

# Transforming Science into Business: Science-Business Roadmap for University-Based Scientific Entrepreneurship

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**Abstract:** Scientific entrepreneurship has become a fundamental pillar for innovation and economic development, especially in countries seeking to strengthen their technological production. However, the journey for researchers to transform science into business still presents significant challenges, including a lack of knowledge about innovation processes, limited access to professional networks, insufficient information on accessing financial resources, and difficulties in structuring viable business models. This study, part of an ongoing postdoctoral research project, proposes the application of the Science-Business Roadmap, a tool designed to guide researchers through the scientific entrepreneurship journey. The framework structures the entrepreneurial process, from identifying market opportunities and challenges to securing financial resources, implementing open innovation, and scaling research-based businesses. The study builds upon insights from research published at the European Conference on Innovation and Entrepreneurship (ECIE) – Innovation and Entrepreneurship of Professors in Public Universities: Case Study in Brazil – which resulted from a doctoral thesis analyzing the experiences of successful entrepreneurial professors in Brazilian public universities. Based on these findings, this research presents the validation of the Science-Business Roadmap as a practical tool to support researchers in transitioning their research from academia to the market. Initially applied at the Federal University of Pernambuco (UFPE), the tool can be used by researchers from various fields of knowledge. Its implementation and validation include interviews, workshops, and user monitoring. Beyond providing a structured model to increase the success rate of entrepreneurial initiatives in public universities, this tool fosters innovative businesses, expanding the impact of academic research. Additionally, this tool plays a crucial role in training scientists and researchers to become successful entrepreneurs, connecting them with companies, investors, and other key stakeholders in the innovation ecosystem. This approach aims not only to generate economic and technological impact but also to strengthen the culture of innovation and scientific entrepreneurship in Brazil and beyond, facilitating strategic partnerships and fostering an environment conducive to transforming science into innovative businesses and driving the growth of deep tech companies.

**Keywords:** Scientific Entrepreneurship, Deep Tech, Open Innovation, Academic Spin-off, Knowledge and Technology Transfer

## 1. Introduction

The transformation of scientific knowledge into tangible innovation represents one of the most significant challenges and opportunities for 21st-century universities (Borges et al., 2021). The so-called “third mission of universities” (Etzkowitz, 2008) expands the role of higher education institutions beyond teaching and research, incorporating the responsibility of generating economic, social, and technological impact through entrepreneurship and innovation. In this context, strengthening scientific entrepreneurship has become a strategic pillar for countries seeking to develop a knowledge-based economy, with emphasis on the role of public universities in generating emerging technologies and deep tech companies.

However, the path from science to market is filled with barriers. Researchers often face obstacles such as a lack of entrepreneurial training, insufficient knowledge about innovation processes, a lack of institutional support, and difficulties in accessing financial resources. These gaps hinder the full realization of universities' innovative potential and limit the creation of science-based businesses. To overcome these challenges — especially in the Brazilian institutional context — it is essential to provide practical tools that can guide scientists in their entrepreneurial journey from academia to the market, connecting research, innovation, and industry.

This article presents the validation of the Science-Business Roadmap (SBR), a tool developed from the roadmapping methodology (Phaal and Keer 2001) applied in a doctoral thesis on the trajectories of entrepreneurial professors in Brazilian public universities (Coelho, 2022). The SBR was conceived as a strategic decision-making support instrument for researchers seeking to transform their discoveries into impactful solutions, thereby structuring the process of developing science-based businesses. This study, derived from an ongoing postdoctoral research project, aims to validate the SBR with researchers from different fields by applying a questionnaire that explores the maturity stage of their projects, entrepreneurial competencies, and perceptions of the tool's applicability.

The following section presents the theoretical background on scientific entrepreneurship, followed by an overview of the national and international landscape, the SBR validation methodology, and analysis of the results in five sections. Finally, the conclusion offers a reflection on the role of the SBR in institutionalizing scientific entrepreneurship within Brazilian universities, contributing to the strengthening of innovation ecosystems, the expansion of connections between science and market, and the development of academic leaders committed to sustainable development and technological transformation.

## **2. Theoretical Background**

Scientific entrepreneurship emerges as a strategic strand of knowledge-oriented innovation, being especially relevant in public universities that concentrate most of the scientific production in countries like Brazil (CGU, 2023). By encouraging the creation of academic spin-offs (SOAs), technology-based startups, and university-industry partnerships, higher education institutions expand their activities beyond academic production, directly contributing to regional economic and technological development (MIT Sloan Management, 2025).

