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Research Article

Universities' entrepreneurship mission in a Dynamic Capability approach: A multicase study in south Brazil

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Vivien Mariane Massaneiro Kaniak[a]*, Rivanda Meira Teixeira[a], Adriana Roseli Wunsch Takahashi[a], and Ananda Silva Singh[b]

[a] *Universidade Federal do Paraná (UFPR), Curitiba, PR, Brazil*

[b] *Universidade Federal de Uberlândia (UFU), Santa Mônica, MG, Brazil*

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*Corresponding author:

Vivien Mariane Massaneiro Kaniak
vivikaniak@hotmail.com

Abstract

Objective of the study: In order to understand how universities in south Brazil have been developing their entrepreneurship mission this study aimed to analyze the role of their Technology Transfer Offices (TTOs) by the lens of the dynamic capability theory, considering sensing, seizing and transforming practices**. Methodology/approach**: qualitative approach, and a multiple case study strategy, 31 semi-structured interviews were carried out with different actors linked to university TTOs as well as documentary research**. Main results**: The results reveal that sensing/seizing/transforming practices have been adopted by the university TTOs and are supporting them to face the new scenario in higher education represented by entrepreneurial and innovational demands**. Theoretical contributions**: They consist on a debate on how universities in Brazil are strategically managing their practices in order to adapt to a new era in higher education throughout the development of dynamic capabilities**. Relevance/originality**: This research provides an in-depth process analysis including the microfoundations of dynamic capabilities to the development and the advance of the third mission of the universities, contributing to the study's originality. Management contributions: The managemental contribution of this study is to offer a view of new modes and practices for other universities that are seeking to operate in an entrepreneurial dimension.

Keywords: University Technology Transfer Offices. TTOs. Dynamic capabilities. University entrepreneurial mission.

Missão empreendedora das universidades na abordagem das Capacidades Dinâmicas: Um estudo multicasos no sul do Brasil

Resumo

Objetivos do estudo: Com o objetivo de compreender como universidades do sul do Brasil tem desenvolvido sua missão empreendedora, este estudo analisar o papel de seus escritórios de transferência de tecnologia (TTOs) pelas lentes da teoria das capacidades diâmicas, considerando-se as práticas de sensing, seizing e transforming**. Metodologia**: abordagem qualitativa e estratégia de estudo de casos múltiplos contendo 31 entrevistas semi-estruturadas foram realizadas com diferentes atores ligados aos escritórios de transferência de tecnologia , além de pesquisa documental**. Principais resultados**: O estudo revelou que as práticas de sensing, seizing e transforming tem sido adotadas pelos escritórios de transferência de tecnologia das universidades e estão servindo de suporte para que elas enfrentem um novo cenário em que a educação superior é representada por demandas empreendedoras e inovadoras**. Contribuições teóricas**: reside no debate de como universidades do Brasil estão gerenciando estratégicamente suas práticas a fim de se adaptar a uma nova era na educação por meio de capacidades dinâmicas**. Relevância/ Originalidade**: Esta pesquisa oferece um processo de análise que incluiu microfundamentos das capacidades dinâmicas e sua importância para o desenvolvimento e avanço da terceira missão das universidades, contribuindo para a originalidade do estudo. Contribuições para a gestão: oferecer uma visão nova de modelos e práticas para que outras universidades, que vem buscando operar em uma dimensão empreendedora, possam se beneficiar.

Palavras-chave: Escritórios de transferência de tecnologia universitários. Capacidades Dinâmicas. Missão empreendedora universitária.

INTRODUCTION

In line with the dissemination of a global knowledge economy, many countries have been facing a new scenario composed of high competition, necessity of constant innovation and creation of distinct strategy (Bergmann et al., 2018; Teece et al., 2016). As a consequence, a considerable amount of interest has been placed in the university as a font of innovation and the development of its third mission which consists of adding contributions to society through creation and exchange of knowledge and technology besides its basic functions of teaching and research (Bellucci & Pennacchio, 2016; Guerrero et al., 2019; Ruiz & Martens, 2019).

As a result the university operating model has evolved over time in order to adapt to current demands and modernize its action (Baycan & Arkali Olcay, 2021; Grimaldi & Fernandez, 2017; Moraes et al., 2020). In the context of this evolution, entrepreneurial universities emerged, which aim to take on new and more complex responsibilities when acquiring assignments that encompass the economic development and sustainability (Bezanilla et al., 2020; Fini et al., 2018; Hayter & Cahoy, 2016). Although there are still few studies that discuss dynamic capabilities in educational organizations in the literature (Heaton et al., 2019; Takahashi et al., 2017), it is possible to find some evidence of the benefits of using this theoretical perspective to improve university's management. Studies demonstrate that success in knowledge transfer, which is a function of dynamic organizational capabilities, is related to the university's ability to orchestrate its resources in this dynamic environment. Thus, performance in knowledge transfer varies in proportion to the dynamic capabilities of universities (Leih & Teece, 2016; Yuan et al., 2018; O'Reilly & Robbins, 2018; O'Reilly et al., 2019).

Dynamic capabilities state for an organization's ability to adapt to a dynamic environment, in order to achieve competitive advantages in a context of constant mutation (Teece & Pisano, 1994). The dynamic capabilities theory can assume a tripartite classification known as a) sensing: identification of opportunities, b) seizing: capture value from opportunities, c) transforming: rearrange internally for a change. These are the most important group of capacities an organization must have in order to maintain its sustainability (Teece, 2012).

