

Innovation and Entrepreneurship of Professors in Public Universities: Case Study in Brazil

Paula Geralda Barbosa Coelho and Márcia Siqueira Rapini

Federal University of Minas Gerais, Belo Horizonte, Brazil

coelhopaula@ufmg.br

msrapini@cedeplar.ufmg.br

Abstract: In the literature on academic entrepreneurship, the creation of academic spin-offs is one of the Knowledge and Technology Transfer (KTT) channels most studied. The use of different KTT channels and the creation of spin-offs can be a source of opportunity for the overflow of knowledge and innovation with wealth creation. Although with a broad spectrum, research on academic entrepreneurship still has gaps to be explored in the literature. In Brazil, there is a lack of studies that explain more specifically how the professor at the public university transfers knowledge and technology and undertakes entrepreneurial activities. The main motivations of the doctoral research presented in this article are the lack of studies concerning the trajectory of successful entrepreneurial professors and the exploration of the use of different KTT channels in academic entrepreneurship for wealth creation. The general goal of the research is to identify the strategies used during the innovation trajectory of entrepreneurial professors in Information Technology (IT), who converted knowledge and scientific assets into wealth. To meet this goal, an adapted retrospective roadmapping approach was used to collect data, to map and to analyze the life trajectory of innovation of six professors from three Brazilian Public Universities in the IT area. The results made it possible to understand how professors innovated, became entrepreneurs and transferred knowledge and technology. They mobilized 136 strategies using different channels (e.g., Entrepreneurs Training, Collaborative Research and Development Projects, Technology Residency, Academic Spin-offs Creation, Academic Consulting). The professors' strategies resulted in a value distribution, with considerable wealth (tangible and intangible). The results showed that although there is no pattern in the professors' trajectories of innovation and entrepreneurship, there are several strategies common to the cases. One of them was to train qualified personnel at the university, based on intensive research in knowledge seeking to solve real market problems.

Keywords: innovation and entrepreneurship, entrepreneurial professors, information technology, knowledge and technology transfer, Brazilian public university, roadmapping

1. Introduction

The university has an important role in entrepreneurship and entrepreneurial activities (Hayter et al., 2018). Innovation and wealth creation can occur from academic entrepreneurship (Shane, 2005). The academic entrepreneurial practice is related to Knowledge and Technology Transfer (KTT) (Rothaermel, Agung and Jiang, 2007). In this sense, a KTT from the university to society can be accomplished in several ways and it occurs in addition to professional development teachings, academic spin-offs creation and patent licensing (Audretsch, Lehmann and Wright, 2014; Orozco-Barrantes, 2020).

In Brazil, studies on innovative activities and academic entrepreneurship are few when compared to the United States and the United Kingdom (Hayter et al., 2018). There are no publications that look at the actors and academic researchers involved in KTT at an individual level (Bercovitz and Feldman, 2008). Despite the studies found in the literature, it is not always wise to indiscriminately “copy” from developed countries if they are not properly adapted to the Brazilian institutional context and characteristics (Orozco-Barrantes, 2020). Taking this into account, Brazil should consider aspects that are more relevant and appropriate to the Brazilian university context (Siegel and Wright, 2015). It should also consider the determinant aspects that help the professor to innovate, to undertake as well as to perform entrepreneurial activities both at the university and at the individual levels (e.g., training, entrepreneur behavior), at the institutional level (e.g., resources, policies, university culture) and his/her access to resources (e.g., financial, physical, human, technological, social) and management (Breschi et al., 2019; Rothaermel, Agung and Jiang, 2007). It would also be important to consider understanding the university's entrepreneurial and innovation ecosystems (e.g., actors, legal structure to foster innovation, economic sectors, stakeholders) and the role that the university and the entrepreneurial professor have within said ecosystems (Lemos, 2012). Moreover, it is important to underscore the fact that several of these aspects may affect the academic researcher's entrepreneurial decision. As far as strategies adopted for the academic entrepreneurship, there is a lack of research applying a structure of strategic choices to factors that influence university strategies and that also examine the narrative adopted by different universities to rationalize and communicate their adopted strategies (Siegel and Wright, 2015).

