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Theoretical-empirical Article

Temporal Flow of Technology Transfer Capability: Beyond the Lifecycle

Fluxo Temporal da Capacidade de Transferência Tecnológica: Além do Ciclo de Vida

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ABSTRACT

Objective: to analyze the behavior of technology transfer capability over time in Brazilian public institutions of higher education. **Method:** the extended case method was adopted in two national institutions of reference in technology transfer management. Interviews, observations, and document analysis were the main techniques for data collection. The analysis was performed using also the techniques of the extended case method. **Results:** became evident that the behavior of a capacity, during its existence, may not obey a linear curve, but vary over different stages and undergo different mutations. **Conclusions:** it was concluded that the lifecycle of a capability would not be exactly equivalent or limited to the heuristic of a biological lifecycle with predictable entropy until the total collapse. Unlike this, considering the environment and the conjuncture, a capability can come back to exist as long as it is understood as opportune and feasible. The findings advance the understanding of the technology transfer process that now has the explanatory potential of dynamic capabilities.

Keywords: technology transfer; dynamic capabilities; lifecycle.

RESUMO

Objetivo: analisar o comportamento da capacidade de transferência tecnológica ao longo do tempo em instituições públicas brasileiras de ensino superior. **Método:** adotou-se o método de caso estendido em duas instituições nacionais de referência em gestão da transferência tecnológica. Entrevistas, observações e análise de documentos foram as principais técnicas para a coleta de dados. A análise também ocorreu por meio das técnicas do método de caso estendido. **Resultados:** evidenciou-se que o comportamento de uma capacidade, durante a sua existência, pode não obedecer a uma curva linear, mas sim variar ao longo de estágios distintos e sofrer diferentes mutações. **Conclusões:** conclui-se que o ciclo de vida de uma capacidade não seria exatamente equivalente ou limitado à heurística de um ciclo de vida biológico dotado de previsível entropia até o total colapso. Diferente disso, considerando o ambiente e a conjuntura, uma capacidade pode voltar a existir desde que se entenda isso como oportuno e exequível. Os achados avançam na compreensão do processo de transferência tecnológica que passa a contar com o potencial explicativo das capacidades dinâmicas.

Palavras-chave: transferência tecnológica; capacidades dinâmicas; ciclo de vida.

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INTRODUCTION

Even though the technological innovation process can come exclusively from a company, when it internally invests in research and development (R&D), or in partnerships with other companies (Chesbrough, 2006), it is assumed, according to Bartlett and Ghoshal (2000) and Vieira and Ohayon (2006), the existence of risks and the high cost of maintaining departments dedicated to this purpose. Transferring technology, with commercial potential, developed in public higher education institutions (HEIs) to the business sector would be an alternative to overcome such obstacles.

In spite of the different technology transfer models suggested in literature (Bercovitz & Feldmann, 2006; Cadori, 2013; Carvalho & Cunha, 2013; Jagoda, Maheshwari, & Lonseth, 2010; Necoechea-Mondragón, Pineda-Domínguez, & Soto-Flores, 2013; Rogers, Takegami, & Yin, 2001; Szulanski, 2000; Takahashi & Sacomano, 2002), it was possible to observe the emergence of a recent research stream that aligns the dynamic capabilities approach to the technology transfer process in the HEIs context (Bejinaru, 2017; Fernandes & Machado, 2019; Heaton, Siegel, & Teece, 2019; Leih & Teece, 2016; O'Reilly, Robbins, & Scanlan, 2019; Teece, Peteraf, & Leih, 2016; Yuan, Li, Vlas, & Peng, 2018).

Therefore, this study assumed that technology transfer can be understood as a dynamic capability. This reasoning is justified under four arguments: (a) the actions and processes involved in technology transfer start from new knowledge, information, and technological solutions previously unknown at market levels, forcing those involved to rethink the preceding forms of negotiation; (b) the need for the technology transfer process to deal with novelties, or technological inventions, that is, to highlight the respective market and social relevance to potential stakeholders, forcing new learning processes, and also the accumulation, modification, or elimination of resources, abilities, ordinary capabilities, and competencies; (c) the stakeholders, possibly acting as legal entities, also have the potential to demand constant adaptation of the technology transfer capability from the technology provider due to their idiosyncrasies; (d) understanding technology transfer as a capability is in line with Helfat et al. (2009) regarding dynamic capabilities, that is, a capability with the potential to create, extend, and modify the organization's base of routines, competencies, and resources to keep it alive and competitive.

In turn, academic research regarding technology transfer involving universities (Bengtsson, 2017; Baglieri, Baldi, & Tucci, 2018; Schaeffer, Öcalan-Özel, & Pénin, 2020) is limited to analyzing the relationship between organizations to circulate or move information or technological knowledge without explaining the complexity of how this capability is actually initiated and developed in an organization over time.

Regarding this perspective, O'Reilly, Robbins and Scanlan (2019) point out that much of the research on the subject focuses on developing interorganizational relationships (external links with the business ecosystem) and neglects building the capabilities to support such links.

In this context, we expressed the research problem by asking the following question: How does technology transfer capability behave over time in Brazilian public HEIs? This study's central objective was to analyze the behavior of technology transfer capability over time in Brazilian public HEIs.

Understanding how technology transfer capability (TTC) evolves in a temporal flow was important in helping not only to disseminate best routines or practices, but also to further improve it and adapt it to the HEIs context. Therefore, this study's results can both contribute to understanding technology transfer within Brazilian HEIs (Berbegal-Mirabent, Gil-Doménech, & Torre, 2020; Chais, Ganzer, & Olea, 2018) and promote the understanding of how dynamic capabilities are developed (Laaksonen & Peltoniemi, 2018).

Following this introduction, the study comprises the following structure: the second section presents the theoretical framework supporting it; the third section details the methodology; the fourth section discusses the results; and, finally, the fifth section highlights the conclusions and final considerations.

THEORETICAL FRAMEWORK

Technology transfer can be understood as the process involving the movement of a technological innovation from an R&D organization to a receiving organization (a public or private company) (Rogers et al., 2001). It may involve licensing, technology-based business incubation, or the ownership transfer of a particular protected invention capable of generating income (Ahn, Zwikael, & Bednarek, 2010; Ministério da Ciência, Tecnologia & Inovação, 2015).

Technology innovation centers (TICs) can assist technology transfer since they are the main intermediary between HEIs and the productive sector. They provide appropriate environments for managing, protecting, and transferring inventions from universities (Lotufo, 2009). In other words, technologies originated in the academic environment are passed on to the productive sector, contributing to creating new products and innovative

companies (Cozzi, Judice, & Dolabela, 2007; Garcia & Gava, 2012).

However, it may also occur through the formalized initiative of the main creators of a given technological invention (Boehm & Hogan, 2014), such as independent inventors (Lei n.º 10.973, 2004; Lei n.º 13.243, 2016) and technology-based business incubators (Garcia & Gava, 2012). Even though both possibilities are not this study's focus, they were understood as possible modalities for technology transfers between HEIs and companies.

