



Scale2Connect:

Expanding Skills2Scale
Alliance to enhance the
academia- enterprise
collaborations for Deep-
Tech Innovations

Strengthening the Role of Universities in Deep-Tech Ecosystems: Evidence from Emerging Regions



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Scale2Connect

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**Strengthening the Role of Deep-Tech Ecosystems: Evidence from Emerging Regions
Scale2Connect Project (Grant Agreement: 101214553)**

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Abstract

This white paper presents the results of an ecosystem analysis conducted within the Scale2Connect project, focusing on strengthening the role of Higher Education Institutions (HEIs) in emerging deep-tech innovation ecosystems. Covering regions in Portugal, Spain, and the Dominican Republic, the study combines ecosystem mapping and stakeholder engagement to identify key challenges and opportunities.

The findings highlight fragmented collaboration between academia and industry, limited support for deep-tech entrepreneurship, and underutilised potential of HEIs in driving innovation. At the same time, they reveal strong opportunities to enhance knowledge transfer, entrepreneurial capacity, and cross-sector partnerships.

Building on these insights, the paper adopts an ecosystem-based approach to innovation, emphasising the strategic role of universities as connectors within regional ecosystems. The results provide evidence-based guidance for strengthening deep-tech innovation environments in emerging regions.

Keywords

Deep tech, innovation ecosystems, higher education institutions, academia–industry collaboration, entrepreneurship, knowledge transfer, startup ecosystems, ecosystem mapping, emerging regions, university innovation, technology transfer, capacity

building

Executive Summary

Innovation ecosystems are critical drivers of economic growth, technological advancement, and societal transformation. In emerging regions, however, these ecosystems often remain fragmented, with limited collaboration between key actors such as universities, industry, startups, and policymakers. Strengthening these connections, particularly the role of Higher Education Institutions (HEIs), is essential for unlocking the full potential of deep-tech innovation.

This white paper presents the findings of an ecosystem analysis conducted within the Scale2Connect project, a Horizon Europe initiative aimed at enhancing academia–enterprise collaboration in emerging innovation ecosystems. The analysis focuses on three regions, Portugal, Spain, and the Dominican Republic, and combines ecosystem mapping with stakeholder engagement and co-design workshops.

The results reveal that while all three regions demonstrate strong research capacity and growing interest in deep-tech innovation, significant structural challenges persist. These include weak university–industry linkages, limited access to funding and support mechanisms for deep-tech startups, and insufficient integration of entrepreneurial training within higher education systems. At the same time, the analysis highlights a clear opportunity for HEIs to act as central nodes within innovation ecosystems by facilitating knowledge transfer, supporting startup creation, and fostering cross-sector collaboration.

Key findings include:

- **Underutilised role of HEIs** in innovation ecosystems, particularly in connecting research with market applications
- **Fragmented stakeholder landscapes**, limiting effective collaboration and knowledge exchange
- **Limited support structures for deep-tech entrepreneurship**, especially in early-stage development
- **Strong potential for ecosystem growth** through targeted interventions and cross-regional collaboration

Building on these insights, the paper adopts an ecosystem-based approach inspired by the methodology of another project, Skills2Scale, emphasising the importance of strengthening HEI engagement across the innovation value chain. It highlights the need for integrated actions that combine capacity building, startup support, and ecosystem networking.

The findings suggest that targeted interventions can significantly enhance the role of universities in deep-tech ecosystems. These include strengthening entrepreneurial education for researchers, creating structured collaboration mechanisms between academia and industry, and improving access to funding and support services for innovation-driven startups.

Ultimately, this white paper contributes to a deeper understanding of how emerging innovation ecosystems can be strengthened through a more active and strategic role of HEIs. The insights presented aim to support policymakers, universities, and ecosystem actors in designing effective strategies that foster sustainable, inclusive, and competitive deep-tech innovation environments.

About the Scale2Connect project

Scale2Connect is a Horizon Europe project that aims to strengthen collaboration between Higher Education Institutions (HEIs), industry, and innovation actors in emerging deep-tech ecosystems. The project focuses on enhancing the role of universities as key drivers of innovation, entrepreneurship, and knowledge transfer.

Bringing together partners from Europe and the Dominican Republic, Scale2Connect works to improve the integration of HEIs within regional innovation ecosystems, support deep-tech entrepreneurship, and foster stronger connections between academia and the market. Through ecosystem analysis, co-design workshops, and targeted capacity-building activities, the project develops and implements an ecosystem-based approach to innovation inspired by the Skills2Scale model.

By promoting knowledge exchange, cross-regional collaboration, and sustainable innovation practices, Scale2Connect contributes to the development of more inclusive, connected, and competitive deep-tech ecosystems.

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1. Introduction

This White Paper presents a comprehensive Ecosystem Analysis Report that maps and analyses the innovation landscapes surrounding the partner institutions involved in this project. This report establishes an understanding of the main strengths, barriers, and opportunities within our respective regional innovation ecosystems, with particular emphasis on deep technology innovation and entrepreneurship.

The primary aim of this report is to identify, categorize, and analyse the innovation ecosystems in which our partner institutions operate. Through this analysis, UCP (Universidade Catolica Portuguesa), UMA (Universidad de Málaga), and UAPA (Universidad Abierta Para Adultos) have each conducted mapping exercises within their local contexts, identifying key stakeholders per region. These stakeholders represent a spectrum of innovation ecosystem actors, including:

- Higher Education Institutions (HEIs)
- Research institutions and centres
- Startups and scale-ups
- Small and Medium-sized Enterprises (SMEs)
- Large corporations
- Investors (venture capital, business angels, investment funds)

- Incubators and innovation hubs
- Accelerators, incubators, and business support organizations
- Public bodies and government agencies

Deep tech startups are early-stage companies built around proprietary scientific or engineering innovations that address complex technological challenges. These ventures are typically spin-offs from academic research or founded by teams with specialized technical expertise, and they aim to commercialize breakthrough technologies with transformative potential.

The report focuses on the following deep technology domains:

- Artificial Intelligence and Machine Learning: including neural networks, natural language processing, computer vision, and autonomous systems
- Robotics and Automation: including autonomous systems, industrial robotics, and human-robot interaction
- Space Technology and Aerospace: covering satellite systems, propulsion technologies, and space exploration applications
- Advanced Manufacturing: including additive manufacturing, Industry 4.0 technologies, and digital fabrication
- Advanced Communications and Networking: including mobile networks (5G/6G), edge and cloud-native networking.

The following sections present the mapping methodology and analysis of each partner's regional ecosystem, providing insights into stakeholder composition, collaboration potential, and strategic opportunities for advancing deep technology innovation within our respective contexts.

2. Local Innovation Ecosystem Mapping Methodology

2.1. The Sample

The empirical foundation of this research is based on three regional innovation ecosystems represented by institutions from Spain, Portugal, and the Dominican Republic. These regions offer a diverse landscape to examine innovation dynamics, ranging from emerging to advanced ecosystems. These cases allow for comparative analysis across varied innovation capacities and socio-economic contexts. The selected countries reflect geographic, economic, and institutional diversity across various cultural and policy environments.

Spain contributes deep tech expertise, particularly in 5G, 6G and advanced communications, and brings valuable insights from the development of regional innovation hubs. Spain bridges moderate and strong innovator status in the EU and serves as a model for scaling and strengthening innovation ecosystems with growing

specialization. Portugal offers perspectives from an emerging ecosystem, shedding light on the institutional challenges and opportunities in building innovation capacity. Portugal’s efforts to attract international talent and boost entrepreneurship make it an ideal context for testing scalable ecosystem models. The Dominican Republic extends the study’s scope beyond the EU, offering a unique lens into innovation challenges in developing economies. The Dominican Republic represents an emerging ecosystem where institutional capacity-building and international collaboration are critical. This inclusion allows for testing the adaptability of the model in a non-European context.

2.2 Data Collection

The study used a mixed-methods approach to ensure a comprehensive understanding of regional innovation ecosystems, combining both quantitative and qualitative data collection strategies. As a first step, we developed a standardized methodology and template for ecosystem mapping, which was then used to identify and classify key stakeholders in each region. These stakeholders include a wide range of ecosystem actors, including higher education institutions, startups, investors, incubators, accelerators, and other relevant organizations. All mapped stakeholders are listed in Table 1. This process was the foundation for deeper analysis by providing a structured overview of each region’s innovation landscape.

Data for the ecosystem mapping were collected and managed in accordance with applicable ethics and privacy regulations, including GDPR and other relevant legislation. Only the information necessary to achieve the mapping objectives was gathered. All data collection partners followed these requirements, and project activities were continuously monitored to ensure compliance. The resulting dataset is aligned with the FAIR principles (Findable, Accessible, Interoperable, and Reusable).

Table 1. Ecosystem mapping of the key stakeholders identified in each region

| Region | Type of stakeholder | Nr of records |
|--|-------------------------------------|---------------|
| Lisbon’s Regional Innovation Ecosystem | Deep Tech Startups | 9 |
| | HEIs | 5 |
| | Research Institutions | 7 |
| | Investments | 9 |
| | Public Bodies | 8 |
| | SMEs | 5 |
| | Large Corporations | 3 |
| | Community Builders | 2 |
| | Innovation Support entities or NGOS | 11 |
| | Total: | 59 |
| Malaga’s Regional Innovation Ecosystem | Deep Tech Startups | 8 |
| | HEIs | 3 |
| | Research Institutions | 6 |
| | Investments | 3 |
| | Public Bodies | 7 |

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| | | |
|--|-------------------------------------|-----------|
| | SMEs | 13 |
| | Large Corporations | 12 |
| | Innovation Support entities or NGOS | 8 |
| | Total: | 60 |
| Santiago de los Caballeros' Regional Innovation Ecosystem | Deep Tech Startups | 6 |
| | HEIs | 8 |
| | Research Institutions | 5 |
| | Investments | 0 |
| | Public Bodies | 10 |
| | SMEs | 16 |
| | Large Corporations | 1 |
| | Innovation Support entities or NGOS | 6 |
| | Total: | 52 |

Building on this foundation, an online survey was conducted, including 20 stakeholders in each of the three regions (see respondents' attributes in Table 2). These surveys were designed to capture quantitative insights into the strengths and gaps of the local ecosystems, as well as the specific needs and opportunities perceived by stakeholders involved in innovation activities. The data gathered through the surveys enabled cross-regional comparisons and helped identify common patterns or unique challenges.