Authors such as Shane (2004) and Etzkowitz (2008) argue that the active involvement of professors in entrepreneurial activities increases the efficiency of technology transfer and enables the generation of wealth from science. However, for this potential to be realized, incentive policies, institutional support, and methodological tools are required to support the researcher's entrepreneurial journey — from identifying opportunities to business modeling, fundraising, and market validation.

In this context, roadmapping methodologies have been widely used to structure innovation trajectories and guide strategic decision-making (Phaal and Keer 2001). In her doctoral thesis, Coelho (2022) proposed the KTTRM (Knowledge and Technology Transfer Roadmapping Methodology), based on the analysis of cases of entrepreneurial professors in Brazilian public universities who successfully transformed scientific research into high-impact businesses. This methodology allowed the mapping of competencies, strategies, and knowledge and technology transfer (KTT) channels, revealing the critical success factors in these trajectories.

The SBR, the subject of study in this article, is directly derived from this methodology and constitutes a practical tool for planning, structuring, and accelerating scientific ventures. By articulating the insights from KTTRM in relation to current demands for open innovation, deep tech, and collaborative ecosystems, SBR aims to support researchers in developing innovative solutions from their research, thereby promoting economic and social impact.

## **3. The Landscape of Scientific Entrepreneurship in Brazil and Worldwide**

Scientific entrepreneurship has gained global prominence as a vector for transforming academic research into high-impact technological solutions. However, institutional, cultural, and financial contexts vary significantly across countries, directly affecting the conditions for creating and scaling deep tech companies and academic spin-offs (ASOs). Cultural traits play a key role in shaping entrepreneurial attitudes, intentions, and education, influencing the effectiveness of entrepreneurship programs across different countries (Fleck, Kakouris, & Winkel, 2021).

The most recent data from the Global Entrepreneurship Monitor (GEM) 2024/2025 – Global Report reveals an ambivalent scenario in Brazil (GEM, 2024). On one hand, there is a high motivation to undertake entrepreneurial ventures: 74.6% of Brazilian adults indicate a desire to “make a difference in the world” as a motivation for entrepreneurship. In contrast, 69.3% cite the desire to “build great wealth or high income.” Additionally, nearly half of the adult population (49.8%) demonstrates entrepreneurial intentions. On the other hand, only 46.1% believe it is easy to start a business, and 51.5% express a fear of failure, reflecting a still high perceived risk.

Among researchers affiliated with Brazilian federal universities, a relevant statistic extracted from the report by the Office of the Comptroller General (CGU), the agency responsible for auditing public spending in the country, indicates that 47% express interest in creating ASOs. This figure reinforces the latent potential for transforming research into innovation but also highlights that the ecosystem still lacks systemic support to convert this interest into established ventures. The CGU (2023) also underscores the challenges universities face in aligning their academic structures with the demands of a more dynamic and market-oriented innovation ecosystem.

A growing body of evidence highlights the strategic role that universities can play in regional economic development by fostering academic entrepreneurship. According to Fiona Murray, Associate Dean for Innovation at MIT Sloan, “The talent is there. It’s just about building the systems and the culture that let it shine.”

A recent study shows that American universities not only train PhDs in cutting-edge research but also embed innovation and entrepreneurship directly into their programs, helping students patent their discoveries and launch startups, bringing science to market. This model demonstrates that when institutions encourage faculty to pursue impact and engage PhD students in commercialization, they become engines of inclusive growth and innovation. This alignment between research, training, and regional economic needs allows universities to transform scientific knowledge into tangible social value — a lesson that can inspire similar strategies in Brazil and other emerging innovation ecosystems (MIT Sloan Management, 2025).

A study conducted with all ASOs of the Federal University of Minas Gerais (UFMG) found that the number of technologies transferred to ASOs represented 5.3% of the total protected Intellectual Property assets between 2001 and 2022. Moreover, the participation of UFMG researchers/professors in the creation of ASOs was associated with greater success in technology transfer, as well as higher returns for the university. For ASOs with participation from university researchers and professors, the average receipt of royalties/access fees was seven times higher than the average observed for other companies that are not ASOs. Additionally, among academic entrepreneurs, it was found that article production per year after the founding of the ASO remained equal to or increased in 75% of cases, with an average increase of 28% in the number of publications per year following the company's founding (Rabelo et al., 2024).