Among the primarily intangible objects to be transferred, this study focused on inventions that can be protected by the intellectual property law (Pimentel, 2005; 2006; 2010) due to the easier delimitation of the technological scope in a public document. It grants certain inventors the monopoly over their intellectual creation (invention) over a given period (Araújo, Barbosa, Queiroga, & Alves, 2010).

In line with Yuan, Lin, Vlas and Peng (2018), and as suggested in the introduction, this study understands technology transfer under the dynamic capabilities perspective. According to the aforementioned authors, whose understanding of this approach is aligned with Leih and Teece's (2016) definition, technology transfer processes in universities represent a set of activities that use their resources in generating value-added products and services to commercialize and ultimately reconfigure them to adapt to climate change. Thus, these processes would be in line with the dynamic capabilities perspective because they come from organizational abilities (institutional) to integrate, build, and reconfigure internal and external competencies, dealing with rapidly changing environments.

In fact, following a linear logic, universities start their research and development activities using financial and human resources based on identified opportunities and to create new technological solutions. Then, a TIC can endeavor in amplifying the value of such technological creations and promote their commercialization. In order to do so, universities have to continuously align their capabilities to the external environment's restrictions and/or opportunities. Such efforts require universities to reconfigure their capabilities when faced with such pressures to increase their technology transfer effectiveness (Leih & Teece, 2016; Yuan et al., 2018).

Therefore, in addition to these authors' aforementioned contributions, in order to promote integration with the technology transfer concept, this study adopted a conceptual perspective of dynamic capability that was more comprehensive and emphasized human intentionality (individuals), rather than the simple abstraction directed to organizational or institutional processes, in transforming such capability, according to Helfat et al. (2009).

As such, in line with the findings of Fernandes and Machado (2019) on Brazilian HEIs' TICs, technology transfer "is a dynamic composite of intentional and organizational actions involving resources, competencies, routines, and capabilities (RCRC) to transfer technology that is able of generating, at least, differentiation among comparable organizations" (Fernandes & Machado, 2019, p. 11).

Technology transfer, as a capability, would therefore be embedded in the newstream production to feed and update the mainstream (Kanter, 1989). In other words, the technology transfer capability would be integrated with the innovation capability by providing raw material, products, processes, and technological knowledge. In other words, mainstream resources and activities for partner companies, according to signed contracts, and also for the university research groups themselves ejecting other new (newstream) business flows, improved products and processes in a conventional, inventive/innovative, and then again conventional cycle, aiming to create or meet society's and/or market's needs and opportunities in time and space (Lawson & Samson, 2001).

Within the scope of studies on dynamic capabilities, technology transfer is initially and indirectly dealt with by classical authors such as Eisenhardt and Martin (2000) and Teece (2007). Aside from them, Zollo and Winter (2002) superficially refer to technology transfer when dealing with replication.

Recently, it has been possible to observe some development around both topics to the extent that some research started to address knowledge and technology transfer processes, and also the performance of technology transfer offices under the dynamic capabilities perspective (Heaton et al., 2019; Leih & Teece, 2016; O'Reilly et al., 2019; Pitsakis & Giachetti, 2020; Yuan et al., 2018).

The dynamic capabilities perspective extends the resource-based view (RBV) argument to the extent that it seeks to know how the resources and capabilities that directly generate incomes are created and updated over time (Griffith & Harvey, 2001; Helfat, 1997; Lee, Lee, & Rho, 2002; Rindova & Taylor, 2002; Winter, 2003; Zott, 2003). However, it is not a simple complement to RBV, but rather an integrative theoretical body under structuring (Teece, 2007; Helfat & Peteraf, 2009).

Overall, dynamic capabilities are created, shaped, and maintained by factors arising from both inside and outside the organizations, and are primarily aimed at, but not restricted to, rapidly changing environments (Teece, Pisano, & Shuen, 1997). They can also operate in relatively stable

environments, which means that the environmental factors do not need to be totally uncertain or complex (Ambrosini & Bowman, 2009). Thus, they can routinely integrate, reconfigure, and gain resources and other capabilities to keep up with and even create environmental changes (Eisenhardt & Martin, 2000).

A dynamic capability can be a mechanism by which a given organization seizes, accumulates, modifies, or eliminates ordinary abilities, competencies, and capabilities (Collis, 1994; Teece et al., 1997; Winter, 2003). They are primarily constructed internally, instead of simply acquired externally (Makadok, 2001), and are the fruit of organizational historical paths (Teece et al., 1997). Factors such as luck or endowment may contribute to their generation (Arend, 2015). However, they are not to be confused with these factors since they are intentional and deliberate (Helfat et al., 2009; Zahra, Sapienza, & Davidsson, 2006).

In turn, implementing dynamic capabilities requires high levels of time and energy from committed managers, in addition to high cognitive, operational, and management costs (Lavie, 2006; Pablo, Reay, Dewald, & Casebeer, 2007). For example, Teece (2007; 2012) recognizes the importance of organizational leaders' entrepreneurial and transformational actions in this framework. Furthermore, other studies highlight the managers' crucial role in the adaptive capability of their organizations (Adner & Helfat, 2003; Eisenhardt & Martin, 2000; Harreld, O'Reilly III, & Tushman, 2007; Helfat et al., 2009; Zahra et al., 2006).

On the other hand, the perception, interpretation, and bounded rationality of organizational leaders, regarding the internal and external environment, may interfere in the creation, reactivation, implementation, enhancement, maintenance, withdrawal, or performance of dynamic capabilities (Aragón-Correa & Sharma, 2003; Ambrosini, Bowman, & Collier, 2009; Connor, 2007; Ferreira, Coelho, & Moutinho, 2020; Helfat & Peteraf, 2003; Holzmayer & Schmidt, 2020; Moliterno & Wiersema, 2007; Winter, 2003; Zollo & Winter, 2002).

In turn, concerns on how capabilities are developed and their behavior over time have been the subject of recurring studies (Gebauer, 2011; Helfat & Peteraf, 2003; Rindova & Taylor, 2002; Romme, Zollo, & Berends, 2010; Teece, 2007; Wang & Ahmed, 2007; Zahra et al., 2006; Zollo & Winter, 2002; Zott, 2003). For instance, Laaksonen and Peltoniemi (2018) highlight the advances of the dynamic capabilities perspective for strategic management according to multiple literature reviews that map theoretical developments and empirical research regarding the topic. However, the latter authors warn that this research line's empirical challenges have received less attention from researchers in the field and, as such, they argue that, for a better understanding, the operationalizations of the alluded research need to gain strong links between the constructs and their respective empirical measures, thus allowing for the continuous theory advancement. Therefore, they list four types of dynamic capability operationalizations (something like: managerial assessments; financial data; organizational experience, actions, and performance; and manager or employee experience, actions, and performance) and provide critical evaluations on these operationalizations. This emphasis on empirical research and operational factors helped define this study, and supported the importance of a longitudinal research that would consider data regarding managers and employees involved in the analyzed TICs, highlighting the relationships of actions, experiences, and results achieved over time.

