for entrepreneurs, which is delivered in conjunction with the chamber of commerce. The Manizales campus also has a science and innovation park, which offers an incubator for students, and professors that already have a minimum viable product. The university offers these entrepreneurs a scholarship as well as continued mentorship and support. There are currently 115 companies engaged with the incubator.

Furthermore, the university has a support offer tailored to industry, facilitated by the science park and the TTO. This includes a sector-specific mechanism for linking research groups with companies in the region of Manizales in the metallurgy-manufacturing cluster, with the objective of understanding specific problems in order to develop solutions and technologies such as the creation of submarines and the development of new construction materials for seismic zones.

The university is also home to support programmes such as *Manizales Mas*, a city programme for entrepreneurship development. The programme is delivered in conjunction with Babson College as a partner. This venture has had limited success, however, due to a lack of consideration of the characteristics of the region of Manizales or the level of industrialisation of the region. Finally, the university participates in Santander’s RedEmprendia initiative, a network of universities, which promote innovation and entrepreneurship practice.

Impact of the COVID-19 pandemic on entrepreneurship education

Students experienced some issues in accessing virtual classes and incubation spaces; however, services are gradually reverting to the usual state. The innovation park, on the other hand, is continuing to deliver its activities virtually. These include counselling support for entrepreneurs and virtual resilience workshops for entrepreneurs and students.

Knowledge transfer strategy

The university encourages a continuous relationship with the business community. The UNAL Manizales campus has a clear mission and vision for its knowledge transfer activities, through which the university aims to contribute to solving global, national, regional and local problems and interacts with a range of stakeholders to transfer knowledge. It has one knowledge transfer office the Directorate of Innovation (Dirección de Innovación) responsible for research, knowledge transfer and extension activities. This office aims to connect academic and research work with local and regional stakeholders (UNAL, 2022[1]).

Connection with the ecosystem driven by knowledge transfer activities

The university connects with stakeholders in many ways. It offers:

- Consulting and advisory services as well as auditing and evaluation of programmes and policies.
- Continuous education programmes for professionals.
- Programmes for students, including an internship programme. Students also provide services to the community such as legal assistance or psychological support.
- Social extension. The university finances programme and projects of high social impact, which strengthen links with various sectors of society in search of social inclusion of vulnerable communities.
- International co-operation projects (ICP). Through academic, scientific, cultural and sports co-operation activities, the university contributes to the exchange and transfer of knowledge and skills with other countries.

The university also collaborates with the industry in the following sectors: health and care, biotechnology, information and communication technology, agro-industry and energy, among others. In addition, the university collaborates with regional, national and international universities and centres devoted to research, innovation and transfer technologies. Local and business actors carry out some teaching and research activities. However, stakeholders reported during the interview process that they wish to have more professionals involved.

Incentives for staff to engage in knowledge transfer activities

All staff aims to be involved in collaborating with external stakeholders. The research and extension office promotes meetings and interactions with the business community to facilitate knowledge transfer. The institution promotes wage increases regarding knowledge transfer activities.

Remaining challenges related to knowledge transfer activities

The most significant obstacle is to change the industrial and business community culture concerning the research and innovative temporal pipelines. They want cheap and fast solutions. To overcome the obstacles, some public regulations should be revised concerning spin-off and patent procedures.

ICESI University

ICESI is a young, private university in Colombia, created by the business community. It started as a business school and evolved into a university by opening up new faculties in areas such as health and social science. It is a medium-sized HEI with 7 000 students on one campus.

Entrepreneurship education

In 1995, ICESI created the Entrepreneurship Development Centre (CDEE), which sits in the business school but offers courses to students of all faculties. There are mandatory entrepreneurship courses for undergraduate business and engineering students, in which they gain practical hands-on experience in start-up creation and ideation. The business school also runs an MBA and a new master's programme in entrepreneurship. To teach these courses, ICESI has a team of professors who are completing their PhD in entrepreneurship, who can train and mentor students.

In addition, the CDEE runs a new programme for researchers and PhD students to gain entrepreneurial skills and understand the pace of the market. These courses are meant to change academics' mind-sets and find market-application solutions to their research.

The university reported that these entrepreneurial activities had an important impact on students: according to their research, 70% of their alumni have started an entrepreneurial venture after graduating and 42% have conducted a business innovation.

Connection with the ecosystem driven by entrepreneurship education

ICESI University connects with other actors in the ecosystem through entrepreneurial activities, such as the "*Empredeton"*, a workshop run by iNNpulsa, the national agency supporting entrepreneurship. ICESI encourages its students to participate in this workshop, where they can meet other aspiring entrepreneurs and gain more knowledge about entrepreneurship (iNNpulsa Colombia, 2019[2]). The university's entrepreneurship centre has also created alliances with other centres in the region of Cali (Cauca Valley) and works on innovation programmes with the business community. It participates in a leadership programme in the region Leaders of the Pacific (*lideres del pacifico*), financed by the United States Agency for International Development (USAID) and which aims to train new entrepreneurial leaders in the region. More importantly, the CDEE offers incubation services to entrepreneurs in Cali who are not university students.

Impact of the COVID-19 pandemic on entrepreneurship education

ICESI reported during the interview process that it managed the transition to online activities in a rapid manner. The incubation programme was not closed and continued online. Some small- and medium-sized enterprises (SMEs) and entrepreneurs struggled to adapt, but most accelerated their transition to the digitalisation of their activities. Their master's programmes and courses on entrepreneurship were also provided online throughout the pandemic.

Remaining challenges related to entrepreneurship education

During the interviews, stakeholders reported that entrepreneurs were facing some challenges in understanding how the universities and the government could help them through their journey. Since government institutions often change, there are no stable interlocutors, which make it difficult to maintain a stable partnership.

Knowledge transfer strategy

The university has two specific strategic objectives that foster knowledge exchange activities:

- Increase the impact and relevance of the university research.
- Contribute to social inclusion, economic development and social care for the environment.

The university has put in place a specialised unit responsible for accompanying the strategic management of research and technology transfer. Originally a business school, the university opened a research department ten years ago and has been doing research that responds to the needs of the firms located in the ecosystem (specialising in biotechnology, environmental sustainability and circular economy). Every year the university organises an internal call to finance knowledge transfer proposals. All university researchers can participate and submit their proposals to the university, which evaluates the project following specific criteria (type of collaboration/research, recipient [NGOs, firms], compliance with United Nations Sustainable Development Goals).

Connection with the ecosystem driven by knowledge transfer activities

ICESI has its main area of influence in southwest Colombia; this includes the Pacific region and the city of Cali. As a university with different faculties, specialised centres and offices, several activities are carried out with different social communities and private or public entities. For instance, ICESI has a close relationship with *Fundación Valle del Lili* in Cali, considered one of the best hospitals in Latin America, and the ICESI Faculty of Health does collaborative work with the hospital (research and teaching). In addition, the hospital carries out collaborative research with other faculties, such as the Faculty of Engineering, for the creation of medical devices. ICESI also has a close relationship with *Tecnoquimicas*, one of Colombia's biggest pharmaceutical company located in Cali. The Faculty of Natural Sciences carries constant collaborative work at a research and educational level with this company.

The CDEE (that fosters entrepreneurship within the university) has an active role in the local entrepreneurial ecosystem. It has co-ordinated different accelerating programmes for local start-ups and programmes focused on the development of SME competitiveness.

ICESI collaborates with external structures supporting knowledge transfer. For example, it has an alliance with REDDI, a technological regional agency of the Cauca Valley, whose objective is to solve business challenges based on specialised technological knowledge, promoting innovation and competitiveness. In addition, it collaborates with companies and other institutions in the development of software or specialised knowledge-based products stemming from research projects.

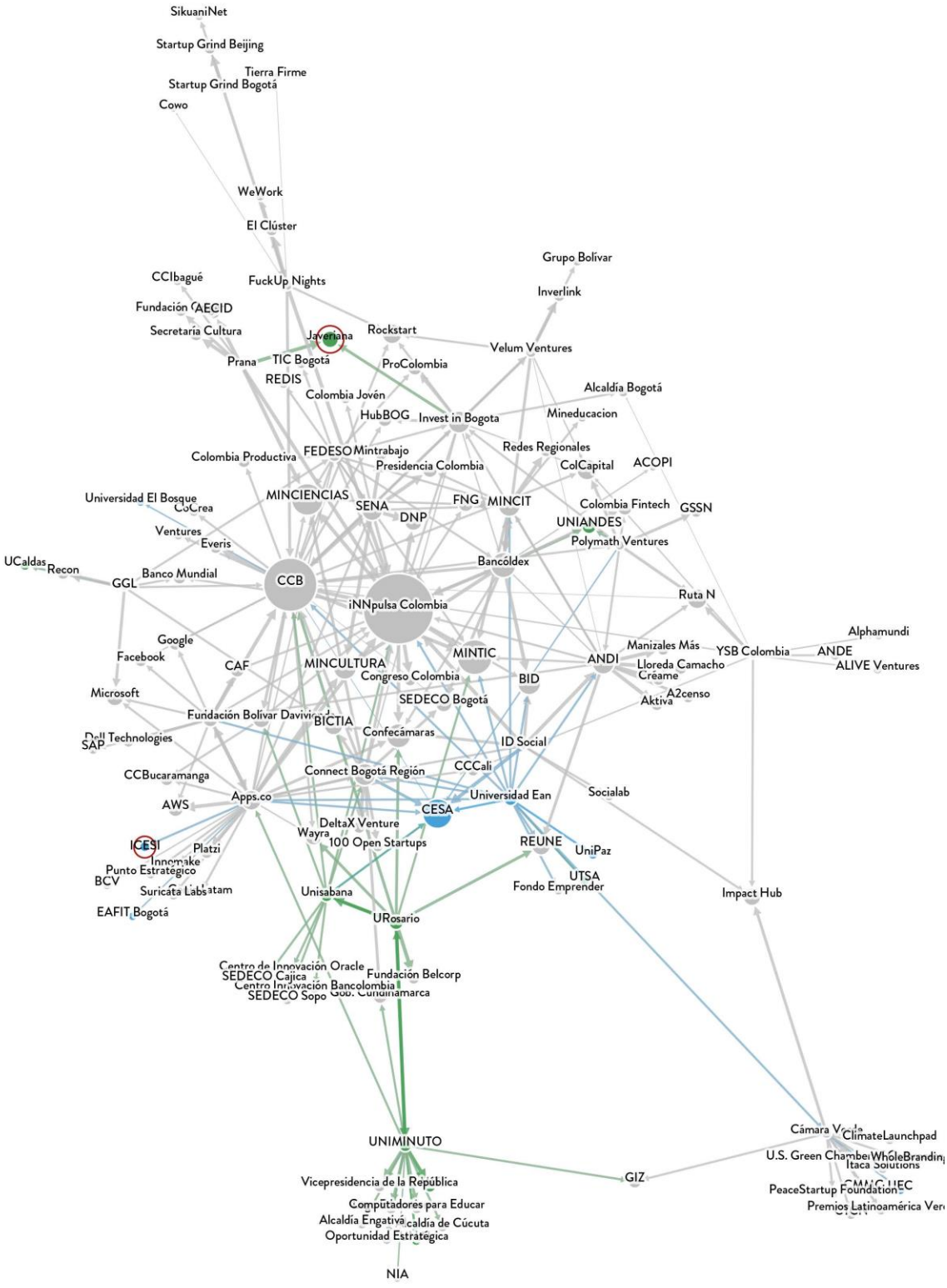
Remaining challenges related to knowledge transfer activities

The university reported having different national and regional interlocutors, which sometimes presents an obstacle to the HEI, as the lack of co-ordination between the different levels of government makes it difficult to have a comprehensive collaboration strategy. In addition, while there is an effort carried out by the university leadership to support applied research that can be used by external stakeholders, often researchers submit research proposals without linking their research to potential beneficiaries. There is a need to build a stronger knowledge transfer culture.

