

Offering technologies for innovation: strategies and challenges

Karin Goebel

*Assessoria de Novos Negócios e Inovação, Instituto Carlos Chagas,
Curitiba, Brazil*

Sabrine Dias Losekann

*Assessoria de Novos Negócios e Inovação, Instituto Carlos Chagas,
Curitiba, Brazil and
Universidade Tecnológica Federal do Paraná, Curitiba, Brazil*

Paola Thalissa Bartoski Polla

*Assessoria de Novos Negócios e Inovação, Instituto Carlos Chagas,
Curitiba, Brazil*

Karla Bernardo Mattoso Montenegro

*Centro de Estudos Estratégicos da Fiocruz Antônio Ivo de Carvalho,
Fundação Oswaldo Cruz, Rio de Janeiro, Brazil, and*

Andréa Rodrigues Ávila

*Assessoria de Novos Negócios e Inovação, Instituto Carlos Chagas,
Curitiba, Brazil*

Abstract

Purpose – This study aimed to analyze the strategies and challenges related to technology transfer (TT) in technology transfer offices (TTOs), specifically regarding actions to offer technologies in their portfolios.

Design/methodology/approach – The qualitative research used a multiple case study based on interviews with TTO managers from seven Brazilian public Science and Technology Institutions (STIs): University of São Paulo (USP), State University of Campinas (UNICAMP), Paulista State University (UNESP), Federal University of Minas Gerais (UFMG), Federal University of Paraná (UFPR), Federal Technological University of Paraná (UTFPR) and Oswaldo Cruz Foundation (FIOCRUZ).

Findings – STIs that invest more resources in their portfolio's active offering and marketing are more successful in TT than STIs with a passive strategy. Although this active strategy has grown in importance, there is a disparity among Brazilian TTOs as some are still passive in commercializing their intellectual property. This research also highlights the need for clear policies to overcome obstacles related to legal uncertainty for researchers who wish to undertake projects as entrepreneurs using the intellectual property of STIs.

Research limitations/implications – The results of this study cannot be generalized since its conclusions are limited to the studied institutions. However, the outcomes indicate some interesting matters for managers of STIs, public policymakers and TT researchers.



Originality/value – Literature on marketing and innovation related to TT between research institutions and companies in developing countries is still limited. Thus, this research contributes to generating knowledge in the field and improving TTOs.

Keywords Technology transfer, Technology transfer office, Technology offering, Technology marketing, Spin-off

Paper type Research paper

1. Introduction

Studies on technology transfer (TT) topics have evolved rapidly, demonstrating the interest of researchers, managers and entrepreneurs in this area (Bozeman, Rimes, & Youtie, 2015). Thus, there are increased expectations that universities and research institutions will be ready to transfer the knowledge generated in their laboratories to companies and society through collaborations and licenses. Most research on TT involving public institutions and companies has focused on developed countries, leaving a knowledge gap in emerging countries like Brazil (Soares & Torkomian, 2021).

The development of studies and strategies for TT by Brazilian Science and Technology Institutions (STIs) is the responsibility of technology transfer offices (TTOs). The TTOs are instituted by law to manage intellectual property and innovation policies, in addition to promote and negotiate the STI's relationship with companies and the commercialization of STI knowledge (Lei n. 13.243, 2016).

However, according to data from the Ministry of Science, Technology, Innovations and Communications (2019), the development of studies and strategies for TT has experienced the lowest level of deployment in Brazil among the activities considered essential in TTO. The authors noticed the low implementation level when they verified that among the 305 TTOs studied in the research, only 25.2% of them considered the development of studies and strategies for TT as implemented. Hence, even after years of the promulgation of the Brazilian Innovation Law (Lei n. 10.973, 2004), which encourages the goal of TTOs – companies interactions, TT remains a challenge for most TTOs. In addition, most TTOs are more focused on protecting intellectual property than on TT, resulting in the vast majority of STIs without signed TT agreements. These indicators show the importance of studies that help TTOs structure TT activities.

In a U.S. study conducted by Siegel, Waldman, Atwater, and Link (2003), entrepreneurs, scientists and academic managers indicated that the barriers to TT might be related to a lack of marketing, technical and negotiation skills. Accordingly, identifying and approaching commercial partners in Brazil remains challenging (Dias & Porto, 2018; Sousa, Zambalde, Souki, & Veroneze, 2018). Such identification and approach of partners are challenging since the practices that aim to promote the commercialization of technologies developed through academic research are still limited (Sousa *et al.*, 2018). Thus, improving the marketing or the offering of technologies to companies to promote TT can be an essential step for STIs to generate innovations (Garnica & Torkomian, 2009; Malvezzi, Zambalde, & Rezende, 2014; Sousa *et al.*, 2018). However, there are few studies concerning technological innovation and universities researching their relation to marketing strategies from the research stage to commercialization (Malvezzi *et al.*, 2014; Sousa *et al.*, 2018; Veroneze, Zambalde, Sousa, & Rennó, 2017).