However, Brazil still faces structural barriers to scaling this model broadly. Nonetheless, initiatives such as those supported by the Brazilian Funding Authority for Studies and Projects (FINEP) — a public institution linked to the Ministry of Science, Technology, and Innovation (MCTI), responsible for promoting innovation and scientific research in Brazil — have sought to bridge the gap between academia and the market. According to the eBook from the I Deep Tech Brazil Seminar, promoted by FINEP and partners (2025), deep techs account for 25% of Brazilian startups but face bottlenecks in funding, entrepreneurial training, and engagement with the productive sector. The publication also emphasizes the importance of developing platforms and programs that support the journey of scientific entrepreneurs, informed by data, market intelligence, and strategic guidance.

In this context, tools like SBR become even more relevant. They not only help structure the journey of the scientist-entrepreneur but also contribute to the creation of a more proactive, connected, and results-oriented innovation culture. By combining practical guidance, strategic visualization, and integration with ecosystem actors, the roadmap helps ensure that Brazilian scientific talent can truly “shine,” as Murray suggests — provided robust and collaborative institutional structures support them.

#### **4. Methodology**

This study adopts a qualitative and quantitative approach to validate the applicability of the SBR as a support tool for the entrepreneurial journey of university researchers. The methodology is grounded in an applied and exploratory research logic, focusing on analyzing the use of the SBR by scientists and researchers from Brazilian public universities, particularly within the context of science- and technology-based ventures.

The validation of the SBR was conducted through a structured questionnaire, designed based on the dimensions and competencies identified in the KTRM methodology (Coelho, 2022; Coelho and Rapini, 2022), which inspired the tool's structure. The questions aimed to investigate the maturity level of scientific projects, the entrepreneurial competencies perceived as most important and most practiced, the challenges faced, and the participants' receptiveness to SBR.

The form was made available online using Google Forms, comprising 20 questions (closed, mixed, and open-ended). A total of 20 academic researchers and entrepreneurs from Brazil were invited to complete the form. We obtained 13 valid responses from researchers affiliated with six federal public universities in Brazil: Federal University of Pernambuco (UFPE), Federal University of Ceará (UFC), Federal University of Minas Gerais (UFMG), Federal University of Goiás (UFG), Federal University of Uberlândia (UFU), and Federal University of Technology – Paraná (UTFPR). Among these, 3 researchers were from UFG, 3 from UFPE, 2 from UFMG, 2 from UTFPR, 2 from UFU, and 1 from UFC. Participants' innovation projects were at different Technology Readiness Levels (TRLs), and they came from diverse fields of knowledge: 6 from Information Technology; 2 from Biotechnology and Health; 2 from Artificial Intelligence and Data Analysis; 1 from Industry and Manufacturing; 1 from Software Engineering; and 1 from Education.

The analysis included descriptive statistical treatment of the quantitative data, cross-referencing perceived importance and actual practice of entrepreneurial competencies, as well as thematic categorization of the open-

ended responses. The data were organized using graphical visualization tools to facilitate the interpretation of the results and their relation to the SBR structure.

## **5. Results and Discussion**

The following section presents the main findings from the validation of the SBR, based on the 13 valid responses obtained from the research questionnaire. The results are organized into five main sections: (i) institutional profile of the respondents; (ii) project stages and areas of focus; (iii) evaluation of entrepreneurial competencies; (iv) perceptions of SBR format; and (v) functional and strategic evaluation of SBR: perceptions and proposals for improvement. This structure allows integrated analysis of SBR's applicability, considering contextual and individual aspects of researchers' trajectories.

### **5.1 Institutional Profile of the Respondents**

The qualitative responses indicate that participants come from institutions with varying levels of maturity in terms of innovation and scientific entrepreneurship. Respondents from universities such as UFU and UFC reported recent institutional advances in innovation rankings and expansion of their patent portfolios, indicating a favorable environment for adopting tools like the Science-Business Roadmap. UTFPR was noted for its technological culture and close ties to the productive sector, being identified as an institution where the tool could potentially be incorporated by the university's Office of Business Relations.

Many participants also emphasized the importance of the tool offering personalized alerts and integration with communication channels such as WhatsApp and email, to expand access to relevant opportunities. There was also institutional interest in using the SBR as a tool for mapping entrepreneurial profiles, reinforcing its strategic potential not only as an individual planning tool but also as institutional support for innovation management in Brazilian public universities. These elements suggest that SBR addresses a concrete gap in supporting researchers' entrepreneurial journeys and can be integrated into institutional innovation policies.