This study investigates the strategies used by six successful entrepreneurial professors from three Brazilian public universities in the Information Technology (IT) area: Federal University of Minas Gerais (UFMG), Federal University of Pernambuco (UFPE) and Federal Rural University of Pernambuco (UFRPE). These universities are ranked as some of the country's best especially in the areas of teaching (undergraduate and post-graduate), scientific research and entrepreneurial and innovation initiatives. In this study, a structured mapping of innovation life experiences was done for each of the professors who, using several KTT channels have transformed knowledge and scientific assets into wealth. The term “wealth” in this study is related to the value that was created, captured and distributed (Bowman and Ambrosini, 2000). Wealth can be a tangible type of asset (e.g., money) or intangible (e.g., strengthening the university brand; creation of technology that can save lives).

2. Theoretical background

Academic entrepreneurship has been seen as an important channel for knowledge and transfer of technology from science to industry and has been receiving greater political attention. Products resulting from research are the most recognized form of academic entrepreneurship (Breschi et al., 2019). There are determinant aspects both at the individual and at the institutional levels that can affect a professor’s decision whether to undertake and to perform entrepreneurial activities at the university. The social capital factor of the scientist, which refers to his/her potential to derive benefits (both tangible and intangible) from interactions and activities in cooperation with individuals and groups can be a determinant factor in the scientific entrepreneurship (Aldridge et al., 2017). Moreover, a professor’s entrepreneurial activities and behavior are directly related to determinant aspects at the institutional level. The universities can make strategic choices (Bowman and Ambrosini, 2000; Casadesus-Masanell and Ricart, 2010) as far as the use of the channel to transfer the knowledge and technology that they wish to emphasize (Siegel and Wright, 2015).

Academic entrepreneurship is a topic that is broader than academic spin-offs and patent licensing which are only a subset of technology transfer (Rothaermel, Agung and Jiang, 2007; Shane, 2005). The university channels for KTT are intrinsically related to the University-Enterprise (U-E) interaction, which is the driving force for innovation, economic development, technology advance and competitiveness in the country (Audretsch, Lehmann and Wright, 2014). The U-E interaction can be a vehicle for the transfer of knowledge and technology for both the university and the enterprise (Dutrénit and Arza, 2010).

Academic Spin-offs Creation is one of the KTT channels used to explore commercially the university's technology innovations and knowledge generated and accumulated from academic research (Shane, 2005). In the development of *Collaborative Research and Development (R&D) Projects* of the university with companies, there is a bidirectional flow of knowledge transfer, from the university to the company and from the company to the university. The bidirectional channel may be the most appropriate to transfer tacit knowledge and can be best to solve technology bottleneck problems by personal interaction with long-term benefits. The development of Collaborative R&D Projects can reduce investment costs and innovation risks for the companies and may foster more research for the universities (Dutrénit and Arza, 2010; Garcia, Rapini and Cário, 2018). The *Academic Consulting* usually prompts an activity for the university’s specific human resource and while in the partnership for the Research, Development, and Innovation (RD&I) or R&D projects different resources are allocated to reach the result established in the work plan for this type of project. Results from the latest Industry Research on Technology Innovation by the Brazilian Institute of Geography and Statistics (IBGE, 2020) show that technology services in Brazil are relevant for innovation in the domestic industry both as a source of information and as encouragement to enter into partnerships and cooperation to generate innovation. There are *Technology Residency* programs at some universities that draw inspiration from Medical Residency Programs. In IT courses are named simply as Residency or Software Residency (Sampaio et al., 2005). The goal of these professional programs is to qualify and train human resources. These Education and Research Institution programs are mostly science applied to every day real life problems, i.e., so the university can understand the skills required by companies to solve their problems and to execute transfers of know-how (tacit knowledge) by the professional qualification and training of human resources. *Entrepreneurs training* can be seen as a KTT channel. Professors and students trained as entrepreneurs by the university and using the university's scientific and technical knowledge from several knowledge areas can be more readily encouraged to easily create new enterprises including knowledge intensive enterprises. Or, still, even without creating an enterprise, they can generate new, marketable products, services and technologies facilitated both by the technical, technology and scientific skills acquired at the university and by learning how “to be an entrepreneur,” transferring even more knowledge and

technology and, as well, by generating even more value (Breschi et al., 2019; Rothaermel, Agung and Jiang, 2007).