This study, therefore, aims to contribute to filling the knowledge gap on TT in developing countries. The main question of this research is: How do Brazilian TTOs offer technologies? Hence, this study aimed to analyze the reality of Brazilian TTOs regarding the offer of their portfolios and identify strategies and challenges for TT. To this end, we surveyed seven Brazilian institutions and their TTOs. Based on the experiences reported, it was possible to propose solutions to help overcome barriers to generating innovations.

This research contributes to increase the incipient knowledge on the field of marketing and innovation related to TT between research institutions and companies in developing countries mentioned by other authors (Malvezzi *et al.*, 2014; Sousa *et al.*, 2018; Veroneze *et al.*, 2017). As to practical implications, managers can use this work to improve and implement the TTOs' technology offering strategies. In addition, the knowledge generated is valuable for developing effective public management strategies and policies to transform STI – company partnerships into something more lasting in Brazil.

2. Technology transfer and technology offer

The term “technology transfer” involves the conveyance of technologies between different organizations. However, we also considered different concepts according to the area and objective of the research (Bozeman, 2000). Sharma, Kumar, and Lalande (2006) point out that the transfer of technology between universities and industry can be split into three categories:

- (1) The noncommercial transfer characterized by publications, field studies, symposia, exchanges and others.
- (2) Commercial transfer characterized by collaborative or industry-contracted research, consulting and technical services, licensing, and sale of intellectual property.
- (3) The creation of new companies (spin-offs).

Although there are other pathways for TT beyond the linear process of invention disclosure, patenting and licensing (Hayter, Rasmussen, & Rooksby, 2018), a traditional TT model comprises several stages, including marketing. At this stage, the goal is to identify potential companies for licensing intellectual property or conducting joint research and development (Siegel *et al.*, 2003). However, Brazil has not yet sufficiently developed these activities (Dias & Porto, 2018; Sousa *et al.*, 2018). The American Marketing Association (2017) defines *marketing* as “the activity, set of institutions and processes for creating, communicating, delivering and exchanging offerings that have value for customers, clients, partners and society at large.” The marketing of technologies can be understood as a combination of TT and marketing (Vieira, 2003) and it is also called technological offer that is considered an essential step of the TT (Closs, Ferreira, Sampaio, & Perin, 2012). The technological offer concept used in this study involves STI practices concerning offering research and intellectual property, aiming to transfer technology to companies or inventors who want to undertake projects as entrepreneurs using the institution's intellectual property. This offer includes all stages, from the development of partnerships to the commercialization of technologies.

The TTOs play an essential role in the TT as intermediaries between STIs and companies, carrying out external marketing activities (Etzkowitz, Webster, Gebhardt, & Terra, 2000). Weckowska (2015) showed that TTOs with practices primarily focused on the relationship between STIs and companies had more licensing agreements than those focused on transactions.

About the competencies in the TT sector, Mom, Oshri, and Volberda (2012) analyzed studies on European professionals and identified the following groups of studies regarding the detected abilities of the TTOs: i) pioneer studies highlighting the importance of a legal profile for handling intellectual property and royalties; ii) studies on skills related to knowledge about technical domains, categorized as central for some research and providing credibility to the sector and the transferred technologies; and iii) more recent studies highlighting the imperative character of skills more focused on commerce and marketing of technologies. Regarding the Brazilian context, Soares and Torkomian (2021) observed that professional profiles focused on research and marketing-related skills were considered

positive for technology licensing. On the other hand, despite its relevance to the TTOs, the legal profile did not increase the number of licenses.

In the study by Siegel *et al.* (2003), entrepreneurs stated that people working in TTOs should be able to put themselves in the company's shoes as negotiators and marketing facilitators rather than academics. While in scientists regard, these workers must know the research field and where the technology would be going. In the view of academic managers, the lack of marketing practice and skills within the TTOs impedes successful TT. It shows the need for employees with marketing knowledge, as most teams comprise patent or business lawyers and not marketing specialists.

2.1 Technology transfer in Brazil

In Brazil, most research is carried out by STIs, which obtain significant investments of public resources, and limited private investment, which is restricted to a few large companies since the development model historically adopted in Brazil prevents companies from making risky investments (Leal & Figueiredo, 2021). However, despite the public investment, Brazilian STIs can hardly transform the research outcomes generated in their laboratories into technologies that reach society. There are few cases of TT to partners capable of placing their inventions on the market (Santos & Torkomian, 2013; Almeida, Luz, & Quintella, 2020). This characteristic confirms the importance of studies that make it possible for the flow of knowledge generated in Brazilian STIs to go to companies that can help generate innovations.