Ecosystem analysis of Bogotá and Cali and the role of ICESI and the Javeriana

As evidenced by the analysis carried out by Global Ecosystem Dynamics, with the support of IDB and the Pacific Alliance on the innovation-driven entrepreneurial economic ecosystems of Bogotá, the universities ICESI and Javeriana play a role in the ecosystem, although it appears to be rather marginal compared to other actors.

Figure 5.1. Ecosystem analysis of Bogotá and the role of ICESI and the Javeriana

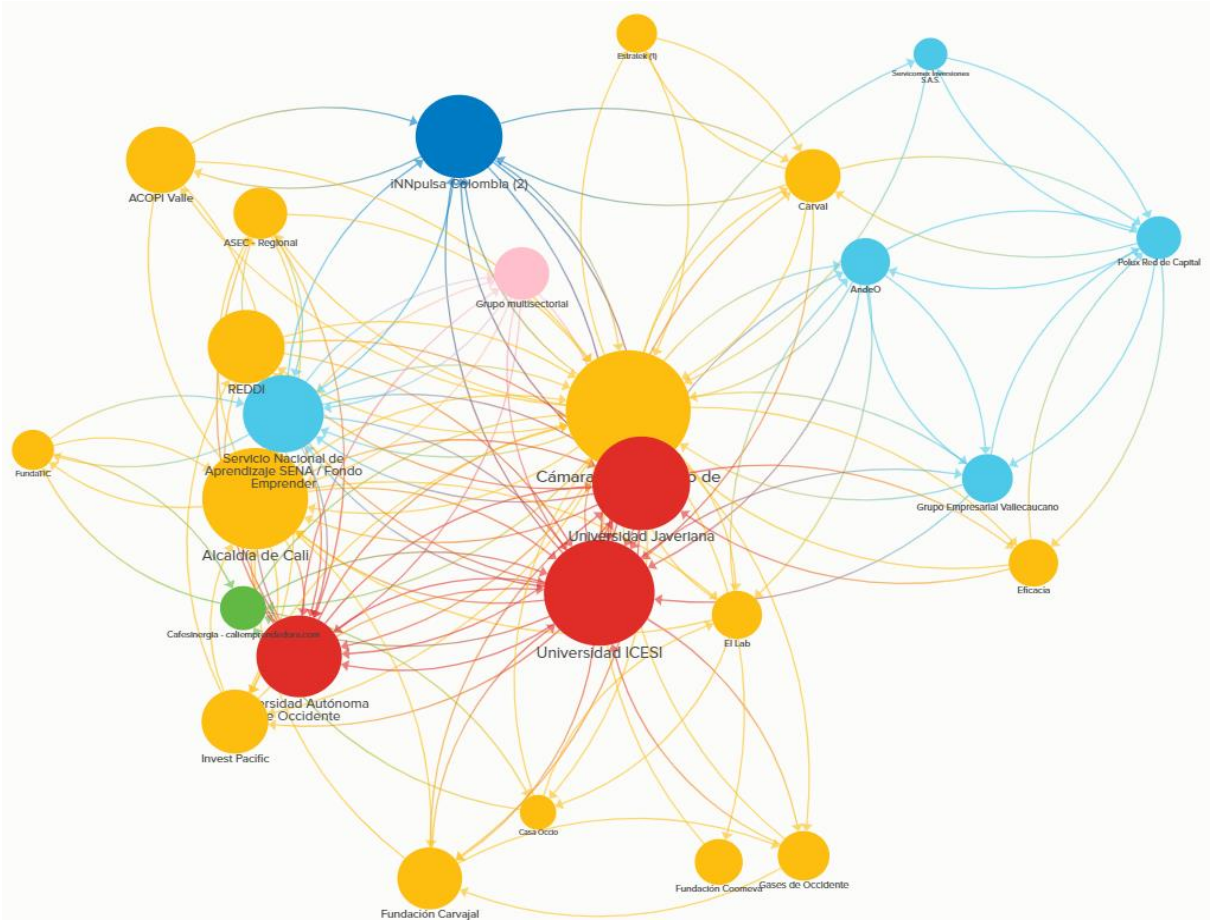


Note: This figure provides a visualisation of the collaborations between actors of the economic ecosystem of Bogotá with a node size dependent on the number of mentions by other participants and the strength of said mentions (weighted in degree), highlighting in blue the universities categorised as Enablers, those focusing primarily on education and capacity building, and in green the universities categorised as Knowledge Generators, those focusing primarily on research and the development of new technologies. These visualisations, along with the interpretation of each node's centrality metrics, allow for the analysis of the positioning of universities mentioned within their innovation-driven entrepreneurial economic ecosystem.
There could be a dissonance between what the university sees as its presence in the ecosystem and what this independent mapping exercise finds. Data collection for each ecosystem was conducted by first identifying as many actors as possible through desk research, which were in turn invited to attend a workshop on strengthening innovation-driven entrepreneurial economic ecosystems and fill an online survey regarding their social dynamics with other actors.
Source: Tedesco, M. (2022[31]), "How and why to study collaboration at the level of economic ecosystems", *D-Lab Working Papers: NDIR*, MIT D-Lab.

In the Bogotá innovation-driven entrepreneurial economic ecosystem (Tedesco et al., 2021), 16 universities were identified: nine knowledge generators and seven enablers. Of these, none stands out as "gravitational centres", taken by the College of Higher Administration Studies, the best-positioned university in the structure according to the metrics shown in the sociogram. In general, a low involvement from all the universities is shown in this ecosystem. So long as ICESI and the Javeriana can be visualised within the structure, their influence appears to be marginal. The National University of Colombia (Manizales Branch) does not appear, which may be explained by the fact that the institution is not in Bogotá.

The analysis of the ecosystem of Cali conducted by the Inter-American Development Bank (IDB) shows however that ICESI is an important actor in Cali with strong ties with local actors (see Figure 5.2). ICESI runs two business-oriented programmes: i) Alaya, which provides free assistance (in business consulting and basic knowledge) to help entrepreneurs to start up, run and grow a business; ii) Propyme, which provides paid advisory and consulting services to companies that have been already established for 5 to 20 years but that are in the process of growth and expansion. ICESI acknowledges that Cali Chamber of Commerce, iNNpulsa Colombia, Alcaldia de Cali and other universities are the actors of the local ecosystem with whom they have main strong relations. They consider that the Cali ecosystem is at an early stage of development and that it needs more articulation between the most important actors. According to ICESI, the main challenges of the Cali ecosystem are related to the generation of deal flow: in their opinion, the Cali ecosystem lacks public financing in the incubation stage and lacks training for potential founders.

Figure 5.2. Ecosystem analysis of Cali and the role of ICESI Colombia



Note: Actors included serve exclusively to innovation-driven start-ups. This figure shows the relations between actors that are either informal or formal for actors who serve innovation-driven start-ups but who can also serve any other type of start-up. Each circle represents one actor and each arrow connecting two circles represents a relation between two actors. The colours represent different types of actors: universities are represented in red, government agencies in blue, financers in light blue, service providers (consulting, mentoring, incubation, acceleration, etc.) in orange, private sector in pink and media in green. The size of a circle is determined by the eigenvector of the actor, which refers to the centrality of the actor in the network (how well connected an actor is to other well-connected actors); larger circles denote higher eigenvectors or more central actors.

To prepare the network analysis, Goñi and Gonzales (2022[4]) also conduct in-depth interviews with the most relevant actors in each ecosystem. These interviews go into detail about the business model of each actor, their specific interactions with the ecosystem, their opinion about the ecosystem development and their perception of what opportunities exist for public interventions to further dynamise their ecosystems.

Source: Goñi and Gonzales (Goñi Pacchioni and Gonzales, 2022[4]).

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6 Case studies in Chile

This chapter analyses initiatives conducted by Adolfo Ibáñez University and the Pontifical Catholic University of Chile to support entrepreneurship education, and knowledge transfer. It also studies the connections that the universities have generated with external stakeholders through these activities in the ecosystem of Santiago de Chile and beyond.

Adolfo Ibáñez University (UAI), Chile

The UAI is a private institution created in 1988. Originally a business school, a Faculty of Engineering was added in 1996. It has three campuses (in Peñalolén, Santiago, Las Condes, Santiago and Viña del Mar) and eight faculties: engineering, science, business, liberal arts, government, law and psychology. It is a small to mid-sized university, with 3 400 undergraduate and 800 postgraduate students. It does not receive funding from the government but is funded through the private foundation Fundación Adolfo Ibáñez. Entrepreneurship is one of the six key values of the university along with critical thinking. The Faculty of Engineering and sciences has developed a strategic plan focused on orienting research and knowledge transfer for sustainable growth in areas that are important for Chile such as energy, space exploration, water and natural resources and mining.

Entrepreneurship education

Currently, there are discussions about creating interdisciplinary programmes to mainstream entrepreneurship education but there is already a master's programme in innovation run by the Faculty of Economics that is open to everyone. There are also master's programmes in technological entrepreneurship and sustainable entrepreneurship.

The Faculty of Engineering has its own design lab: a 100 m^2 facility that enables prototype development and laser printing. The Start-up School project in the Faculty of Engineering and Sciences:

- Aims for students to discover their calling and develop science-based start-ups.
- Builds synergies within the innovation ecosystem which has a data observatory, is working with Google, Microsoft, Huawei and Icare, and partners with CORFO, the state agency that supports entrepreneurship, to have students participate in the Start-up Chile programme seed accelerator.
- Employs three pillars: building skills and abilities (entrepreneurship mindset), building a local ecosystem and building a strong connection with Chile and the rest of the world.
- Has a methodology for entrepreneurship class in Start-up School which follows design-thinking and methodology of active learning (workshops in class and teams: identifying a problem and focus on the solution).
- Has an engineering curriculum where students in the fifth year are encouraged to do internships in a company in order to get into the Start-up School (and a third of students participate in this track).