The work related to this study is the one by Hirose and Phaal (2016) – the authors used roadmapping with a retrospective approach, as a research method to capture entrepreneur's past experiences and personal perspectives on the emergence of technology ventures (e.g., independent ventures, spin-offs, or internal corporate ventures). In this work, multiple case studies with 13 companies have been conducted in Europe and Asia-Pacific regions, including the United Kingdom, The Netherlands, Japan, and Australia, to demonstrate the utility and applicability of the approach in a variety of ventures and technological sectors across different country settings.

3. Methodology

This is a qualitative and exploratory research with multiple case studies of the life trajectory of innovation of IT entrepreneurial professors (professor's trajectory) using different KTT channels. This study used the roadmapping method. The use of roadmapping is a powerful and practical way to support organizations in their strategy, for long-term planning, innovation and forecasting activities (Kerr and Phaal, 2021). An adaptation of the retrospective roadmapping method was applied (Hirose and Phaal, 2016) for data collection, mapping and qualitative analyses of the trajectory of the successful IT professors at the UFMG, UFPE and UFRPE universities. In the roadmapping section, an interview takes place and, in parallel, the preparation of the roadmap. The roadmap is a map containing collected data and that can be drawn either physically in a cardboard (using post-its) or digitally using the appropriate software. Roadmapping can be used for prospective planning (visualization of the future). It can also be used in a retrospective approach where the timeline is inverted to provide a useful framework for application of historical projects development, as a tool for research and diagnostic and to learn from the past.

The goal of this study was to investigate the strategies used by entrepreneurial IT professors, from Brazilian federal universities, in KTT, while creating and distributing value using different channels. Personas were created for the entrepreneurial professors selected for this study for purposes of anonymity: Prof. Charles and Prof. Joseph (from UFMG); Prof. Kim, Prof. Walter, and Prof. Willy (from UFPE); and Prof. Oswaldo (from UFRPE).

An adapted roadmap was used for data collecting and analyses in order to meet the goal proposed in this study; it includes choosing dimensions for the roadmap (prepared at the roadmapping session). An adaptation was also made for the application of the roadmap, i.e., organization and execution of interviews with each professor where, in parallel, a roadmap was prepared with a timeline of the stages of their innovation trajectory.

The first thing done in the roadmapping section was to present to the professor the roadmap dimensions and an explanation of its meaning. After that, the professor was asked to freely talk about his experience with entrepreneurship and innovation throughout his life, observing aspects that could fit into the roadmap dimensions. The interviewer used a table prepared by him with questions about each dimension of the roadmap (e.g., Has a business model been developed?; Was any project management methodology used?; Did the technology created have a pioneering or disruptive innovation?). These questions were not presented to the professor. These questions were used by the interviewer to better understand what the professor said. But, if the professor did not mention anything in his narrative about these questions, then the interviewer asked him those questions sometime during the interview. The interview lasted two hours. Only one of the interviews (Prof. Oswaldo's interview) was done remotely. During the interview, for each professor, data was collected and distributed in eight dimensions which were then adapted for the roadmap: *Strategy, Technology, Value Created, Value Distributed, Partnership, Main Stakeholder, Resource, and Environment*.

3.1 Data analysis

After each interview, the data was refined by listening to the interview, each of which was recorded, and by consulting the Internet for additional information for the data collected from each professor. During the refinement phase, the data was recorded in a spreadsheet with eight tabs, each one representing one of the eight roadmap dimensions. In addition, to help understand the logical sequence of findings (data), considering the timeline of the professor's trajectory stages, the roadmap of some professors was redrawn in a digital format while the spreadsheet was being filled out. This spreadsheet made it easier to analyze individual and global cases.