Table 2. Survey respondents per region

| Region | Type of stakeholder | Nr of records |
|--|-------------------------------------|---------------|
| Lisbon's Regional Innovation Ecosystem | Deep Tech Startups | 2 |
| | HEIs | 7 |
| | Research Institutions | 2 |
| | Public Bodies | 1 |
| | SMEs | 3 |
| | Large Corporations | 1 |
| | Innovation Support entities or NGOS | 4 |
| | Total: | 20 |
| Malaga's Regional Innovation Ecosystem | HEIs | 3 |
| | Research Institutions | 2 |
| | Public Bodies | 1 |
| | SMEs | 5 |
| | Large Corporations | 7 |
| | Other | 2 |
| | Total: | 20 |
| Santiago de los Caballeros' Regional Innovation Ecosystem | Deep Tech Startups | 1 |
| | HEIs | 7 |
| | Investment | 1 |
| | Public Bodies | 2 |
| | SMEs | 2 |
| | Large Corporations | 2 |
| | Innovation Support entities or NGOS | 5 |
| | Total: | 20 |

To complement the survey findings and deepen the analysis, in-depth interviews were

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carried out with selected stakeholders, 10 interviews in each region (see Table 3). These interviews provided qualitative data on collaboration patterns, perceived gaps, and innovation processes. To enhance data validity, we ensured the confidentiality and anonymity of the interviewees, with their explicit consent to encourage open discussion.

The purpose of the interviews was to validate and enrich survey findings, explore context-specific factors influencing collaboration, and feed into co-design workshops. Together, the mapping, surveys, and interviews offer a comprehensive picture of the ecosystems, supporting both regional analysis and comparative research across different innovation contexts. See interview guide in Appendix I.

Table 3. Interviewees’ information: the stakeholders, their position, and code

| Region | Type of stakeholder | Position | Code |
|---|-------------------------------------|---|------|
| Lisbon’s Regional Innovation Ecosystem | Deep Tech Startup | AI researcher | A1 |
| | Deep Tech Startup | Presales Engineer & Partnerships | A2 |
| | Deep Tech Startup | Co-Founder & AI Engineer | A3 |
| | Community builder | Lisbon AI week co-founder, AI tooling engineer | A4 |
| | Community builder | CEO of product weekend | A5 |
| | Private Capital | Angel investor | A6 |
| | Innovation Support | Startup mentor | |
| | Deep-tech Startup | Co-founder | |
| | Private Capital | Angel investor | A7 |
| | Public Authority | Expert Evaluator (European Commission) | |
| Deep-tech Startup | Co-founder | | |
| Accelerator | Digital product manager | A8 | |
| University incubator | Vice president, R&D project manager | A9 | |
| Accelerator | Innovation manager | A10 | |
| Malaga’s Regional Innovation Ecosystem | Deep Tech Startup | Founder of university spin of technology-based startup | B1 |
| | Deep Tech Startup | Founder of an AI startup | B2 |
| | SME | Co-founder of the technology-based company, professor on languages and computer systems | B3 |
| | SME | Project coordinator | B4 |
| | SME | R&D of solar panels for satellite technology | B5 |
| | Research Centre | Senior scientist at the Spanish National Research Council | B6 |
| | Corporate | Analyst | B7 |
| | Public Body | IT and telecommunications unit of the Local Police | B8 |
| | Accelerator | Project coordinator | B9 |
| | Large Corporation | R&D manager | B10 |
| Santiago de los Caballeros’ Regional Innovation Ecosystem | HEI | Vice rector in a virtual distance higher education institution | C1 |
| | NGO | Vice president and the director of operations of the NGO | C2 |
| | Software development company | Manager | C3 |
| | Consultant | Expert consultant for social impact | C4 |
| | Accelerator | Startup mentorship | C5 |
| | Public Body | National Industrial Property Office, granting trademarks | C6 |
| | Entrepreneurship | Innovation and projects manager for financial services | C7 |

| | | |
|----------------------|------------------------------|----|
| organisation | | |
| Software development | Technology director | C8 |
| company | | |
| NGO | Training director of the NGO | C9 |
| C10 | | |

2.3 Data Analysis

The interview data analysis was conducted in a systematic, multi-stage process for each region separately. First, each regional representative created summary tables for the interviews conducted in their region, extracting key themes and insights from the stakeholder conversations. All the interview transcripts and summary tables were then reviewed to identify patterns and themes within each region. Using NVivo 15 software to support the coding and synthesis process, preliminary findings on the main strengths, barriers, and opportunities emerging from the interviews were drafted. This qualitative analysis enabled depth of understanding through stakeholder perspectives and experiences within each regional innovation ecosystem.

The survey data analysis was conducted separately for each region, calculating average scores for quantitative indicators to assess ecosystem maturity and collaboration quality. These quantitative findings provided additional validation and context for the interview insights, confirming and enriching the themes identified through qualitative analysis. The final regional assessments integrated both data sources, with survey results complementing the depth of interview findings with measurable indicators. A comparative analysis across the three regions was then conducted in Chapter 4 to identify common themes and regional differences in innovation ecosystem characteristics.

3. Assessment Results

3.1. Lisbon's Ecosystem Overview

The assessment of Lisbon's innovation ecosystem in Portugal (Figure 1), based on interviews with ten key stakeholders spanning accelerators, community builders, investors, and startup founders, reveals an emerging but maturing landscape. The data shows that the main strengths are growing early-stage support mechanisms, corporate innovation initiatives, and student entrepreneurial initiatives. The main barriers identified include bureaucratic complexity, collaboration misalignments, and a risk-averse culture. The opportunities lie in using AI as an enabler for innovation, adopting a problem-driven approach to collaboration, and using the small domestic market as a driver for developing a global mindset. These main findings are listed in Table 4, and each point is elaborated in chapters 3.1.1–3.1.3

Table 4. Overview of the Lisbon ecosystem mapping key insights

| Section | Key Insights | Quotes/Examples/Highlights |
|---------|--------------|----------------------------|
|---------|--------------|----------------------------|

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| | | |
|----------------------------|---|---|
| Ecosystem Strengths | Growing early-stage support mechanisms | <p>"They're really great with the program, especially for first-time founders, people with not a lot of business experience. They try to create a variety of topics and themes to educate those founders." A6</p> <p>"In Portugal you have money for early stage and the first seed rounds, I think there is no problem with that. When you come with later stages" A7</p> |
| | Corporate innovation initiatives | <p>"Big companies like EDP, Galp, Fidelidade have been the most curious in allowing the startups to collaborate with them." A8</p> <p>"Companies like EDP, Galp, and Vodafone help with programs, prizes, and awards for startup challenges and hackathons." A7</p> |
| | Student entrepreneurial initiatives | <p>"In terms of promoting the startup ecosystem in university students, especially engineering students, Junitec has done a phenomenal job with their incubation program." A2</p> <p>"The several students that gathered and tried to push forward the innovation and entrepreneur mindset inside the university." A7</p> |
| Barriers | Bureaucratic complexity | <p>"We have a regulatory friction that is a lot bigger here than in the US. The public procurement cycles are very slow and very long." A7</p> <p>"Lots of bureaucracy creates bottlenecks and critical parts. Nothing can be done in parallel." A6</p> |
| | Academia-industry collaboration challenges | <p>"Industry wants to move really quick and doesn't really care if the models are open source or not, academia has different incentives." A3</p> <p>"Most of the times universities are more on the academia side, so they don't see with very good eyes companies and companies have their own timelines." A9</p> |
| | Risk-averse culture | <p>"The biggest problems I would say is there's a lot of lack of funding for big tech specifically because big tech you need big dollars, and the investors don't have that good risk profiles." A2</p> <p>"The VC space in Portugal is still underwhelming and angels as well. I think that they're very risk averse compared to the US and even the UK." A6</p> |
| Opportunities | AI an accelerator for innovation | <p>"AI is unlocking a lot of potential in the sense of like companies or people, entrepreneurs with limited access to funding and opportunities can build much more, much faster." A4</p> <p>"The route to actually achieving something would have been really, really different, in one week we would be able to have our prototype running and testing already." A2</p> |
| | Problem-driven approach for collaboration | <p>"The desire, for example, to bring impact to our community. A lot of people love Portugal, and they want to see a difference." A9</p> <p>"If academia starts with challenges that the companies have, then they already build something that has a purpose." A8</p> <p>"Organize different activities where you bring a company...they just organize a hackathon with a university where the winner will get one year of free tuition and the opportunity to work at that company." A2</p> |
| | Small domestic market driving for developing a global mindset | <p>"The most pressing issue is that like is if you are like selling to the Portuguese market, most companies don't have the buying power or just infrastructure needed to adopt AI at scale." A3</p> <p>"We are a small country. So, every time someone starts or tries to start a startup in Portugal, they ultimately need to think overseas. I'd say that gives you a big advantage because you're not focusing on</p> |

your local market, you're focusing on the world market." A2



Figure 1. Geographic location of Lisbon, Portugal

3.1.1. Ecosystem Strengths

The data shows three main strengths emphasised from the interviewees: (1) growing early-stage support mechanisms, (2) corporate innovation initiatives (3) student entrepreneurial initiatives.

Growing early-stage support mechanisms

The Lisbon innovation ecosystem demonstrates growing infrastructure development, particularly in early-stage startup support mechanisms, with multiple organizations actively supporting startup formation and growth. Survey results confirm this assessment, with the overall maturity of the regional innovation ecosystem ranked at 3.5 out of 5, and respondents identifying industry, academia, and private capital as the most influential actors, primarily in the AI, energy, healthcare, and ICT sectors.

A2 (Table 4), with his 10-year engagement in the ecosystem, identified key players: "Startup Lisboa and Startup Portugal have been active in organizing events, bringing startups together for either events, workshops, meetings with investors, meeting other founders, going to Web Summit or international events in Brazil and Canada." He

highlighted Unicorn Factory Lisbon as an accelerator program attempting to build "Y Combinator or Tech Stars type programs," noting success in food and tourism sectors. A3, a deep tech startup founder, confirmed the value of organizational support: "Unicorn Factory has been doing a nice job organizing events, getting people to come here, helping companies get leads but also demystifying AI, both risks, limitations and opportunities."

The ecosystem demonstrates a stronger support for early-stage startup mechanisms. Survey results confirm that incubators, accelerators, and networks are the main support mechanisms in the ecosystem. A6, an investor, assessed accelerator programs from a participant perspective: "They're really great with the program, especially for first-time founders, people with not a lot of business experience. They try to create a variety of topics and themes to educate those founders." He specifically valued mentorship access: "The mentors they have got access is really solid, more than 100 mentors available at Unicorn Factory Lisboa and that you can reach out."

Beyond formal organizational support, Lisbon demonstrates a vibrant builder community that provides informal networking and collaboration opportunities. A4, a community builder active in organizing AI-focused events, emphasized the community dimension: "I think we have a very big builders' community in Portugal. You can see that by checking event pages like Luma or Meetup, where there is always something happening in Lisbon, especially around tech." From his organizing experience with Lisbon AI Week, he noted consistent community engagement and institutional participation: "I've seen very cool projects starting in Lisbon from being in this type of events. Everyone who attends this type of events, whether they're speaking or not, is building something, which is quite impressive for a country as small as Portugal to have this type of community."