### **5.2 Project Stages and Areas of Focus**

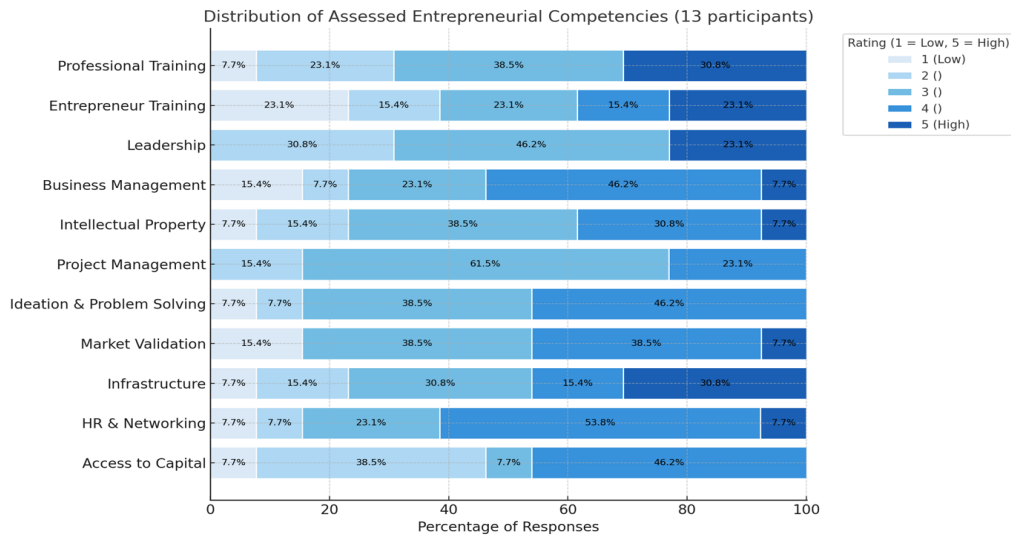
The data indicate significant diversity in the Technology Readiness Levels (TRLs) of participants' projects or ventures. Most respondents classified their projects between TRL 4 and TRL 7, which corresponds to the stages from laboratory concept validation to prototyping in relevant environments—suggesting that SBR is especially useful in the intermediate phases of technological development.

The project areas were also diverse, including Information Technology, Artificial Intelligence, Software Engineering, Biotechnology, Health, Manufacturing, and Education. This demonstrates the SBR's cross-disciplinary potential in supporting researchers from various fields, highlighting its adaptability and applicability in multiple scientific and technological contexts.

Additionally, it is worth noting that participants were affiliated with universities located in Brazil's South, Northeast, and Central-West regions, such as UFPE (Northeast), UFC (Northeast), UFMG (Southeast), UFU (Southeast), UTFPR (South), and UFG (Central-West). This geographic diversity already offers a sample of the institutional landscape in different parts of the country. However, plans are underway to expand the application of the Science-Business Roadmap to researchers from additional universities—particularly in the Northern region—to ensure broader national representation and to understand regional variations in the scientific and technological innovation ecosystem.

### **5.3 Evaluation of Entrepreneurial Competencies**

The identification and development of entrepreneurial competencies have already been highlighted as critical success factors in the entrepreneurial process of academic researchers, as noted in Coelho's doctoral thesis (2022), which investigated the trajectories of entrepreneurial professors at Brazilian public universities. That study found that the ability to combine scientific and entrepreneurial competencies was essential for enabling the creation of spin-offs, executing Research, Development, and Innovation (R&D&I) projects, and providing services in partnership with companies to facilitate the effective transfer of knowledge and technology. Thus, understanding how researchers perceive their entrepreneurial skills is a fundamental step toward improving tools such as SBR.



**Figure 1: Distribution of Self-Assessed Entrepreneurial Competencies**

Source: Authors' own elaboration, 2025.

Figure 1 presents the distribution of entrepreneurial competencies self-assessed by the participants based on their current projects or ventures. The analysis revealed relevant patterns regarding both strengths and gaps in the trajectories of researchers engaged in innovation. Among the competencies with the highest concentration of maximum scores (score 5 – “excellent knowledge and extensive practical experience”), the following stand out:

- **Project Management:** 23.1% assigned the maximum score, and 61.5% assigned score 4, indicating an advanced level of mastery of this competency.
- **Ideation and Problem Solving:** 46.2% assigned score 5, demonstrating high creative and analytical capacity.
- **Infrastructure:** 30.8% assigned score 5, and another 15.4% assigned score 4, reflecting partial access to resources and innovation environments.
- **Professional Training:** 30.8% assigned score 5, and 38.5% score 4, evidencing a strong academic background in training talent.