The individual analysis of the cases examined the most significant aspects of each case, key questions about the strategies used, important points of the findings in each one of the dimensions of the roadmap, the lessons learned cited by the professor (barriers and facilitators for academic entrepreneurship), and channels used for KTT. The global analysis of the cases sought to revisit each case and interpret its main findings, formulating propositions, grouping/categorizing and compiling the narratives between the cases, contextualizing, understanding and recording the perceived and observed reality, along the trajectory of the entrepreneurial professors, and confronting the relevant evidence with the theoretical review carried out in the study.

4. Results and discussion

Several results were found in this study. Results that contribute to the literature and that are relevant to the Brazilian context will be presented and discussed. Overall, 136 strategies used by the professors were identified. These strategies were classified according to their nature (Table 1).

Table 1: Strategies used by entrepreneurial professors

Nature	Total	Example of Strategy Used
Management	71	Invite other university professors to participate in the spin-off's society; Come up with solutions and products of impact, knowledge-intensive, with a lot of research, keeping up on the latest results from the world's literature. Hiring of a Project Manager for the team; Prepare and execute a Business Plan; Prepare relevant Scientific Production, accepted at the distinguished conferences; Initially choose a community and begin to solve its problems, using own research; Attend spin-offs team meetings.
Personnel Qualification	28	Prepare a research agenda (during orientation for master's and PhD students) focusing on research geared towards real market problems (applied research).
Resources	32	Hire a highly qualified team: technical, business, commercial and strategic; Create strategic alliances with other professors from the university's departments in order to offer course subjects such as entrepreneurship and innovation at the same time. In this way, these courses, non-officially, thus avoiding university bureaucracy and then becoming, in practice, one sole course with professors from several departments. The students enrolled in these courses attend classes together at one sole location (for instance, the university's main auditorium); Participate (as coordinator, consultant or researcher) in collaborative R&D projects with domestic and foreign companies; Have a strong relationship, and constantly interact, with stakeholders.
Market	5	To be "bilingual", know how to speak academic language and corporate language, updated on the latest literature research, and knowing how to listen/understand both society and the market; Create a multiplatform, multiuser software in several languages.

Of all the strategies, 78 (57%) appeared only once in a case and 58 (43%) appeared in more than one case (use of similar strategies). Among the 58, 27 (46%) strategies were "Management". This evidence reinforces the importance of a professor's access to management knowledge for their entrepreneurial activities (Breschi et al., 2019; Shane, 2005) either by hiring a professional manager for project development or by acquiring a partner for his/her spin-off that understands financial management (Hayter et al., 2018). Moreover, the professor may hire a complementary team with experience and knowledge of management, business, products and markets, among other subjects or he/she can either enroll in management courses or use the partner's expertise (e.g., investor) (Shane, 2005). As far as "Management" strategies it is important to point out that in the strategies classified as "Intellectual Property Management" none of the UFPE professor's narratives included information on the university's Technology Transfer Office (TTO). This evidence also suggests that the few IP experiences observed in the cases may be related to an individual's cultural issues and the university's IP culture (O'Shea et al., 2005) on issues related to the university's TTO (for instance, when it contains abusive terms in the license; a request for higher amounts for royalty participation and hiring; has bureaucratic practices for licensing and hiring; or, still, will only do IP protection with exclusivity) (Feld, 2020).

The use of several "Resources" was identified as "Physical" (e.g., the university's research lab), "Social," "Technological," "Human," and "Financial". Considering the strategies classified as "Resources," the "Financial" type was the most used by the professors regardless of the type of KTT channel. This evidence is in line with the recurrent need for money for entrepreneurial activities and innovation and, especially, to maintain and invest

in spin-offs growth since, frequently, it requires a greater effort for its technical and market development, among other needs (O'Shea et al., 2005; Shane, 2005). It was also observed that all professors distributed the financial value “Money” (“tangible”) to the university, their students and themselves, by participating in more than one enterprise, using more than one KTT channel, resulting in technologies, products, services and/or spin-offs. A total of 68 distributed values were found in the cases. The cases showed a large amount (60) of the distributed value of the “intangible” type (only eight are the “tangible” type). Table 2 shows a sample of 12 of these distributed values in the cases that were identified according to their nature.