Connection with the ecosystem driven by entrepreneurship education

The faculty also has a data observatory whose mission is to process, store and make available data in order to contribute to the development of innovation. The Ministry of Science, Technology and Innovation, as well as Amazon Web Services, sponsor the observatory.

The university is creating its own incubator but does not intend to get government funding from CORFO because they have enough private funding. The institution is also building a network of mentors. Additionally, angel investors are involved as interest grows in start-ups in the early stages.

For extracurricular activities, the university engages with hackathons, initiatives from the government, and Amazon and Huawei organised hackathons and data-driven business models to fight climate change. The Faculty of Engineering organises a contest in partnership with Santander Bank.

Remaining challenges related to entrepreneurship education

The university would like to continue its international expansion, especially in Latin America, creating more linkages and becoming a leading university at the regional level in terms of entrepreneurship development.

The university needs to improve its governance in order to mainstream entrepreneurship and the entrepreneurial and innovative agenda across all faculties. The technology transfer office (TTO) should be strengthened.

Knowledge transfer strategy

Technology transfer is mentioned in the university's institutional mission and development plan. To implement the knowledge transfer strategy, the UAI has chosen to set up a TTO at the central level and then create centres at the faculty or school level. The specialised centres of the different schools and faculties of the UAI cover different areas and combine research, continuous education, and extension and technology transfer activities. These centres allow the university's interaction with different communities and the construction of a bidirectional and mutually beneficial relationship in areas such as energy, mining, finance, entrepreneurship, public policy, urbanism, culture and heritage.

Connection with the ecosystem driven by knowledge transfer activities

The UAI Faculty of Engineering of reported working with the Integrated Centre for the Piloting of Mining Technology (CIPTEMIN), a not-for-profit corporation which works to develop innovative technologies for the mining sector. The university's researchers are working with CIPTEMIN to develop technology solutions for mining companies, such as technologies for smart mining and technical solutions for small-scale mining. This co-operation is essential in responding to the needs of the market since CIPTEMIN helps to prepare the technological readiness of the technology and research developed by the Faculty of Engineering. The university also works with regional authorities of the sixth region to attend to the needs of the mining sector. Researchers are collaborating with technical schools and miners to help them use more developed technological solutions.

Incentives for staff to engage in knowledge transfer activities

The university ambitions to gradually enrich the training of students with technology transfer activities, as well as those academics undertaking applied research. Incentives currently vary according to the school or faculty and each faculty has a performance evaluation for their staff, which include technology transfer indicators.

Remaining challenges related to knowledge transfer activities

What has been a disincentive in the past is that the universities' internal accreditation processes did not consider innovation and linkage with the external stakeholders. There were only incentives for scientific publications but not for other contributions such as the generation of intellectual property (IP), technological contracts and spin-offs. The university is working to create a new set of indicators.

As a private university, there are few important regulatory barriers but, as any university, it faces some barriers when interacting with businesses (priorities and time horizons are different). There is no established culture of collaboration between academia and business: contacts are rather sporadic and ad hoc (project-based).

To push new technologies onto the market, the university reported lacking expertise in the protection of IP and commercialisation. The university also lacks resources to fund knowledge transfer and, in an immature innovation ecosystem (with a low degree of collaboration amongst actors or of investment in research and development), this is a major obstacle, as the university would need resources to scale up much of its activities in order to stimulate innovation.

Pontifical Catholic University of Chile (PUC)

This private university that has 5 campuses (4 in different districts of Santiago and 1 in the city of Villarrica) and 18 faculties covering multiple disciplines (social sciences, engineering, arts, architecture, law). The university focuses on innovation, digitalisation and service to the community.

Entrepreneurship education

In the School of Engineering, there are mandatory entrepreneurial courses for all undergraduates and an "innovation challenge" for first-year students which encourages design-thinking to find solutions to a problem or prototype design. There is also a practical course for third-year students using the lean start-up methodology, during which students must develop an entrepreneurial project. The School of Design also has a "challenges to business creation" course in which teams of students find opportunities for new businesses. The business school has courses on design-thinking and social innovation and offers an MBA which includes design-thinking for business creation and social entrepreneurship.

Connection with the ecosystem driven by entrepreneurship education

The university's Innovation Center UC (*Centro de Innovacion UC*) aims at promoting entrepreneurship throughout the institution, through events, networking and projects with the public and private sectors. It is linked to the Research Vice-rectorate. The centre was created thanks to a donation from the Angelini group (USD 15 million) and is now self-funded. It has its own building, which helps to congregate all initiatives, offers services to companies to help these scale up their innovation potential and is currently working with biotechnologies (such as Sinovac) and telecommunications companies. The centre connects the companies with research and data analytics teams within the university and is looking to expand these services to other countries in Latin America. It is currently collaborating with Colombia, Mexico and Peru, in particular with the University of The Andes and the Tecnológico de Monterrey. In addition, as a part of the innovation centre, Incuba UC is a programme that supports entrepreneurs that already have a project (currently 120).

Impact of COVID-19 pandemic on entrepreneurship education

During the pandemic, the university engaged in virtual mentoring initiatives, which allowed for more participants since there were no limitations on space. It has been especially challenging for the School of Design as this required some creative thinking, but the situation has since improved as it is offering hybrid-learning courses.

Remaining challenges related to entrepreneurship education

The university will be focusing its efforts on tackling a number of development challenges in the area of entrepreneurship education. As with large proportions of higher education institutions (HEIs) adapting to current and future demands, the university is working to manage its exposure to market resources. It receives funding from both the public and private sectors (Santander) but still has some dependence on market forces. Private sector funding tends to be allocated to determining projects, providing the university with a temporary income, as opposed to public funding which represents a more continuous source of revenue.

Additionally, given the relevance of its respective functions in entrepreneurship education, the university recognises that there are benefits to improving dialogue and exchange between the TTO and the innovation centre.

Knowledge transfer strategy

As a large university, faculties are granted a high degree of autonomy. Each faculty has its own mission, rules and evaluation procedures for academics. Knowledge transfer is no exception. Strategic priorities are set by the central administration, which created a Department of Development and Transfer, but each faculty sets its own priorities and organisational structures.

During the interview process, stakeholders discussed knowledge transfer activities carried out by the university's School of Engineering and the School of Business Administration. Knowledge transfer is an integral part of the School of Engineering's vision and mission. The school has established structures and programmes to promote knowledge transfer, such as the Research and Innovation Directorate and the Industry Liaison Office, whose mission is to serve as a link between academia and the public and private sectors to transfer knowledge and technologies.

The university's business school also conducts knowledge transfer activities. A Public Commitment and Engagement working group has strategic collaboration objectives, such as fostering social responsibility in students and participating in public debate.

Connection with the ecosystem driven by knowledge transfer activities

The university reported connections with the business sector and the government. For instance, since 2015, the School of Engineering has carried out a transformative strategic plan, Engineering 2030, with the support of the Production Development Corporation (CORFO, Ministry of Economy). The main goal of the 2030 engineering project is to contribute to the integral and economic development of Chile through renewing education, research, entrepreneurship and global connections.

The university has also been active during the pandemic, providing support to external stakeholders. The Faculty of Engineering participated in the COVID-19 National Board and contributed with solutions in all sectors affected by the pandemic, including in the health, social and economic spheres. Based on new developments or its focus on technologies, in the first semester of 2020, the PUC School of Engineering generated more than 20 innovative scientific-technological solutions to support the management of the pandemic, from COVID-19 detection kits, disinfection equipment and methods for monitoring ventilation conditions that allowed the reopening of restaurants.

The business school is more focused on helping entrepreneurs. There are several examples, such as consultancy work carried out by professors of the faculty, the Innovation and Future Festival and seminars gathering entrepreneurs and students to develop innovative ideas.

Incentives for staff to engage in knowledge transfer activities

It is not mandatory for researchers to participate in knowledge transfer activities; however, those who take part in these activities receive financial compensation as follows:

- Inventors are paid royalties, in the case of licensed technologies.
- Researchers with spinoff companies may request to, to dedicate time to the company (for a period of two years).
- Researchers are rewarded on the annual TTO anniversary.
- Faculty regulations recognise technology transfer and spinoff activities for evaluation of research.
- The university has funds for IP and seed funding.

Remaining challenges related to knowledge transfer activities

- Stakeholders reported a number of challenges remaining in the development of knowledge transfer activities. Principally, they noted a need for greater incentives, both for industry, in the sense of industry understanding the importance of research and development to stay competitive, and for academics, to be attracted to and remain informed of developments in applied science over pure science.
- There is a clear ambition to embed trust building into activities. Lack of trust between stakeholders has been identified as a limiting factor: it is particularly hard to establish when there has been no previous contact between stakeholders. Stakeholders believe that efforts to align language and expectations between stakeholders would also support trust building.
- New opportunities for collaboration should be created to decrease intrinsic research risks.
- Harmonising knowledge transfer activities across faculties within the university would make for a more unified image.