Also, dynamic capabilities represent an established theory to guide research in the field of strategy, but which was only recently discussed in the context of universities (O'Reilly et al., 2019). According to the authors, universities can achieve better results in their role of transferring knowledge and technology once they develop their dynamic capabilities. It is in this scenario that this research lies, since its main objective is to better understand how Brazilian universities have been developing their third mission by analyzing their TTOs' practices, from the dynamic capabilities' theory perspective. It is expected, thus, that this study contributes to fill gaps regarding the fact that not enough attention has been paid to discussing how universities' strategies towards developing their third mission are being developed (Giuri et al., 2019) and the need for more critical reflection on how universities have incorporated the third mission into their activities (Benneworth et al., 2016). The regional focus of this study is the state of Paraná, located in South Brazil, which represents the fifth largest economy in the country. Formed by 399 cities, the state has about 50 higher education institutions. In addition, Paraná is distinguished for having universities that occupy a prominent position in the World University Rankings (2020), such as the Federal University of Paraná (11th in the ranking) the State University of Maringá (32nd position in the ranking), the State University of Londrina (38th position in the ranking), the Federal University of Technology – Paraná (43rd position in the ranking), the Pontifical Catholic University of Paraná (46th position in the ranking). This means that out of 2000 Universities in the world, 57 of them are from Brazil and are in the World University Ranking (2020). 5 of the Brazilian Universities in this ranking are located in Paraná. It means that these Universities' teaching and research projects contribute to local and global developments, thus, being one of the reasons why analyzing its practices is relevant.

To achieve the research's objectives, five TTOs were investigated. A qualitative study was carried out using a multiple case study research strategy, which allowed analyzing the main activities developed at the TTO's studied , from the dynamic capabilities' perspective.

It is expected that this research contributes to this research domain providing an in-depth analysis of universities' TM practices, based on the microfoundations of the dynamic capabilities' theory. To university managers, it is expected that this research serves as reference on how to rethink and adopt strategies to maintain universities' sustainability even during challenging and uncertain times.

This paper is structured as follows: section 2 presents the theoretical background on university' s third mission and on dynamic capabilities in universities, section 3 describes the methodology adopted to carry the study and section 4 presents its results. In section 5 the results are discussed and in section 6 the main conclusions, limitations of the research are presented, as well as suggestions of future research.

THEORETICAL FRAMEWORK

Universities and third mission

Changes in the global scenario such as economic, financial and environmental crisis has been leading universities to constantly redesign and readapt their missions since the creation of the first HEIs in Paris and Bologna (Etzkowitz, 2002) and after the first academic revolution took place in the 19th century (Etzkowitz et al., 1998). From that period on, HEIs mission was not only to teach, but also to develop academic research as well. However, this happened until a second academic revolution took place, in the late 1980s (Etzkowitz & Leydesdorff, 1998) and HEIs began to play an important role as contributors to the economic and social development for the society (Abreu et al., 2016). This third mission (TM) of HEIs suggests the relationship between universities and society as a large concept and is connected with the interaction and mutual contribution between universities and the rest of society (Mora et al., 2015; Romero et al., 2020). The activities of universities' TM include three dimensions performed by universities on external environments: technology transfer and innovation, continuous education and social engagement (Secundo et al., 2019).

These are some of the reasons why universities that encompass the TM play an important role to society's economic development, to generate new companies, new products and/or services and, consequently, new jobs (Abreu et al., 2016; Secundo et al., 2019). TM demands, thus, that University managers rethink their institutions' operating models in order to align them with the HEIs' stakeholders' needs and demands (Romero et al., 2020). In this scenario, universities had to became not only more entrepreneurial, but also better strategically managed (Guerrero, Heaton, & Urbano, 2020; Leih & Teece, 2016).

The social and economic contribution of the university – related to its TM - already figures as the second most researched topic in the literature, as pointed out by Romero et al. (2020) in a recent research reviewed on entrepreneurial universities. Studies such as Guerrero et al. (2018) affirm that the university should serve as a resonance channel, in order to contribute to society's economic and social development with its multiple activities. In this context, the authors argue that efforts are needed to improve the understanding of the economic impact of the teaching, research and entrepreneurial activities developed by and in these universities.

The authors assume that the impacts generated through the TM go beyond the results commonly analyzed in conventional formats and that therefore, they may be misunderstood.

Fini et al. (2018) also argue that the university should assume a role of social responsibility when developing researches that bring changes or benefits to different areas, such as economics, culture, public policies, services, health, the environment, or even generate better and improved products and services based on knowledge. Moreover, the authors highlight the need to reflect on the ethical concerns of those who benefit from the impacts of science commercialization and advocate a change of focus: science commercialization should serve as a driver for social change, in order to benefit society. It is important to highlight that the authors who defend this point of view are not unfavorable to science commercialization, they only advocate that the university should act as a mechanism to convert public research and investments into practical applications with potential economic and social impacts (Fini et al., 2018; Guerrero, Heaton, & Urbano, 2020).

It is worth highlighting that even though TM has been thoroughly discussed in entrepreneurial university's research domain, the expression's definition is not consensual among researchers, being thus, considered synonymous to 'technology transfer' and 'entrepreneurial university' (Trencher et al., 2014). However, is this research TM's concept used is Compagnucci and Spigarelli (2020, p. 1) who consider that "the TM refers to an extensive array of activities performed by the higher education institutions which seek to transfer knowledge to society in general and to organizations, as well as to promote entrepreneurial skills, innovation, social welfare and the formation of human capitol".

The TM consists, thus, in a set of activities held by entrepreneurial universities - those that combine academic research and business needs (Compagnucci & Spigarelli, 2020) - that are transitioning from the tradition two-mission model to another one that consider not only the HEIs' inner demands, but also its stakeholders.

Dynamic capabilities in universities

As the organizational environment became more complex and dynamic, organizations were forced to create and maintain their competitive advantages, since having only strategic resources and internal capabilities was no longer enough to deal with situations of rapid and unpredictable changes (Teece & Pisano, 1994). Universities are a subset of these organizations since they have to properly manage such changes and to develop dynamic capabilities in order to survive in the environment in which they are inserted (Gallardo & Navarro, 2003). Consequently, strategic management has become more and more important for universities (Gallardo & Navarro, 2003), since they have unique characteristics and specificities, thus being considered as organizations of internal and external complexity (Leih & Teece, 2016). Their typical internal complexity is related to the degree of sophistication of the various areas of knowledge and the capacity of the university's employees. External complexity, on the other hand, is derived from the degree of uncertainty and instability of the environment itself (Gallardo & Navarro, 2003).