Table 2: A few values distributed from the strategies used by the entrepreneurial professors

Type	Nature	Example of Distributed Values
Tangible	Money	Participation of the professor on the academic spin-off’s profits and dividends.
	Research	Grants for research scholarships for professor and/or research and internship for students.
Intangible	Award	Awards earned in competitions/contests recognizing the relevance of knowledge, research, technology or university undertaking giving visibility to the university and the researchers involved.
	Competitive Advantage	Commercialization/distribution of software/hardware in several countries.
	Entrepreneurship	Startups founded by university students with professor support.
	U-E Interaction	Expansion of networking and proximity to market companies.
	Infrastructure	Improvement of the infrastructure of the professor's laboratory.
	Job Creation	Hiring market professionals.
	Marketing	Recognition in Brazil and the world of the university’s competencies and excellence in research and projects related to the professor’s field of knowledge.
	Personnel Qualification	Hundreds of students currently work on Games area because they had studied in a pioneering discipline in Brazil (and Latin America) that was created by the professor.
	State of the Art	Relevant scientific research publications with high worldwide impact.
	Training	Training of specialized professionals for the market.

Figure 1 shows the KTT channels used by the professors. The identified KTT channels are described in the gray arrows. The professors used them in each stage of their trajectory. The main channel is highlighted in bold, i.e., the most used by the professor at that stage. It can be seen in Figure 1 that Professor Kim (UFPE) in his fourth stage (Stage 4) stated that he used the channel “Technology Residency” (his most used channel) as well as other channels: “Academic Spin-offs Creation” and “Collaborative R&D Project”. This professor took part in a Software Residency program (channel same as “Technology Residency”) enabled by a proposed Brazilian IT Law, with a multinational company (channel same as “Collaborative R&D Project”) and he created, at the same time, a spin-off with her master’s student (channel same as “Academic Spin-Off Creation”).

It is worthy to note that the professors from this study still continue to research, to innovate and to engage in entrepreneurial activities. Five of them continue to be founding partners of spin-offs (still open and operational). This is evidence of the strong positive effects of financial resources for innovative activities and continuity both for the company (spin-off) and for the individual researcher. It is also worthy to note that the strategies classified as “Resources” of the “Social” type were used during all the professor's trajectory stages as they counted on the support of strategic partners. In all of the professors' trajectory stages, it was also observed strong interactions and collaborative activities with several stakeholders: Professors and students (from their own departments and from other departments); the university’s TTO; companies and market suppliers; several government institutions; other research institutions; technology park; and suppliers. This evidence suggests that access to social resources, by establishing good relationships and social networks is aligned to the success of the entrepreneurial professor. It also suggests that social resources can foster a process of discovery and the exploration of market opportunities, increasing access to resources (e.g., human, physical and financial resources), the maintenance of partnerships already established and to the acquisition of new partnerships (O'Shea et al., 2005). Thus, this evidence also strengthens the fact that access to social resources (the researcher’s social capital) expands the professor’s tendency to use more KTT channels, either by developing more collaborative R&D projects, supplying more academic consulting, participating in more technology residency programs or creating more spin-offs (Aldridge et al., 2017). The evidence in the cases related to “Social

Resources” also highlights the importance and need of entrepreneurial professors (or a team member or spin-off) to have skills to access and to explore relationship networks, research networks and business networks both within and outside the university (Hayter et al., 2018; Shane, 2005).