Ecosystem analysis of Santiago de Chile and the role of the UAI and the PUC

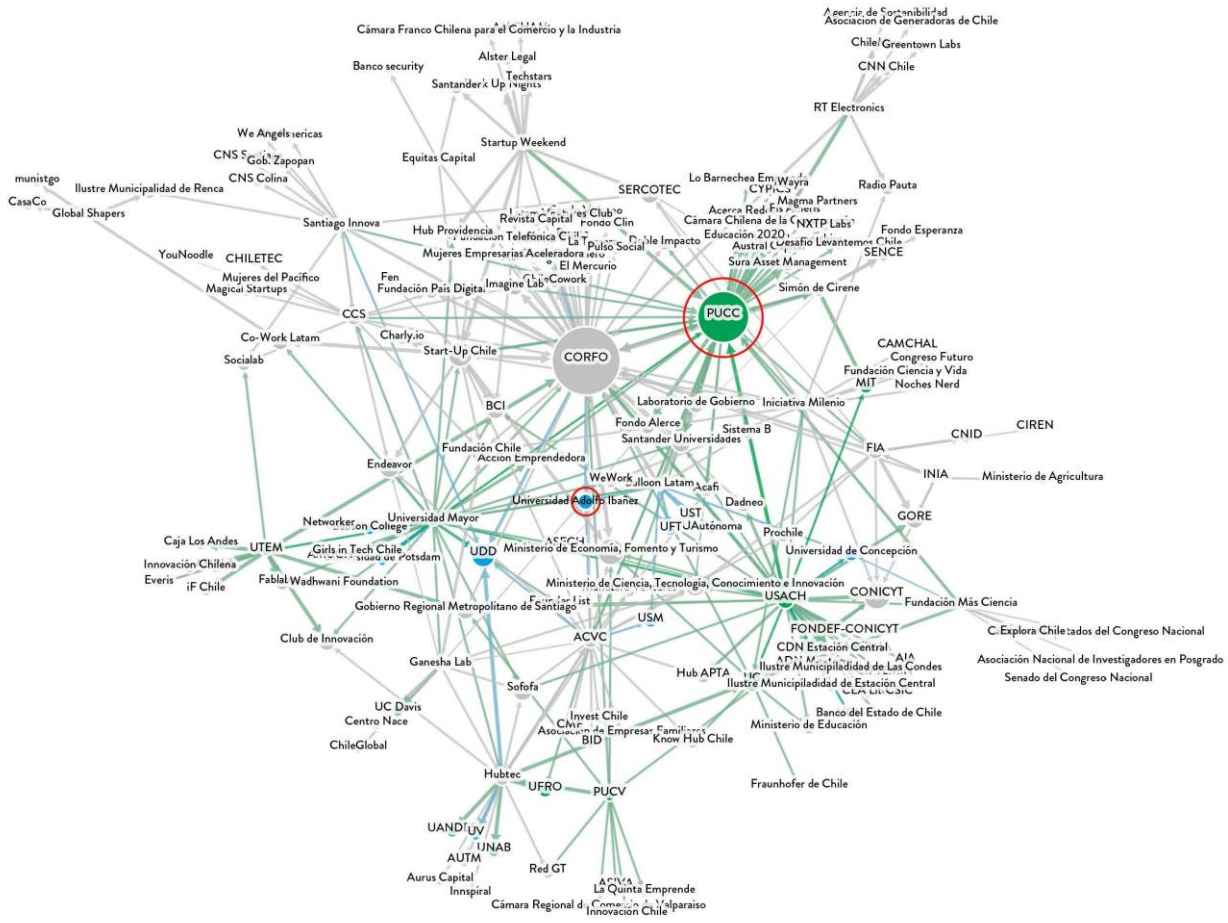
As evidenced by the analysis carried out by Global Ecosystem Dynamics, in collaboration with MIT D-Lab and supported by Santander Universidades, on the innovation-driven entrepreneurial economic ecosystems of Santiago de Chile, the UAI and the PUC play a role in the ecosystem.

This ecosystem presents a vast number of universities, with 12 enablers and 11 knowledge generators. From these, only the PUC shows a solid positioning in the study (Tedesco, 2022[1]) it is considered to be a gravitational centre with high intensity and mentioned 13 times by correspondent actors.

In contrast, the UAI presents a smaller influence in Santiago de Chile's innovation-driven entrepreneurial economic ecosystem, locating itself on the periphery of it.

The PUC is classified as a knowledge generator and the UAI as an enabler.

Figure 6.1. Ecosystem analysis of Santiago de Chile and the role of the UAI and the PUC



Note: This figure provides a visualisation of the collaborations between actors of the economic ecosystem of Santiago de Chile with a node size dependent on the number of mentions by other participants and the strength of said mentions (weighted in degree), highlighting in blue the universities categorised as Enablers, those focusing primarily on education and capacity building, and in green the universities categorised as Knowledge Generators, those focusing primarily on research and the development of new technologies. These visualisations, along with the interpretation of each node's centrality metrics, allow for the analysis of the positioning of universities mentioned within their innovation-driven entrepreneurial economic ecosystem.

There could be a dissonance between what the university sees as its presence in the ecosystem and what this independent mapping exercise finds. Data collection for each ecosystem was conducted by first identifying as many actors as possible through desk research, which were in turn invited to attend a workshop on strengthening innovation-driven entrepreneurial economic ecosystems and fill an online survey regarding their social dynamics with other actors.

Source: Tedesco, M. (2022[1]), "How and why to study collaboration at the level of economic ecosystems", *D-Lab Working Papers: NDIR*, MIT D-Lab.

Reference

Tedesco, M. (2022), "How and why to study collaboration at the level of economic ecosystems", *D-Lab Working Papers: NDIR*, MIT D-Lab. [1]

7 Case studies in Brazil

This chapter analyses initiatives conducted by the University of São Paulo and the University of São Carlos to support entrepreneurship education, and knowledge transfer. It also studies the connections that the universities have generated with external stakeholders through these activities in the ecosystem of São Paulo, Brazil and beyond.

University of São Paulo (USP), Brazil

Founded in 1934, the university has 5 000 faculty members, 90 000 students, 335 undergraduate and 264 graduate programmes, 42 schools, 4 incubators and 1 Technology Park. It has campuses in seven municipalities in the state of São Paulo, the biggest being the campus of São Paulo, followed by the São Carlos and Ribeirão Preto. The university has a very comprehensive outreach strategy, works with museums, research centres as well as hospitals to conduct research, including the country's largest health complex Hospital *das Clínicas da Universidade* de São Paulo.

Entrepreneurship education

Entrepreneurship education varies from school to school. The physics institute does not offer entrepreneurship courses *per se*, but rather innovation courses at the undergraduate level. In other schools such as engineering, students follow entrepreneurship courses at an early stage. For graduate students, there is an entrepreneurship and innovation master's programme in São Paulo and 25 different courses covering innovation and entrepreneurship.

The *"residência* em *inovação"* is a new programme for graduate students, akin to an internship through which students will benefit from mentoring and a place to work at the INOVA.USP Centre for Innovation, an arm of the innovation agency that aims to attract companies and investors. This programme has just started but is expected to be a success.

Connection with the ecosystem generated by entrepreneurship education

The university has four incubators, all in the state of São Paulo, with two in the city, Habits and Cytec. The university is an innovation hub as the number of companies incubated is quite high: 576, as well as 1 934 "DNA USP companies" (companies created by students) and seven unicorns created by former students.

The university also has a science and technology park that, unlike the incubator, is more generic and devoted to agri-business. Its aim is to create a strong ecosystem for students to connect with firms from the agri-business sector and develop their entrepreneurial ventures. The university does not run an acceleration programme but is now establishing a tighter relationship with investors for start-ups to have more support to scale up. There is also the innovation centre of the University of São Paulo (INNOVA.USP) that gathers all research activities throughout the university and fosters collaborative activities. Hackathons are organised by student associations and are supported by the innovation agency on annual basis (100 students).

Other initiatives include:

- A conference for science-based start-ups: the last edition was held last June, and 77 technologies were presented to investors.
- A pre-incubation programme in partnership with FAPESP, a public research agency of the state of São Paulo (before going to the incubator – six months to develop project funded by FAPESP through the *Programa de Innovación Tecnológica en Pequeñas Empresas* (PIPE) "Novos negocios N2": 14 editions of this initiative; more 400 students; 90 start-ups in 30 countries.

Impact of the COVID-19 pandemic on entrepreneurship education

The impact of the pandemic was strong, courses shifted online, with success since many more students are taking courses. Three hundred students now attend the entrepreneurship courses.

Remaining challenges related to entrepreneurship education

The university had to create infra-legal norms for faculty members to create their own start-up or to licence a technology (as public employees are not allowed to do so). There is progress to be made as the legislation needs to further clarify the status of academics who both own a start-up and teach (to avoid conflict of interest).

Knowledge transfer strategy

The USP's mission is to "promote knowledge through teaching and research, and to extend to social services that are linked to knowledge and teaching" (University of São Paulo, 2022[1]). The university also specifies its commitment to supporting "social, technical, and green innovation" through the sharing of knowledge, embedding knowledge transfer as a fundamental component of its teaching and research activities (University of São Paulo, 2022[1]).

The university has recently put in place an innovation policy (in December 2021) and is working to create a set of institutional incentives for professors to conduct more transfer activities. In addition, the USP is currently undergoing a change in administration, with the election of a new hierarchy with a new vice-rector of research. As such, the new administration wants to develop the social impact of innovation.

The agency INNOVA.USP is at the heart of the university's knowledge transfer strategy. It was created four years ago in 2018 and is mandated to reach out to the private sector and be the recipient of private sector demands (from big companies and small- and medium-sized enterprises [SMEs]). In addition, the Department of Collaboration (*departamentos de convenios)*, created in 2021, keeps track of all agreements signed by the university with external partners and is home to the university's technology transfer office (TTO). There are also TTOs on the campuses of Piracicaba, Ribeirão Preto and São Carlos.

Connection with the ecosystem driven by knowledge transfer activities

The USP has four incubators in three different cities and in two of them; the institution has agreements with the city hall to promote the development of start-ups through the creation of science parks. In Ribeirão Preto, the USP campus has already set up a technological park (in a consortium with the city hall) and in the city (Piracicaba), the USP campus intends to have the technological park consolidated by the end of 2022.

The USP works with any company interested in innovation, particularly in the areas of energy, biotechnology and construction. For example, the USP has signed an agreement with the Brazilian Portland Cement Association (ABCP). The agreement is managed by the School of Engineering (*Escola Politécnica*) on the USP side and focuses on improving construction technologies. Since the ABCP is an association of industries, developments are dispersed throughout the industrial community. The USP also works with the Federation of Industries of the State of São Paulo (FIESP) in a programme to improve SMEs but the lack of innovation culture in those companies is a problem most difficult to overcome.

The USP collaborates with the federal government to support knowledge transfer, particularly with the Brazilian Company of Research and Industrial Innovation (EMBRAPII), which has seven units within the USP, through which the universities conclude agreements with the companies on a specific subject.

Another form of collaboration includes industry involvement in education. In some business or engineering disciplines, business or industry representatives frequently give lectures and students work in industrial plant to develop activities. In some of the entrepreneurship courses, students are grouped into teams to develop and present a business plan and are given mentors from the business or venture capital community who participate in the final evaluation (and mentor the teams during the development of the project).

The USP is also making sure that the students benefit from their collaboration strategy. The university has developed a collaboration with FEA Angels (a network of former students of the Faculty of Business and Administration, created to foster entrepreneurship by mentoring and funding) and gathered 130 mentors to help the start-ups in the university's incubators. As another example, construction company Tegra Incorporadora is supporting students developing start-ups in the construction business.

The USP is also drafting an "investment policy" to allow the university to invest in spin-offs to not only foster entrepreneurship but also improve knowledge exchange. For the start-ups to succeed, the help of mentors and venture capital is crucial.

Incentives for staff to engage in knowledge transfer activities

The USP is working to develop a culture of innovation and entrepreneurship as part of both teaching and research activities, through its innovation policy approved last year.

The university also recommends that innovation and entrepreneurship activities be valued for career advancement evaluations of faculty and technical and administrative staff (University of São Paulo, 2022[1]).

The document states that the USP will offer a new set of institutional incentives for its staff to develop innovation activities:

- Scholarships to students (undergraduate or graduate) and post-doctoral fellows.
- Awards to students, post-doctoral fellows, professors, technical and administrative personnel, collaborating researchers and spin-off companies.
- Innovation grants for professors, technical and administrative workers, post-doctoral students, undergraduate and postgraduate students, and collaborating researchers to conduct research and development (R&D) projects developed in collaboration with for-profit or non-profit entities.