Depending on the complexity environment, models based on dynamic capabilities can assist university managers to better manage the challenges they may face (O'Reilly & Robbins, 2018; Takahashi et al., 2017; Yuan et al., 2018). The concept of capabilities originated by the seminal authors refers to the key role played by strategic management, which acts in the adaptation, integration, and reconfiguration of organizational and functional competences; dynamics refer to the changing conditions of the environment. (Teece & Pisano, 1994). In this scenario, the dynamic capabilities theory can help these managers prioritize the competitive and conflicting demands of the university with a long-term orientation (Teece, 2018).

Thus, the dynamic capabilities' perspective, when applied to universities, aims at contributing for their survival. This is so due to the fact that, in a context where change is the norm and dynamism is essential, profound changes in the cultural systems of organizations and investments in human capital are fundamental. In this scenario, the dynamic capabilities' perspective can assist managers to improve their organizations' operations and capacity to change, whenever necessary (Leih & Teece, 2016).

The dynamic capabilities' theory assumes a tripartite classification, that consist of groups of capabilities that an organization must have to maintain its sustainability. These groups are: a) sensing: identification of opportunities, b) seizing: capture value from opportunities, and c) transforming: internal rearrangement for change (Teece, 2012). The university's capacity for 'sensing' encompasses the recognition of financial, technological and societal opportunities (Leih & Teece, 2016; Teece, 2018). In addition, managers must recognize threats and dysfunctional units within the organization that can be changed. Also, dait's important to encourage academic and non-academic departments to identify opportunities and even impediments for the university's survival, in order to improve their operations and keep up with the dynamic context in which they are inserted. Moreover, universities can create value by stimulating entrepreneurship in the local economy and providing opportunities for students to word while they are still studying in the university, order to gain real-life experience (Guerrero et al., 2018).

Regarding 'seizing' activities, Heaton et al. (2019) argue that this is the stage of capturing value for the university, that is, converting opportunities into actions. Value can come in a monetary form, such as when funds are raised for new investments; or in a non-monetary form, through the promotion of projects that improve its reputation or attract new talents, for example. Thus, the 'seizing' capacity also encompasses selecting partners that are suitable and can contribute for the university to achieve its purposes (Heaton et al., 2019).

Regarding the 'transforming' capacity group of the dynamic capabilities, the framework presented by Heaton et al. (2019) also supports the importance of maintaining a flexible and horizontal structure, as academic entrepreneurship requires the transition of department boundaries and requires interdisciplinary collaboration. Changes in the salaries of the universities' employees and in the recognition structures that are used to motivate them are also considered crucial to achieving a balance between research and teaching. Also, engaging not only in the first and second missions (teaching and research, respectively), but also in the third mission help universities from emerging economies such as Brazil, to play a decisive role concerning the development of innovation ecosystems, stimulating local economy and employability options (Guerrero, Urbano, & Gajón, 2020) as they became called 'entrepreneurial universities'.

Since Universities' traditional management practices had to be restructured (Teece, 2018) so that they could effectively contribute to social, technological and economic advances (Etzkowitz et al., 2000), the dynamic capabilities approach shows itself relevant to Universities transform themselves, by contributing to strategic management practices (Teece, 2018).

Moreover, it is worth highlighting that it is through the TTOs that the third mission of the university can take place, since they help the university and the organizations of the productive sector to work together and aligned. In this scenario, since dynamic capabilities and contribute The TTOs are, thus, the link between the university and the productive sector, as they are the ones that favor partnership development in search of national technological development (Lopéz-Martinéz et al., 1994). It is through the TTOs that universities have the opportunity to 'commercialize' its knowledge/research, often aiming at helping solve problems in the productive sector (Dalmarco et al., 2011). This commercialization

is facilitated by the TTOs, since it is up to them to support the cooperators (Dornbusch & Neuhausler, 2015), in addition to opening access to extra resources for the university, as well as new research possibilities (Siegel et al., 2007).

METHODOLOGY

The present study adopted a qualitative research approach and employed a multiple case study strategy. The qualitative approach was selected once it is considered to be the most suitable method to understanding a complex social phenomena (Merriam, 2009). Besides the qualitative research fitted into this study once it permits to arise insights on emerging topics (Yin, 2011), such as the mechanisms that are presented in the practices of TTOs of Brazilian universities and give them base to reach their entrepreneurship mission.

In line with defended by Yin (2017) the case study strategy was elected because it consists of the best path to answers search questions such as "how" and "why" addressed to a contemporary phenomenon. Once this questions deal with operational process over time rather than incidences (Miles et al., 2014) it seemed appropriate to this research. The tactic followed was the use of the replication logic between multiple cases (Miles et al., 2014; Yin, 2017; Eisenhardt, 1989). Regarding reliability, useful to minimize errors and biased views, a study protocol was used and a database with all information was maintained (Yin, 2017).

The definition of the cases used in this study considered two criteria. The first was that the university own a TTO to guarantee that the institution hold entrepreneurial actions besides its teaching and researching missions. The second criterion was that the universities were located in the State of Paraná, due to the representativeness of the phenomenon and to identify emerging empirical patterns in the universities (Eisenhardt, 1989). Based on these criteria, eight institutions were mapped in the state and five of them accepted to participate in the study and were also considered relevant to the target of the research. All the institutions that accept to participate happen to be public HEIs.

This study is based on five cases represented by three federal HEIs situated in the city of Curitiba (ALPHA, BETA, GAMMA) and other two state HEIs, located in the north of the state of Paraná, in the cities of Maringá (EPSILON) and Londrina (DELTA).

The research protocol which consists of detailing the procedures was followed in the application of the case study to guide the researcher in conducting the research (Yin, 2017). It was developed in four sections as it is demonstrated by Table 1.