On the other hand, the competencies with the most perceived gaps were (considering score 1 as “little knowledge and little experience”):

- **Business Management:** Only 7.7% assigned score 5, while 15.4% assigned score 1, indicating weaknesses in administrative and strategic aspects.
- **Intellectual Property:** Only 7.7% assigned score 5, indicating challenges in protecting and managing generated knowledge.
- **Market Validation:** Also, with only 7.7% assigning the maximum score (5), highlighting difficulties in connecting science with real market demand.
- **Human Resources and Networking:** 7.7% assigned score 5, suggesting weaknesses in engaging with the innovation ecosystem.
- **Access to Capital:** No participant assigned the maximum score, and 7.7% assigned score 1, reinforcing the perception of barriers to financing.

These findings reinforce the importance of the SBR as a tool for developing key competencies in the scientist-entrepreneur journey. The current version of the SBR already addresses critical areas such as strategic management, fundraising, business modeling, and knowledge protection—several of which align with internationally validated competencies from the European Entrepreneurship Competence Framework (EntreComp) (Bacigalupo et al., 2016), such as resource mobilization, planning and management, and risk management. As a next step, future research will focus on incorporating and validating complementary competencies not yet covered, including creativity, strategic vision, ethical and sustainable thinking, self-awareness, self-efficacy, financial literacy, and teamwork. This integration aims to enhance the SBR’s ability to

foster entrepreneurial mindsets and support the transformation of research into innovative businesses, while assessing the relevance and applicability of these competencies in the Brazilian context.

### 5.4 Perceptions of the SBR Format

Participants' receptiveness to SBR was broadly positive, accompanied by valuable suggestions for institutional adoption and improved user experience. Figures 2 and 3, used to support the question about the visualization and design of the tool, highlight participants' strong interest in visual models that clearly and structurally communicate the SBR content.

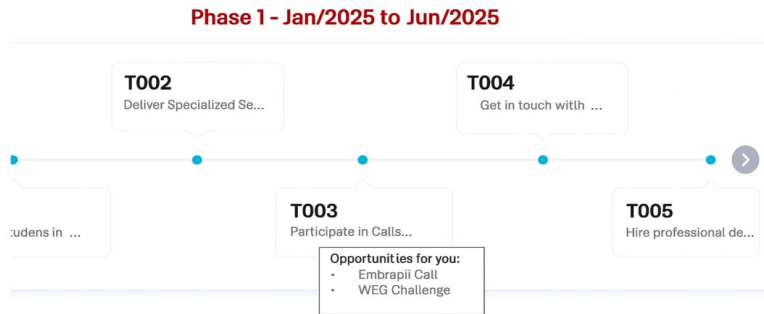


Figure 2: Timeline with strategies prioritized in the short term

Source: Authors' own elaboration, 2025.

Figure 2 illustrates a timeline of short-term prioritized strategies, exemplifying the visual journey of the researcher and forming the basis of SBR. Figure 3 presents the KTRRM framework, structured around temporal phases and strategic dimensions, developed in the doctoral thesis on the trajectories of successful entrepreneurial professors at Brazilian public universities (Coelho, 2022). It is a proposal for the prospective planning of the Scientist's Entrepreneurial Journey. Both visual representations can be integrated into the SBR tool to provide effective visualizations of this journey, contributing to user engagement and tracking of the development stages of scientific ventures.

When asked about their preferred format to visualize their entrepreneurial journey, 46.2% of respondents indicated a preference for "all the above visualizations," showing a desire for multiple forms of accessing information. The remaining responses were distributed among the framework format (46,2%), timeline format (23.1%), list of strategies (7.7%), and integration into a smart system (7.7%).