A clear consensus emerged regarding the Portuguese funding landscape's distinct characteristics at different stages. While early-stage capital availability receives positive assessment, later-stage funding represents a systematic constraint on company scaling. A7 described the landscape: "In Portugal you have money for early stage and the first seed rounds, I think there is no problem with that. When you come with later stages, Series A, B, and so on, you will have some four or five players, not more." A6 characterized the overall venture capital landscape as "still underwhelming," noting that Portuguese investors are "very risk averse compared to the US and even the UK." A2 observed that Portuguese venture capitalists "behave more like private equity funds, less VC funds," suggesting a misalignment between the risk profiles required for venture capital and actual investment behaviour in the market. Survey results confirm this gap, indicating limited support beyond early startup stages and difficulty translating innovation into broader economic impact.

Corporate innovation initiatives

Participants identified specific large companies demonstrating meaningful commitment to startup collaboration and innovation programs. These corporate players provide resources including pilot opportunities, technical infrastructure access, commercial relationships, and market validation for emerging ventures.

A8, from her accelerator experience facilitating corporate-startup connections, identified key players: "Big companies like EDP, Galp, Fidelidade have been the most curious in allowing the startups to collaborate with them." She characterized their approach as enabling "practical pilots," emphasizing that genuine collaboration involves actual product testing rather than superficial engagement. A7 supported these corporate players: "Companies like EDP, Galp, and Vodafone help with programs, prizes, and awards for startup challenges and hackathons."

However, A7 distinguished between different corporate engagement approaches: "Some of them are more investing in the design area because of brand awareness and not trying to gather knowledge inside the corporates. But I think Galp and Breeze are good examples of corporates that invest in this sector, but also besides the brand awareness, they got other tools, new angles of approach to the market, new solutions to their core business." A8 also noted evolution in corporate motivation: "In the beginning it was like a marketing expense just to be perceived as innovators, but nowadays it's more innovation companies really looking to work with these companies. I believe there is still a bit of marketing here, but it is becoming a little bit more real."

This suggests movement from brand-oriented innovation toward considerable technology integration and business model experimentation. The consistency of specific company mentions across multiple participant types suggests these organizations have achieved ecosystem-wide recognition for their innovation engagement. However, the equally consistent observation that "there should be many more" such companies indicates this represents a small subset of Lisbon's corporate landscape rather than widespread practice across large firms.

Student Entrepreneurial Initiatives

Participants identified entrepreneurial energy and initiative among university students as a notable ecosystem strength. This entrepreneurial drive manifests through student clubs, thesis projects choosing startup-relevant topics, participation in hackathons and competitions, and willingness to join early-stage ventures despite uncertainty.

A2, from his experience both as a former university student and now as a startup founder collaborating with universities, provided evidence of student-driven entrepreneurial infrastructure: "In terms of promoting the startup ecosystem in university students, especially engineering students, Juntec has done a phenomenal job with their incubation program. It is open to other universities, not just Técnico. And then also the hackathon they do for all university students across the country." A9, from

within Junitec, described their bridging function: "Our role was to bridge the gap between academia and the startup environment in the industry." This suggests student organizations create infrastructure that universities themselves do not provide institutionally.

A7 characterized students as the primary source of university innovation: "Most of these come from the students, not so much from the universities." He emphasized their initiative: "There are several universities that have entrepreneur clubs like Técnico Liga" and noted that entrepreneurial activity primarily originates from "the several students that gathered and tried to push forward the innovation and entrepreneur mindset inside the university."

The evidence also indicates students actively seek startup-relevant experience during their studies. Multiple founders described supervising master thesis students who deliberately choose applied projects with commercial potential. A1 noted: "We are very active in having master thesis students that work directly with us," indicating student willingness to engage with startups rather than purely academic projects.

3.1.2 Lisbon's Gap Analysis

The data shows three main barriers emphasised from the interviewees: (1) bureaucratic complexity (2) academia-industry collaboration challenges and (3) risk-averse culture.

Bureaucratic complexity

The most broadly identified barrier across all ten interviews relates to bureaucratic complexity in accessing and receiving government support. This goes beyond simple administrative inconvenience to represent a threat to startup survival and an obstacle to innovation participation. Survey results confirm these challenges, with respondents describing innovation policies and support measures as fragmented, bureaucratic, and inefficient. Respondents further noted that administrative burden slows participation and discourages founders, while policy design and rollout are too slow compared to market and innovation cycles.

Government funding and procurement delays

The bureaucratic challenges manifest in government funding timelines and payment delays. A8 articulated the cash flow threat: "The government takes a long time to pay, that startups are afraid that they do not have the capital to survive until they receive." A7 provided specific timeframes demonstrating severity: "We have six-to-nine-month delay before the pilot approval, and for a startup that is really the time between life and death." He compared Lisbon's regulatory friction unfavourably: "We have a regulatory friction that is a lot bigger here than in the US. The public procurement cycles are very slow and very long."

Access to funding was also the main barrier mentioned in the survey for deep-tech startups, with the seed/venture funding availability ranked as 2.3 out of 5. A6 identified structural process design issues: "Lots of bureaucracy creates bottlenecks and critical parts. Nothing can be done in parallel," with activities forced into serial dependency. This sequential requirement prevents efficient workflows and compounds time delays, as each step must fully complete before the next begins.

A5 described how complexity creates market distortions: "There is a complicated and bureaucratic system especially to get funding. That discourages a lot of the most innovative companies from pursuing them because it's wasted time that they won't be focusing on their product." He elaborated on his own experience: "We had to hire professional consultants specialized in it," highlighting how bureaucratic navigation requires specialized expertise unavailable to most founders, creating dependency on intermediaries and effectively gatekeeping access.

University-industry partnership friction

Bureaucratic complexity extends beyond government programs to affect university-industry partnerships, creating friction that participants describe as manageable in principle but prohibitive in practice. The primary source of this friction is intellectual property (IP) negotiations.

A1 described how IP discussions dominate partnership conversations: "We have a lot of long discussions about this, mainly due to intellectual property." She questioned the sustainability of partnerships under these terms: "In the end why would we want to keep these partnerships and keep having students if then the university asks for a lot, and they want to say that everything belongs to them." A2 characterized European IP focus as strategically misaligned: "I would say a lot of reduced bureaucracy on intellectual property, because in Europe we want to have all the intellectual property, but we don't have any property whatsoever, so we focus on the wrong thing at the wrong time."

A9 provided specific operational detail from her student organization experience: "When I was at Técnico Lisboa, one of my goals at the time was to allow master students to do their master thesis directly with companies and use that work as a master thesis project. But our main obstacle was the bureaucracy. You need to invest some time, you have contracts, you have the IP that needs to be taken care of."

The consistency of bureaucratic complexity identification across all interviews, spanning every participant role and sector, establishes this as the ecosystem's most pervasive structural barrier. Its manifestation across government funding, procurement, and academic collaboration indicates systemic rather than isolated dysfunction.

Academia-industry collaboration challenges

Misalignments exist between academic research and industry development (see Table

5), creating partnerships that fail to deliver practical value despite effort from both parties. These misalignments manifest in two key areas: conflicting timelines and incentive differences, and research agenda disconnection.

Conflicting timelines and incentives between academia and industry

A core challenge comes from the difference in operational timelines between academic research and industry development cycles. A3 described the problem: "The time pressure for stuff to happen is so different in industry and academia. And often when the paper is ready, technology is obsolete." This means academic outputs arrive too late for industry application, making the partnership unproductive regardless of research quality.

Academic and industry partners operate under different incentive structures that create conflicts. A3 characterized the difference: "Industry wants to move really quick and doesn't really care if the models are open source or not, academia has different incentives." A9 elaborated: "Most of the times universities are more on the academia side, so they don't see with very good eyes companies and companies have their own timelines. The company wants it to be non-disclosed at the end of the project, but the university needs it to be open for being published and evaluated." This structural incompatibility between corporate confidentiality requirements and academic publication mandates creates partnerships where neither party can fully achieve their objectives.

A7 identified institutional-level delays: "From universities we have also a problem that is the slow tech transfer." In AI specifically, A3 noted acceleration of this dynamic: "The pace of evolution in AI, the models that are released every month or so, is so fast that academia tends to lag a bit behind in practical application." Monthly model releases create a pace that academic publication cycles cannot match, making collaborative projects outdated before completion.

A3 described disappointing outcomes from attempted collaboration: "Most stuff that initially we were like, OK, let's do this with academia. It's not something we really want to focus on, but it's useful. And the result was that when it was done, it was not useful anymore." He noted that his company found themselves "sacrificing more hours guiding students than we would spend doing stuff ourselves," suggesting that the supervision burden exceeded the value received.

Research agenda disconnection from practical needs

Multiple participants identified disconnection between academic research agendas and practical industry problems, with research pursuing academic interest rather than application needs. A8, from her accelerator point of view, observed that "we are missing the opportunity there because we are creating a lot of stuff that just becomes

theoretical and that could be applied." She characterized universities as sometimes "creating stuff just to create because it's fun," suggesting that research agendas driven primarily by academic curiosity rather than practical application create valuable knowledge that nonetheless fails to transfer to industry use.

A4, a community builder active in Lisbon's AI ecosystem, acknowledged progress while identifying persistent limitations: "There's been a better adoption or at least better partnerships between academia and the traditional business, but still for me, it's still a bit behind the real potential of having the knowledge, the scientific knowledge behind the academia with the actual practical use that the traditional business brings." He contrasted Portuguese performance with leading global examples: "We can take examples from Google, OpenAI, Anthropic. They all have a lot of academic papers or research papers coming out from their own institution. I think in that case we are not there yet."

Table 5. Stakeholder collaboration assessment scores in Lisbon from the survey

| Indicator | Mean |
|--|------|
| Academia ↔ Industry collaboration | 3.1 |
| Industry ↔ Public sector collaboration | 2.7 |

Risk-averse culture

Cultural attitudes toward risk-taking and entrepreneurial failure create systematic barriers to innovation participation, particularly affecting career decisions and resource allocation. This risk aversion manifests in three key areas: negative perception of failure, limited risk tolerance, and lack of experienced mentors.

The interviewees highlighted an existence of a negative perception of entrepreneurial failure. A9 articulated: "Definitely when building your own company, you need to be risk averse, so being able to take a lot of risks and learning from the failures that you have. So maybe if you go for a job interview and you tried to build a couple of companies in the past and they were not successful, in the Portuguese environment that would not be greatly seen." She identified this as creating risk avoidance: "I feel like that's one of the reasons why people don't make that much risk, because maybe in the future that would be something that runs against them." This indicates that entrepreneurial failure carries long-term career consequences that discourage people from attempting entrepreneurship.

The risk-averse culture extends to investment behaviour, creating challenges for capital-intensive ventures. A2 identified specific limitations: "The biggest problems I would say is there's a lot of lack of funding for deep tech specifically because deep tech you need big dollars, and the investors don't have that good risk profiles." A6 confirmed this assessment: "The VC space in Portugal is still underwhelming and angels as well. I

think that they're very risk averse compared to the US and even the UK."

Finally, the ecosystem has a shortage of experienced entrepreneurs who can provide guidance based on proven success. A5 identified how this limitation maintains: "There are too limited success stories and examples. We end up having as kind of thought leaders or key mentors, people that have not achieved that many impressive things." A7 added: "We still don't have many seniors in the ecosystem. When I mention seniors, it's about people that are second time, third time or more founders. You have to wait maybe five more years to have a pool of experienced founders."