We listed some recommendations such as the contributions resulting from Laaksonen and Peltoniemi (2018), which, added to Fernandes and Machado (2019), influenced this study: (a) identifying the capabilities or resources that are altered by dynamic capabilities; (b) giving dynamic capabilities an indirect role in affecting performance; (c) using different sources for dynamic capabilities data and performance data; (d) explaining whether dynamic capabilities are specific to the organization or common practices and whether it appropriately operationalizes them; (e) being consistent on the analysis level of the dynamic capabilities theory development and empirical testing; (f) using longitudinal data to capture the accumulation of accumulated capabilities and change over time; (g) balancing quantity, variety, and aptitude in measuring previous experiences, actions, and performances; (h) evaluating outcomes and opportunities on a learning perspective. Although they are all important, some of them had more or less influence on conducting this study, such as the appreciation of the capabilities' accumulation and their changes over time, which was crucial in defining this study's objective.

Regarding the development and evolution of dynamic capabilities, Helfat and Peteraf's (2003) contribution seemed more consistent and elucidative in presenting their lifecycle, helping to explain the fundamental sources of organizational heterogeneity and the evolution of capabilities themselves. The capability lifecycle concept is based on observing that products and resources are two sides of the same coin. Thus, capabilities would have development paths following recognizable patterns in stages, making explicit their dynamic nature. Despite this similarity, the authors highlight differences between the life of a product and a capability. They highlight the fact that capabilities can support multiple products at the same time.

Assuming that TTC is a dynamic capability, the organization's current position in its environment, its trajectory, social capital, trust, perceptions, learnings, and its

leaders' decisions along the referred path also collaborate to technology transfer (Ambrosini & Bowman, 2009; Blyler & Coff, 2003; Eisenhardt & Martin, 2000; Lavie, 2006; Pablo et al., 2007; Rosenbloom, 2000; Teece et al., 1997; Zollo & Winter, 2002). Under this perspective, the first stage of the lifecycle would be the foundation, and according to Helfat and Peteraf (2003, p. 1000) it takes place "when a group of individuals organizes around an objective that centrally requires or involves creating a capability."

In addition to internal factors, encompassing leaders' and their teams' actions, the authors acknowledge that the possible influences and conditions of the external environment generate a capability's heterogeneity. However, they preferred to abstract this variable, which, on the other hand, was very important for this study.

The next stage would be the development itself, where the capability would improve over time in a rather irregular way and as a result of the team's own actions, achievements, and learning involved in such evolution. Development ceases, reaching maturity, when the evolutionary curve becomes flat as gains, results, and experiences reduce their transformative effects, probably as a result of the limits inherent to available technologies, inputs, employees, the state of the art, or known best practices, and so on (Helfat & Peteraf, 2003).

Maturity can be achieved deliberately by leadership decision, and/or as a result of team or organizational consensus when it is deemed good enough. Ultimately, everything provides different trajectories and end points for each dynamic capability, and a perfect replication or re-editing is not possible precisely because of their idiosyncrasies. At this stage, only the capability should be maintained, thus becoming ingrained and so customary that it would tend to be tacit.

According to Helfat and Peteraf (2003), the ramifications during a capability's evolution occur after strong impacts from internal or external factors, i.e., by force of leadership decisions or by some public policy, respectively. At the impact point, the capability can undergo six types of modifications: renewal, reimplantation, recombination, replication, reduction, or deactivation (death). Importantly, the authors acknowledge that these "may not represent all possible ramifications" (Helfat & Peteraf, 2003, p. 1005). Furthermore, they make it clear they treat the term 'retirement' as 'death.' In other words, retirement would be a capability deactivation or death according to this excerpt: "some extreme situations may force a firm to completely retire a capability, which means the capability dies" (Helfat & Peteraf, 2003, p. 1005).

Therefore, the great asset of Helfat and Peteraf 's (2003) proposal is precisely to present not what originates the capabilities, but what happens to them during selection events over their existence. It is a unique contribution that was useful during this study's empirical and analytical phase. The following section presents this study's methodological steps.

METHODOLOGICAL PROCEDURES

This study started from the premise that technology transfer would be a dynamic capability and, as such, would have a variable behavior over time, according to Helfat and Peteraf (2003). Thus, we sought to empirically verify how this dynamic capability behavior evolves in a temporal flow (Laaksonen & Peltoniemi, 2018). Based on this objective, we conducted a survey on scientific production regarding the topic, which served as this study's theoretical foundation, and used the extended case method (Burawoy, Burton, Ferguson, & Fox, 1991; Burawoy, 2009).

Therefore, this is a qualitative study with interpretivist inspirations (Berger & Luckmann, 2004; Burrell & Morgan, 2006; Merriam & Tisdell, 2015) of two cases extended both historically and in depth aimed at reconceptualizing and extending the theory (Burawoy, 2009; Burawoy et al., 1991). Research adopting qualitative case studies may favor obtaining valuable information on dynamic capabilities that otherwise would not be possible (Barreto, 2010). 'Fine-grained' investigations are rich in contextualized data (Godfrey & Hill, 1995) and are useful when uncovering dynamic capabilities' actions (Grant & Verona, 2015).

According to Burawoy, Burton, Ferguson and Fox (1991) and Burawoy (2009), the extended case method's purpose is to ascertain anomalous situations in the pre-existing theory and propose theoretical refinement based on the confrontations between the empirical data analysis and the literature review, and between such empirical data and new data collection, until saturation. This study aimed at doing precisely that.

Among the cases that could be addressed, we selected those of the University of São Paulo (USP) and the State University of Campinas (Unicamp) due to their respective relevance in the technology transfer management at the national level (Dias & Porto, 2013; 2014), because the TICs are almost exclusive environments for TTC to occur, and also given the easy access to people and data provided by the national legislation on transparency and access to public information (Lei complementar n.º 131, 2009; Lei n.º 12.527, 2011).

We adopted a script with questions formulated and elaborated by the authors themselves, and indirectly using the contributions and recommendations exposed in the theoretical framework, we interviewed members of

those educational institutions, mostly from the respective TICs, and who directly worked in technology transfer contracts after 2003. There were nine interviewees, totaling 09h53min11sec of recordings, as shown in Table 1.

Table 1. List of interviewees.

Brazilian public HEI	Position	Code
USP	Technology Transfer Technical Director	SPTT00
	Researcher 01	SPPE01
	Intellectual Property Technical Director	SPPI02
	Technology Transfer Agent	SPAT03
	Administrative Analyst	SPAA04
Unicamp	Partnership Director	UNDP00
	Intellectual Property Director	UNPI01
	Researcher 02	UNPE02
	Executive Director	UNDE03

Moreover, we also conducted systematic observations during the interview period. Complementarily, we accessed 112 documents such as processes, virtual pages, contracts, secrecy terms, official letters, and memos, all related to technology transfer, aiming at triangulating the data sources (Basso Júnior et al., 2016; Zappellini & Feuerschütte, 2015).