Recent research by Leal and Figueiredo (2021) on Brazilian technological innovation also reinforces the need to identify barriers that inhibit STI – company interactions. Identifying these barriers would undoubtedly enable technologies to reach the market effectively. Among the barriers to TTs in Brazil, we can mention the lack of several essential factors, such as (1) qualified personnel in TTOs (Simões & Santos, 2018; Sousa *et al.*, 2018); (2) the innovation and entrepreneurship culture at universities (Chais, Ganzer, & Olea, 2018); (3) the institutional policies and procedures for managing TTs (Closs *et al.*, 2012; Sousa *et al.*, 2018); (4) the valuation of technologies (Chais *et al.*, 2018; Closs *et al.*, 2012); (5) the understanding of possible forms of interaction between industry and STIs (Sousa *et al.*, 2018). As we can see, some of the mentioned barriers are related to TTOs. Simões and Santos (2018) state that a rapprochement between the academic sector and industry is crucial to consolidate technology transfer through the universities. However, in Brazil, TTOs are predominantly new, establishing themselves at the beginning of the learning process (Soares & Torkomian, 2021). Research by Malvezzi *et al.* (2014) identified the primary deficiency of the TTOs studied as the lack of marketing planning for their patents because they have no specific departments for this purpose.

Actions to promote or stimulate TT from Brazilian universities to markets are timid from the research stages to the commercialization of the technologies. Proactive market analyses to understand the needs of companies and society are limited, leading to the development of research with little market attractiveness. Among the marketing practices investigated, the most prevalent are the traditional commercial ones, such as participation in fairs and technical events, publication in specialized magazines and reports in newspapers, television or radio. On the other hand, the least used practices involved creating marketing plans for each technology, allowing identification of specific strategies to enhance the results of the offer. It was also observed several obstacles to implementing marketing strategies in academic institutions, such as the lack of communication between universities and companies and the shortage of publicity surrounding the possibilities of this interaction (Sousa *et al.*, 2018).

Finally, given that TT in Brazil is at an early stage, academic institutions could use successful flows from other institutions with more expertise (Simões & Santos, 2018). Hence, the present study aims to improve the technological offer in Brazil.

3. Methodology

The research was descriptive and exploratory and used a qualitative approach by conducting multiple case studies (Gil, 2002) including technical visits and interviews with TTO managers of seven Brazilian public STIs. The coordinators of the TT activity or collaborators in this area appointed by their coordinators were interviewed. Information from the scientific literature and the institutions' websites were used as secondary data sources allowing data triangulation. The use of distinct data sources for the research turns the results more reliable and contributes to the validation of the study. Table 1 shows the selected STIs and the identification code of the interviewees.

The authors chose the studied institutions after evaluating their technology portfolios and outcomes. Their choice also considered the outcomes related to the financial revenues from commercial exploitation of the institutions' inventions, demonstrating distinction in technology offer. These criteria led to the choice of State University of Campinas (UNICAMP), University of Sao Paulo (USP), Paulista State University (UNESP), and Federal University of Minas Gerais (UFMG). In addition, Federal University of Paraná (UFPR) and Oswaldo Cruz Foundation (UTFPR) were included in the research to understand the experience of TTOs from outside the Southeast region. The Southeast is the most prominent region regarding results from TT and with older TTOs (Ministério da Ciência, Tecnologia, Inovações e Comunicações, 2019; FORTEC, 2020). It is noteworthy that UFPR and UTFPR are public institutions in Paraná state, Southern Brazil that filed the most significant number of patent applications for invention in 2019. The UTFPR is the most prominent resident depositor of computer programs in Brazil (Instituto Nacional da Propriedade Industrial, 2020).

All the studied universities are among Brazil's ten resident public institutions that filed the most applications for inventions in 2019 (Instituto Nacional da Propriedade Industrial, 2020). The authors included FIOCRUZ Institution to understand the experience of a Brazilian research institution that is not a university. Ávila (2019) found that most of the literature on technology offers discusses the transfer of licenses from universities to companies. The technology offers and the transfer of licenses resulting from public research institutions that are not universities are little studied. In addition, FIOCRUZ is prominent STIs in Latin America regarding public health. Its intellectual property team was nominated for and received the international 2017 Global Counsel Awards.

STI	TTO	State	Interviewee codes
State University of Campinas (UNICAMP)	Innovation Agency of Unicamp (INOVA)	São Paulo	A1
			A2
			A3
			A4
University of Sao Paulo (USP)	USP Agency for Innovation (AUSPIN)	São Paulo	B1
Paulista State University (UNESP)	UNESP Agency for Innovation (AUN)	São Paulo	C1
Federal University of Minas Gerais (UFMG)	Transfer and Technological Innovation Coordination (CTIT)	Minas Gerais	D1 D2
Federal University of Paraná (UFPR)	UFPR Agency for Innovation	Paraná	E1
Federal Technological University of Paraná (UTFPR)	UTFPR Agency for Innovation (AGINT)	Paraná	F1
Oswaldo Cruz Foundation (FIOCRUZ)	FIOCRUZ Technology and Innovation Management System (GESTEC-NIT)	Rio de Janeiro ^a	G1

Table 1. Interviews conducted in the STIs selected for the study

Note(s): ^aThe headquarters is in Rio de Janeiro, with units in other states of Brazil

Source: Prepared by authors

Among the sources researched for selecting the institutions studied, it stands out the scientific literature, the media disclosures and the institutional reports available on the websites of STIs, as well as the government and funding agencies.