3.1.3 Opportunities for Lisbon's Innovation Ecosystem

This section focuses on the Collaboration Potential and Suggested Actions for creating regional smart specialization strategies. The data shows three main opportunities emphasised from the interviewees: (1) AI as an accelerator for innovation, (2) problem-driven collaboration, (3) small domestic market necessitating a global mindset.

AI an accelerator for innovation

The emergence of AI represents an opportunity for the Lisbon's entrepreneurial ecosystem, changing how startups are built and scaled. Informants across multiple stakeholder groups emphasized AI's democratizing effect on entrepreneurship. A4, observed that AI is "unlocking a lot of potential in the sense of like companies or people, entrepreneurs with limited access to funding and opportunities can build much more, much faster." This sentiment was echoed by startup founder A3, who noted that "you don't need a very deep technical background. You can just create stuff very fast, very easily," lowering barriers to entry.

The acceleration effect extends beyond ideation to execution. A4 reported that "the amount of lines of code that I produce daily have been falling drastically" since AI tools emerged. Startup founder A2 illustrated the change: "the route to actually achieving something would have been really, really different, in one week we would be able to have our prototype running and testing already." suggesting that AI has compressed traditional development timelines from months to days. A8 highlighted AI's potential to create new entrepreneurial opportunities: "AI will allow for more trial. So, people just creating stuff and just seeing if it happens. I think it may really open the opportunity for more start-ups appearing."

As the AI hype cycle has matured, with participants now able to differentiate meaningful application from opportunistic positioning. Portuguese investors have moved beyond reflexive AI enthusiasm toward critical evaluation of actual technological substance. A7, an investor, articulated the shift in investor perception: "I think that we have come through the point that the AI will like a magic words like OK anything with AI I want to invest that that point was is in the past now."

However, informants stressed that AI adoption requires strategic thinking rather than superficial implementation. A9 cautioned that "for AI to make a difference, it has to be something structured and thought with in advance," warning against using AI merely "for the tabloids thing without actually thinking of a strategy." She emphasized the importance of bringing "people from successful companies" together to develop coherent strategies rather than pursuing AI initiatives simply to appear innovative during election cycles.

A1's experience reinforced the need for responsible AI deployment: "we are part of those players that we acknowledge that AI needs to be handled with very carefully" given the high-stakes nature of their space industry applications. She observed the ecosystem's AI hype critically, noting that "at this point it seems that all companies sell AI even though they are not using," suggesting superficial adoption risks undermining genuine innovation.

Problem-driven collaboration

The Lisbon's ecosystem demonstrates strong mission-oriented innovation that, when channelled through problem-driven collaboration, creates significant opportunities for impactful academia-industry partnerships. However, realizing this potential requires restructuring how research agendas align with practical needs.

A9 observed the impact orientation: "the desire, for example, to bring impact to our community. A lot of people love Portugal, and they want to see a difference," manifesting in companies "working with the government, for example, trying to build AI for the government to increase efficiency and innovation."

Yet current academic approaches often disconnect from these practical opportunities. A8 argued for reorientation: "academia has to stop to do stuff just for doing...they have to really focus on giving solutions to companies." She emphasized starting with real challenges: "if they start with challenges that the companies have, then they already build something that has a purpose," creating win-win scenarios that sustain engagement from all parties.

A9 advocated for educational restructuring to enable problem recognition: "if we want to really bring universities and companies closer together, the education factor has to be more realistic in a sense that a student that studies mechanical engineering or biomedical engineering or other fields, they need to be more familiar with what is the real world of engineering so that they can be more familiar with the challenges and can actually be closer to the reality." This real-world exposure enables students to identify opportunities that academic isolation overshadows.

Practical mechanisms for enabling these collaborations emerged across informants. A2 proposed partnership models: "organize different activities where you bring a

company...they just organize a hackathon with a university where the winner will get one year of free tuition and the opportunity to work at that company." Rather than symbolic prizes, he advocated providing "a platform for them to try something," enabling real testing and development. A1 suggested mutual value: "they give us all that knowledge and all the research, but we could also provide them something that they found interesting for the classes," creating mutual learning.

A2 also emphasized faculty composition: "bring more people of private sector to be professors," ensuring "professors that are actually active in working at industry or companies" can bridge theoretical and practical knowledge. Investor A7 illustrated successful problem-driven collaboration through retail innovation, describing how Galp's partnership with Sensei enabled AI-powered autonomous pharmacies, demonstrating the potential when corporates "open the doors to the start-up to make a pilot" with genuine application contexts.

Small domestic market necessitating a global mindset

A strategic strength identified particularly by startup founders and community builders is the necessity for Portuguese ventures to think globally from inception due to limited domestic market size. This constraint, which might appear as a weakness, provides competitive advantage by forcing strategic decisions and operational approaches that align with scaling requirements from day one.

A3 described AI-specific limitations: "The most pressing issue is that like is if you are like selling to the Portuguese market, most companies don't have the buying power or just infrastructure needed to adopt AI at scale." This forces international focus from inception, bypassing domestic market learning opportunities. He reflected on strategic implications: "we actually started in Portugal, which is in hindsight maybe was a mistake," acknowledging that domestic market testing may delay rather than facilitate growth.

The necessity extends to capital markets. Investor A7 noted: "for later rounds you also always have to have co-investment or investors from other regions, mainly UK, US and Northern European countries." This requirement for international co-investment indicates Portuguese capital markets cannot independently support scaling, necessitating cross-border relationships and global network development as core competencies rather than optional capabilities for Portuguese ventures.

However, A2 reframed this constraint as competitive advantage: "we are a small country, so every time someone starts or tries to start a startup in Portugal, they ultimately need to think overseas. I'd say that gives you a big advantage because you're not focusing on your local market, you're focusing on the world market."

3.2. Malaga’s Ecosystem Overview

The assessment of Malaga’s innovation ecosystem in Spain (Figure 2), based on interviews with ten key stakeholders spanning accelerators, SMEs, and startup founders, reveals an emerging but maturing landscape. The data shows that the main strengths are the university and the technology park acting as central innovation hubs, and the availability of European and public funding programs. The main barriers identified include funding challenges and deployment barriers, bureaucracy and administrative burden, and academia-industry misalignment on objectives, timelines, and incentives. The opportunities lie in strengthening connection mechanisms between actors, leveraging AI and other emerging technologies, and developing hybrid profiles and industrial doctorates. These main findings are listed in Table 6, and each point is elaborated in chapters 3.2.1–3.2.3

Survey results show the overall maturity of the regional innovation ecosystem ranked at 3.5 out of 5, and respondents identified industry and academia as the most influential actors, primarily in the ICT sector. Further, the survey results indicate that the region hosts an emerging deep-tech community, with 57% of respondents explicitly identifying it as such. However, a significant share of respondents (29%) remains uncertain, suggesting that while momentum is building, the ecosystem is still consolidating and lacks full visibility or maturity.

Table 6. Overview of the Malaga ecosystem mapping

| Section | Key Insights | Quotes/Examples/Highlights |
|----------------------------|--|---|
| Ecosystem Strengths | The technological park and university acting as central innovation hub | "The University and the Technological Park as the main institutional actors." B1 "The University of Málaga has been a fundamental actor." B6 |
| | The availability of European and public funding programs | "We have carried out projects at the regional level with the regional government ... And then at the European level, we have Eurostar." B4 "My company has won a technological innovation award from the Junta de Andalucía. I also know of colleagues who benefit from FEDER funds." B5 |
| | Presence of multinational companies driving ecosystem growth | "My general vision is good with the whole issue of Google and the tech companies in Málaga, they can contribute quite a bit." B9 "One of the most interesting things I have seen in the ecosystem here in Malaga is that there are quite a few major companies, and that carries a lot of weight." B10 |
| Barriers | Funding challenges and deployment barriers | "For a small company, the loans are somewhat scary because they require results that, if not met, can lead to the withdrawal of funding". B3 |
| | Bureaucracy and administrative burden | "The university's technology transfer program has rejected the contract three times already." B5 "Bureaucracy creates a 'mess' in people's heads." B9 |
| | Academia-industry misalignment on objectives, | "Their incentives are misaligned, as transfer activity does not count significantly towards researcher accreditation, only publications do." |

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| | | |
|----------------------|--|---|
| | timelines, and incentives | B1 "There is a very large gap from research to applicability". B6 "Objectives are basically very misaligned." B7 |
| Opportunities | Strengthening connection mechanisms between actors | "Large companies could access pools of startup ... organized by capabilities." B7 "Map the real needs of large companies... so startups focus on them." B7 |
| | Leveraging AI and other emerging technologies | "AI... is transforming technical and organizational work processes very quickly." B4 "Main advantage of AI is the speed of creating a Proof of Concept." B2 |
| | Developing hybrid profiles and industrial doctorates | "The university should develop hybrid profiles, people who understand both technology and business, to act as a 'node' or connector between the two worlds." B7 "The synergy is '100% fluid' because I can easily direct student projects to the company's needs and connect promising students to other innovative firms." B1 |



Figure 2. Geographic location of Malaga, Spain

3.2.1 Malaga's Strengths

The data shows three main strengths emphasised from the interviewees: (1) the university and the technology park as central innovation hubs, (2) the availability of European and public funding programs, and (3) the presence of multinational companies driving ecosystem growth.

The university and technological park (PTA) as central innovation hubs

The Technological Park of Andalusia (PTA) emerged as a central strength of Malaga's entrepreneurial ecosystem, consistently recognized across multiple stakeholder types. Participants identified the PTA as the primary physical and institutional hub where innovation activity is concentrated, attracting both national and international companies. As B7 put it: "I see the Technological Park (PTA) as the main actor, 100% ... I do not see that same interest in deep tech within large companies like the Big Four." B5 elaborated: "In Málaga, in the Technological Park, more and more is happening, at least at a technological level."

Stakeholders emphasized that the concentration of technology-focused companies in the park generates network effects and facilitates informal knowledge exchange. The park serves as a magnet for multinational corporations that establish local offices in Malaga, creating an ecosystem that forces companies to attend to needs beyond Spain, as B4 put it "I believe that the university is the main driving force, as well as some technology centres linked to the university and multinational companies with a local presence that have set up in Malaga." (B4)

The University of Malaga (UMA) is universally recognized as a main driver of innovation in the ecosystem. B6 states that: "The University of Málaga has been a key player in the development of these technologies and their outreach to rural areas." Stakeholders described the university's multifaceted role as a generator of research and technological advances and a bridge between theoretical research and market applications. As B3 put it: "I believe that both universities and companies are the main drivers." The survey responses confirm this finding, as 45% of the respondents list academia as the most influential actor in the ecosystem.

The university's involvement extends beyond traditional academic functions to include active participation in collaborative projects through subcontracting arrangements, joint European projects, and the creation of technology-based companies (spin-offs). B1 explained: "Our company emerged as a spin-off. We entered the University of Malaga's spin-off competition and were given €3,000. We had a clear idea of what the funding sources would be if we set up the company. As a research group, we were collaborating with companies that were asking us for development work."