Table 1

Research Protocol

Section A – Global vision of the investigation	
Research problem	• How universities from Parana develop their entrepreneurship activities in light of the dynamic capabilities?
Research questions	1. How are the features of the universities from Parana and their TTOs? 2. What are the entrepreneurial activities developed in the TTOs? 3. How do the dimensions of sensing, seizing e transforming operate though the activities in the TTOs?
Unit of analysis	• Organizational
Section B – Data collection procedures	
Data collection planning	• Survey of universities in Paraná having TTOs for at least two years. • Selection of the pilot case. • Construction of the pre-interview script. • Validation of the interview script based on the considerations of the qualification board. • Contact ALPHA to verify interest in participating in the research. • Scheduling the date for carrying out the pilot case study. • Elaboration of the cover letter and the Informed Consent Form. • Modification of the script after a pilot study.
Evidence collection	• Contacting universities to verify their interest in participating in the survey and sending a cover letter. • Positive feedback from five universities. • Scheduling interviews and visiting all TTOs. • Printing and delivering the Free consent terms for signature on the date of the interviews (one copy for the participant and one copy for the researcher). • Sending the content to the interviewees after the transcription of the interviews.
Section C – Data collection questions	
	• Applying the interview script.
Section D – Guide to the case study report	
Report hearing	• Bank of experts, project advisor. • Members of the academic community. • Revise texts and verified recommendations in the literature.
Report preparation	• Definition of guidelines for writing the results, discussion of data analysis for each case and comparative analysis. • Highlighting of study contributions after analysis. • Emphasis on sufficiency of evidence. • Conducting the theoretical-empirical confrontation between data and perspectives, considering both corroboration and refutation.
Results	• Storage of research results in a database for consultation.

Note: Elaborated by the authors based in Yin (2015).

Concerning data collection, this study adopted the triangulation of data sources which is important to enlarge the understanding of phenomena as well as expand the validity and reliability of research (Miles et al., 2014; Yin, 2017). For this reason, this study handled with documentation research (website of the university, written archives, public reports and other sources made available by the interviewers) and semi-structured interviews with the main actors involved with the university TTO. A total of thirty-one interviews were conducted. The interviews were carried out from September to March 2020. In order to preserve the identification of the universities they were named: Alpha, Beta, Gamma, Delta and Epsilon for the purpose of this research. Table 2 presents the details of the interviews.

All the verbal data were recorded in a digital tool, transcribed afterwards and its content was sent to each of the people interviewed for revision of the content as recommended by Yin (2017) to guarantee validity. All interviewers also gave their informed consent in order to allow the inclusion of the information in the study. The interviews with the university's staff were conducted face-to-face whereas the other interviews were online. A total of 23 documents were selected for analysis due to the information that could support the understanding of the characteristics of the universities, the TTOs process or entrepreneurial activities developed.

NVivo software (version 11) was used to facilitate the organization and analysis of data. This digital tool assists the researcher in the analysis of unstructured materials and in their compilation, allowing him to compare and decipher information (Woolf & Silver, 2018).

The category analysis system chosen was the semi-open one, which allows the analysis to be started with predefined categories but has some flexibility to change during the reading of the data (Laville & Dionne, 1999). Then the analysis followed three steps according to Miles et al. (2014) recommendation of cycle coding. First interview data and secondary data were obtained, stored, and organized. Second, the coding phase was operated starting with first cycle code which consists of the codes initially assigned to the data chunks (Miles et al., 2014). Initially 24 codes were assigned that were mostly based in the list of research questions. In the third cycle coding the initial codes were summarized in small number of categories, and twelve codes remained after all.

Table 2

Interviews conducted

University	Interviewed	Origin	Duration
ALPHA	E1	University employee	1:15
	E2	University employee	0:28
	E3	Startup incubated entrepreneur	0:33
	E4	Manager of associated company	0:38
	E5	Startup incubated entrepreneur	0:52
BETA	E6	University employee	0:09
	E7	University employee	0:48
	E8	University employee	0:40
	E9	University employee	0:35
	E10	Startup incubated entrepreneur	0:36
	E11	Startup incubated entrepreneur	0:25
GAMMA	E12	University employee	1:07
	E13	University employee	0:27
	E14	University employee	0:11
	E15	Manager of associated company	0:26
	E16	Startup incubated entrepreneur	0:18
DELTA	E22	Startup incubated entrepreneur	1:22
	E23	University employee	0:19
	E24	University employee	0:20
	E25	Startup incubated entrepreneur	0:18
	E26	Manager of associated company	0:22
EPSILON	E27	University employee	0:48
	E28	University employee	0:09
	E29	University employee	0:32
	E30	University employee	0:15
	E31	Manager of associated company	0:19

Note: Elaborated by the authors.

RESULTS

This study examined the practices of Brazilian universities' TTOs related to their third missions development, based on the tripartite classification – sensing, seizing and transforming - of the dynamic capabilities' theory (Teece, 2007). Table 3 presents the description of the cases here analyzed by evidencing the universities' and their TTOs' year of foundation, the universities' location and their TTOs' main missions.

Sensing Capabilities

The Alpha University's 'sensing' dimension was evidenced due to the fact that the TTO is always concerned with the internal and external environment, thus, monitoring both of them frequently. One of the activities that the TTO develops regarding this dimension is contracting professors who are engaged with the industry – and not only with teaching and research - and who constantly participate in fairs, events and conferences in general. In order to identify opportunities, the TTO of the University usually uses open notices or their members' social networks to attract companies. Although there isn't a proper strategic planning that the University's TTO follows , the coordinator believes their main threat lies in the facts that the deans of the University never stay long in their function, for different reasons. Thus, this implies in a lack of certainty regarding investments and funds received by the TTO.

Table 3

Cases' description

University	Location	Founded year of		TTO's mission/function
		University	TTO	
Alpha	Curitiba	1912	2008	To support the internal community in the demands of protecting knowledge; guide procedures on technology transfer; define training plans and events for entrepreneurship and innovative business generation projects.
Beta	Curitiba	2008	2018	To stimulate, articulate, guide and advise the institutional actions aimed at the institute's technological innovation
Gamma	Curitiba	2005*	2002	To identify opportunities and boost the potential for innovation and entrepreneurship of their employees and students.
Delta	Londrina	1970	2008	Activities of the International Technology-Based Business Incubator
Epsilon	Maringá	1969	2008	Manage the institutional politics of innovation and intellectual property.