In order to contribute to factual accuracy and the credibility of the interpretations, all the material transcribed during the interviews was sent to the interviewees by e-mail, so that they could evaluate whether the content reflected the reality apprehended, restrict potential confidential information, and add information and details they deemed necessary.

Interview and observation techniques are in line with the epistemological guidelines of the extended case study method (Burawoy et al., 1991; Burawoy, 2009). Such techniques provided contextual evidence *in loco*, which was later evaluated and analyzed taking the researchers' theory and experience as reference. Thus, it enabled the explicitness, in an interpretative way, of the relations, structures, and processes in which the investigated individuals were inserted.

The analyses arising from evidences of interviews, documents, and systematic observations conducted in 2015 were later updated through the analysis of documents accessed up to 2020, including contemporary secondary data, such as laws, decrees, resolutions, senses, and other official publications. The collection and analysis cycle was interspersed with that of theoretical confrontation, leading to a new succession of access to sources and the consequent confirmations, adjustments, and analyses until stabilization or some sort of redundancy.

Thus, we used the theory to design and conduct the observations, interviews, and documentary selections. After the first data collection, we revisited the theory once more to assess the need to collect more data. This procedure occurred in a cyclical manner until the limit of possible evidence identifiable in the empirical process and regarding the overcoming of the existing theory was reached. Therefore, the handmade and reflective nature of the adopted procedures is evident, comprising: intervention, process, structuring, and theory reconstruction (Silva, 2018).

In order to assist in the aforementioned cycle of theoretical confrontations until saturation, we used constituent and operational definitions for the following aspects evidenced during the investigation: external environment; intellectual precedence; apprehension; prior path; dynamic capability; operational or substantive capability; codification; competence; organizational knowledge; context; detection; organizational strategy; project management; manager (leader); innovation; market; mainstream; newstream; (public) policy; position; learning process; operational process; reconfiguration, transformation, or modification; resource; operational routine; and society. Furthermore, the events of selection, retirement, suppression, replication, renewal, reimplantation, and recombination of capabilities, following Helfat and Peteraf (2003), formed initial beacons for conducting this study.

It is worth emphasizing that the classifications, or typologies, in stages and transformations of the temporal flow used here, despite being based on the contributions of Helfat and Peteraf (2003), were developed using the empirical data found, their confrontation with the

literature, and throughout this study, and are, therefore, an original result of the undertaken research. Interview and observation scripts, as well as constitutive and operational definitions, are publicly available. The following section presents and discusses the results obtained.

RESULTS PRESENTATION AND DISCUSSION

We developed the logic for analyzing a TTC's behavior based on the lifecycle of a capability proposed by Helfat and Peteraf (2003). However, when facing the empirical reality, we could notice inconsistencies between these authors' theoretical proposition and the observed practice that needed to be solved, which will be discussed next. It is supported, for example, by O'Reilly et al. (2019) who stress the importance of understanding the capabilities that support interorganizational relationships.

The TTC focused on in this research allowed both the creation and the empirical verification of the temporal flow logic of capabilities. Thus, a capability's lifecycle may not be exactly equivalent or limited to the heuristic of a biological lifecycle endowed with predictable entropy until total collapse. It does not even follow a pre-established linear order over time, as shown in Figure 1 (which represents the time frame with the greatest oscillation, or transformational flow, between the TTC's creation and mutations in each of the surveyed HEIs). Furthermore, it presents summarized information on the main findings of each HEI, indicating, respectively, whether they caused positive or negative effects on the alluded TTC development.

Regarding Figure 1, it is important to explain the stages and the meaning of each symbol adopted to express the capability behavior characteristics over time. In total, we identified eight possible types of transformations TTC may undergo over its existence, which are: creation, replication, recombination, improvement, renewal, reimplantation, regression (suppression), and retirement.

Creation is represented by the star indicating the year in which the capability was born. The empirical evidence for it comes from historical records of effected transfer-related actions, facts, or events. For example, when a certain transfer sector was created through some institutional resolution or some technological licensing, it occurred in an emerging way.

Replication was represented by three asterisks arranged in pyramid shape. For example, with the TTC implementation process underway, an organization may constitute operational procedures, however primitive and provisional, to guide its technology transfers. This pioneering initiative may attract the interest of other institutions wishing to learn or adopt these 'best practices.' Therefore, replication can be evidenced when transfer models used by the organization are presented in forums or to visitors due to their interest.

The third TTC transformation type would be recombination, which was symbolized by four small rhombuses grouped together to form another larger rhombus. It could be evidenced if some of the resources, competencies, routines, or operational capabilities, which comprised the TTC, were recombined and that this was prominent enough to allow the TTC to be improved or sustained over time. For example, two substantive capabilities may have been joined together to form a genuine or differentiated, or even increased, capability.

The fourth TTC transformation type would be improvement. Although it is also a synonym for improvement, development, or even updating, this mutation can be emphasized by a symbol of a circle with gear-like points. This emphasis along the TTC evolutionary trajectory is important if none of the other transformational possibilities prominently occur. For example, TTC may be between implementation and juvenility, at the beginning of implementation, and then the improvement symbol would emphasize that the capability would be exclusively in that transformational process itself, as shown in the studied HEI cases, according to Figure 1.

Improvement, as a type of transformation, can be empirically verified, for example, when small improvements covering the information system, operational procedures, and continued training would favor sustaining or evolving, in terms of stage, the TTC over time. Thus, this type of indication is also intended to cover several transformations at the same time, not singling out one in particular as the one responsible for the evolution or maintenance of the alluded capability.

The fifth possible type was renewal, represented by a circle with a star. It can be empirically verified if an improvement, or incremental improvement, has been intense and comprehensive. For example, redesigning the technology transfer information system and updating procedures that would be governed by a new resolution or internal policy.

Suppression, or regression, would be the sixth possible transformation type and is represented by the arrow to the southeast, showing a decrease in TTC. The seventh transformation type is reimplantation, symbolized by a curved arrow in a circular shape. Its occurrence is conditional and sequential to the types of regression or retirement. Unlike what Helfat and Peteraf (2003) propose, reimplantation can occur in the same organization that gave rise to TTC.