Availability of European and public funding programs

Multiple funding programs at European, national, and regional levels were identified as a strength supporting innovation and research collaboration. Stakeholders highlighted the availability of programs such as Eurostars, CDTI initiatives, regional government funding, and FEDER funds that provide financial resources for innovation projects. These programs enable companies, particularly SMEs and startups, to undertake research and development activities they might not otherwise afford. B5 explains that "with the international dimension the PTA is taking, the Málaga City Council stays small; often the aid comes more at a national or international level."

The ecosystem benefits from a variety of funding mechanisms, including direct subsidies, public-private collaboration schemes, and support for technology transfer. Organizations like the Chamber of Commerce, the PTA, and regional government agencies actively disseminate information about available funding calls, helping stakeholders navigate the landscape. B5 states that "my company has won a technological innovation award from the Junta de Andalucía. I also know of colleagues who benefit from FEDER funds." The survey results also show that funding schemes were frequently listed (50%) among the types of support mechanisms that exist in the region, alongside incubators and accelerators.

However, while the availability of programs is recognized as a strength, participants also noted challenges in accessing and managing these funds, which are addressed in the gaps section. As B9 explains: "There are many services, many incentives, and many collaborating factors and companies, and even programs with funding, but we all encounter the same problem: the users are not reaching us."

Presence of multinational companies driving ecosystem growth

The presence of major multinational companies in Malaga has become an important factor for attracting additional companies and investment to the region. Stakeholders emphasized that large companies like Google, Ericsson, and Vodafone make it easier for other firms to justify establishing operations in Malaga. As B10 explained, "One of the most interesting things I have seen in the ecosystem here in Malaga is that there are quite a few major companies, and that carries a lot of weight." He further emphasized the importance of this presence: "The fact that there are major companies here is a key factor in justifying our decision to come. For example, Google having offices in Malaga is very important and has helped a lot. In fact, Vodafone is here now too." This concentration of major companies creates benefits beyond the large companies themselves, as B10 noted: "Innovation isn't just about having 3 large companies that might work in a specific sector, but also about having other types of companies around them that work on cutting-edge technologies and are also available."

The multinational presence was also recognized by other stakeholders, with B4 observing that "multinational companies with a local presence that have set up in Malaga", and B5 describing how "the companies I see are not just based exclusively in Málaga; they are multinationals with offices everywhere that see a business opportunity in Málaga." B9 noted the positive impact of this trend, stating, "My general vision is good with the whole issue of Google and the tech companies in Málaga, they can contribute quite a bit." This strength creates a pattern where the presence of established multinationals attracts both companies and specialized service providers, thereby strengthening Malaga's position as a technology hub.

3.2.2 Malaga's Gaps

The data shows three main gaps emphasised by the interviewees: (1) funding

challenges and deployment barriers, (2) bureaucracy and administrative burden, and (3) academia-industry misalignment on objectives, timelines, and incentives.

Funding challenges and deployment barriers

Despite the availability of funding programs identified as a strength, stakeholders across all organizational types reported challenges related to funding access, adequacy, and deployment. Three dimensions of this gap emerged from the interviews.

First, participants emphasized the difficulty of initial research funding versus final deployment funding, noting that while seed funding may be available, scaling and commercialization face a funding desert, especially for deep-tech startups that require extended development periods before generating revenue. As B7 puts it: "There are funding problems; there is support for initial research, but not for the final deployment." Second, large companies expressed limited interest in supporting deep-tech startups because of their long time-to-profitability, creating a gap in private investment. "Often, a deep tech startup is not of interest to a firm like ours because it will not generate profit in the first, second, or third year of development." (B7)

Third, several stakeholders highlighted the mismatch between funding structures and SME needs, particularly the loans-versus-grants issue, where SMEs are hesitant to take on debt with uncertain innovation outcomes. B3 explains: "Regarding the Ministry's projects, at the company level, we use public-private collaboration projects. Universities are funded 100%, but companies only receive 80%, and it's in the form of a loan. This works well for a large company, as it improves their cash flow, but for a small company, the loans are somewhat scary because they require results that, if not met, can lead to the withdrawal of funding." The survey results also confirm these results, where access to funding was the main barrier identified for deep-tech startups (mentioned 16 times out of 20). The limited seed and venture funding availability further confirms this, scoring 2.5 out of 5 in the Malaga region.

Bureaucracy and administrative burden

Administrative complexity and bureaucratic requirements emerged as a barrier affecting multiple aspects of the innovation ecosystem. Participants described the burden of justifying project expenditures as extremely tedious and time-consuming, with excessive regulation of spending creating challenges for SMEs that lack dedicated administrative staff. As B4 puts it: "There is the difficulty of dealing with administrative bureaucracy. Justifying projects is very tedious ... And it is also very difficult to qualify for funding and get a project off the ground. In some cases, you need a company to help you propose and then justify it. No matter how good your idea is, you have to fill out the paperwork correctly and know how to explain it."

The complexity of qualifying for funding and correctly completing proposal paperwork

was identified as a hurdle, with multiple stakeholders noting that good ideas fail to receive support because applicants do not know how to properly structure proposals or navigate administrative requirements. Further, several participants mentioned that European funds, while valuable, impose traceability requirements that, although justified, can become problematic if not managed with specialized expertise. As B4 put it: "European funds require traceability, which I think is perfect, but if you don't know how to justify it correctly, it can be a problem."

SMEs reported difficulty with the inflexibility of spending plans in multi-year projects, where administrative rules do not accommodate the dynamic reality of business operations. The administrative burden disproportionately affects smaller organizations and creates a competitive advantage for larger companies with dedicated proposal-writing and project-management teams. B3 explains: "The main barriers are the management and justification of expenses, and the very limited budgets. All innovation projects have many risks, both technological and commercial, and you cannot be asked to follow a plan to the letter when something might appear on the market during those 3 years that forces you to change the entire project strategy. ... There is an excessive regulation of spending, data on the people who will participate in the project, and in an SME, you cannot know if in 3 years these people will have to be dedicated to other tasks, requiring you to bring in new people."

Academia-industry misalignment on objectives, timelines, and incentives

A misalignment between academia and industry was identified across multiple dimensions (see Table 7), creating substantial barriers to deeper collaboration. The most frequently mentioned aspect concerns different time horizons: universities pursue multi-year research projects aimed at fundamental advances and publications, while companies need quick solutions and short time-to-market to remain competitive. This temporal mismatch means that by the time university research produces results, market conditions may have changed. As B1 puts it: "There are different operational rhythms, companies demand results in 3-6 months, while the university's pace is slower (1-2 years). B4 elaborates on this: "In terms of collaboration between academia and industry, of course, there is a kind of difference between timelines and expectations. The projects or grants that come out are around three years, which is quite a long time. Projects or research at the university take longer. And of course, the timelines in the company are different; the time to market is different. So, the company is looking for quick solutions. "

A second dimension involves divergent objectives, with universities incentivized by publications and theoretical contributions while companies prioritize commercial viability, scalability, and return on investment. Multiple stakeholders noted that technology transfer activities are not adequately valued in researcher accreditation systems, creating a disincentive for academics to engage deeply with industry. B7

explains: "The main issue is that objectives are misaligned: the university looks for theoretical technological advances for the future, while the company looks for operational impact, scalability, and ROI."

B1 adds that: "The collaboration primarily works well for short-term consultancy projects. It fails for long-term, joint research projects because companies lack the mutual trust to commit to a medium-term path with the university. Companies often prefer to hire the skilled personnel from the university projects to ensure full control, rather than collaborating." This relates to intellectual property concerns, with companies protective of their IP and hesitant to share proprietary information in collaborative projects, while universities seek publishable outcomes.

The gap in industrial doctorate programs was specifically highlighted because of this misalignment, with few such positions filled in Malaga compared to other regions like Barcelona or Germany. B5 explains: "Here, the problem we have, and in fact, I spent a year in Germany, where I could see it a bit differently, is that in Germany, what we call the Industrial Doctorate was very fashionable: you are actually a worker for the company and the company half-finances your thesis. Here in Spain, I know there is a niche in Barcelona, but in Málaga, there is not much of that; many of these industrial doctorates remain vacant."

Table 7. Stakeholder collaboration assessment scores in Malaga from the survey

| Indicator | Mean |
|--|------------|
| Academia ↔ Industry collaboration | 3.3 |
| Industry ↔ Public sector collaboration | 3.2 |

3.2.3 Malaga's Opportunities

The data shows three main opportunities emphasised from the interviewees: (1) strengthening connection mechanisms between actors, (2) leveraging AI and other emerging technologies, and (3) developing hybrid profiles and industrial doctorates.

Strengthening connection mechanisms between actors

Stakeholders across all organizational types identified the need for better mechanisms to connect different actors in the ecosystem as an opportunity for strengthening innovation and collaboration. Multiple participants suggested creating organized pools or databases of startups categorized by capabilities and sectors, allowing large companies to efficiently match their technological needs with available startup solutions. B7 explains: "I would like to see closer relationships where large companies can access 'pools of startups' organized by capabilities or sectors. A company could publish a technological need, and organized startups from that pool could submit

development plans and funding requests." The concept of improving visibility and discoverability was emphasized repeatedly, with recognition that many valuable connections fail to happen simply because actors do not know about each other's existence or capabilities.

Several stakeholders proposed mapping exercises to identify the real technological needs of large companies, enabling startups and researchers to focus their efforts where funding and commercial opportunities exist. "It is also essential to map the real needs of large companies, so startups know where to focus to get funding." (B7) The opportunity extends to improving connections between entrepreneurs and available support services, addressing the persistent problem of entrepreneurs not reaching existing programs.

Participants also suggested strengthening the network structure that already exists informally, making collaboration pathways more explicit and accessible. B9 elaborates on their efforts: "We work as a network precisely for that reason. We have contacted everyone—the associations, the city councils—who all have something to promote entrepreneurship, and they all encounter the same problem." B4 adds that: "There are many initiatives and many meetings at the PTA level, at the university level, and at the Chamber of Commerce level. There are always many informational meetings about the various open calls for proposals." The underlying insight is that many ecosystem resources exist but remain underutilized due to information asymmetries and a lack of systematic connection infrastructure.

Leveraging AI and emerging technologies

Artificial intelligence and other emerging technologies represent an opportunity for ecosystem development, with applications spanning multiple sectors and organizational types. Public sector organization identified concrete applications for AI, demonstrating public demand that could drive innovation. As B8 explains: "For us, artificial intelligence in our world would have several applications. One of them would be applied to video surveillance ... We work with many databases and data representations, where currently, we have predefined searches, but we want to develop artificial intelligence so that, using natural language, this data can be accessed."