Note: * Gamma University has its central campus located in the capital city of Curitiba-PR and it was renamed in 2005 having existed for over a century as an important school of apprentices and center of technology.

In Beta University, the 'sensing' dimension was perceived in its TTO activities such as: participation in events, meetings with potential partners from the government and industry, the development of an online process to capture ideas and proposals from the internal members of the academy - which can even evolve to innovation projects. Another action the TTO develops is a yearly agricultural event that is carried out in different cities where the institution has a campus. The main objective of this event is to connect students and professors with the local agricultures in order to raise and find solutions to the latter's main problems.

In Gamma University, the 'sensing' dimension was perceived by strong interactions between the director and other members of the academic community, being these interactions, the main strategy developed by the TTO to develop such dimension. Also, the interviewees of Gamma University highlighted the importance of participating in the city's entrepreneurship events, networks and ecosystem. Also, one way to identify opportunities, observed in the data collected, was through public notices' opening. The threats mentioned by the TTO's interviewees recognized cited were the lack of infrastructure for the incubators and the fact that the entrepreneurial education activities are not aimed at the external community. Also, the TTO doesn't receive royalties for technology transfers, which was seen by the interviewees as the main threat to the TTO's sustainability.

In Delta University the 'sensing' dimension of the university has been to develop strategies to monitor its internal and external environment through open use communication channels scheduling personal meetings with potential partners and intense participation in the entrepreneurial ecosystem of Londrina. In Epsilon University the 'sensing' dimension activities that were observed through the empirical data were: intensifying the contacts that professors already had with companies, intensifying networking and using relationship techniques to attract new partnerships. Also, to better identify potential opportunities, the TTO counts with an internal system to follow the professors/researchers from the moment they contact a company to the moment an intellectual property is requested.

Seizing Capabilities

Regarding Alpha University's TTO activities related to the 'seizing' dimension, it was observed that they don´t have an organized system to identify potential opportunities. In fact, the decision on which project is going to be selected is made personally by the coordinators or the director of the TTO. In the case of Beta University's TTO 'seizing' dimension activities regards undertaking actions to transform opportunities into actions by uniting all the ideas brought by the internal members of the TTO and filtering the best ones. This decision is usually made by the members of the TTO aiming at obtaining the best ideas via consensus.

Regarding Gama University's TTO 'seizing' activities , it was observed that the university captures opportunities and students' innovative ideas mainly from contests, hackathons, and events. Usually, the best projects are recognized through prizes and they are encouraged to be better developed due to their innovative potential. The interviewees highlighted that TTO receives funds from the university and from public institutions and the startups incubated in the University pay rental fees to use their infrastructure.

The empirical data from Delta University allowed realizing that the decision-making process is considered fast, when made inside the TTO, but slower, when it involves the whole university. An important feature found in the data collected from this case regards fund raising. The University's TTO has the autonomy to raise financial resources and manage them and they also receive part of the profits of their incubated startups and donations are collected from community members such as great businessman in the region. In Epsilon University, this dimension is developed through capturing opportunities via a council that evaluates proposals that vary from intellectual property demands to technology transfer. The selection of the startups that are going to reside in the incubator is also made by a team but, as the incubator is managed by the city's administration and by the university jointly, a range of professionals, not just academics, are part of the decision-making board.

Transforming Capabilities

In Alpha University the 'transforming' dimension was present in the reformulation of the TTO. It can be considered a huge transformation, since prior to the TTO being created, deals with other partners were managed and innovative production activities were held by fragmented units placed in other universities as well. These separated units were integrated when the TTO was created, and their processes went through reformulation. The size of the team was enlarged, as well as the expertise of the professionals was enhanced. According to the interviewees of Alpha University, there has been great transformation in the TTO's internal culture, such as more providing more flexibility to the employees and increasing the entrepreneurial culture of the university.

Concerning the support of the high administration, all the interviewers were unanimous in affirming that the current dean represents a fundamental base for the improvement of the nucleus. And even though they consider the decision-making process as a centralized one, they state that it does not affect their productivity negatively.

Beta University's 'transforming' dimension occurred through improvements in internal processes of the TTO in order to increase data security and to improve projects and ideas from internal agents. To create their own model of TTO they made benchmarking with other universities in order to combine, recombine resources and to be innovative. They also undertook actions to embed this dimension in their culture, through the development of communication strategies focused on innovation and through constant connection with all University campi to disseminate the idea. Processes' flexibility and decision-making decentralization were observed in the empirical data collected, since senior managers are usually committed to open dialogues, encourage autonomy and search for new knowledge, provide fast feedbacks and are constantly seeking for process' improvements in the TTO.

Regarding Gama University's activities related to this dimension, the main action observed was the installment of a management system that integrated the activities of all of the University's campi. As they have several campi across the state, the system made it possible to organize and maintain strategic information available anytime they were needed, fastening the TTO's processes. In Delta University this dimension was present in actions such as: reorganization of the TTO, changes in its business model, reorganization of the patenting processes and in partnership formation and resources' combination – such as knowledge fusion and knowledge exchange between HEIs, startups, companies, and researchers.

Epsilon University's 'transforming' dimension was perceived in actions such as the TTO's processes' reorganization, such as changes in its infrastructure and as the implementation of a new system to manage technology transfer projects. Also, the TTO used to be located in a small room at the main campus of the University and used to function alongside other departments of the university. After a partnership developed with the city mayor office, a new area destinated for innovation practices inside the campus was built and the TTO moved to a better and exclusive installation.

Transfer Technology Offices (TTOs) results

As it was mentioned before many where the results of the TTOs for the university, students and society as a whole. Table 4 demonstrates a summary of the TTOs characteristics as well as results achieved.

DISCUSSION

In the 'sensing' dimension, monitoring the internal and external environment of the university' was present in all of the cases here analyzed. The most common practices evidenced were creating events to capture entrepreneurial ideas from students (ALPHA, GAMMA, BETA), maintaining good relationship with professors (ALPHA, GAMMA, BETA, DELTA, EPSILON), facilitating the access to information to internal members of university (BETA, DELTA, EPSILON).