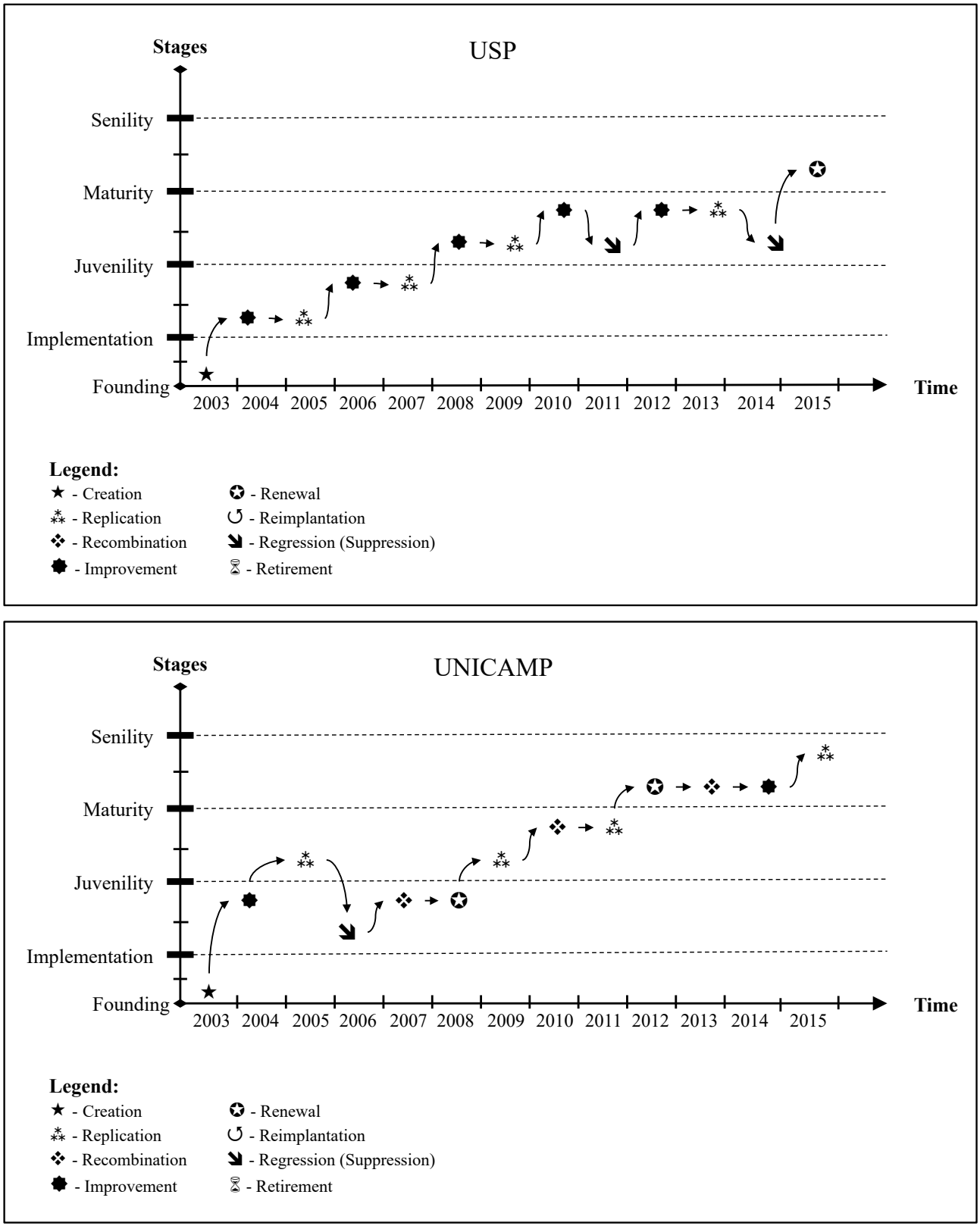

Figure 1. Period of greatest TTC transformational flow in each investigated HEI.

Retirement, the eighth transformation type, has the hourglass with time running out as its symbol. We preferred this term and symbol because during the research we found that retirement, regression, and reimplantation would be closely related since regression tends to retirement, and reimplantation would be when the TTC would leave dormancy and return to active duty.

It is worth pointing out that retirement can happen suddenly in any stage range, and does not necessarily require a smooth, continuous, or abrupt suppression until it reaches the lowest point on the ordinate axis, the 'foundation' stage. Note that foundation is a one-time-only event. Once the dynamic capability is created, it can only be retired or reimplanted. However, there can be more than one retirement or reimplantation without affecting the evolutionary principle.

The accelerated way the TTC could reach retirement, for example, would be if a new national law were to be enacted to dispense the existence of TICs in public HEIs and, by political option of a certain institution, if the Rector decided to abort everything related to technological transfer, even with a mature TTC. In this hypothetical scenario, there may be a suppression due to the dismantling of the infrastructure as a whole, the reallocation of permanent staff to other sectors of the institution, and the non-renewal of temporary contracts in effect until then. The TTC might even regress some stages, but it would be retired almost immediately.

Thus, as shown in Figure 1, the capability at the USP's TIC is on the rise until 2011, when it suffers a suppression, then it recovers, but regresses again in 2014, until it grows abruptly and reaches maturity. The capability oscillates more significantly in 2006 at the Unicamp's TIC due to legal issues and employee transition, leaving the juvenile stage and in need of reimplantation. However, in the following years there is a linear evolution until reaching maturity. Next, there is a summary presentation and discussion of TTC behaviors in both HEIs over time.

The two centers created the TTC in 2003. In 2004, the style of the technology transfer technical director at the USP's TIC was more operational, reactive, ordinary, relatively entrepreneurial, creative, and intellectual, toward improving this capability and because of the external and internal institutional pressures for this development. In other words, a favorable institutional environment according to Yuan et al. (2018) and O'Reilly et al. (2019).

The center started to invest in inter-institutional interactions to absorb possible transfer experiences and to train its employees, evidencing, according to Teece et al. (1997), Ambrosini and Bowman (2009), Ferreira, Coelho and Moutinho (2020) and Holzmayer and Schmidt (2020), the relative environmental dynamics in which the TICs were inserted.

In the Unicamp's TIC, the improvement occurred in a transformational, proactive, extraordinary, entrepreneurial, creative way. It was materialized and led by the executive director, revealing the intentionality suggested by Zahra, Sapienza and Davidsson (2006), and the strategic role of such decision-makers in effectively building a conducive environment, according to Bejinaru (2017) and Heaton, Siegel and Teece (2019).

In 2005, the TTC activities and processes became standardized operational routines, ordinary at the Unicamp's TIC, leading the center to replicate its best practices to other Brazilian institutions. That same year, after Resolution No. 5,175/2005, the USP's TIC emphasis was on setting up standardized procedures. The successful contract with a company favored the positive image of the agency and favored the replication of its transfer model to other universities. This USP capability has remained at the same stage because of communication problems and limitations regarding the use of physical documents and folders.

The joint efforts of the coordinator and the transfer director at USP allowed the improvement and elevation of the TTC stage in 2006. For example, through the beginning of the SUPERA Park operation (business incubator), with support from the São Paulo state government, the adoption of the ABC Curve to classify the technologies, and the signing of an international licensing agreement. This TTC leap reinforces Bejinaru (2017) and Heaton et al. (2019) regarding decision-makers' actions toward the economic development of their surroundings, which is the result of technological knowledge transactions. The importance of such decision-makers has proven to be a key issue on other occasions throughout the TTC's development, as we can see below.