The university will also put a framework in place so that innovation and entrepreneurship activities are appraised in career advancement evaluations of faculty and technical and administrative staff (University of São Paulo, 2022[1]).

Remaining challenges related to knowledge transfer activities

As mentioned by other public universities, and as is the case of the USP, there is a barrier to the creation of start-ups and spin-offs by faculty members as it raises legal issues. Professors and university staff have a professional contract, which implies full commitment to university work, and, as such, they cannot dedicate any working time to developing other activities such as managing a start-up. The university should set up clear rules that allow professors to develop such activities as part of their professional responsibilities, as at present, professors (as the case in many countries) are bypassing the rule and starting their own business but in someone else's name (a spouse or a family member).

Universities are a part of the innovative process, fundamental research is the basis of innovation, and the university should be ready to answer the demand (legal framework). There are still hurdles that hamper business-industry partnerships. As a large, long-standing university, the USP's internal procedures to set up a partnership agreement with a company are lengthy and require many steps, which are perceived as an obstacle by the private sector. The Brazilian fiscal system is also time-consuming: companies spend a lot of time completing administrative procedures to pay taxes, which is a big problem for an SME or a young company.

Federal University of São Carlos (UFSCar), Brazil

The Federal University of São Paulo was created in 1968 and was the first higher education institution (HEI) to have settled in São Carlos in the state of São Paulo. It now has four campuses: Araras, Lagão do Sino, São Carlos and Sorocaba and more than 20 000 students. Twenty disciplines are related to the subject of innovation and entrepreneurship. The university's main campus (city of São Carlos) benefits from a vibrant ecosystem: the University of São Paulo also has a campus there and 20% of the population is involved in academic activities. The university created the first incubator in Latin America and is supported by entrepreneurs, and federal and state agencies.

Entrepreneurship education

There are mandatory classes in entrepreneurship for engineering students. Undergraduate students of physics, chemistry, education and psychology have elective disciplines on entrepreneurship. Entrepreneurship is taught transversally and students from different faculties can take these courses.

At the graduate level, the university has a special programme, ITI UFSCar, resulting from a partnership with the business sector and international researchers to offer students' academic training that integrates the markets' perspective. The programme has a Master in Business Administration (MBA) in Information Technology and Innovation.

The university also has a Master in Business Innovation (MBI) that was created six years ago by a professor who attended the Massachusetts Institute of Technology (MIT). The MBI is focused on the entrepreneur's human abilities (design thinking model, focused on business model creation).

In addition, all PhDs in innovation (which are partly co-financed by companies) have mandatory training on leadership and soft skills developed in partnership with EMBRAPII.

Connection with the ecosystem driven by entrepreneurship education

The university has issued 300 patents and 20 license agreements working on innovations such as the genetic modification of sugar cane. The university has received around BRL 6 million in royalties from intellectual property (IP) development in the period 2017-20. Its Innovation Agency is responsible for co-ordinating activities and training to promote the culture of innovation and entrepreneurship within the university. The agency has also started registering companies founded by the university's students, staff and researchers, created an innovation search portal and a Doctorate in Innovation. It is also in charge of IP transfers and thus operates as a sort of TTO. The agency produces a report on its annual activities (*Relatório de Atividades da Agência de Inovação da UFSCar*), tracking all activities it carries out, as well as key performance indicators on its knowledge transfer activities (number of patents, licence agreements).

The agency also conducts innovation challenges every year and problem-solving activities with companies, such as the "bike bus challenge". The university has three technological parks and an innovation lab. There is an ecosystem surrounding the university with several FabLabs and several makers' spaces.

Other activities within the community include:

- Several extension activities, workshops for all levels of education, a young scientist programme as an initiation to science, as well as a programme called "small citizen": food, clothing and robotics, science lessons and a partnership with several science museums (astronomical observatory). The university's community library is a space to meet and exchange and is heavily used by the community.
- A good relationship with the universities of São Paulo and Campinas, with an exchange of PhD students and graduate students.

Impact of the COVID-19 pandemic on entrepreneurship education

During the pandemic, all activities were carried out remotely, including lectures and lessons. The pandemic had a negative impact on student engagement: human interaction fosters innovation and entrepreneurship; hence, students were a little demotivated, giving up courses and reporting feelings of depression with a clear loss of engagement that impacted entrepreneurship education.

Remaining challenges related to entrepreneurship education

There are challenges regarding IP development, as one-third of the profit goes to the university and another third to the inventors. Regarding the involvement of professors in companies, the law authorises professors to be partners in companies: they can help students create a company but cannot be involved in it. Brazilian law is very complicated: the innovation law was revisited in 2018 but many universities are applying their own rules. Another issue is bureaucratic procedures for TTOs for patent development.

Knowledge transfer strategy

As stated in the most recent institutional development plan (2018-22), the university's expansion into the state of São Paulo has enabled the institution to train researchers and local professionals, produce research and expand the dissemination of "knowledge, culture and art" (Ministry of Education/UFSCar, 2021[2]). The university has intensified its dialogue with society and all its teaching, research and transfer activities are articulated to respond to the social demands of the regions where the campuses are located. Knowledge transfer is as important as teaching and research and the university aims to make knowledge accessible. As stated in the UFSCar plan, "the university mission is to develop, teach and disseminate Science and Technology for free" and for that, the university is in permanent dialogue with different segments of society (Federal University of São Carlos (UFSCar), 2022[3]) . It receives its main funding from the federal government, through its annual federal law.

Connection with the ecosystem driven by knowledge transfer activities

The university has created links with several industries to provide teaching, research and extension activities. In the city of São Carlos, the university benefits from a rich ecosystem, as the city counts on the presence of other HEIs (such as the São Carlos School of Engineering) and Brazilian Agricultural Research Corporation (EMBRAPA) units. The city is an important technological and educational centre.

A salient feature of the university has been its ability to connect with actors in the ecosystem, which are not producers of high-technology goods or services but are at the heart of the country's productive sector. It especially interacts with the food and agriculture industry (companies such as Magnesita), the metallurgic and mining sector (Alcao, CBMM, CSN, Vale), pulp and plastics (Surazo, Vetra), the oil industry (Petrobras) but also sugar and alcohol plants. It also works with other universities (University of São Paulo) and science parks (Parqtec).

As stated previously, the innovation agency has been a fundamental pillar of this knowledge transfer strategy as it deals with issues related to the protection of IP rights arising from research developed in house and any issues related to technology transfer. It also pays attention to connecting the dots within the university, trying to make students from different academic orientations connect and conduct research together.

The university is also invested in contributing to cultural activities and social projects, with a dedicated culture co-ordination office, responsible for the university's transfer activities related to the art and culture, carried out in partnership with external stakeholders. The university recently worked with the municipality of São Carlos, the University of São Paulo and a local NGO to organise a virtual music festival in memory of a local violinist (USP, 2021[4]).

The university has also contributed to supporting SMEs in partnership with the federal and state government. EMBRAPII, a federal agency that supports industrial innovation, has offices in UFSCar to develop research projects with local companies and SMEs in particular. EMBRAPII has a programme of innovation in small enterprises, with funding to create a new product or service. The São Paulo Research Foundation also has a programme to support innovation in SMEs *Pesquisa Inovativa em Pequenas Empresas* (PIPE). Often, SMEs are not aware of these programmes and the university plays an important role in presenting these programmes to local companies.

A major milestone achieved by UFSCar is that it has contributed to making the city of São Carlos an attractive city for graduates to stay after their studies. The city has suffered from brain drain in the past, with graduates with a high level of studies (often PhDs) leaving for other cities or countries. The university has doubled its efforts to build partnerships with companies and SMEs to disseminate knowledge and transfer. It has also increased the offer of courses in partnership with the industry, such as data science courses (in partnership with Santander), inviting professors from the industry to teach. As a result, their highly skilled graduates were more able to find a job suited to their qualifications or create their own venture.

The university sets its strategic plans in a very collegial manner, involving students and community members. The new development plan of the university sets extension and interaction with society as strategic priorities, in addition to inclusion and diversity (several grants are offered to students, which includes rent payment).

Incentives for staff to engage in knowledge transfer activities

UFSCar's innovation policy also establishes that any internal personnel, professors, students and technical and administrative staff who contribute to the development of any IP that is licensed are rewarded with part of the royalties obtained from the license, according to their intellectual contribution to the invention. Usually, one-third of the royalties obtained go to the investor and the proceeds are allocated to the university and innovation agency. Furthermore, there are optional measures in place allowing UFSCar community members to receive resources in the form of scholarships, from projects funded by companies and other external institutions. UFSCar also invests in training for professors: for instance, it has developed a course on the use of digital information communication technology (TDIC). The university also encourages professors to undertake post-doctoral studies abroad, a way to incentivise training.