> We launched Hackathon 2016 – the objective of the Hackathon was to encourage the creation of innovative solutions for the public management developing softwares focused on projects. The university is hosting the competition which offers as a prize to the winner a trophy and a course of its choice (E12 - Gamma University).

Another practice cited was communicating to the internal and external members of the TTOs, all activities that the members of the TTOs undertook (BETA, DELTA, EPSILON). The idea of tracking new creations and opportunities in the university incubator startups was observed in Epsilon University, but not in the other cases.

However, the results allowed observing that all researched institutions pursue new potential opportunities in the internal and external environment. They believe universities have to monitor their environment, with a future vision in mind. This is accordance with Leih and Teece (2016) and O'Reilly and Robbins (2018), especially regarding the practices of seeking opportunities and exchanging knowledge with other organizations. When it comes to 'identification of opportunities', the results pointed that only Gamma University actively prospect for opportunities, since they have a director of business relations to play this role in each of the University campus. The other universities (ALPHA, BETA,

DELTA, EPSILON) have a model of passive prospection in which opportunities end up 'come' to the TTO only because of the tradition and reputation of the university and its professors. Another way of identifying opportunities observed in Gamma and Delta's cases was hunting talents from the incubator. Once a startup has made profit by developing a new product or service, they believe that other solutions will emerge from them.

Table 4

TTOs – characteristics and results

University	Characteristics of TTO
Alpha	*Beginning of the innovation agency*: 2008 *Team*: 11 people *Indicators*: 534 patents deposited (28 patents granted), 20 applications for industrial design, 52 computer programs, 21 trademarks, 13 contracts of patent partnership, 6 cultivars, 33 licensing contracts, 46 co-ownership, 15 other contracts, 14 incubated companies. *Infrastructure*: It does not have its own building, it works in a shared space in the University Foundation building. *Type of action*: 3 coordinations: entrepreneurship and business incubation, intellectual property, technology transfer
Beta	*Beginning of the innovation agency*: 2013 (TTO) – 2018 (Innovation Agency) *Team*: 9 people *Infrastructure*: It works on one floor inside the administration building. *How it works*: Innovation agency supports the TTOs of each campus spread across Paraná.
Gamma	*Beginning of the innovation agency*: 2002 *Team*: 9 people *Indicators*: 256 requests for intellectual property, 153 registered and 102 granted. Of these 155 were computer program records, 61 invention patents, 30 utility model patents, 10 joint ownership. 35 startups incubated in Paraná. *Infrastructure*: The UTFPR innovation agency does not have its own building for its activities but shares space with other administrative centers from the university. *Method of operation*: It has an innovation agency that coordinates the actions of existing NITs on campuses across the state. Each NIT has a director of business and community relations and a coordinator. Some campuses have incubators and technology parks, but not all
Delta	*Beginning of the innovation agency*: 2000 (INTUEL) 2008 (AINTEC) *Team*: 8 people198 *Indicators*: 26 patents deposited, 4 Applications for trademark registrations, 13 Applications for registrations of computer programs, 3 External patents deposited, 22 external Trademark Registration Applications, 10 incubated startups. *Infrastructure*: Own building donated by businessman in the region. *Operating method*: 4 subdivisions: Intellectual Property Office, Office of Design, Technology Transfer Office, INTUEL (incubation of companies).
Epsilon	*Beginning of the innovation agency*: 2008 *Team*: 5 people *Indicators*: 100 patents deposited, 21 patents granted, 32 registrations of computer program granted, 3 trademark registrations granted, 24 incubated companies. *Infrastructure*: Own building used together with the incubator and some junior companies. *Method of operation*: 2 subdivisions: Intellectual property and Transfer of Technology. The incubator is managed by the city hall in partnership with the university.

Note: Elaborated by the authors.

From the exposed, a research proposition (Proposition 1) can be developed:

> Participating in events, interacting with other organization and individuals, creating processes to capture ideas, participating in entrepreneurial networks and being a part of local entrepreneurial ecosystems contribute to develop the 'sensing' dimension of dynamic capabilities theory in universities that aim at developing their third mission.

Exploring opportunities is related to 'seizing' dimension practices. The evidence on this behalf showed how the TTOs explore opportunities. Alpha, Beta and Epsilon do this by making joint decisions and assuring that the TTO team and the members of the university council should be aligned in the decision-making processes.

> Each project we develop we try to align the decisions. We prefer to work together, because it is lighter for everyone, there are more people feeling part of the project and more minds thinking. (E1 – Alpha).

The importance of making joint decisions is in accordance with Teece (2007), since the author states that in order for the seizing process to flow, there should be no bureaucratic obstacles or slow decision-making. Thus, it is remarkable how the researched universities found ways to streamline the decisions about which projects should be selected and developed.

It was observed that there is a substantial role of the directors of Gamma, Beta and Delta in opportunities' search (sensing) and capture (seizing) since they actively participate in negotiations and partnerships' development. This brings them closer to the type of university leadership mentioned by Heaton et al. (2019) as being the ideal one for the development of dynamic capabilities. For these authors, also, the university's successful involvement with its innovation ecosystem depends not only on the institution itself, but also on the capacity and involvement of its leaders in this environment.

The results concerning 'seizing' activities showed that Alpha, Gamma and Delta presented more mature practices in this dimension, which can possibly be explained by the time of existence of the entrepreneurial activities held at the university. As they are older universities, they had been developing entrepreneurship long before the creation of their TTOs and they already had experience in both detecting and seizing opportunities that could generate value for the university.

Another proposition (Proposition 2) can be developed considering the results obtained from the 'seizing' dimension on dynamic capabilities in the universities analyzed:

> Having an organized system regarding constant sources of financial, human and material resources and its allocation contribute to develop the 'seizing' dimension of the dynamic capabilities theory in universities that aim at better developing their third mission.