KTRRM (Knowledge and Technology Transfer Roadmapping)							
RESPONSIBLE RESEARCHER (WHO?)		UNIVERSITY:		RESEARCH LAB/GROUP:		VERSION: _____	
PARTICIPANTS IN THE ROAD-MAPPING SESSION (WHO?):						DATE: __/__/20__	
	Now	PHASE 1 Short Term	20__	PHASE 2 Medium Term	20__	PHASE 3 Long Term	Vision
	Type	Value Creation	When?	Type	Value Creation	Type	Value Creation
<b>Technologies/Knowledge</b> Choose the Technology(s) and/or knowledge for the KTT (Knowledge and Technology Transfer). Does it already exist or will it be developed? What value does the technology/knowledge create, and what is the value proposition for the client(s) that differentiate it from competitors' current offerings? Type: health software, embedded hardware, sales process, specialized services, teaching of technical intelligence, etc. Value Creation: disruptive or patented technology, or with incremental innovation, differentiated and innovative in teaching.	What?	Why?	Transition Strategy	Transition Strategy			Why?
<b>Strategies</b> What strategies will be used for the KTT, considering the chosen channels, to gain competitive advantage and distribute value to generate results? Example: Use EMBRAPII resources to improve the technology. Train, with quality, entrepreneurial students and in a specific area (e.g., Natural Language Processing).	How?						
<b>Resources</b> What resources (e.g., financial, physical, human, technological) need to be acquired for KTT (Knowledge and Technology Transfer)? (Note: a strategic partnership should provide some resource, for example, funding, equipment, or a research network).	How much?						
<b>Stakeholders</b> Who are the main internal stakeholders (e.g., students, professors) and external stakeholders in the university (e.g., healthcare companies)? Who are the main strategic partners – that is, those who provide some resource (e.g., government, investors, company X)? Who are the potential customers? (e.g., elderly population)	Main: - Potential clients:	Strategic Partnerships: - Strategic Partnerships: Who?	Main: - Potential clients:	Strategic Partnerships: - Strategic Partnerships:	Main: - Potential clients:	Strategic Partnerships: - Strategic Partnerships:	
<b>Environment</b> What is the target market to consume the transferred technology and/or knowledge? What ecosystem elements act as facilitators or barriers to KTT? Example: Target Market: healthcare equipment industry Facilitators: favorable economic environment, SEBRAE and EMBRAPII funding for R&D projects, entrepreneurial university jobs, Brazilian Innovation Law ("Lei do Bem"), market needs. Difficulties: lack of available equipment at the university; university's buying policy; team lacking business management skills.	- Target market: - Facilitators (opportunities) - Difficulties (threats):	Where?	- Target market: - Facilitators (opportunities): - Difficulties (threats):	- Target market: - Facilitators (opportunities): - Difficulties (threats):	- Target market: - Facilitators (opportunities): - Difficulties (threats):	- Target market: - Facilitators (opportunities): - Difficulties (threats):	
<b>KTT Channel</b> What is the main channel for this phase, and are there other channels? Example: Strategic Partnerships and Service Provision (Secondary).	Main: How?	Others (Secondary):	Main:	Others (Secondary):	Main:	Others (Secondary):	

Figure 3: KTRRM (Knowledge and Technology Transfer Roadmap Methodology) Framework

Source: Adapted from Coelho (2022).

These preferences indicate that a combination of visual roadmap, interactive timeline, and personalized strategy list could enhance researchers' engagement with the tool. Additionally, they emphasize the importance of a user-friendly interface, smart alerts, and integration with communication channels such as WhatsApp and email, as suggested in the open comments.

## **5.5 Functional and Strategic Assessment of SBR: Perceptions and Improvement Proposals**

In addition to the overall evaluation of the format and applicability of SBR, participants also answered a set of specific questions related to advanced features, ecosystem integration, and institutional use possibilities of the tool. The main findings, listed below, reinforce the robustness of the proposed model and its potential impact on strengthening scientific entrepreneurship:

**Entrepreneurial journey planning:** All participants (100%) consider that visualizing the roadmap in temporal phases (short, medium-term, and long-term) facilitates the planning of the entrepreneurial journey. Additionally, 92.3% of respondents expressed a clear intention to share the roadmap with their teams, highlighting its potential for collaborative use within research groups and innovation centers. Meanwhile, 7.7% responded "Maybe," indicating a cautious but open stance toward its collective adoption.

**Use of artificial intelligence and personalization:** All respondents (100%) positively evaluated the use of Artificial Intelligence (AI) in generating personalized roadmaps based on their responses, the current stage of their projects, and successful entrepreneurial cases of professors who created wealth (Coelho, 2022).

**Integration with ecosystems and smart platforms:** The integration of SBR with intelligent platforms was considered relevant by 100% of participants, especially for mapping funding calls, market opportunities, and technological demands. Moreover, 92.3% approved the feature of recommending people with shared interests (such as other researchers, mentors, and investors), reinforcing the SBR's potential as a connector for scientific and entrepreneurial collaboration networks. All participants also believe their institutions would be interested in accessing the aggregated data generated by the platform.