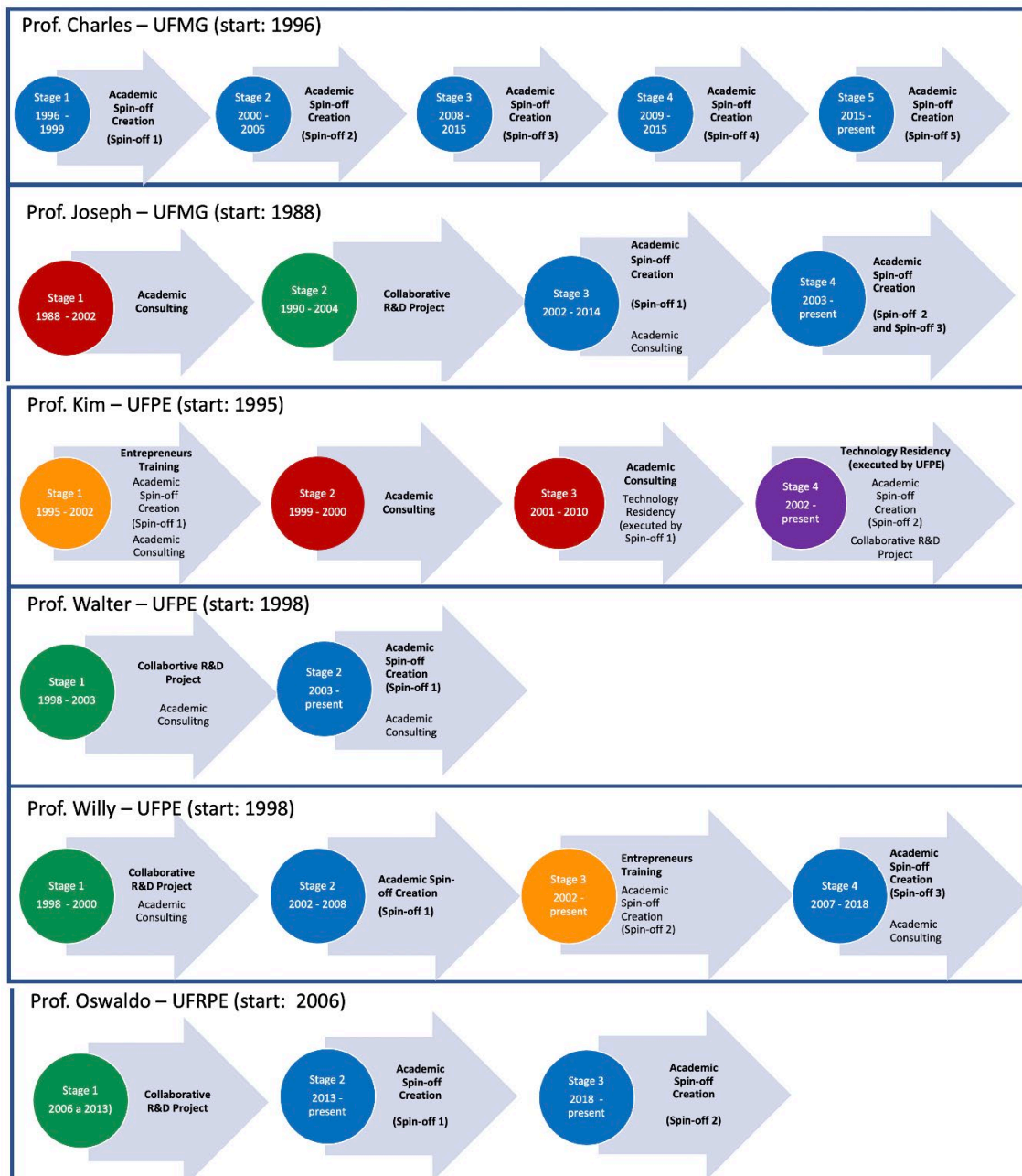


Figure 1: KTT channels used by the entrepreneurial professors along their trajectories