The information obtained from interviewees was collected through semi-structured interviews (Cruz Neto, 2002) using a previously validated script with open-ended questions related to the TT process based on the literature review. Interviews were conducted on-site, except for the remote interview conducted for Unesp due to the COVID-19 pandemic.

The interviews were conducted from September 2019 to June 2021, recorded, and then transcribed. As Bardin (2016) recommended, the authors used content analysis technique. The contents of the interviews were coded and then grouped in categories of significant subjects defined previously that interfere within TT (Table 2):

The interviews were conducted by two researchers and the transcription and categorization were done by a third researcher. These works were verified by the researchers who carried out the interviews. The purpose was to ensure an unbiased data and complete with missing information. Excerpts of statements of the interviews were used in the discussion of results to illustrate evidence of research findings. The research ethics committee approved this study, and the participating STIs and the interviewees signed the approval and consent forms.

4. Results and discussion

4.1 Profile of the technology offer team and results of technology transfer

Table 3 shows the profile of the TTO teams involved in technology offering and the resulting contracts signed, as well as the financial revenues from the transferred technology, allowing a comparative analysis of cases. Although the STIs do not standardize these data presentations, specifying their comparison over the same period allows for contextualizing the results in TT. Thus, the results suggest that TTOs that actively offer technologies and invest in STI portfolio dissemination and marketing efforts are more successful in TT.

Categories	Codes
Results of the technology transfer	- TT contracts - Financial revenue
Professional profile of the technology transfer team	- Size - Academic background - Skills - Performance
Technologies portfolio	- Portfolio construction - Portfolio utility
Strategies for offering technologies	- Internal mapping of technologies - Internal selecting of technologies - Portfolio promotion strategies - Methodologies to identify potential partners - Methodologies to approach potential partners
Offering technology licenses to inventors and the creating spin-offs	- Entrepreneurship policy - Conflict of interest
Good practices and challenges	- Achievements - Difficulties

Source(s): Prepared by authors

Table 2.
Categories and codes used on content analysis technique

Table 3.
Profile of the TT teams
and technology
transfer (TT) results

STI	TT team performance	Do you make an active offer?	Sector responsible for the active offer			TT contracts signed Number no. Period	Source	Financial revenue from TT	
			Name	Partnerships	Employees (n ^o)			Sector responsible for marketing	Value period
UNICAMP	Commercial and Contracts	Yes	Partnerships	4	Institutional Relationships and Communications	245 (2004–2020)	Relatório Anual 2020 (n.d)	R\$13,281,685,42 (2005–2020)	Relatório Anual 2020 (n.d)
USP	Commercial and Contracts	Yes	TT	5	Communication	37 (2013–2019)	Anuário Estatístico 2019 (n.d), Anuário Estatístico 2020 (n.d)	R\$15,400,000,00 (2000–2019)	Inovação em números (n.d)
UNESP	Commercial and Contracts	Yes	TT	2	Entrepreneurship and Marketing	32 (2010–2020)	Anuário Estatístico 2020 (2020), Anuário Estatístico 2021 (2021)	Not informed	Anuário Estatístico 2020 (2020), Anuário Estatístico 2021 (2021)
UFMG	Commercial and Contracts	Yes	Strategic Alliances Management	5	Communication	109 (Accumulated through December 2020)	Patentes e Transferência Tecnológica (n.d)	R\$8,131,077,00 (Accumulated through December 2020)	Patentes e Transferência Tecnológica (n.d)
UFPR	Contracts	No	–	–	Communication	53 (Accumulated through September 2021)	Nossos Números (2021)	R\$388,169,37 (2018–2020)	Relatório de atividades 2018 (n.d), Relatório de atividades 2019 (n.d), Relatório de atividades 2020 (n.d)
UTFPR	Contracts ^a	No	–	–	–	1 (accumulated through 2019)	Interview	None (through 2019)	Interview
FIOCRUZ	Contracts	No	–	–	–	10 ^b (accumulated through 2018)	Ávila (2019)	\$3,500,00 (Only in 2020)	Interview

Note(s): ^aIt does not have an exclusive employee for technology transfer

^bThe number refers to the licensed technologies, as there are no consolidated data on the number of contracts signed

Source(s): Prepared by authors

Interviews revealed that professionals in the TTOs TT sector came from various backgrounds, especially from the law field. Traditionally, there is an emphasis on legal competence, as observed for FIOCRUZ and UTFPR, where professionals working in TT are solely from the legal domain.