**Institutional and governmental interest:** Most respondents (92.3%) recognize that SBR can assist funding agencies in identifying and mapping scientific entrepreneurial profiles, strengthening public policies aimed at innovation and technological development. Only 30.8% of participants believe that funding agencies would cover the cost of structured access to the information generated by the tool. Another 61.5% responded "maybe," indicating a cautious openness to the possibility, while 7.7% do not believe this is viable. These findings suggest that there may indeed be interest in paying for the information produced by SBR; however, monetization will depend on demonstrating its value and effectively engaging with the relevant agencies. Regarding institutional acceptance, 92.3% believe the tool would be well received in their universities. Open responses reinforce the positive perception to BR adoption among universities, especially those with a technological profile and an innovation focus. One respondent noted: "Yes. Given UTFPR's profile as a technological university focused on delivering value to the market, the tool would certainly be widely used by the Pro-Rector of Business Relations." Another participant added: "At my institution (UFU), there has been a recent advancement in the innovation ranking [...]. UFU's patent portfolio has grown significantly, and researchers' interest in innovation and entrepreneurship has also increased." These statements also highlight that successful adoption depends on the engagement of leadership and integration with innovation centers, as emphasized by a researcher from UFC: "I believe that the Science-Business Roadmap would not only be well accepted but also highly functional and strategic, especially if introduced by academic leaders with credibility."

**Perceived value as a guiding tool:** When asked about the potential of the SBR tool to guide their entrepreneurial journeys based on the best paths already taken by successful entrepreneurial researchers, 76.9% of participants responded positively. This data reinforces the perceived value of the tool as a strategic guide, capable of providing practical directions inspired by real cases to overcome recurring challenges in translating science into business. Another 23.1% responded "maybe," indicating openness to the proposal and signaling opportunities further to improve the experience and personalization of the SBR recommendations.

**Monetization and sustainability potential:** When asked about their willingness to pay a subscription to use the SBR tool, if it truly adds value to their entrepreneurial journey, 30.8% of participants fully agreed, and another 30.8% partially agreed, totaling 61.6% potential acceptance of the subscription model. Another 23.1% were indifferent, while 15.4% disagreed. These data indicate a relevant openness to monetizing the solution, especially if practical results in journey personalization and connection to real opportunities are demonstrated. This also signals the importance of exploring hybrid funding models, such as freemium versions, institutional support, or public subsidies.

**Suggestions for Tool Improvement:** Participants' suggestions highlight relevant pathways for improving SBR, emphasizing technological integration, usability, and practical applicability. One respondent proposed creating a "resource and opportunity radar linked to the researcher's WhatsApp or email," while another suggested developing a "tool website" to facilitate access. The importance of managing "multiple journeys simultaneously" and adopting metrics such as TRLs, Key Performance Indicators KPIs, Lean Canvas, and even alignment with the SDGs was also mentioned. One structured suggestion recommended that the tool "incorporate regulatory milestones, professional profiles by stage, and risk analysis, in addition to an interactive version with a repository of best practices and adaptation for use in institutional proposals such as PIBIC, CAPES, and CNPq."<sup>1</sup> These comments demonstrate the high level of engagement and critical thinking among participants, who recognize the value of SBR and propose improvements for its consolidation as a robust solution integrated into scientific and entrepreneurial culture.

**User initial engagement:** 84.6% expressed interest in participating in the pilot of the Minimum Viable Product (MVP) version of the tool free of charge.

These results provide strong validation of the SBR, reinforcing its potential as a practical and scalable solution to support scientist-entrepreneurs across multiple dimensions — from strategic planning to connecting with real opportunities and the innovation ecosystem, thereby turning science into business.

## 6. Conclusions

The preliminary validation of the SBR with researchers from different Brazilian public universities demonstrated its relevance as a support tool for the entrepreneurial journey within the academic context. The results indicate a widely positive reception of the tool, reinforcing the demand for solutions that structure the transition from science to market in a strategic and personalized way.

The SBR proved to be especially useful in the intermediate phases of technological development, assisting researchers in challenges such as business modeling, market validation, and fundraising. The analysis highlighted gaps in entrepreneurial competencies, underscoring the importance of digital tools that support developing these skills. In addition to contributing to the individual planning of scientist-entrepreneurs, SBR is consolidating itself as a solution with institutionalization potential, by supporting universities in mapping innovative profiles, integrating with ecosystems, and building stronger internal innovation policies. Its personalization, usability, and integration with external data strengthen its proposition as a strategic tool for entrepreneurial intelligence.

Therefore, although the tool is still undergoing validation and refinement at the Center for Informatics of UFPE, initial findings suggest that SBR has the potential to be consolidated as a strategic tool for the institutionalization of scientific entrepreneurship in Brazilian public universities. Its adoption can foster a culture of innovation, strengthen regional ecosystems, and support the development of academic leadership committed to technological transformation and sustainable development.

## Ethics Statement

This research did not involve the collection of sensitive data or experiments involving human subjects and therefore did not require approval by a Research Ethics Committee.