The strategies classified as “Human” type of “Resources” used by the professors showed a preference by the professors to hire “qualified” or “highly qualified” personnel. In this context, since the university is responsible for developing people, including through the professors, strategies used by the professors related to “Personnel Qualification” was actually expected especially due to the type of KTT channel used (e.g., Technology Residency, Collaborative R&D Project). However, an evidence relatively unexpected was that some professors' spin-offs came about from research projects developed by students (especially those in the master and doctorate programs) who then became partners of the professor in his spin-offs. The professor's own students or other university students appeared in several stages of the professor's trajectory in the cases. Even though it seems obvious, this evidence strengthens the relevance of the university’s teaching and research mission and the development of qualified personnel (Guarany, 2010). However, it is worthy to note that most strategies in the cases related to “Personnel Qualification” show the “care” and contribution of the entrepreneurial professors

in the training quality of their students (O'Shea et al., 2005). They used "Training of Qualified Labor" strategies, be it by teaching differentiated disciplines (including seeking to solve market problems) where the student learns not only theory but also the practice (Martinelli, Meyer and von Tunzelmann, 2008); or, by guiding the master and doctorate students "efficiently"; be it by creating disciplines that result in jobs and competitiveness for the students; or even by hiring the students to participate in collaborative R&D projects with companies. Moreover, the expressive amount of strategies related to "Personnel Qualification" that appears in the cases also reinforces the fact that in order for the academic entrepreneurship and entrepreneurial activity to occur it is necessary that the university and the professors are truly responsible and have the same "care" shown by the professors in this study in the development of "qualified" human resources (Hayter et al., 2018; Rothaermel, Agung and Jiang, 2007).

Analyses of the strategies used classified as "Market" show that there is a concern among the professors about good communication skills in the business context (Shane, 2005) and that it is a must to have a team member who is "bilingual," i.e., someone who can speak both the academic language as well as the market language, who knows how to listen and understand their problems (social needs) (Aldridge et al., 2017). Also, in some strategies classified as "Personnel Qualification" it is possible to perceive the professor's concern with the "Market," for instance, when the professor stated that while teaching and during orientation for the master and doctorate students, he required that his students solve real market problems and that they also need to understand and to solve society's problems. This evidence reinforces the importance of developing technologies that create value for the market and for society in academic entrepreneurship (Bowman and Ambrosini, 2000; Casadesus-Masanell and Ricart, 2010; Hayter et al., 2018).

However, it is important to point out that many instances of innovation in the cases began with a student creating a software developed in a machine (computer) and using a free software as a platform for development. This can be seen in Professor Kim's (UFPE) trajectory when he created his second spin-off with his master student. This evidence suggests that in order to build a groundbreaking technology and/or disruptive technology in the IT area it may only be necessary to implement an algorithm that solves a problem using a computer. On the other hand, it is important to note that the creation of a groundbreaking technology does not, in itself, generate a business venture. Lastly, as far as a KTT, it was noticed that the more a technology that was transferred creates value (e.g., technology with disruptive innovation or pioneering), more value was distributed, showing a strong value creation of the technology. Likewise, it was also noticed that the more a knowledge that was transferred creates value, more value was distributed (Bowman and Ambrosini, 2000).

In sum, from the evidence shown in the results, it was noticed that some determinant aspects in the academic entrepreneurship for an effective KTT (with wealth creation) deserve attention for the possible evolution of more innovative and entrepreneurial activities by the professors, taking into account the context of Brazilian public universities and the IT field. Table 3 shows the main determinant aspects found in the cases related to both institutional level, i.e., university level (Level U) and the individual level, i.e., the professor as an academic entrepreneur (Level I).