Research organizations emphasized opportunities in combining AI with other technologies like 5G/6G for rural digitalization, autonomous vehicles, and precision agriculture, showing potential for regional competitive advantage. As B6 elaborates: "On the one hand, there is the capacity for remote and robust communication for sending information, and on the other hand, robotics is of great interest to us for operating remotely or in times that are not easy for people to operate."

Companies across sectors reported increasing receptivity to AI solutions, with growing willingness to adopt and invest in these technologies. B2 says that: "My focus is on

solving problems for companies using code or AI. Most of my solutions involve AI, since companies are increasingly receptive to it." Whereas, B7 adds: "Lately, we have been working with AI agents to automate data processing." Stakeholders noted that while concerns exist about AI's long-term trajectory and infrastructure requirements, current momentum presents a window of opportunity for ecosystem actors to position themselves in emerging markets. The technology also offers potential solutions to some ecosystem challenges, such as automating bureaucratic processes, improving matching between needs and solutions, and enabling new forms of collaboration.

Developing hybrid profiles and industrial doctorates

The development of professionals with hybrid profiles and the expansion of industrial doctorate programs emerged as a strategic opportunity to bridge the academia-industry gap. Stakeholders emphasized the need for individuals who understand both technical domains and business contexts, capable of acting as translators or connectors between academic research and commercial application. As B7 put it: "The university should develop hybrid profiles, people who understand both technology and business, to act as a 'node' or connector between the two worlds." These hybrid profiles would facilitate communication, reduce misunderstandings, and help align different stakeholder objectives.

Multiple stakeholders mentioned the underutilization of industrial doctorates in Malaga despite their potential benefits, noting that positions often remain vacant. Expanding and reforming these programs could address several ecosystem challenges simultaneously: creating talent with deep technical knowledge and practical business experience, enhancing long-term collaborative relationships between universities and companies, generating commercially relevant research outputs, and retaining talent in the region. Success would require addressing current barriers, such as bureaucratic obstacles in program access and company concerns about intellectual property and commitment duration. "Key barriers include bureaucracy in programs like Industrial Doctorates" (B1). However, he brings his company as an example of a success story in terms of collaboration, specifically because he holds both roles (professor and CEO). "The synergy is '100% fluid' because I can easily direct student projects to the company's needs and connect promising students to other innovative firms," B1 adds.

3.3. Santiago de los Caballeros Ecosystem Overview

The assessment of Santiago de los Caballeros's innovation ecosystem in the Dominican Republic (Figure 3), based on interviews with key stakeholders spanning accelerators, community builders, investors, and startup founders, reveals an emerging but maturing landscape. The data shows that the main strengths are institutional programs supporting entrepreneurship, grassroots innovation, and community-driven initiatives. The main barriers identified are the disconnect between academia and industry, the unfavourable tax and regulatory environment for startups, financial constraints, and a

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risk-averse culture. The opportunities lie in integrating advanced technologies, enhancing productive partnership addressing national challenges, and replicating successful regional and international models. These main findings are listed in Table 8, and each point is elaborated in chapters 3.3.1–3.3.3

Table 8. Overview of Santiago de los Caballeros' ecosystem mapping

| Section | Key Insights | Quotes/Examples/Highlights |
|----------------------------|---|---|
| Ecosystem Strengths | Institutional programs supporting entrepreneurship | <p>"We're working on a national award for best practices in the manufacturing sector." C5</p> <p>"Technology and Innovation Support Centres (CATI) centres are successful programs operating at a high level across Central and South America." C6</p> |
| | Grassroots innovation and community-driven initiatives | <p>"We have incubated and pre-incubated over 500 projects and created the largest AI community in the Dominican Republic with over 1,000 people." C2</p> <p>"Entrepreneurship isn't made for suits and ties; it's for rolling up your sleeves." C2</p> |
| Barriers | Disconnect between academia and industry | <p>"There is no link between academia and industry." C7</p> <p>"Universities teach theory but don't prepare students for real processes." C2</p> |
| | Unfavourable tax and regulatory environment for startups | <p>"There is no incentive for deep tech startups to emerge" C2.</p> <p>"Neighbouring countries have more business-friendly tax programs". C7</p> |
| | Financial constraints and risk-averse culture. | <p>"It all starts with culture, in every area. It's about creating that innovation mindset and giving them the strategies and tools." C5</p> <p>The ecosystem lacks "capital injections for startups." C7</p> |
| Opportunities | Integration of advanced technologies | <p>"We created an innovation and startup hub focused on artificial intelligence, focusing on micro-niche solutions that solve specific problems". C2</p> <p>"We need laboratories where technology can be tested without fear, ... I'm working towards creating a sandbox that allows universities, startups, and companies to actively participate." C7</p> |
| | Productive partnership addressing national challenges | <p>"I envision projects being created from within the universities themselves, with a whole system in place where these projects address existing, real challenges faced by companies, allowing for direct channelling and a seamless flow, making the university a hub for innovation." C5</p> <p>"Businesses are not seeking solutions to sargassum; universities should work together with them." C6</p> |
| | Replication of successful regional and international models | <p>"Appropriate Technology initiative from South Korea was successfully implemented in the Dominican Republic." C6</p> <p>"Regional and international models (Chile, Colombia, Brazil, US free-market approach) provide templates." C7</p> |



Figure 3. Geographic location in Santiago de los Caballeros, Dominican Republic

3.3.1 Santiago de los Caballeros' Strengths

The data shows two main strengths emphasised from the interviewees: (1) institutional programs supporting entrepreneurship, and (2) grassroots innovation and community-driven initiatives. Survey results show that the overall maturity of the regional innovation ecosystem ranked at 2.9 out of 5, and respondents identified academia and non-traditional or mixed actors ("Other") as the most influential actors, primarily in the agriculture, healthcare, and AI sectors.

Institutional programs supporting entrepreneurship

The Dominican Republic has developed several institutional programs that provide structured support for entrepreneurs, particularly through government agencies and specialized centres.

A flagship government-run entrepreneurship and innovation programme, *EmprendeLab* represents an approach to startup support. As described by a government representative, C7: "We launched *EmprendeLab* to support startups and help them validate and iterate their business ideas in five categories: agritech, Industry 4.0, techno-industry, software, and creative industries". The government official C7 emphasized that this programme "integrates financial and non-financial services to support entrepreneurship," providing a support structure for startups beyond just capital.

Intellectual Property Infrastructure provides critical protection for innovations. The National Industrial Property Office (ONAPI) plays an active role, with C6 stating: "Our office promotes initiatives that foster innovations related to registration and protection of industrial property". The Technology and Innovation Support Centres (CATI) represent a successful regional model established by the ONAPI at universities, supporting IP for researchers and businesses. As one official C6 noted: "CATI centres are successful

programs operating at a high level across Central and South America". These centres "provide patent information and support inventors, entrepreneurs, and universities" (C6), creating accessible touchpoints for intellectual property guidance throughout the country.

The government is developing award programs to drive innovation in key sectors. One official, C5, mentioned: "We're working on a national award for best practices in the manufacturing sector, Industry 4.0." Awards serve as motivation and validation: "I believe it's a benchmark and a best practice" (C5). The government-sponsored competitions provide entrepreneurs with resources and visibility. One entrepreneur, C3, described their experience: "I participated in a competition run by MESIC. I understand that's a successful program." By celebrating innovation successes, award programs help shift organizational culture toward embracing change and experimentation.

However, it was noted that multiple government entities work on entrepreneurship without coordination. One participant questioned: "Why the Ministry of Industry and Commerce? Why the SME Centres? Why are the universities all so fragmented and lack a unified structure? Why is the National Entrepreneurship Network still just a paper entity? (C2)" This fragmentation creates inefficiencies, duplicated efforts, and confusion for entrepreneurs trying to navigate the support system.

Grassroots innovation and community-driven initiatives

The Santiago de los Caballeros' entrepreneurial ecosystem in the Dominican Republic demonstrates a grassroots innovation movement led by NGOs and community hubs that have successfully democratized access to entrepreneurship resources. This bottom-up approach has created momentum outside traditional institutional structures.

Community organizations have achieved scale in their pre-incubation and incubation efforts. As C2, one NGO leader explained: "We have incubated and pre-incubated over 500 projects and created the largest AI community in the Dominican Republic with over 1,000 people." This demonstrates the capacity of grassroots organizations to support early-stage entrepreneurs and create networks and knowledge-sharing platforms that would traditionally require institutional investment. These communities function as innovation hubs with active participation. As the NGO leader, C2, explained: "Currently, in the area of innovation, we're acting as a hub where the community holds regular presentations of projects and analyses from internal members." The hub model enables peer learning and collaborative problem-solving outside formal institutional structures.

Multiple NGOs operate with clear social missions. An NGO training director, C9, described their focus: "One of them is the training director of an NGO that works with entrepreneurs to secure investment. The other is my personal project, which aims to support micro and small businesses and instil an entrepreneurial mindset and culture to help them grow." This shows that these grassroots initiatives operate with a clear

mission to democratize entrepreneurship. As one community leader, C2, described their approach: "Entrepreneurship isn't made for suits and ties; it's for rolling up your sleeves", which reflects a commitment to making innovation accessible beyond elite circles and traditional business environments.

The informal innovation actors also serve as voices for systemic change. One participant characterized their role as: "We're the rebels of the ecosystem; we shout what others keep silent (C2)". This willingness to challenge established norms and advocate for change indicates a dynamic, self-aware ecosystem that actively works to address its own limitations.

3.3.2 Santiago de los Caballeros' Gaps

The data shows three main barriers emphasised from the interviewees: (1) disconnect between academia and industry, (2) unfavourable tax and regulatory environment for startups, and (3) financial constraints and risk-averse culture.

A disconnect between academia and industry

Although universities (CUDE/UAPA) play a role in training and supporting startups through promoting fairs and innovation events, the most consistently mentioned gap across all stakeholders is the absence of meaningful, structured collaboration between universities and the business sector (see Table 9). This disconnect creates a barrier to innovation and entrepreneurship development.

The disconnect begins at the foundational level of university education. A government official C7 emphasized: "There is no link between academia and industry". This absence of early connection means students graduate without understanding real industry challenges or how their knowledge applies to practical business problems. Although the university vice rector C1 did mention that: "The institution has promoted the development of innovative initiatives since its inception", another industry representative C6 reinforced that: "There is no link between academia and industry."

Universities remain oriented toward traditional teaching models rather than applied research and industry engagement. An intellectual property official, C6, observed: "Universities still think their primary role is teaching". This mindset prevents universities from seeing themselves as innovation partners and knowledge co-creators with industry. Universities fail to prepare students for real-world business challenges. An NGO representative, C2, noted: "Universities teach theory but don't prepare students for real processes." This creates a skills mismatch where graduates lack the practical knowledge employers need.

The business sector compounds the problem by believing it can solve the challenges independently: "Companies perceive technology solutions as too expensive; universities lack budgets to undertake projects" (C6). This creates a vicious cycle where neither side reaches out to the other, despite both having complementary needs and capabilities. One stakeholder, C7, described the situation: "Business sector conducts in-house research without sharing challenges". Companies invest in R&D but fail to

leverage the expertise and resources available at universities, leading to duplicated efforts and missed opportunities for collaboration.