There was a capability suppression reducing the number of effective licensing contracts in the Unicamp's TIC due to legal issues and employee transition. That same year, managers' reactive, transformational, entrepreneurial, creative, and intellectual actions were initiated to adapt the capability to current legislation, recombining two TTC components.

In the following year, 2007, there was an operational, reactive, ordinary, routine, materialized, and best practices action that, after the effective recombination between the communication capability and the relational capability, allowed the TTC recovery, and also the resumption of the Unicamp's TIC transfer model replication to other TICs.

The coordinator's leadership style and the creation of a committee favored the formalization of technology

transfer procedures at the USP's TIC. However, the analysis and dissemination routines of the technologies were not carried out due to lack of personnel. Another restriction to the capability stage progression at USP was the communication deficiency.

In 2008, the USP's TIC created the Regularization Sector and signed a partnership with Oxford University to disseminate some of its technologies. Moreover, according to SPTT00, some employees have had "… several international experiences. The team went abroad …, they went to understand, for example, how the [Massachusetts Institute of Technology] worked." Overall, the USP Agency benchmarking became more intense and started comprising prominent international models. This has favored the TTC's improvement.

The TTC showed renewal in 2008 at the Unicamp's TIC, and the actions demonstrated more operational, proactive, ordinary, routine, materialized, and best practices flows. In 2009, replication was evident through the *Projeto InovaNIT* and the publication of a best practices book (Lotufo, 2009). In the same year, the USP's TIC licensed the I3 software. However, despite promises of improvement in the rapid identification of USP's competencies, the system has not progressed due to lack of dedicated technical staff. It restricted the rise of the TTC, which remained at the same stage, including over state legislative issues.

In turn, the *Pró-NIT* project made USP's image more attractive to other TICs and favored capability replication. According to the Unicamp's TIC, Pró-NIT "… involved seven institutions and the intention was to improve our procedures, our technology transfer, and intellectual property protection processes" (UNDP00).

In 2010, the USP's TIC started to identify, in licensing to startup companies, the need to improve its negotiation competence. Relational learning and management capabilities favored the improvement of this competence and TTC. It occurred by way of what we call, in alignment with Lawson and Samson (2001), the mainstream-newstream-mainstream mesocycle.

That is, in the first position there would be the current resources, capabilities, routines, and competencies (RCRC) with mainstream characteristics. Managers, researchers, and employees would begin the activities of detecting, apprehending, changing, and codifying these RCRCs, making it the second position (newstream). Finally, current actions and new actions to transfer technology that were codified and/or disseminated would shape the new RCRC composite and, again, with mainstream characteristics making it the third and final position.

The TTC continued to develop at the Unicamp's TIC in 2010. The agglutination of the system for managing contracts, agreements, and trading history records (CACOM) with that for managing intellectual property (MANTIS) into a single system (Security System — SISE), incorporating new modules that even allowed managing royalties, was favorable to this recombination.

In 2011, the ordinary, routine, materialized actions and best practices were evidenced, despite some proactive actions such as establishing a partnership with the Innovation Agency of the University of Cambridge. Thus, despite the replication of the Unicamp technology transfer model, the stage remained the same as in 2010.

For the USP's TIC, 2011 was characterized by the TTC regression due to the abandoning of the I3 software (which served as a means of capturing the university's R&D competencies), the ABC Curve classification method, and given the address change to Avenida Brasil, making explicit the interpretive and rationality limitations of organizational leaders, according to Moliterno and Wiersema (2007), Ambrosini, Bowman and Collier (2009), Ferreira et al. (2020) and Holzmayer and Schmidt (2020).

The change in the facilities' location, a result of the transition and interests of the new rectorate beginning its management, "created a problem because we were far from the professors here on campus" (SPTT00). The negative effect was not greater due to the arrival of new employees, the proximity of large companies' offices, and the acceleration of the procedures for signing agreements, which could no longer exceed 30 days.

There was a recovery in TTC's internship at the USP's TIC in 2012. That same year, a partnership with Microsoft encouraged an improvement in intellectual property protections and transfers. Moreover, the publication of a brief informative on the institution's main achievements, projects, and licensed technologies was undertaken. It promoted the agency's visibility, as it served as a "showcase [of the agency's actions] before other institutions and society as a whole" (SPPI02). Other factors for the recovery were the promotions of events such as the Venture Capital Company Meeting with the São Paulo TICs, the USP Innovation & Entrepreneurship Fair (USPiTec), and the establishment of the AcTTiba Project Open Innovation with RedEmprendia.

From that year on at Unicamp's TIC, the standard operating procedures started to be modified and were renewed, demonstrating a proactive, ordinary, routine, materialized, and best practices operational flow. The stimulus to speed up the bureaucratic procedures for signing partnership contracts, the creation of Inova Descobre (a product of the Unicamp Challenge), the

adoption of the business model canvas (BMC), and the improvements derived from the partnership with the University of Cambridge have favored TTC's maturity and renewal.

The TTC maturity stage remained the same in 2013 at Unicamp because of the Rector's Office and the TIC board. The change in leadership did not suppress capability, but it did slow down the pace of development, as was the case with the SISE system, where implementation and improvement were paralyzed.

On the other hand, "Inova developed [the tool] Unicamp Competencies" (UNDP00), adopted social media (LinkedIn and Facebook) as new alternatives to disseminate inventions, and hired a consulting firm to improve technology supply profiles. These have all resulted in a new learned and reconfigured communication capability. Thus, according to Helfat and Peteraf (2003), recombination was evidenced.

Some problems from previous years persisted at the USP's TIC and were added to the growing actions of retroactive regularizations in 2013, i.e., despite the efforts "the volume of retroactive regularizations was still large" (SPAT03). As a result, the Attorneys' Office at USP was forced to intervene with a working group to investigate the reasons why the professors did not execute the agreements in advance. Although it remains at the same stage, this center's TTC has been replicated for Latin American organizations.

In 2014, the USP Agency's capability was suppressed, mostly because of two headquarters changes due to another interference coming from the new Rector, moving from Avenida Brasil to the former location at the Rectory and, finally, going to an environment shared with a company. Upon returning to the Rectory building, for example, "the building was invaded on moving day!" (SPTT00). Students invaded and blocked the access to the USP's TIC files and equipment for two months in a row.

The regression was not greater due to the resuming of the Inteum software implementation, the creation of the Communication Sector, the Internationalization Project with new multilingual flyers of technology supply, the national and international benchmarking visits carried out, the adoption of the e-Convênios system, and the drafting and approval of Resolution No. 7,035/2014. In the resolution's case, its impacts did not occur until 2015.