Table 3: Main determinant aspects for academic entrepreneurship in Brazil

Main determinant aspects for the evolution and occurrence of academic entrepreneurship at Brazilian public universities	Level	
	U	I
Supply of resources (e.g., physical, financial, human, technological, social) to foster more intensive research on knowledge and excellence, accomplish more KTT and encourage more academic entrepreneurship.	X	
Reformulation of the university's internal policies considering the determinant aspects for academic entrepreneurship, the local ecosystem and the Brazilian context in order for the university to be truly entrepreneurial and favors the occurrence of more academic entrepreneurship.	X	
Training of qualified manpower and training of entrepreneurs from the undergraduate to postgraduation, teaching theory and practice, solving real societal and market problems.	X	X
Management teaching and practice (e.g., projects, business, strategic management): Methodology, tools and techniques and the market's best practices.	X	X

Main determinant aspects for the evolution and occurrence of academic entrepreneurship at Brazilian public universities	Level	
	U	I
Perform intensive research on knowledge that generates innovation and technologies with higher degree of maturity and technological base and well-founded to solve really societal/market problems.	X	X
Development/improvement of some soft skills (interpersonal skills) inherent to the entrepreneur.	X	X
Access to knowledge and management practices and/or acquisition/access to people (professionals) with this knowledge to carry out KTT.	X	X
Investment in the use and combination of other knowledge and technology transfer channels (besides patent licensing) which are more adequate to the IT field to create wealth.	X	X
Use of several KTT channels in order to complement the training of qualified manpower (e.g., Academic Spin-off Creation, Collaborative R&D Projects, Academic Consulting, Entrepreneurs Training, Technology Residency).	X	X
Understand and follow upon the evolution and opportunities related to the main elements and characteristics of the entrepreneurial and innovation ecosystems (e.g., market, economic sectors, current legal framework, initiatives to foster innovation, main stakeholders, success stories, culture, geographic proximity) and the role the university and the academic entrepreneur have in the ecosystem.	X	X
Access to financial resources outside the university (e.g., government, investors).	X	X
Access and expansion of social network, research network and business network both within the university and out (social resources).	X	X
Expansion of interaction with the market, getting to know its demands, challenges and opportunities.	X	X

5. Conclusions

Although in Brazil patent licensing has been the most encouraged channel for technology transfer in most universities (Azevedo, 2005), none of the professors applied for a patent licensing. The professors in these cases used several types of KTT channels. They were able to create and to distribute a considerable amount of value. Thus, one of the important results of this study is to demystify the patent as the sole channel for KTT with value creation and distribution.

As it can be seen, from the strategies used and the variety and amount of needed resources (especially financial) the KTT (regardless of channel) is not simple and does not happen in a linear and natural fashion. Another result that called attention, common to all the cases, was that every KTT came about from students or the qualified training and effective orientation by students. Behind the strategies used, along the life trajectory of innovation of IT entrepreneurial professors, is the training of people, that ends up by fostering and encouraging entrepreneurship and the generation of new ventures. This result shows that it is important to work on the training of qualified students (Guaranys, 2010), from their undergraduate level, broadly, taking into account the training (basic teaching) in knowledge areas (competencies) up to teaching of innovation and entrepreneurship in well-structured disciplines. People training at the university is the thread that leads to academic entrepreneurship, including forming entrepreneurial professors (Siegel and Wright, 2015).

In the case studies, no university programs were identified to encourage a professor's academic entrepreneurship. The research suggests that the main motivation for the professors to be entrepreneurs, at the start of their trajectory of innovation, was not solely related to "making money" but the achievement of transferring results of successful, pioneering and/or innovative research as well as bringing benefits to society (Dias, 2018; Kirchberger and Pohl, 2016). The distributed tangible value of the cases appears to be a consequence of the KTT with the choice of several strategies using several types of channels.

Despite several contributions, this work also has some limitations. The research included only cases of successful entrepreneurial professors, operating in the IT field, and their "success stories". It is suggested a bigger sampling in future research that includes both success stories and failures in academic entrepreneurship. It is also suggested the inclusion of other Brazilian public universities. This expanded research may allow, for instance, to compare case results in a way that it is possible to understand the best and worst strategies used by the professors taking into account a KTT with wealth creation at the same university or among universities. Besides

allowing for the comparison of results, also consider the determinants for academic entrepreneurship as far as similarities and differences among components of the entrepreneurial and innovation ecosystems of each university (e.g., university policies and culture, local innovation system).

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