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<sup>1</sup>TRL: Technology Readiness Level; KPI: Key Performance Indicator; SDG: Sustainable Development Goal (United Nations 2030 Agenda); PIBIC: Institutional Program for Scientific Initiation Scholarships; CAPES: Coordination for the Improvement of Higher Education Personnel; CNPq: National Council for Scientific and Technological Development.

## AI Use Disclosure

For this article, generative artificial intelligence tools were used exclusively to support the creation of graphic images with improved visual quality, based on data collected in the research. All textual content was developed by the authors based on their research experience and critical analysis of the results. The AI-generated images were reviewed and validated to ensure fidelity to the original data and the scientific purpose of the study.

## References

- CGU (2023) *Assessment of the role of federal universities in the national innovation ecosystem*. Brasília: Office of the Comptroller General (Controladoria-Geral da União). Available at: <https://www.gov.br/cgu/pt-br/assuntos/noticias/2023/12/cgu-avalia-papel-das-universidades-federais-no-ecossistema-nacional-de-inovacao> (Accessed: 26 June 2025).
- Bacigalupo, M., Kampylis, P., Punie, Y., & Van Den Brande, L. (2016). *EntreComp: The Entrepreneurship Competence Framework*. EUR 27939 EN. Luxembourg: Publications Office of the European Union. JRC101581. Available at: [https://joint-research-centre.ec.europa.eu/entrecomp-entrepreneurship-competence-framework\\_en](https://joint-research-centre.ec.europa.eu/entrecomp-entrepreneurship-competence-framework_en)
- Borges, B. D., Soares, M. P., and Silva, S. M. (2021) "Programs and instruments for promoting innovation with technology-based companies in Brazil", *Journal of Technology Management & Innovation*, 16(2), pp. 28–40.
- Coelho, P.G.B. (2022) *Trajectories of professor-entrepreneurs in the field of information technology who generated wealth: case studies in three Brazilian federal public universities*. PhD thesis. Federal University of Minas Gerais (UFMG). Available at: <https://repositorio.ufmg.br/handle/1843/49025> (Accessed: 26 June 2025).
- Coelho, P.G.B. and Rapini, M.S. (2022) "Roadmapping for the study of entrepreneurial and innovation experiences of professors from Brazilian public universities", *XLVI Meeting of ANPAD – EnANPAD 2022 – ITE Division*, 23 September, pp. 1–21.
- Coelho, P. and Rapini, M. (2024) "Academic entrepreneurship using multiple channels of knowledge and technology transfer", *Brazilian Journal of Management and Innovation*, 11(3). doi:10.18226/23190639.v11n3.03.
- Etzkowitz, H. et al. (2008) "Pathways to the entrepreneurial university: towards a global convergence", *Science and Public Policy*, 35(9), pp. 681–695.
- FINEP (2025) *I Deep Tech Brazil Seminar: Diagnosis and Perspectives*. Rio de Janeiro: Funding Authority for Studies and Projects (FINEP). Available at: <https://drive.google.com/file/d/1yKc7yUPVBqkWm-8Bfc7I3P5HmoDafHDj/view?usp=sharing> (Accessed: 27 June 2025).
- Fleck, E., Kakouris, A., & Winkel, D. (2021). Cultural traits of entrepreneurship education: a cross-national study. *Journal of Entrepreneurship in Emerging Economies*, 13(5), 838-863. <https://doi.org/10.1108/JEEE-09-2020-0323>.
- GEM – *Global Entrepreneurship Monitor (2023) Global Report 2023/2024*. Available at: <https://www.gemconsortium.org/reports/latest-global-report> (Accessed: 26 June 2025).
- MIT Sloan School of Management (2025) "U.S. universities are filling a regional innovation gap". *Ideas Made to Matter*. Available at: <https://mitsloan.mit.edu/ideas-made-to-matter/u-s-universities-are-filling-a-regional-innovation-gap> (Accessed: 26 June 2025).
- Phaal, R. and Kerr, C. (2001) "Technology roadmapping: linking technology resources to business objectives", *Centre for Technology Management, University of Cambridge*. Available at: <https://www.ifm.eng.cam.ac.uk/research/ctm/technology-and-innovation-management/technology-roadmapping/> (Accessed: 26 June 2025).
- Rabelo, J.P.A., Rapini, M.S. and Domingues, N. (2024) *Academic entrepreneurship: a characterization of UFMG's spin-off companies*. In: *VIII National Meeting on Industrial Economics and Innovation*, Goiânia, Brazil. Goiânia: ABEIN.
- Shane, S. (2004) *Academic entrepreneurship: university spinoffs and wealth creation*. Cheltenham: Edward Elgar Publishing. ISBN: 9781843765450.