Also in 2014, the Unicamp's TIC led the creation of the Inova São Paulo Network. Furthermore, improved standardized procedures have positively strengthened this TIC's TTC to allow its improvement. The Inova best practices reached the highest consistency level in 2015, reaching characteristics of an operational, ordinary, routine, materialized flow, but tending toward reactivity and mainstream.

The improved technology supply targeting by adopting Questel Orbit (an information system to identify companies working in certain intellectual property areas), the creation of two new projects, and the constitution of a new committee have allowed for a leap in the center's transfer capability maturity. The TTC started to be disseminated in various ways, such as at events of the National Forum of Innovation and Technology Transfer Managers (Fortec) and at state innovation networks.

The maturity of the TTC in Unicamp's TIC, despite demonstrating capability solidity, has restricted its own dynamism. Perhaps mild regressions would be beneficial by favoring more radical transformations in how the transfer is done. On the other hand, at the USP's TIC, 2015 showed the persistence of the dependence on fellows at this center.

Despite this limiting factor, the advances in implementing and adopting new information systems such as Inteum, Conexão USP, and Plataforma iTEC, and the improvements in the e-Convênios system, have enabled a leap in the TTC's stage. Furthermore, the agency's informative was divided and improved, becoming two journals: the *Inovação Informa* and the *Boletim de Propriedade Intelectual*.

Positive measures, such as delegating new competencies to the coordinator and elaborating the USP's Pre-Acceleration Program (Pixel), at the end of 2015, added to other advances, allowed the renewal and abrupt elevation of the TTC at the USP's TIC, making it reach maturity tending to senility. Contrarily to the Unicamp's TIC, the achievement of the capacity maturity stage by USP Agency was not considered satisfactory and stable by the collaborators, who showed intensified interest in continuing to improve the technology transfer method, including, if necessary, radically, reinforcing the relevance of leadership intentionality for capacity development, which is in line with Helfat et al. (2009), Bejinaru (2017) and Heaton et al. (2019).

Although the evidence found between 2003 and 2015 was sufficient to support this study's analysis and contributions, even answering the initial questioning of how technology transfer capability would behave over time in Brazilian public HEIs, in the following five years (2016-2020), new documents were added for analysis in a complementary and non-exhaustive way to update the initial findings.

Figure 1 shows that Inova reached the beginning of the senile stage in 2012, and further advanced in maturity in 2015. Meanwhile, this advance came later at the USP's

TIC and reached the first level of senility only in 2015. In 2016, the USP's TIC still maintained its heavy reliance on fellows and managerial and communication limitations.

On the other hand, the Inter-USP community, the consolidation of the Conexão USP service, the increase in entrepreneurship grants and international relations with the Latin American and European Cooperation on Innovation and Entrepreneurship (LISTO), the European and Latin American Business Services and Innovation (ELAN), and the Eli Lilly and Company (LILLY), the latter in favor of open innovation and new drug discovery, allowed the TTC improvement and even elevated it to the second level of the senile stage. Six technology transfer contracts were signed in 2016, one more than in 2015, and twice as many events were held.

In terms of stage, in 2015 the Unicamp's TIC had already reached the maximum TTC level and in 2016 it maintained actions to keep it stable and consolidated. In this year, the annual report began having a more attractive layout for the public, demonstrating the vocation to disseminate (replicate) its best practices. It is possible to list the increase in the number of licensing contracts signed, which went from 15 in 2015 to 23 in 2016, in addition to the substantial increase in agreements and partnership agreements with companies (a total of 30). Furthermore, in 2016, the book *Unicamp, 50 years: innovation & technological entrepreneurship (Unicamp, 50 anos: inovação & empreendedorismo tecnológico)* was published, highlighting the trajectory of the aforementioned TIC. The consolidation of the Unicamp technological innovation challenge and the increase in the Inova Jovem were also evidenced.

In the following years, between 2017 and 2019, there were no changes in the development of TTC at the Unicamp's TIC, which consistently came to have replication characteristics due to the higher consolidation level of the mainstream type of this capability. For example, between 2016 and 2019 there were practically no differences in the annual amounts of licensing contracts signed, nor significant changes in the maintenance of programs, communications, reports, projects, events, and management systems, all of which maintained very high levels by Brazilian standards.

In 2017, the USP's TIC had a 50% drop in technology licensing and supply contracts compared to 2016. However, TTC was kept at the highest stage level due to the consolidation of educational incentive programs, such as: NEXO, Innovation Workshop, Espyral, Entrepreneur Workshop, Pixel Program, and SBRT. Moreover, TTC was improved with the change of the newsletters, which are now called *Acontece na USP* and *Acontece no Mundo*, one starting in September and the other in December of the same year.

Another novelty that supported the TTC was the launching of the first edition of the *Trajetória pela Inovação* event, an event that rewards teachers who have excelled in producing scientific, technological, or cultural innovations. Since these changes occurred in the second half of the year, the effects were not realized until 2018 and 2019, the years in which the TTC began having replication characteristics and remained in the second and final level of the senile stage.

For example, in 2019, the USP's TIC held the second edition of *Trajetória pela Inovação* and created the space in its website called *Inovações em Números*, which now presents a synthesis of the institution's technological production in the areas of intellectual property, technology transfer, entrepreneurship, and events and communications.

Finally, in 2020 both TICs suffered from the COVID-19 pandemic effects. The USP's TIC showed less ability to absorb the impacts of these adversities, since, as verified, the event *Trajetória pela Inovação* had no edition in the referred year, nor did the data on its virtual portal have improvements or updates. Thus, we identified a TTC suppression, taking it to the same senile level as in 2015. On the other hand, Inova surprised and managed to more than double the number of signed technology transfer contracts, reaching 48 in that year, achieving TTC renewal characteristics, even at the highest level of senility. After having presented the comparative findings at both USP and Unicamp, the following section presents this study's conclusions.

CONCLUSIONS

During data analysis, the capability lifecycle proposed by Helfat and Peteraf (2003) did not prove to be consistent with the observed reality. When confronted with the empirical data, we noticed inconsistencies in the current literature, which we adjusted to allow a better evidence of the temporal flow of dynamic capabilities.

For example, in their seminal study, Helfat and Peteraf (2003) presented a model in which, while the horizontal axis represented the cumulative amount of activity to which the capability would be directed, the vertical axis informed the capability level per activity unit. Even though this heuristic was useful to guide this study on TTC, it proved to be insufficient and confusing in its empirical operationalization.

In other words, the expressions 'cumulative activity quantities' and 'capability levels per activity unit' were not consistent, proving to be vague and imprecise, which

required adjustments to better express the results found. In fact, the authors themselves acknowledge that "for the founding and development stages the nature of the lifecycle makes it difficult to specify the point of transition from one stage to the next with precision" (Helfat & Peteraf, 2003, p. 1003). Furthermore, they pointed out they lacked results and "empirical evidence on the exact form of the lifecycle of a capability" with regard to a curve or graph (Helfat & Peteraf, 2003, p. 1004), something that this study sought to improve in terms of greater precision and graphical explanation based on an empirical investigation.