Regarding 'transforming' activities, in all cases analyzed their processes were reorganized, leading to main changes in the TTOs, helping them better adapt themselves to their demands. Evidence showed that there were robust efforts from the universities to exchange knowledge, practices, and resources in order to capture external knowledge. Such practices are aligned with Zahra et al. (2006), who claim that an entrepreneurial organization promotes organizational learning processes as it interacts and makes exchanges with the environment.

All universities have experienced situations of confrontation with a previous culture, which was initially out of alignment with entrepreneurial and innovative activities. Thus, in order to develop such activities they had to undergo some changes in their culture. Alpha and Beta reported how they acted to disseminate the culture of innovation and entrepreneurship internally to the TTO and that was mainly done through the dissemination of information to professors and students and going to different campuses to do so.

Epsilon's coordinator mentioned that fostering the internal relationship was crucial for a cultural change. He stated that the alignment between university researchers and the TTO took place when the number of startups that were incubated and patents and partnerships with other organizations increased. These occurrences are in line with Teece et al. (2016), who highlighted how difficult it is for organizations to change their culture, since such transformation involves breaking old models and creating an internal crisis until the change is produced.

Another widely cited practice was the importance of having the dean's recognition of the TTO's value for the university. This aspect was strongly mentioned by Alpha, Epsilon and Gamma. Complementary to this, Beta and Delta interviewees declared that having an open dialogue with the dean is equally import to align objectives. Leih and Teece (2016) have also discussed the role of university senior management in the development of the entrepreneurial university. For the aforementioned authors, such leadership is essential in creating a culture and climate that support and stimulate technological innovations and also that foster the university's business. Besides, Lopes et al. (2021) point that changing the culture of organization towards a more adherent to an entrepreneurial one, leads the institution to think in a larger dimension, contributing to transform its values.

Finally, regarding the decentralization in the TTOs' management, there was no unanimous opinion among the interviewees. Universities such as Alpha and Epsilon reported that their managerial model is very centralized, however it does not hinder the accomplishment nor prevents the TTOs' growth.

On the other hand, Gamma, Beta and Delta universities attribute the success of their entrepreneurial activities precisely to power and decision-making processes' decentralization. According to Teece (2007), decisions' decentralization through the decomposition of organizational structures is highly indicated to facilitate governance and improve management. For the author, it is not possible for an organization to meet its customers' demands or adopt new technologies if there is a high degree of centralization in its decision-making processes. In this context, Gamma, Beta and Delta seem to have found a decentralization model since there is autonomy for the TTO to act. Delta's coordinator highlights his autonomy to manage the TTO's activities by saying he was given "carte blanche" from the dean of the University to make decisions.

Thus, it seems that these universities have found a way to decentralize their managerial processes, making them more based on the results to be delivered than on the 'way' that these are achieved. In the case of Gamma University, the results are delivered in the form of goals achieved annually and each nucleus of the university is free to formulate its strategy to achieve their objectives. A remarkably similar way of management takes place at Beta and Delta universities as well.

From the previously exposed, it is possible to develop another proposition (Proposition 3) considering the results obtained from the 'transforming' dimension on dynamic capabilities in the universities:

> Aligning the internal culture of TTOs to the entrepreneurial University, reorganizing its processes and installations, having support from the dean office of the University and systems and procedures to manage technology transfer and innovation processes contribute to develop the 'transforming' dimension of the dynamic capabilities theory in Universities that aim at better developing their third mission.

In sum, the results showed that the universities that participated to this research are fulfilling their third mission, or social mission, which goes beyond the traditional model that comprised mainly the 'teaching' and 'research' missions. It is evident, though, that not all universities here analyzed are moving at the same pace or are focused on the same purposes. However, it is possible to state that its TTOs are accomplishing their objectives by developing dynamic capabilities through sensing, seizing and transforming mechanisms which are helping them strengthen their operations with entrepreneurial and innovative educational models.

CONCLUSIONS

The general objective of this study was to analyze how universities in South Brazil have been developing their entrepreneurship mission in the light of the theory of dynamic capabilities. Based on the research findings, it was possible to verify that new management processes and models have been implemented over the years of operation of the TTOs in order to improve their performance models and adapt them to changes. The main change was seen as achieving the universities' third mission and overcoming the traditional model that comprises focusing only on teaching and research, to an entrepreneurial one.

The results showed actions that were undertook by the TTOs of the Universities and that contributed to better develop each of the three dimensions – sensing, seizing and transforming – of the dynamic capabilities theory. Regarding the 'sensing' dimension, actions such as participating in events, being in constant contact with industry and business members and creating processes to capture ideas, interaction and participating in networks and in entrepreneurial ecosystem were present in the empirical data of this research.

When it comes to the 'seizing' dimension of the dynamic capabilities theory, it was identified a lack of an organized system to capture opportunities' and in the other cases, actions were undertaken by the TTOs to improve the third mission of the university, such as: filtering ideas from members of the TTO and selecting the best ones, capturing ideas from contests and hackatons in which students participate, funds from the university and institutions, autonomy to raise financial resources and manage them, councils to evaluate proposals such as intellectual properties and technology transfer demands.

Regarding the main findings of this research when it comes to the 'transforming' dimension of the dynamic capabilities' theory, it was observed that to improve the university's third mission, some actions were undertaken by their TTOs, such as: transforming the internal culture of the TTO, seeking for better installations, support from the deans of the university is essential, processes' reorganization, having systems and procedures to manage technology transfer and innovation processes.

In all the universities difficulties emerged from the shock of the entrepreneurial culture with the traditional culture of the university that was strongly based only in researching and teaching. However, analyzing the results obtained it is possible to state that the cases in this study have been succeeding in their process of redesigning and cultural change since most have already surpassed the research / teaching model and are currently operating with the entrepreneurial model. Finally, it became evident that TTOs have been increasing their relevance and are supported by top management, which may lead to the supposition that TTOs tend to occupy an even more prominent role in these universities in the coming years.