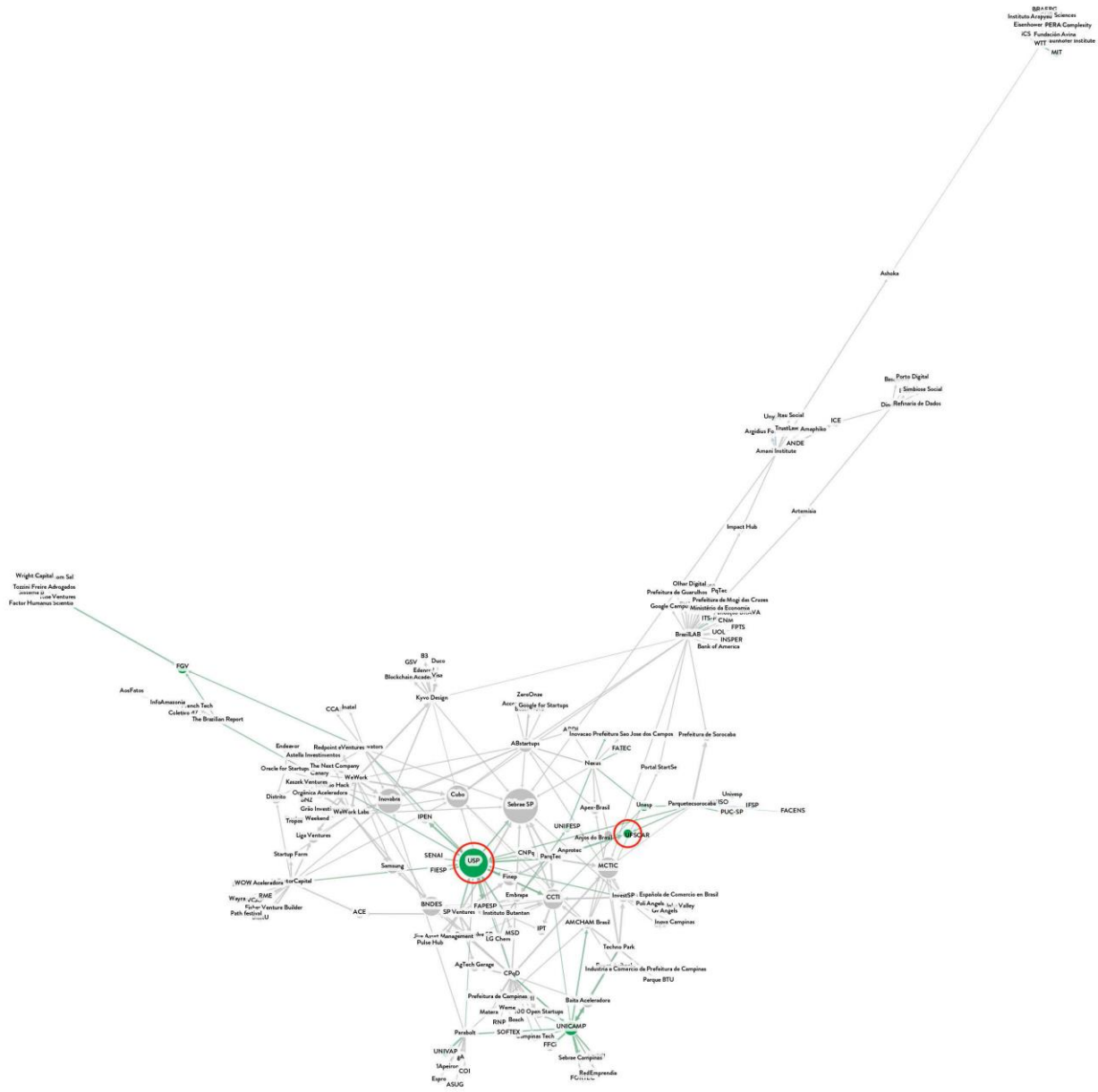
Remaining challenges related to knowledge transfer activities

Stakeholders during the interview reported that there is only one lawyer for the whole university (comprising four campuses); legal support for IP development is therefore limited. The contracts issued by the TTO need a number of months to be signed off by the legal officer. All projects that are financed by the government take time to put in place. The bureaucracy, as in many other countries, is a real barrier to knowledge transfer, whereby to access grants and state funding for research projects depends on the submission of a vast amount of paperwork. There is also a problem of reputation, as the university is often perceived as being bureaucratic by external stakeholders and companies in particular.

Ecosystem analysis of São Paulo and the role of the UFSCar and USP

As evidenced by the analysis carried by Global Ecosystem Dynamics, in collaboration with MIT D-Lab and supported by Santander Universidades on the innovation-driven entrepreneurial economic ecosystems of São Paulo, the UFSCar and USP play a role in it.

Figure 7.1. Ecosystem analysis of São Paulo and the role of the UFSCar and USP



Note: This figure provides a visualisation of the collaborations between actors of the economic ecosystem of São Paulo with a node size dependent on the number of mentions by other participants and the strength of said mentions (weighted in degree), highlighting in blue the universities categorised as Enablers, those focusing primarily on education and capacity building, and in green the universities categorised as Knowledge Generators, those focusing primarily on research and the development of new technologies. These visualisations, along with the interpretation of each node's centrality metrics, allow for the analysis of the positioning of universities mentioned within their innovation-driven entrepreneurial economic ecosystem.

There could be a dissonance between what the university sees as its presence in the ecosystem and what this independent mapping exercise finds. Data collection for each ecosystem was conducted by first identifying as many actors as possible through desk research, which were in turn invited to attend a workshop on strengthening innovation-driven entrepreneurial economic ecosystems and fill an online survey regarding their social dynamics with other actors.

Source: (Tedesco, 2022[5])

In São Paulo's ecosystem, seventeen universities were identified (Tedesco, 2022[5]). Of these, thirteen are knowledge generators and four enablers. It highlights that only the USP has a relevant positioning as a gravitational centre, having been mentioned by eleven actors from the total study participants.

On the other hand, UFSCar does not appear as a relevant actor from the point of view of ecosystem participants. Although the UFSCar was not part of the participating actors, this does not affect its weight and influence in the ecosystem, since the mathematical models and metrics represent the perspective of all participating actors of the ecosystem and not their own perspective.

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8 Case study in Argentina

This chapter analyses the University 21 of Cordoba's efforts to support entrepreneurship education, and other knowledge transfer activities. It also studies the connections that the university has generated with external stakeholders in regional and national ecosystems through these activities.

Siglo 21 Business University (Siglo 21)

Established in 1995, this private university is the largest in Argentina. Founded by an entrepreneurial family, the university's institutional mission is to train entrepreneurial leaders. Entrepreneurial training is embedded across all career tracks, including those in social sciences and law. Recognising its role in building links with industry and in creating the leaders of the future, the university focuses on building and sustaining the national and local ecosystem through a variety of activities. It has developed a partnership with governments, companies and investors to support entrepreneurship and contribute to social and sustainable growth.

Entrepreneurship education

The university has a comprehensive entrepreneurship education offer, which includes elective and mandatory entrepreneurship courses for undergraduate, graduate and postgraduate students covering subjects such as entrepreneurship development, creativity and entrepreneurship and digital tools for entrepreneurship. In order to embed entrepreneurship education, all faculties deliver entrepreneurship courses including in applied sciences, social sciences, law and administration.

Since 2017, undergraduate students have had the option to supplement their studies with a Certificate in Entrepreneurial Competencies. This certification is open to students in any career track who want to focus their degree on entrepreneurship; indeed, there are law students at the university undertaking this specialisation. The certificate consists of two core subjects, two specialisation subjects, one Professional Practice module with a focus on the application of internal innovation in organisations, and one final degree project with an entrepreneurial theme. This certification is registered as a supplement to the degree title in the student's transcript. This programme has been successful and has attracted over 300 students.

A bachelor's degree in entrepreneurship was launched by the university in August 2021, followed by the opening of the programme in both face-to-face and virtual mode in March 2022.

Siglo 21 also has an entrepreneurship-focused extracurricular offer for students with activities including two annual Entrepreneurship and Innovation Challenges centred on issues affecting local organisations and the community. The challenges bring together students, graduates and professors in a space that encourages them to think and act on solutions in conjunction with the business sector and organisations.

Other extracurricular endeavours include Fair 21, an annual event with a community outreach focus, which promotes the development of innovative ideas community and learning about the dynamics of professional life whilst generating links with the business world. It is now in its fifth edition.[1] Impulso 21 is an online pre-incubation programme for students, graduates, professors and researchers of Siglo 21, which provides selected candidates with scholarships to go through ideation, modelling and validation of ventures. The best projects from the programme also receive a stimulus fund for their development. In conjunction with Santander, the university also delivers the Impulso X national programme for women entrepreneurs,[2] which aims to strengthen the leadership role of women entrepreneurs within national ecosystems. The most recent Impulso X offered online incubation, acceleration support and funds of up to ARS 1 080 000 for successful projects.

Finally, the university also puts on hackathons, which offer ideation spaces where companies set students a challenge and ask them to develop a possible solution together with teachers and company staff.

Connection with the ecosystem generated by entrepreneurship education activities

The university fosters a number of connections with actors within the ecosystem including the Economic Development Agency of the City of Córdoba (ADEC): the university partners with ADEC to feed into the development board of the municipal government of Córdoba.

The university also works closely with social incubators such as Mayma and Fundación Avina and is working with an NGO Pro Mujer to create an entrepreneurship centre. Furthermore, Siglo 21 has collaborated with the incubator Incutex's Company Builders programme[3], which selects, promotes and finances technology-based ventures that aim to develop solutions for the education system.

The university also brings together over 100 active mentors who engage in the university's entrepreneurial activities every year. These mentors come from incubators and are often professors, executives, advanced entrepreneurs and other key players.

There are a number of partners funding entrepreneurship education activities at the university: these include Santander Bank, which has provided incentive funds for entrepreneurs to fund their projects over a number of years. The Córdoba Innovation and the Entrepreneurship Agency within the framework of the Córdoba Incuba and Vincular Córdoba programmes also supports entrepreneurship education activities in Cordoba.

The university is also organising multiple events collaborating with institutions to stimulate entrepreneurship:

- In 2020, Feria 21 and the local event Vincular Córdoba merged into a two-day event involving the main actors of the entrepreneurial ecosystem (40 institutions).
- The National Scientific and Technical Research Council (CONICET) and the Ministry of Science and Technology of the province of Córdoba as partners of the university organised the Entrepreneurship with Science Challenge for 2022. The latest edition of *Desafío Emprendé con Impacto*, a contest in that more than 65 entrepreneurial teams participated including teams of students from the university Siglo 21. The contest was co-organised with the Ministry of Science and Technology of Córdoba, Banco Santander Argentina, Grido, Incutex, Renault and Stellantis Tarjeta Naranja.

Impact of the COVID-19 pandemic on entrepreneurship education

In terms of entrepreneurship activities, although co-curricular activities were already a blend of face-to-face and virtual, the virtual model was enhanced even further. In terms of curricular content, the greatest impact was seen in those subjects involving interdisciplinary work where it was necessary to apply new pedagogical strategies and tools (including Mural, a collaborative virtual tool that facilitates remote teamwork) to encourage online collaborative work. The pandemic was also an opportunity to raise the profile of some co-curricular programme events such as Feria 21 and Impulso 21, which significantly increased their level of participation. For example, Feria 21 had 8800 participants, whereas the 2019 edition, which was held in person, had 1 500 attendees and a limited number of potential participants.

Remaining challenges related to entrepreneurship education

The university has identified a number of entrepreneurship education activities, which have the potential to be developed such as the new bachelor's degree in entrepreneurship; further expanding the university's entrepreneurship pre-incubation programme, Impulso 21, into Latin America, the Caribbean and Asia; and initiating the development of more specific entrepreneurship programmes.

Knowledge transfer strategy

The university is mainly dedicated to teaching, with a small percentage of the university's budget allocated to knowledge transfer and research. Three percent of the institution's total budget is allocated to research and university transfer activities and 97% percent to teaching and general administration activities.

Nevertheless, the university has been making efforts to expand its research and knowledge transfer activities. In the latest strategic plan (2021-27), the university states its intention “to expand the impact of its outreach and community service programmes for organisations and companies through research, promotion of culture and open innovation”. In addition, the university has adopted specific structures dedicated to knowledge transfer, with full- and part-time staff, demonstrating its commitment to driving forward the knowledge transfer agenda. Specific activities include:

- Extension Secretariat: Centre for Entrepreneurship and Innovation, Centre for Social Sustainability, Centre for Internationalization, Centre for Alumni and Employability.
- Vice-rectorate for Institutional Management: Vida 21 Area (sports, arts and culture).
- Vice-Rector Office for Graduate Studies, Innovation and Research: Global Corporate Liaison Centre, Training and Development Department.
- Research Secretariat: Directorate for Scientific Communication and Transfer, Innovation Coordination (IDEA21), Observatory of the Future.