There are TTOs whose TT teams act only in formalizing contracts. In contrast, others invest time in commercial activities, offering the technologies. Some TTOs have been structuring working groups with a commercial profile to be responsible for offering technologies. These TTOs hire professionals proactively dedicated to approaching companies and helping with marketing and communications actions aimed at social disclosure and media advertisement. This strategy agrees with [Mom et al. \(2012\)](#) and [Soares and Torkomian \(2021\)](#). It shows the valuation gained for these professional profiles together with the Brazilian TTOs. In contrast, other TTOs respond only reactively to demands from researchers or companies. However, some TTOs are structuring an active offer to promote technologies, like FIOCRUZ, seeking to fill this institutional gap.

[Malvezzi et al. \(2014\)](#) did not identify a department or planning sector dedicated to marketing strategies in the TTOs of UFMG, UNICAMP and USP. However, the present study verified the incorporation of marketing plans, indicating changes in the performance profile of the TTOs at these institutions. In this sense, interviewee C1 highlights the importance of having a sector dedicated to the communication and marketing of technologies in the TTO:

It is the area that, for us, is like our right-hand assistant because there is no way for us to negotiate, attract a company and do marketing. (...) It is tough, and many of these technologies also require professionals with a background in advertising/publishing/dissemination.

Confirming this perception, A2 mentioned that the institution excessively cares about protecting intellectual property when it provides most of its financial and human resources for this activity. Therefore, the institution leaves the offer of technology in the background:

There was a time when we had eight analysts in the intellectual property area. It is no use having eight analysts in the intellectual property area if you have only one guy offering patents. Things have to be more balanced.

Another observation about Brazilian TTOs reveals that they use institutional services in the general communication and marketing division. These are not a priority concerning other institutional disclosures, which compromises the effectiveness of supply actions. Moreover, this research revealed that the most mature TTOs, concerning TT, invest in teams fully dedicated to marketing actions. Hence, the authors recommend that research institutions hire employees with business experience to work in the TTO ([Siegel et al., 2003](#)), a professional profile already considered by UNESP. C1 highlighted: *“the type of professionals we hire for the transfer area are those with knowledge/experience in business, so they are individuals who have worked with companies (...), have been associated with private companies, and were responsible for business management.”*

In addition, TTOs managed by directors holding corporate experience has facilitated the creation of links with such TTOs. The corporate experience enables a better understanding of market potential, complexity and flexibility needed for negotiations ([Siegel et al., 2003](#)). This research identified this type of professional profile at UNICAMP and UFMG, institutions whose directors have experience in companies from countries with a strong culture of innovation. Interviewees from these STIs corroborated the importance of this strategic profile in contributing to better results.

The staff of TTOs at UNICAMP and UFMG emphasized the importance of integrated work for effective TT, according to the competencies identified by [Mom et al. \(2012\)](#) and [Soares and Torkomian \(2021\)](#). D1 quotes: *“when negotiating a technology, we have to evaluate three pillars: commercial, technical and legal.”*

The observation reinforces the importance of marketing expertise in TTO productivity. TTOs with marketing strategies signed more TT contracts and obtained higher revenue from licensing than institutions without these strategies.

Furthermore, it was possible to observe that institutions located in the Southeast region concentrate the highest amounts of financial revenue. This can be explained by the greater background of institutions located in these regions in relation to technological commercialization, as observed by [Garnica and Torkomian \(2009\)](#) in São Paulo ICTs.

4.2 Portfolio of technologies

One of the barriers to the STI-company connection is the limited disclosure of available cooperation possibilities ([Sousa et al., 2018](#)). The technology portfolio is one of the tools to overcome this barrier. UTFPR's website only provides a list of patent applications filed with the National Institute of Industrial Property (INPI). It is the only surveyed institution that does not have a technological portfolio. The other STIs presented several technology presentations in their portfolios. Thus, the authors observed elements such as images, explanatory videos, content organized in areas of interest or maturity stage, and bilingual versions in these portfolios. Although rare, UNICAMP reported the interest of a Chinese company stirred by an image published in the portfolio, demonstrating the usefulness of illustrative resources to complement textual information. However, rare were the cases in which companies sought STIs as they did not see proactive efforts for strengthening the portfolio on the part of the institution. Hence, unanimously among respondents was the idea that the portfolio is not a gateway but a support tool to address potential partners. In other words, it is also necessary to promote technologies to make the portfolio efficient. Respondent A1 talks about the importance of a communication plan to support the portfolio: *"it is no use just having the window there, the [technological] profile and such, if we do not have good marketing initiative, good communications initiatives in all that."*

Another observation reported by most respondents is that researchers and the TTO team handle the development of technological standards. Development of technological standards comprises a summary of the technology's features in a more commercial language. Only UNICAMP reports that an outsourced company is responsible for developing these standards. It allows the TTO team to dedicate more time and effort to the technology offerings initiatives.