Considering the universities' difficulties for bringing about the third mission mainly in emerging economy countries, the contribution of this study was, in a practical way, to offer a view of new modes and practices that can contribute to other universities that are seeking to be able to operate in an entrepreneurial dimension. Processes and mechanisms to do so and that are presented is this research can help university's managers to better develop the institutions' performance in time, since this entrepreneurial management can help companies' and societies' needs to be met. This can be done by helping Universities that still operate in a traditional way to transform themselves in entrepreneurial universities.

Data of this research can also help students broaden their view of the possibilities that these institutions can offer them, since the more aligned to an entrepreneurial university such institution is, the wider are the possibilities students can find, whether in the private sector or in the public one. The empirical data of this research can also provide new insights to these institutions' managers helping them respond more effective and efficiently to the challenges they may face, thus, contributing to the sustainability of the Universities they work in.

As a theoretical contribution the paper offers a debate on how universities in Brazil are strategically managing their practices in order to adapt to a new era in higher education throughout the development of dynamic capabilities. In this regard, these results provide particular insights about how university TTOs are operating in the dimensions of sensing, seizing and transforming.

As a limitation of this study is the fact that its universe was limited to the state of Paraná in Brazil and considered only universities with TTOs. This may have excluded important information about activities carried out by other universities with smaller nuclei or departments, but which are not yet characterized like TTO. Also, only one dynamic capabilities framework was applied in this study. Since the research literature suggests many different frameworks that can use different principles to evaluate capabilities, using one framework to discuss the theme can create biasesbet. Thus, it is suggested that future studies are carried out applying other dynamic capability frameworks in order to evaluate and compare the similarities and differences of the results obtained when different models are applied. This can help identify if the results of the phenomenon here analyzed are the same regardless of the methodology used.

Another limitation of this research regards the limited number of cases analyzed, which does not provide generalization of the results obtained. Thus, it is suggested that future studies comprise more Universities, from other states and regions of Brazil, in order to compare the results from this research to the ones from studies that discuss Universities' TTOs from other contexts. This would help obtain a broader dimension of the phenomenon analyzed.

Also, to compliment this study, it is suggested that future studies use a quantitative analyzes, so that they can help statistically validate the findings that emerged in this research. Another possibility of future research is to analyze how the universities' third mission are developed, from the relational capabilities' perspective. Since this perspective is considered as a 'branch' of the dynamic capabilities' theory, analyzing what actions related to each dimension and component of the relational capabilities are undertaken by universities, may result in prominent future studies.

Conflit of interest statement

The authors declare that there is no conflict of interest.

Authors' statement of individual contributions

Roles	Contributions			
	Kaniak V.M.M.	Teixeira R.M.	Takahashi A.R.W.	Singh A.S.
Conceptualization	■	■	■	■
Methodology	■	■		
Software	■			
Validation	■			■
Formal analysis	■	■	■	■
Investigation	■			
Resources	■			■
Data Curation	■			
Writing - Original Draf	■			
Writing - Review & Editing	■	■	■	■
Visualization	■			
Supervision	■	■		
Project administration	■	■	■	
Funding acquisition	N.A.			

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AUTHORS BIOGRAPHIES

Vivien Mariane Massaneiro Kaniak *is PhD in administration from the Federal University of Paraná (UFPR), Master in Management from the Federal Technological University of Paraná (UTFPR), Specialist in People Management, Graduated in Psychology from the Federal University of Paraná (UFPR) and in Administration from Faculdade Estacio de Sa. Has teaching experience in the areas of people management and work psychology.*

E-mail: vivikaniak@hotmail.com

Rivanda Meira Teixeira *holds a master's degree in business administration from COPPEAD/UFRJ (1979) and a degree of Doctor of Philosophy in management studies from Cranfield University, England (1996). Performed postdoctoral research on tourism management in conjunction with Bournemouth University in England (2000). Later in 2001 was involved in a research project on tourism small business and entrepreneurship in collaboration with prof Alison Morrison at Strathclyde University, in Scotland. In 2007 spent a sabbatical year at HEC, Montreal, Canada, working on a research project on entrepreneurship process under the guidance of prof. Louis Filion. In 2015 carried out postdoctoral research on entrepreneurship at FGV-SP, in collaboration with prof. Tales Andreassi. Worked as a full professor at Federal University of Sergipe (UFS) for about 32 years. At UFS participated as a researcher, lecturer and supervisor at the master program in development and the environment (PRODEMA) and as well at the professional master program in economics (NUPEC). At UFS leaded the team for creation of the business administration master program (PROPADM). After this master started in 2011 was the program coordinator for 3 years. Worked as full professor at Federal Paraná University for about 10 years and participated at the management master and doctorate programs (PPGADM). Performed at CNPq as productivity scholar from 1998 to 2022. Her main research interests include Sustainable Entrepreneurship; Entrepreneurship and Innovation, Entrepreneurial Learning, Entrepreneurial Social Networks; Entrepreneurship in Tourism and Management of Small Tourism Businesses; Management Qualitative Research.*

E-mail: rivandateixeira@gmail.com

Adriana Roseli Wunsch Takahashi *is full professor of administration at the Federal University of Paraná/PR. She works in the Doctorate and Masters courses in Business Administration. Coordinates the research group Strategy, Dynamics and Behavior in Organizations - Processes and Practices, registered with CNPQ. She holds a Masters in Business Administration from the Federal University of Paraná/UFPR and a Doctorate in Business Administration from the University of São Paulo/USP, with a sandwich doctorate from Lancaster University (UK). Performed Post-Doctoral Internship at Fundação Getúlio Vargas/SP. She was a visiting professor at Mendel University (CZ), research professor at FEA/USP and carried out a research project at the Manchester Business School (UK) with funding from the British Academy. Her main research interests are: Dynamic Capabilities, Strategic Competences, Organizational Learning and Qualitative Research.*

E-mail: adrianarwt@gmail.com

Ananda Silva Singh *is Ananda Silva Singh is a professor at the Federal University of Uberlândia (UFU) - Campus Santa Mônica. She has a Doctorate degree and a Masters degree in Business Administration and graduated in Production Engineering and in Business Administration. Her main reserach interests are: Teaching and Research in Administration, Entrepreneurship and Sustainability.*

E-mail: ananda.singh@ufu.br