The institution also regularly collects indicators to assess the quality of its research and knowledge transfer activities.

Connection with the ecosystem driven by knowledge transfer activities

The university carries out collaborative work with multiple actors in the community, at the local, national and regional levels. The university has strong links with companies of different sizes as well as international universities, sports and cultural institutions, and governmental and non-governmental organisations. In the case of companies, most collaborative work is related to the development of professional practices and student internships, the strengthening of internal and external capacities of the companies (in the form of in-house programmes, specific internal competencies and community support) and the understanding of common problems and needs in the corporate world through research.

As for the public sector, the university has developed co-operation activities on issues related to community development. For example, the university organises the annual ICT Week, a networking event which looks to promote technology issues relevant to the local area, in collaboration with the province of Córdoba’s Ministry of Industry, Commerce and Mining, the Ministry of Science and Technology, the Ministry of Education, chamber of commerce and the Córdoba Technology Cluster.

The university also collaborates with ADEC (under the municipality of Cordoba), engages in research and provides technical assistance in the development of local strategic proposals, and contributes to the development of technical reports.

Remaining challenges related to knowledge transfer activities

University stakeholders noted that there are a number of remaining obstacles in the implementation of knowledge transfer activities. When it comes to financing these activities, and particularly in relation to calls for funds for transfer activities, requirements can be highly restrictive. Furthermore, there is still an overreliance on state funding due to limits in the private investment coming forward.

The duration of programmes was also found to affect the effectiveness of knowledge transfer activities. There is a large number of rapid transfer events, in which the academic sector can meet the socio-productive sector. However, engagement opportunities, which are sustained over the long term, are limited. Stakeholders reported that a shift towards longer-term alliances has the potential to generate more sustainable alliances and programmes with greater community impact.

The difficulty in determining agreed indicators that can measure the effectiveness of activities was also cited as a challenge. There are limitations in understanding the effectiveness, efficiency, return on investment and real impact of transfer actions. Furthermore, there is no national framework for the co-ordination of activities; these are carried out on an ad hoc basis.

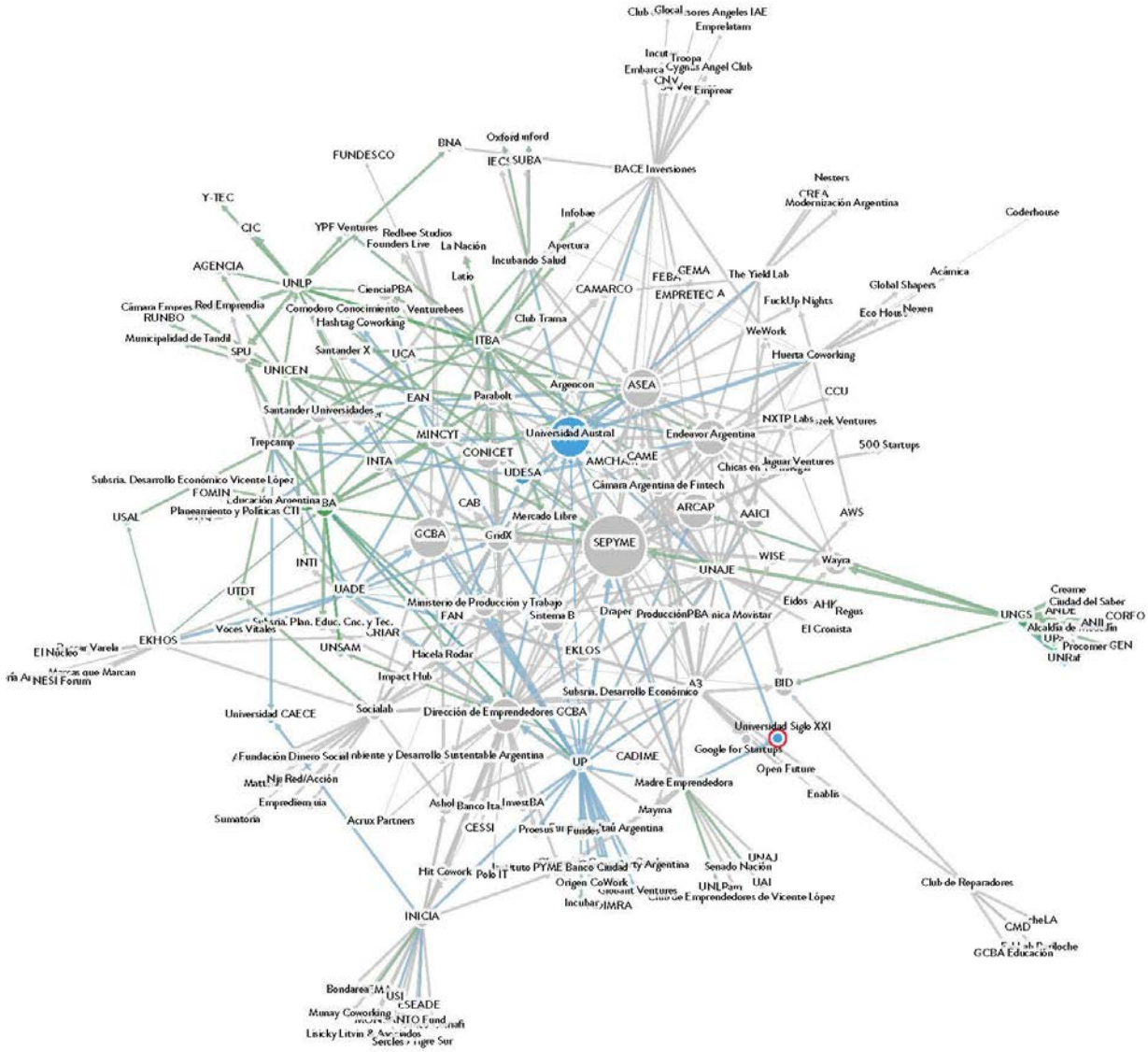
It was also noted that there was a lack of awareness of the opportunities available for the academic sector to engage with the productive sector. This means that it takes time for approaches and relations to mature to the point that parties have a clear understanding of the language in use have received the necessary training and are able to implement joint transfer actions.

Informality, related to the point above, was also identified as a potential barrier to effective knowledge transfer activities. Given that small- and medium-sized enterprises (SMEs) or third-sector institutions are dominant in the country, a culture has been forged which is strongly concentrated on rudimentary processes or with limited access to information technologies that favour linkages. This produces a lack of knowledge about university-based possibilities, thus generating gaps in access to transfer.

Ecosystem analysis of Buenos Aires and the role of Siglo 21

While the Córdoba ecosystem has not been studied with the methodology used in the report, Siglo 21 is also an actor in the ecosystem of Buenos Aires. As evidenced by the analysis carried out by Global Ecosystem Dynamics, in collaboration with MIT D-Lab and supported by Santander Universidades, as part of its Participatory Innovation Ecosystem Mapping of the innovation-driven entrepreneurial economic ecosystems of Buenos Aires, the University of Siglo 21 plays a role within it.

Figure 8.1. Ecosystem analysis of Buenos Aires and the role of Siglo 21



Note: This figure provides a visualisation of the collaborations between actors of the economic ecosystem of the city of Buenos Aires with a node size dependent on the number of mentions by other participants and the strength of said mentions (weighted in degree), highlighted in blue the universities categorised as Enablers, those focusing primarily on education and capacity building, and in green the universities categorised as Knowledge Generators, those focusing primarily on research and the development of new technologies. These visualisations, along with the interpretation of each node's centrality metrics, allow for the analysis of the positioning of universities mentioned within their innovation-driven entrepreneurial economic ecosystem.

There could be a dissonance between what the university sees as its presence in the ecosystem and what this independent mapping exercise finds. Data collection for each ecosystem was conducted by first identifying as many actors as possible through desk research, which were in turn invited to attend a workshop on strengthening innovation-driven entrepreneurial economic ecosystems and fill an online survey regarding their social dynamics with other actors.

Source: Tedesco, M. (2022[1]), "How and why to study collaboration at the level of economic ecosystems", *D-Lab Working Papers: NDIR*, MIT D-Lab.

In the city, the second-largest number of involved universities among the Latin American economic ecosystems was observed (Tedesco, 2022[1]), with 27 universities, 11 of which are enablers and 16 knowledge generators.

However, Austral University alone was recognised as a gravitational centre, with 12 collaboration mentions in the study, highlighting that this university was not part of the data collection.

On the other hand, Siglo 21, which did not take part in the data collection, also appears to have marginal participation in the ecosystem structure according to the metrics shown by the Complex Network Analysis modelling.

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Notes

[1] For more information, see https://21.edu.ar/noticias/mas-de-8000-personas-vivieron-feria-21-vincular-cordoba.

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9 Case study in Uruguay

This chapter analyses the Technological University of Uruguay UTEC's efforts to support entrepreneurship education, and knowledge transfer activities. It also studies the connections that the university has generated with external stakeholders through these activities in the ecosystem of Montevideo and at a national level.

Technological University of Uruguay (UTEC)

UTEC is a public university with a technological character, focused on research and innovation, and offers careers in engineering, arts and applied sciences. It has branches in eight regional departments outside the capital city of Montevideo (Colonia, Mercedes, Rio Negro, Paysandú, Durazno, San José, Maldonado, Rivera), and 4 000 students. The university's ambition is to foster technological development across countries and establish strong links with local communities and the productive sectors.

Entrepreneurship education

UTECinnova is a department of innovation and entrepreneurship that aims to stimulate crosscutting capabilities, and foster research linked to the productive sector, whilst offering a technological services platform. The department aims to develop 21st-century competencies in students by offering a range of career paths based on a wide range of electives. In addition, all majors at the university require students to demonstrate a set of professional competencies, which include entrepreneurial aptitudes, and is offered to students on any career track with business ideas. Extracurricular activities at the university include hackathons, innovation weeks centred on problem-solving workshops and the 2018 Start-up Weekend, which allowed participants to receive support and feedback on their idea as well as foster exchanges with major enterprises.

Connection with the ecosystem driven by entrepreneurship education

UTEC is part of the *Uruguay Emprendedor* entrepreneurship network supported by the National Agency for Research and Innovation (ANII) and supports the development of local ecosystems. UTEC is collaborating with ORT University's Centre for Innovation and Entrepreneurship, as part of the "*ARENA emprendedora*" project, which aims to enhance the entrepreneurial skills of women on the Durazno, Mercedes, Paysandú and Rivera campuses.