The ecosystem lacks formal structures to facilitate knowledge transfer mechanisms. While the foundational structures of IP frameworks exist at institutional levels, without mechanisms to protect and commercialize research outputs, there is little motivation for collaboration. A government representative, C7, explained the need: "We need to incentivize intellectual property creation early". The university vice rector C1 highlighted this regulatory challenge: "It is unclear to what degree the institution has the right to commercialize this product, which was developed through research that was thoroughly reviewed by the ministry. Considering that researchers contributed their intellect, I think the regulatory framework could be improved to facilitate its commercialization."

Table 9. Stakeholder collaboration assessment scores in the Dominican Republic from the survey

| Indicator | Mean |
|--|------|
| Academia ↔ Industry collaboration | 3.0 |
| Industry ↔ Public sector collaboration | 3.1 |

Unfavourable tax and regulatory environment for startups

The Dominican Republic's tax structure and regulatory framework create obstacles for startup development and innovation, discouraging entrepreneurial activity.

Startups face punishing taxation from their earliest stages. An NGO leader C2 described the reality: "You receive seed capital and immediately pay 27% in taxes." This immediate tax burden consumes precious early-stage capital that startups desperately need for product development, market validation, and team building. The tax system fails to incentivize investment in research and development. The same NGO representative stated: "There is no incentive for deep tech startups to emerge" (C2). Without tax breaks, credits, or deductions for R&D spending, companies have little financial motivation to pursue innovation, especially in complex, long-term deep technology projects. The survey results also confirm a low R&D infrastructure availability score, rating 2.6 out of 5.

The problem becomes more acute when viewed in a regional context. A government official C7 acknowledged: "Neighbouring countries have more business-friendly tax programs". This puts the Dominican Republic at a competitive disadvantage for attracting investment, talent, and startup relocations within Latin America. Beyond taxation, the regulatory framework itself creates barriers. He added "regulatory and tax obstacles" as a major barrier to startup growth. These obstacles slow down company formation, increase compliance costs, and consume entrepreneur time that could be

spent building products and serving customers.

Further, the legal structure fails to accommodate modern entrepreneurship models. An NGO leader explained: "Within the regulatory framework of the Dominican Republic, social entrepreneurship, which is really the area where we should be operating, doesn't fit; it's not contemplated. But since it's not included within the regulatory and fiscal framework, the appropriate tax structure for us is that of an NGO (C2)." This regulatory gap forces innovative organizations to adopt inappropriate legal structures, limiting their operational flexibility and growth potential.

Frustration was also expressed with unfulfilled promises: "Why hasn't the CONFIE Fund been fully launched? The CONFIE Fund has been launched three times already. It's three or four million pesos. That's nice, but they've spent 10 million pesos on the launch and press conferences, inviting pop and style icons (C2)". This highlights how resources are misallocated to publicity rather than substance.

Financial constraints and risk-averse culture

Entrepreneurs face constraints in accessing the financial resources necessary to launch, grow, and scale their ventures, particularly in technology-intensive sectors. The ecosystem lacks "capital injections for startups" (C7). The survey confirmed this concern, as seed/venture funding availability was ranked 2.2 out of 5. This capital scarcity is problematic for deep technology ventures that require longer development timelines and larger upfront investments before generating revenue. The innovation and special projects manager C7 representative emphasized the lack of "channelling access to capital that is substantial and long-term".

The absence of organized angel investor networks compounds the funding challenge. Without these early-stage investors, promising startups struggle to bridge the gap between their own savings and larger institutional funding rounds. Universities and research institutions face their own funding limitations. An intellectual property official noted: "Funding constraints limit innovation projects" (C6). This prevents promising research from being developed into commercial applications, creating a bottleneck in the innovation pipeline. Access to funding was identified as the main barrier for deep-tech startups, with 78% of respondents reporting it as a key challenge.

Beyond financial constraints, the Dominican Republic's entrepreneurial ecosystem faces cultural and mindset challenges that limit innovation, collaboration, and risk-taking. A fear of idea theft prevents entrepreneurs from openly sharing concepts and seeking collaborative support. A software company representative, C8, observed: "We have people who are entrepreneurial, very willing to build and create, but they don't feel confident enough to go to an entrepreneurship centre or an incubator and openly present their ideas. They're afraid of intellectual property violations or a lack of recognition for their inventions".

Stakeholders recognize that culture change must be led intentionally and systematically. An industry representative C5 emphasized the foundational nature of

culture: "It all starts with culture, in every area. It's about creating that innovation mindset and giving them the strategies and tools". Further, the ecosystem lacks safe spaces for experimentation and learning from failure. The software company representative C8 described the psychological barrier: "It is like having an open sky to take flight, without fear that if the flight fails, you'll have a parachute to land on your feet." Entrepreneurs need assurance that failed experiments won't destroy their prospects, but such safety nets remain largely absent.

3.3.3 Santiago de los Caballeros' Opportunities

This section focuses on the Collaboration Potential and Suggested Actions for creating regional smart specialization strategies. The data shows three main opportunities emphasised from the interviewees: (1) integration of advanced technologies, (2) productive partnership addressing national challenges, and (3) replication of successful regional and international models.

Integration of advanced technologies

The Dominican Republic has significant opportunities to leapfrog traditional development paths by embracing and integrating advanced technologies into its entrepreneurial ecosystem. These technologies (AI, IoT, Blockchain, Big Data) offer pathways to create competitive advantages in niche markets. From the survey, AI, cybersecurity, robotics, and the Internet of Things were mentioned as the main deep-tech areas represented.

There is strong potential to develop specialized AI applications that address specific local problems. C2 described their approach: "We created an innovation and startup hub focused on artificial intelligence, focusing on micro-niche solutions that solve specific problems". This specialized focus creates a community of practice and shared knowledge that can accelerate development.

Companies are finding practical ways to integrate AI into their operations. A software development company representative explained a specific implementation: "With a professionally recorded voice, we were able to use AI technology to inject various texts into the voice, allowing it to replicate the content. This helped us accelerate the human work of converting texts into audio, making that audio accessible to people with disabilities or hearing impairments (C8)." This example shows how AI can be pragmatically applied to improve service delivery and accessibility, creating immediate value rather than requiring years of R&D.

There is an opportunity to create safe testing environments for new technologies. An innovation and special projects manager, C7, explained their vision: "We need laboratories where technology can be tested without fear, ... I'm working towards creating a sandbox that allows universities, startups, and companies to actively participate ". This collaborative sandbox model could accelerate technology adoption and innovation by providing a structured yet flexible environment for testing.

Productive partnership addressing national challenges

Strengthening the role of Universities in Deep-Tech Ecosystems: Evidence from Emerging Regions

The opportunity exists to transform the current disconnect between universities and businesses into productive partnerships that address real problems facing the country. Effective institutional support requires coordination across all ecosystem actors. The need for systematic collaboration is clear: "So, there really should be a working group involving the private sector, academia, and government, focused on a work plan with clear, objective, and reasonable results, leaving a lasting impact (C7)."

There is a vision for a new model where universities become problem-solving hubs. An industry representative, C5, described their ideal future: "I envision projects being created from within the universities themselves, with a whole system in place where these projects address existing, real challenges faced by companies, allowing for direct channelling and a seamless flow, making the university a hub for innovation." He further explained how it could work: "In this course, we're going to create a project that will be useful for a company that has a challenge (C5)". This approach would embed real-world problem-solving into the curriculum itself, creating value for both students and companies.

Specific national problems present opportunities for collaboration. For example, the sargassum seaweed problem affecting Caribbean beaches represents the type of challenge that requires both academic research and industry implementation, where currently "businesses are not seeking solutions to sargassum; universities should work together with them" (C6). This could be done through internship programs as C8 suggests: "One of these initiatives, for example, involves internship programs, which will help these students move into companies and, from within those companies, build practical knowledge before receiving their degrees." They also highlighted more advanced models: "But there are also innovative models where the company comes to the university, creates laboratories, creates collaborative spaces, and so the students don't have to move to the company; the company is already at the university" (C8).

There is recognized potential to strengthen technical education. A consultant observed: "I believe there's a great opportunity for Dominican universities to emphasize the importance of technical work because we face a significant sociocultural obstacle: the perception that technical careers aren't important because what matters is a university degree" (C4). Addressing this gap could create pathways for practical, hands-on innovation that doesn't require four-year degrees but still contributes significantly to the ecosystem.

Stakeholders recognize coordination gaps. One government representative explained: "There is a lot of potential in the Dominican ecosystem. It's interesting because there are many entities wanting to use entrepreneurship as a strategic pillar of their operations or work plans, but I really see a deficiency in how they lead or develop it (C7)." This suggests that while commitment exists, execution capabilities need strengthening.

Replication of successful regional and international models

The Dominican Republic can learn from and adapt proven models from other countries, accelerating its own ecosystem development without reinventing the wheel. Several Latin American countries offer relevant models. A government official C7 referenced: "Regional and international models (Chile, Colombia, Brazil, US free-market approach) provide templates." Each country has developed approaches suited to its context that could inspire Dominican adaptations. One participant specifically mentioned: "Neighbouring countries have more business-friendly tax programs," suggesting that the Dominican Republic could study and adapt fiscal incentives that have worked in similar Caribbean and Latin American contexts.

Further, tax incentive structures for innovation from Spain offer a concrete model. Spain's innovation tax system offers a concrete model. An industry representative, C5, explained: "This is already in place in Spain; tax deductions can be made for innovations that are implemented, integrated, and demonstrable, and that are sustainable within the company. So, if I need to invest \$100,000 to innovate in my business, that can be deducted from my taxes". This example provides a specific policy mechanism that could be adapted to the Dominican context.

There are successful examples of technology transfer that have already worked in the Dominican Republic. An intellectual property official noted: "Appropriate Technology initiative from South Korea was successfully implemented in the Dominican Republic" (C6). This demonstrates that international models can be adapted locally when properly implemented.

There is an opportunity to create innovations that can be commercialized internationally. A government representative mentioned the goal of "promoting exportable intellectual property" (C7), recognizing that successful innovations from the Dominican Republic could serve regional and global markets, not just the domestic economy.

4. Comparative Analysis

This chapter compares the strengths, gaps, and opportunities in the Lisbon, Málaga, and Santiago de los Caballeros regional innovation ecosystems. Although each region operates in its own national, cultural, and economic context, the analysis reveals both similarities and differences in how these ecosystems function and develop.

4.1 Similarities Across Regions

The similarities emerged in the areas of (1) academia-industry collaboration challenges, (2) bureaucratic complexity and regulatory friction, and (3) leveraging advanced technologies as innovation enablers.

4.1.1 Academia-Industry Collaboration Challenges

A prominent similarity among all three regions is the disconnect between academic

institutions and industry. In Lisbon, stakeholders see a misalignment of incentives: industry prioritizes speed and commercial results, while academia focuses on open-source models and traditional research metrics. Companies often find academic processes too slow. Málaga faces similar difficulties, as university-business links are weak and mechanisms for innovation transfer need strengthening. In Santiago de los Caballeros, the issue is especially acute; stakeholders report "no link between academia and industry" (C7) and say universities teach theory without preparing students for real-world processes. This reflects systemic challenges in how academic institutions are structured and incentivized relative to innovation needs.