A common aspect identified in the portfolios of the institutions surveyed is the focus on offering patents and other protected assets. Although some STIs have an exposed portfolio, they usually offer their exposed competencies for partnership development only after a researcher's request or a company search. Institutions could further explore this issue to promote cooperation with industry in the initial stages of research. This further exploration would allow obtaining more significant opportunities for licensing or development of innovations, as noted by [Malvezzi et al. \(2014\)](#). Interviewee B1 corroborates this perception: *"In Brazil, if you did not develop the project collaboratively from the beginning, for several reasons, it will hardly be explored."* In this regard, USP has recently started mapping its competencies and services, as well as actively seeking companies' demands to attract partnerships from the beginning of the research. Hence, this university invests in activities allowing companies to learn about the university's research and present industry demands to researchers. This initiative highlights efforts in relationship-focused marketing practices, as proposed by [Weckowska \(2015\)](#) and seen at UNICAMP by [Dias and Porto \(2018\)](#). USP gathers, in its portfolio, an innovation *hub*, information such as research projects, laboratories, skills, patents and startups from its innovation ecosystem. The institution attempts to facilitate the visibility of the diversity of its possible interactions.

4.3 Strategies for the offer of technologies

The authors observed that mapping of technologies starts when the inventor communicates an invention to the TTO. In most of these cases, all patents go to the portfolio, prioritizing those with a higher degree of maturity and others believed to have a better commercial profile than the others for an active offer. In some more structured TTOs, such as UNICAMP, inventions pass through stages of analysis regarding patentability, market potential and the profile of the team involved in developing the technology. Since the studies of [Dias and Porto \(2018\)](#), there has been advancement in structuring a more judicious patenting policy at UNICAMP. Interviewee A1 discusses the importance of this selection process: *“We do not have patents; we have a business.”* A2 comments on UNICAMP’s vision change: *“what we actually want is not about decreasing the number of patent applications. I think it will end up happening, but [what we want is] to focus efforts on commercialization.”*

STIs promote technologies in the market on several fronts ([Table 4](#)). We can see from the interviews that the primary strategy of TTOs regarding most results in TT is the active approach to potential partners. A1 explained: *“We have to offer, to have proactive offers. I am not waiting for the company.”* UNICAMP has a well-defined methodology and a team dedicated to developing offer strategies, including fulfilling licensing contract goals. While UFMG’s highlighted strategy is to send monthly messages about the new protected technologies, seeking to keep the link with companies that are part of its network active.

Besides UNICAMP and UFMG, USP and UNESP engage in active offers for companies. In contrast, the other institutions are more passive, acting reactively to the inventor’s request or approaching companies interested in STI intellectual property. The STIs used diverse ways to identify potential partners, including the search for market players on Google, social

STI	Strategy
UNICAMP	<ul style="list-style-type: none"> Online portfolio, events, STI-company connection platform, press releases, social networks, “UNICAMP Challenge” – an entrepreneurship competition that develops business models for patents in the technology portfolio Active in approaching potential partners by email and phone Prioritizes efforts to search for qualified partners instead of number of approaches
USP	<ul style="list-style-type: none"> Online portfolio, events Active in approaching potential partners by email and phone Prioritizes broad-reaching efforts on companies, aiming at 20 companies for each technology in Brazil and abroad
UNESP	<ul style="list-style-type: none"> Online portfolio, events, STI-business connection platforms, international partnership project to connect with French companies, internal acceleration program, research on large company scenarios to check trends in product launches Active in approaching potential partners by email and phone
UFMG	<ul style="list-style-type: none"> Online portfolio, events, STI-company interaction platforms, email marketing Approaching potential partners by email and phone
UFPR	<ul style="list-style-type: none"> Online portfolio Publishing offers on the website Use the “Patent License Offering for exploration purposes” service offered by INPI. This action provides the advantage of reducing the number of annual fees paid to the INPI
UTFPR	<ul style="list-style-type: none"> Publishing offers on the website or Official Federal Gazette, only those they believe have a better potential for technology transfer
FIOCRUZ	<ul style="list-style-type: none"> Online portfolio and events Implementation of active approaches, such as specific actions from the TTOs to reach potential partners, replacing the passive approaches usually used in response to researchers’ demands or contact initiated by some company

Source(s): Prepared by authors

Table 4.
Technology offering strategy

networks such as LinkedIn, competitive intelligence platforms and patent searching. These diverse ways can be free or commercial such as Questel Orbit, as well as the indication from inventors and their alumni placed in the companies. According to the accounts, the first step in approaching partners is to identify the strategic contact inside the company, such as new business or innovation analysts. This search is a tremendous challenge, as it depends on a relationship network or a significant investment of time to avoid ineffective interaction channels. Thus, some STIs conducting a proactive technology offer utilize partners database built from previous relationships and even paid tools to obtain contacts. However, in most institutions, the inventor is one of the prominent individuals responsible for the marketing, niche indication and technology offering to key people within companies and is the one approached by companies at events or through interpersonal networks. Moreover, in some institutions, the partner search initiative comes exclusively from the inventors. These findings agree with [Garnica and Torkomian's \(2009\)](#) study, which points to inventors as protagonists in the search for commercial partners.