The university also hosts Lab-A UTEC, a lab and space dedicated to digital technologies where students, professionals, artists and the community can exchange. The lab has a presence on three campuses: Durazno, Frey Bentos and Rivera. The lab also encompasses an incubation programme for technological entrepreneurship ventures. It offers a space for the design of electronic programmes and prototype conception, as well as support on how to obtain seed funding.

Furthermore, the Program for the Promotion of Research, Development and Innovation (IDEI) (*Programa de Fomento de la Investigación, Desarrollo e Innovación*) supports research, development and innovation and organises workshops to support creativity innovation, problem-solving, decision-making and collaboration. It also organises technological innovation projects with the industry sector, particularly enterprises in the agri-business sector.

Impact of the COVID-19 pandemic on entrepreneurship education

Over the space of two months, the university was able to transpose all activities to a virtual format of some kind, adapting most courses to student modalities. Lab activities were particularly difficult to adapt, however, and the adaptation process led to new types of virtual courses. The university also reported that sustaining human contact was challenging, particularly when it came to keeping in touch with entrepreneurs. This was managed by implementing regular virtual catch-ups with teams developing an entrepreneurial idea.

Remaining challenges related to entrepreneurship education

One of the university's future ambitions is to encourage the development of strategic research groups of an interdisciplinary nature, based on better identification of demands and gaps in the industry. There is also a desire to develop technology transfer offices (TTOs), which work on industrial property.

Knowledge transfer strategy

As a technical university, promoting technology transfer and innovation is a central part of its mission. In the university's strategic plan for 2021-25, the creation of a technological service platform and a technology transfer unit is highlighted. The university has a knowledge transfer strategy that is tailored to the needs of the ecosystem. Through its 11 campuses located across the country, it aims to bring education to remote territories (80% of the higher education offer is located in Montevideo) and enable higher participation of adults in the higher education system (which is low at 20%). The university also tailors its curriculum, research and transfer activities to adapt to the demands of local stakeholders. In fact, each campus was created to respond to local demands.

Connection with the ecosystem driven by knowledge transfer activities

Knowledge transfer activities are decentralised and carried out at the campus level. Each campus is located in a productive region. For instance, the campus located in the north of the country on the border with Brazil has a different specialisation in order to adapt to the productive industries present there (logistics and commerce) compared to the campus located in the southwest on the border with Argentina which links its activity with the export industry focused on dairy and agri-food products. Meanwhile, the university's geographically central campus specialises in sustainable development and renewable energy.

Each campus has the freedom to conduct its transfer activities through the channels considered appropriate and has a designated "transfer co-ordinator". The university regularly provides analytical services, consultancy and contract research to local businesses and the government. It also has open labs accessible to the community. Its main partners are private sector companies and local governments, but collaboration also takes place with national government agencies (such as the National Agricultural Research Institute and the National Patent Office). The university also collaborates with international entities and has recently developed a partnership with a coding boot camp, 4Geeks Academy, which offers coding and artificial intelligence courses in a short (four month) highly intensive format pioneering this modality among Latin American universities. This initiative is supported by the Inter-American Development Bank (IDB) and is carried out in consultation with the private sector.

Stakeholders reported during the interview a high degree of co-operation between campuses, despite their different specialisations. The Technological Services Platform (managed at the central level) includes dedicated personnel to support engagement activities and advise all campuses on technology transfer.

Incentives for staff to engage in knowledge transfer activities

Staff are able to benefit from an extra payment for their participation in projects and services related to transfer activities. During staff evaluations, knowledge transfer is considered as important as teaching and research activities. Academics also receive compensation if they agree to relocate to a city different to their city of origin.

Remaining challenges related to knowledge transfer activities

At present, a key difficulty is identifying the needs of the productive sector ecosystem. Traditional industries present in the country (for instance the agriculture industry) do not have the capacity to absorb technological innovation. In addition, most local businesses are small- and medium-sized enterprises (SMEs) with no previous experience of working with academic institutions. The university also faces internal obstacles such as incomplete policies and guidelines to promote knowledge transfer. There is also a lack of resources allocated to knowledge transfer, no specific budget line and no legal services to support the development of intellectual property. The university reported its ambition to incorporate staff with technological expertise.

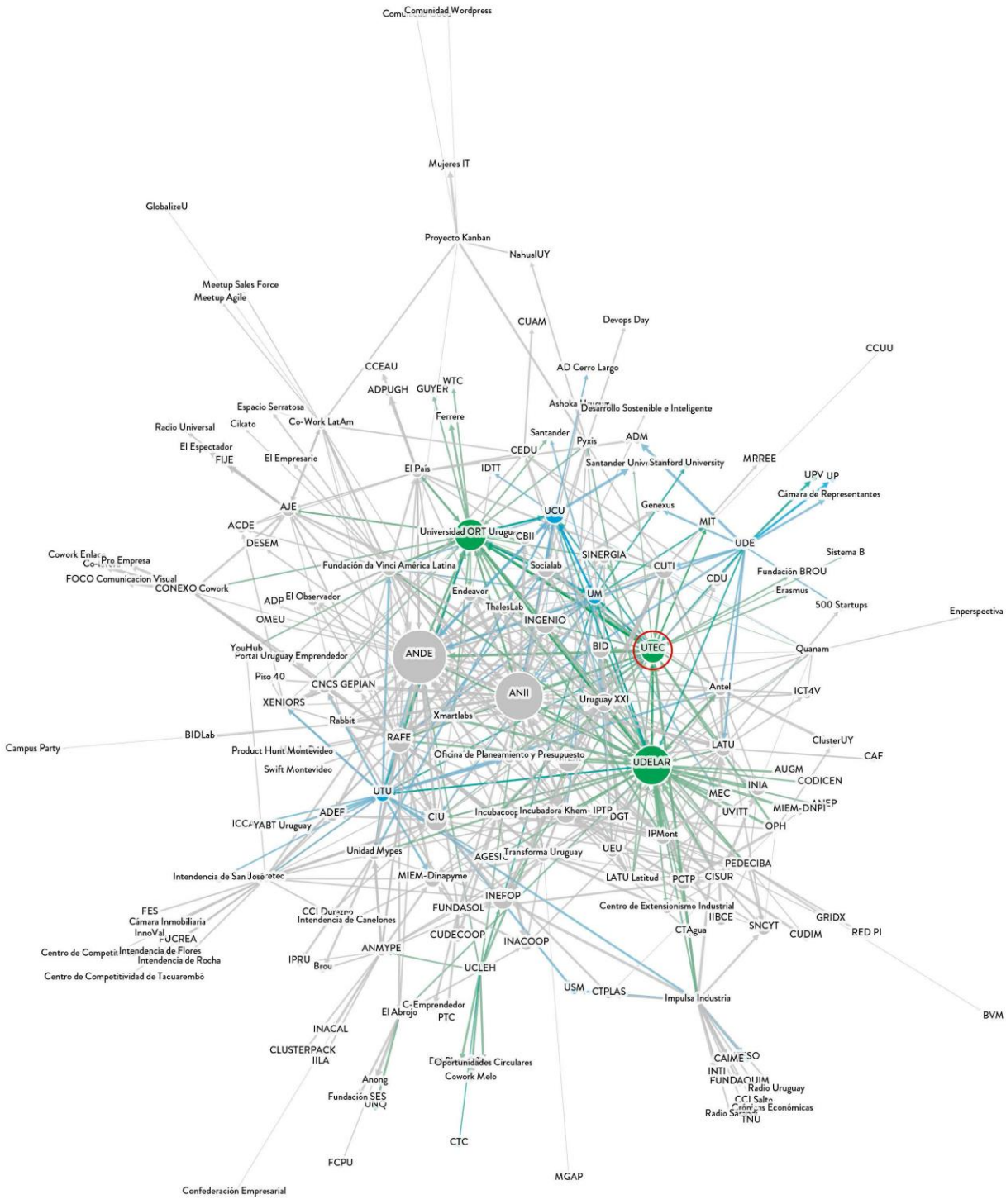
Ecosystem analysis of Montevideo and the role of UTEC

As evidenced by the analysis carried out by Global Ecosystem Dynamics in collaboration with MIT D-Lab and supported by UTEC and ANDE as part of its Participatory Innovation Ecosystem Mapping of the innovation-driven entrepreneurial economic ecosystems of Montevideo, UTEC is a significant player within it.

Fifteen universities were identified within the Montevideo ecosystem (Tedesco, 2022[1]). Of these, seven are knowledge generators and eight are enablers. The University of the Republic, ORT Uruguay University, UTEC and the Catholic University of Uruguay have a solid position in the ecosystem, and they are considered gravitational centers.

It is worth noting that UTEC, despite not having a physical academic presence in Montevideo, given it is focusing its efforts on other parts of the country, is a fundamental actor in Montevideo's ecosystem structure, indicating its potential as a redistributor of resources from the entrepreneurial and innovation pole of the capital to the rest of the country.

Figure 9.1. Ecosystem analysis of Montevideo and the role of the UTEC



Note: This figure provides a visualization of the collaborations between actors of Montevideo's innovation-driven entrepreneurial ecosystem with a node size dependent on the number of mentions by other participants and the strength of said mentions (weighted in degree), highlighting in blue the universities categorised as Enablers, those focusing primarily on education and capacity building, and in green the universities categorised as Knowledge Generators, those focusing primarily on research and the development of new technologies. These visualisations, along with the interpretation of each node's centrality metrics, allow for the analysis of the positioning of universities mentioned within their innovation-driven entrepreneurial economic ecosystem.
There could be a dissonance between what the university sees as its presence in the ecosystem and what this independent mapping exercise finds. Data collection for each ecosystem was conducted by first identifying as many actors as possible through desk research, which were in turn invited to attend a workshop on strengthening innovation-driven entrepreneurial economic ecosystems and fill an online survey regarding their social dynamics with other actors.
Source: Tedesco, M. (2022[1]), "How and why to study collaboration at the level of economic ecosystems", *D-Lab Working Papers*, MIT D-Lab, Massachusetts Institute of Technology, Cambridge.

Reference

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OECD Skills Studies

Innovative and Entrepreneurial Universities in Latin America

The review examines how higher education institutions are supporting innovation and entrepreneurship in their surrounding communities. The study focuses on eleven universities located in six countries in Latin America: Chile, Colombia, Mexico, Brazil, Argentina and Uruguay.

The study finds that selected institutions are actively supporting entrepreneurs (university students, but also local entrepreneurs) through courses, incubation and acceleration activities. It also shows that universities are actively engaging with external stakeholders in their surrounding communities, to spur innovation through joint-research, organisation of events (such as festivals, competition). It finds that that while COVID-19 pandemic brought about some challenges, universities managed to stay afloat and keep a steady stream of support to entrepreneurs and partners. The review also illustrates the challenges that universities face when developing these activities (lack of funding, unclear regulation for intellectual property development, etc.) and highlights some opportunities that universities should leverage, particularly in the current context.

In collaboration with Santander

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