4.1.2 Bureaucratic Complexity and Regulatory Friction

All three ecosystems struggle with bureaucratic barriers that slow innovation and entrepreneurship. Lisbon faces challenges with government payment delays that threaten startup capital survival, alongside public procurement cycles that are notably slower and more complex than in benchmark markets like the United States. Málaga similarly contends with complex regulatory requirements for startups, with stakeholders specifically noting bureaucratic obstacles and calling for simplified administrative processes for new ventures. Santiago de los Caballeros confronts what stakeholders describe as an "unfavourable tax and regulatory environment for startups," with neighbouring countries offering more business-friendly tax programs and insufficient incentives for deep tech ventures to emerge. This pattern indicates that despite operating under different national frameworks, all three regions face similar challenges in adapting governmental and regulatory structures to the fast-paced, resource-constrained reality of startup ventures.

4.1.3 Leveraging Advanced Technologies as Innovation Enablers

All three regions identify advanced technologies, particularly AI, as opportunities for ecosystem acceleration. Lisbon stakeholders emphasize using AI as an enabler for innovation across various sectors, recognizing that technological advancement can help overcome some traditional barriers. Málaga similarly identifies digital transformation and advanced technologies as key opportunities. In their case, combining AI with other technologies like 5G/6G for rural digitalization, autonomous vehicles, and precision agriculture shows potential for regional competitive advantage. Santiago de los Caballeros is creating an innovation and startup hub focused on AI with emphasis on micro-niche solutions addressing specific problems, alongside proposals for technology sandboxes allowing universities, startups, and companies to experiment without fear. This convergence suggests a shared recognition that emerging technologies offer pathways to leapfrog traditional development limitations and create differentiated competitive advantages.

4.2. Differences Across Regions

4.2.1 Distinct Strengths

The three regions demonstrate different types of competitive advantages that reflect their contexts. Lisbon's primary distinction lies in its growing institutional maturity; the ecosystem benefits from well-established accelerators and corporate innovation initiatives from major companies like EDP and Galp that create structured pathways for startup-corporate collaboration. Málaga, by contrast, has an active Technological Park of Andalusia (PTA) and a university acting as a central innovation hub. The PTA is seen as one of the primary physical and institutional hubs where innovation activity is concentrated, attracting both national and international companies. The concentration of technology-focused companies in the park generates network effects and facilitates informal knowledge exchange. Santiago de los Caballeros demonstrates a grassroots innovation energy that compensates for less developed formal infrastructure. The creation of the Dominican Republic's largest AI community and incubation of over 500 projects through community-driven efforts showcases a pragmatic "roll up your sleeves" approach distinct from European institutional models.

4.2.2 Distinct Barriers

The barriers faced by each region operate at different levels of ecosystem development. In Lisbon, while adequate early-stage funding exists, gaps emerge in later-stage capital for scaling deep technology ventures, reflecting investor risk profiles that have not evolved to support capital-intensive innovation. Málaga's distinct barriers centre on funding and deployment challenges. Specifically, the scaling and commercialization phase faces a funding desert, especially for deep-tech startups that require extended development periods before generating revenue. Further, large companies expressed limited interest in supporting deep-tech startups because of their long time-to-profitability, creating a gap in private investment. Santiago de los Caballeros faces financial constraints. Namely, entrepreneurs face constraints in accessing the financial resources necessary to launch, grow, and scale their ventures, particularly for deep technology ventures that require longer development timelines and larger upfront investments before generating revenue. Further, the absence of organized angel investor networks makes promising startups struggle to bridge the gap between their own savings and larger institutional funding rounds.

4.2.3 Distinct Opportunities

Each region's opportunity landscape reflects how its unique characteristics can be utilized strategically. Lisbon's founders exhibit a global orientation from inception, forced by the small domestic market to think internationally, which becomes a competitive advantage in digital markets. Málaga's opportunities rely on developing hybrid profiles and industrial doctorates, which were seen as a strategic opportunity to bridge the academia-industry gap. The industrial doctorates in Malaga often remain vacant despite their potential benefits. Expanding and reforming the industrial doctorate programmes would create a pool of individuals who understand both

technical domains and business contexts, capable of acting as translators or connectors between academic research and commercial application. Santiago de los Caballeros distinct opportunity lies in an explicit strategy of replicating successful international models from South Korea, Chile, Colombia, and Brazil, which provides concrete pathways by adapting proven frameworks to Caribbean and Central American contexts.

Key findings

The ecosystem analysis across Portugal, Spain, and the Dominican Republic reveals a set of common structural patterns that shape the development of deep-tech innovation ecosystems in emerging regions.

- **Underutilised role of Higher Education Institutions (HEIs):**
While universities demonstrate strong research capacity, their role in commercialization, startup support, and ecosystem coordination remains limited.
- **Fragmented collaboration between ecosystem actors:**
Interactions between academia, industry, startups, and policymakers are often ad hoc, lacking structured mechanisms for sustained cooperation.
- **Limited support structures for deep-tech entrepreneurship:**
Early-stage startups face barriers in accessing funding, mentorship, and specialized support services, particularly in deep-tech sectors.
- **Insufficient integration of entrepreneurship within HEIs:**
Entrepreneurial training and innovation support are not systematically embedded in higher education systems, especially for researchers.
- **Strong potential for ecosystem development:**
All regions show increasing awareness of innovation and entrepreneurship, with stakeholders expressing strong interest in collaboration and capacity-building initiatives.
- **Need for stronger HEI positioning within ecosystems:**
Universities have the potential to act as central nodes connecting knowledge, talent, and innovation actors, but this role is not yet fully realised.

Recommendations

Based on the findings, the following actions are recommended to strengthen the role of universities in emerging deep-tech innovation ecosystems:

- **Strengthen university–industry collaboration mechanisms**
Develop structured platforms and incentives for collaboration between HEIs, industry, and startups, including joint research initiatives, innovation labs, and co-creation programmes.
- **Embed entrepreneurship and innovation within HEIs**
Integrate entrepreneurial education and training into academic programmes, with a particular focus on researchers and deep-tech disciplines.
- **Enhance support for deep-tech startups**
Expand access to mentoring, incubation, acceleration, and early-stage funding tailored to the specific needs of deep-tech ventures.

- **Position HEIs as ecosystem coordinators**
Support universities in taking a more active role in orchestrating innovation ecosystems, facilitating connections between key stakeholders.
- **Promote cross-sector and cross-regional collaboration**
Encourage knowledge exchange and partnerships across regions and sectors to accelerate learning and ecosystem development.
- **Improve access to funding and investment pathways**
Develop mechanisms to connect startups and research-driven innovations with investors, including public–private funding schemes.
- **Adopt an ecosystem-based approach to innovation policy**
Design policies that support integrated, system-level interventions rather than isolated initiatives.

Conclusion

This Ecosystem Analysis Report provides a comprehensive baseline assessment of the innovation landscapes across three distinct regions: Lisbon (Portugal), Malaga (Spain), and Santiago de los Caballeros (Dominican Republic). Through systematic stakeholder engagement involving 20 survey respondents and 10 in-depth interviews per region, the study has mapped key ecosystem actors and analysed the dynamics shaping deep technology innovation and entrepreneurship in each context.

The analysis reveals that while each regional ecosystem has unique characteristics and strengths, all three ecosystems demonstrate potential for leveraging advanced technologies, particularly artificial intelligence, as enablers for innovation. Further similarities across regions include academia-industry collaboration challenges, bureaucratic complexity, and regulatory friction. Additionally, there are clear pathways for strengthening connection mechanisms between ecosystem actors, developing hybrid profiles that bridge academic and industrial contexts, and adopting problem-driven approaches to collaboration that can overcome existing misalignments. The findings presented in this report establish the foundational understanding necessary for subsequent project activities. The identified strengths, gaps, and opportunities will directly inform partnership development strategies and guide the design of co-creation tasks aimed at strengthening regional innovation capacities.

Appendix I. Interview Guide

Introduction

My name is xx from yy, and we are part of the Scale2Connect project. Scale2Connect aims to strengthen academia–enterprise collaboration and support deep-tech innovation in emerging ecosystems.

Thank you for taking the time to participate in this interview. The purpose of our conversation is to understand the local innovation ecosystems and identify needs, challenges, and opportunities. We're interested in exploring how context-specific factors of the ecosystem influence academia–enterprise collaboration.

Before we begin, I'd like to confirm a few things regarding confidentiality. Your responses will remain anonymous, and any identifiable information will be removed from our analysis. I'd also like to ask for your permission to record this interview to ensure accuracy. Are you comfortable with this, and do you have any questions about the process?

Background of the interviewee

Main question: Could you briefly describe your role and organization?

Follow-up: How is your organization involved in innovation or research collaboration?

Follow-up: What deep tech domains (e.g., AI, 5G/6G, biotech, robotics, etc.) are relevant to your activities?

Theme 1: Current Ecosystem Dynamics

Main question: What would you say are the main actors driving innovation in your region?

Follow-up: What role does your organization play in the ecosystem?

Main question: How would you describe the current level of collaboration between academia and industry?

Follow-up: What mechanisms currently exist for collaboration (e.g., joint labs, internships, incubators)?

Follow-up: Can you give any specific examples?

Theme 2: Barriers and Gaps

Main question: In your opinion, what are the main barriers to stronger academia–enterprise collaboration?

Follow-up: Can you give any specific examples?

Follow-up: Are there regulatory, cultural, or funding-related obstacles?

Main question: Do existing training programs or innovation policies meet the needs of deep tech startups or researchers?

Follow-up: Have you or your organisation participated in any of these programs? How was your experience?

Theme 3: Opportunities and Best Practices

Main question: Can you share any success stories or good practices of successful collaborations or programs in your region?

Follow-up: What conditions made these initiatives successful?

Main question: How do you see emerging technologies, particularly AI, reshaping your regional innovation ecosystem?

Follow-up: Could you share specific examples of how AI has changed collaboration patterns or working relationships within the ecosystem?

Theme 4: Future Vision and Recommendations

Main question: How do you envision the ideal collaboration between universities, startups, and companies in 5 years?

Follow-up: How do you see AI affecting these collaborations?

Follow-up: How can policy and funding instruments support these goals?

Main question: What specific actions should the Scale2Connect project prioritize to strengthen the ecosystem?

Follow-up: Can you give any specific examples?

Closing

As we wrap up, is there anything else you'd like to add about AI's impact on your team or anything you feel we missed?

Wrap-Up

Thank you for sharing your insights and experiences. Your perspective is invaluable to our project, and we'll ensure you receive a summary of our findings if you're interested. If you are interested in future project activities or would like to receive project updates, or if your organization is willing to engage in co-design workshops or pilot activities, let us know.