4.4 Offer for inventors and creation of spin-offs

One form of TT experts have encouraged in Brazilian STIs is the formation of spin-offs or startups based on inventions created in the institutions. In this regard, A2 reported: *"The idea is to dedicate effort (. . .) not only to transfer technology to already established companies but also to founding new companies from that technology. Therefore it is about to focus more efforts on entrepreneurship."*

However, the technology offered to nascent companies with an STI researcher as a partner is surrounded by doubts and legal uncertainties. A1 explains: *"One of the bottlenecks that we had and continue to have is that we want to create spin-offs. We end up not understanding so much that we will also offer the technologies to the inventors from now on."* In this context, B1 comments on the limitation in signing contracts with companies whose partners are STI professors: *"I cannot sign contracts, whether partnerships or licensing agreements, with a business partner who is also a professor at our institution."* The authors highlighted this conflict of interest as a relevant issue in encouraging entrepreneurship. At UNICAMP, UNESP, UFMG and UFPR, the inventor does not need to step down from his position as an STI researcher for the technology to be licensed to a company in which he is a partner. However, the researcher cannot occupy the director position, as provided for in legal and internal requirements. Conversely, the researcher needs to withdraw from his academic activities at USP. STI understands that there are legal impediments to licensing technology for companies where a public employee is a partner. At UTFPR, this matter was still under discussion during this study.

A relevant aspect of resolving interest conflicts is to overcome the challenge of an STI in regulating the permission to cooperate with a company where the researcher is a partner, while taking care of the public interest. Settling this matter would be essential to overcoming what is known as the innovation valley of death. In this regard, B1 points out that *"most technologies will not survive if using the university's laboratories and facilities is avoided."* When questioned about having a regulation on the legal relationship between STI and companies with the participation of public employees, only interviewees from UFMG and UNICAMP stated that they already had a regulation in force. UNICAMP is the only institution with an innovation policy that explicitly permits STI to co-develop a technology licensed to a partner company where the technology researcher holds a college assignment. This regulation is a significant incentive for nascent spin-offs, which often do not have enough resources to mature the technology.

In contrast, UFMG did not yet engage in a co-development agreement, services supply or sublease laboratory space for companies with STI researchers on their corporate staff. UFMG

understands that it would constitute a conflict of interest. In these circumstances, the institution recommends that the company make alliances with other partners to continue the technology development. On the other hand, FIOCRUZ has an innovation policy that enables licensing of its inventions to companies where the public employee, who invented the technology, is part of the corporate staff. However, this institution still has no internal regulation that clarifies the conditions for the inventor researcher and the company. Such regulation would clarify whether the inventor researcher needs to resign from his position at FIOCRUZ or whether the company can continue developing the licensed technology as a partner of the STI.

Regulation of conflicts of interest can bring more legal certainty for STIs and entrepreneur researchers. According to [Caldera and Debande \(2010\)](#), besides increasing the creation of spin-offs, the institutions that developed this regulation encourage researchers to participate in TTs. Such participation would result in a more substantial number of licenses and their attendant revenue.

4.5 Good practices and challenges in the technology offer process

Analysis of the achievements and difficulties interviewees mentioned highlights topics on prominent good practices and the challenges STIs face regarding technology offerings. Although these topics cannot be generalized, they indicate points of interest for STI managers, funding agencies and public policymakers. The above topics represent perceptions limited to the outcomes of the surveyed institutions. They are:

4.5.1 Marketing of technologies. Institutions with the most consolidated technology offering process relate the advance in licensing to a structured methodology of an active approach to potential partners and a specialized team exclusively dedicated to commercial activities. On the other hand, the lack of structured marketing for the technologies is one of the most considerable obstacles to licensing advancement. In this regard E1 emphasizes: “*the difficulty is in the offer, it is in the actual marketing, taking it [the technology] out.*”

4.5.2 Restructuring the TT area. The area responsible for this activity should have a commercial sector, not only a legal one. E1 suggested: “*the TT area should be large and split into two, OK? [legal] and commercial (. . .) it had to be commercial (. . .) most of them are only legal.*”

4.5.3 Offering STI technologies to inventors. Creating spin-offs with STI researchers in its corporate structure requires clear rules on institutional innovation policies, specifically clarifying conflicts of interest.

4.5.4 Degree of maturity of the technologies. Most STI technologies are less mature than companies look for, requiring financial and facility support from the STI and funding agencies to develop and become attractive to companies.

4.5.5 Internationalization of the portfolio. A limiting factor is the lack of experience on the part of the TTOs regarding internationalization. Depending on the area of innovation, such as biotechnology, Brazil has few companies capable of absorbing the projects and must seek potential partners outside the country. Thus, it would be necessary to train the TT team to interact with these foreign companies through necessary and complex negotiations.

4.5.6 Valuation of technology. It is difficult to identify and apply a reliable methodology to determine the value of a technology. Most TTOs do not have a team dedicated to this task. Only UFMG claimed to have a specialized team and methodology for this activity.

4.5.7 Expand disclosure on STI-company interaction opportunities. There are several ways to cooperate with STIs. However, they are unknown to companies, requiring marketing work from TTOs.

4.5.8 Lack of mapping of companies' demands. When offering their portfolio of solutions to the industry, STIs generally “seek questions” for the answers already generated in their

laboratories instead of generating answers to market challenges, which experts could further explore. As F1 points out: “*it is no use for us to invent something and then go hunting [for companies].*” The interviewee’s account shows the challenge of balancing market demands and the STI’s mission. These institutions must also fulfill their social role of generating knowledge and researching essential solutions for society. However, these solutions are not always commercially attractive.

4.5.9 *Demystify the focus on the number of patents.* The national culture of performance indexes that measure the number of patents filed and not those actually licensed can generate a low-quality portfolio with high maintenance costs. As F1 mentions: “*we have (...) a quantitative goal, so we should file 100 applications per year, both patent or any type of registration.*” Thus, there is still an overvaluation of the quantitative indicator associated with the number of patents that may not accompany the qualitative indicators connected to licenses or technologies effectively transferred.

The good practices observed are not equally used by all interviewees. Much of what is considered an achievement in one STI is rightly seen as a difficulty in another. This scenario confirms the high disparity between the maturity stages of Brazilian TTOs, as observed by [Dias and Porto \(2018\)](#).

5. Conclusion

The results of this study suggest that although TT has increased in importance, there is still a disparity among the performance levels of Brazilian TTOs. The TTOs that are more mature than others invest more resources in active offering and marketing the technologies in their portfolios through a specialized team dedicated exclusively to these activities. Thus these TTOs obtain more success in TT. In contrast, other TTOs do not conduct active offerings and marketing or focus the search for partners to develop technologies exclusively on the figure of the inventor. Instead, they passively respond to the commercialization of their intellectual property. Therefore, experts suggest that it is necessary to restructure the TTOs and invest in technological marketing to enhance the efficiency of TTs in Brazil.

The authors also observed the need for a regional approach to balance the performance of the TTOs. For instance, the results of the São Paulo institutions surveyed are in contrast with those of Paraná. Paraná’s actions on TT are at an initial stage of maturity. Strategies applied in other countries, such as creating a professional, for-profit TTO, as is the case of Oxford University in England, could also be analyzed by public managers. An office of this kind could serve more than one STI, including several institutions from the same state or region. Hence, efforts could be added to serve institutions with fewer resources.

The results of this study also indicate some aspects of leveraging TTs from STIs to companies. These leverage aspects may be the need to implement intellectual property protection and maintenance policies to turn inventions into business, not just patents. Thus, it is necessary to have a competent team dedicated exclusively to offering the technologies and developing a marketing plan for the portfolio, balancing efforts between intellectual property and TT. In addition, it is essential to maintain a continuous relationship with companies to understand their demands, directing research on STIs to solve market problems.

Some STIs studied are at the forefront of entrepreneurship, a new subject in the public management environment, requiring the exchange of experiences between STIs and an expanded discussion with funding and oversight agencies. Specifically, most spin-off formation cases may appear to be a conflict of interest. For example, when a researcher is the inventor of the technology and, simultaneously, a partner in the company that will commercially exploit it with STI. As in other countries, the challenge is to find legal certainty for the creation of spin-offs and legally protect the STI. Many technologies may not reach society if this practice is not adequately regulated. Hence, clear institutional policies are

needed to avoid situations where the researcher must choose to leave the company or STI to develop the spin-off. Losses can be significant when the researcher is not authorized to continue working as a member of the research institution and the company in which he is a partner. After all, STIs, through the license royalties, and companies, would benefit from the inventors' insights in the day-to-day development of the spin-off.

This research indicates points of interest for TT researchers, STI managers, funding agencies, and public policymakers. It identifies both good practices that have been established and the difficulties faced by the studied TTOs in offering technology. Thus, it increases the data in the incipient literature on the field of marketing and innovation involving TT between research institutions and companies in developing countries mentioned by other authors (Malvezzi *et al.*, 2014; Sousa *et al.*, 2018; Veroneze *et al.*, 2017). This work also contributes to developing effective public strategies and policies to transform STI-company partnerships into something ever-present in Brazil. The authors suggest further studies due to the study limitations. Its data cannot be generalized since the analyzed perceptions restrict themselves to the results of the institutions studied. Mainly when the only research institute studied is not a university. These studies can assess the strategies for offering skills and technology developed by other public and private research institutions, not limited to universities. We also suggest the study of company perceptions about requirements for development and partnerships and the barriers related to TTs through interactions with STIs.

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Corresponding author

Karin Goebel can be contacted at: karingoebel9@gmail.com

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