Considering the long-term survival of organizations (O'Reilly III & Tushman, 2008), the recommendations of Laaksonen and Peltoniemi (2018) and the temporal flow heuristics developed in this investigation, we were able to score year by year, from 2003 to 2020, the creation and other types of TTC transformations by varying the trajectory line between four of the five possible stages, namely: founding, implementation, juvenility, maturity, and senility. Mutation types that are evidenced include: creation, replication, recombination, improvement, renewal, and regression or suppression.

Although TTC retirement was not graphically evidenced, if it were, and in line with Teece (2007) and Ambrosini and Bowman (2009), it could be reactivated or come out of dormancy. It almost occurred in 2014 at USP. Political decisions, invasions, and so on can abruptly paralyze the use or life of dynamic capabilities. However, it does not mean its death, as addressed, for example, by Eisenhardt and Martin (2000) and Helfat and Peteraf (2003). Thus, this study contributes to filling a gap by defining that, unlike biological existence, a capability can revive as long as leading managers understand this as timely and feasible and considering the environment and the conjuncture in its time and space.

In this context, based on the temporal flow considered in the research, we understand there is a possibility of senility as a stage and of abrupt and stationary retirement at a point between maturity and senility, not exactly requiring a suppression. Moreover, the capability reimplantation or exit from dormancy can also occur at any stage and after retirement. This finding refines Helfat and Peteraf's (2003)proposal.

Furthermore, it became evident that the behavior of a capability, during its existence in the organization-environment-context, may not follow a linear curve, filling gaps left by Ahmad-Zaidi and Othman (2011) and Buzzao and Rizzi (2021), but may vary over time and across the five stages. As an example, a capability can be founded or created, it can be implemented and then jump to maturity. It can then be retired and, some time later, be reimplanted at that same maturity stage. It could rise to senility and then be abruptly suppressed to the implantation level and so on. All this would depend on the reality that is being researched.

We understand that this study's findings make an original contribution to the literature that supports the themes explored, insofar as they are an authentic and unprecedented theoretical contribution for proposing the explanation of the development of a specific dynamic capability, which would be that of technology transfer, and thus adding to the theoretical body of research that deals with dynamic capabilities (Almeida-Guerra, Tondolo, & Camargo, 2016; Collis & Anand, 2021; Heaton et al., 2019; Silva & Machado, 2017; Wang & Ahmed, 2007). Moreover, it allows the agglutination of two knowledge branches for being compatible (Heaton et al., 2019; Leih & Teece, 2016; O'Reilly et al., 2019; Yuan et al., 2018). As a consequence, the results may allow advances in the understanding of the technology transfer process, which now has the potential to explain the evolution of the temporal development, and in dynamic capabilities' stages.

In summary, the evidence revealed the absence of TTC evolutionary linearity, the plausibility of retirement as a dormancy stage, not as 'death,' and that capability does not necessarily need to undergo previous degradation, suppression, and move toward the lower stages, down to level zero (foundation), as addressed by Helfat and Peteraf (2003).

Furthermore, we found the operational and systematic usability of the suggested graphical format (Figure 1) containing stages, transformation types (represented by symbols), and adjustable time range regarding focus, improving Helfat and Peteraf's (2003) rough heuristic representations focused on capability level per unit of activity and cumulative amount of activity.

On the other hand, one of the study's limitations concerns the time scope chosen. The annual approach used in this study, while useful and functional, probably missed many microevolutions and TTC transformations. If an 'increased' temporal 'lens' were adopted, in months, for example, perhaps the descriptions would be more detailed, clear, and precise. In other words, they could be exclusively focused on the 2014 and 2015 USP years to better elucidate, month by month, the facts and events of TTC development.

The opposite could also occur and the temporal flow could make explicit only the main type of change that occurred in a given quadrennium. In this case, we lose in practical explanation and gain in explanatory and theoretical time scaling, for example, to study a particular dynamic capability of a century-old company.

Another limitation referred to the fact that the USP and Unicamp cases did not allow evidencing the TTC retirement or reimplantation. Regardless, we could infer, at USP, the temporary TTC freezing by a few weeks, a 'retirement' not visible in the timeframe chosen because there was a prompt reimplantation mitigating its effects. Thus, we preferred to avoid including this evidence in the temporal flow heuristic divided into years. Therefore, the year-to-year analysis did not adequately capture these events. In addition, there is a need for further clarification regarding the timing or reasons that would cause a capability to move from the maturity to the senility stage. Consequently, knowing how the capability would properly behave in this senile stage could emerge in future research.

Other possibilities for future studies are related to indirect technology transfer, i.e., the portfolio of inventions held by a given organization could awaken the interest in another organization to establish an R&D partnership in related areas and, consequently, favor the transfer of pre-existing technological information and know-how from one organization to another — however, without directly licensing or surrendering the creations listed in the intellectual property portfolio. Moreover, further research could better square the TTC's dynamic role in contracts between university and emerging (incubated) companies, such as spin-offs and startups, before and after they graduate, and how such an innovation ecosystem (Heaton et al., 2019) influences and is influenced by TTC dynamism.

Further efforts could also be undertaken, based on Teece (2007), Leih and Teece (2016) and Garrido, Kretschmer, Vasconcellos and Gonçalo (2020), to understand the process of technology transfer capability development based on the capabilities of opportunity and threat detection, opportunity exploitation, and asset recombination (respectively, sensing, seizing, and reconfiguration).

Furthermore, aligned with the propositions of Yuan et al. (2018), research could be conducted aimed at including elements intrinsic to the technical and institutional environments in the technology transfer process and, finally, according to Silva and Rossi (2018) and Della-Corte et al. (2021), further research from the relational capabilities perspective could better explain the cooperative processes between university and company. Therefore, it would allow the highlighting of advantages and benefits for both sides involved in technology transfer relationships.

REFERENCES

Adner, R., & Helfat, C. E. (2003). Corporate effects and dynamics managerial capabilities. *Strategic Management Journal*, *24*(10), 1011-1025. https://doi.org/10.1002/smj.331

Ahmad-Zaidi, M. F., & Othman, S. N. (2011). Exploring the concept of technology management through dynamic capability perspective. *International Journal of Business and Social Science*, *2*(5), 41-54. Retrieved from http://ijbssnet.com/journal/index/226

Ahn, M. J., Zwikael, O., & Bednarek, R. (2010). Technological invention to product innovation: A project management approach. *International Journal of Project Management*, *28*(6), 559-568. https://doi.org/10.1016/j.ijproman.2009.11.001

Almeida-Guerra, R. M., Tondolo, V. A. G., & Camargo, M. E. (2016). O que (ainda) podemos aprender sobre capacidades dinâmicas. *Revista Ibero Americana de Estratégia, 15*(1), 44-64. https://doi.org/10.5585/riae.v15i1.2168

Ambrosini, V., & Bowman, C. (2009). What are dynamics capabilities and are they a useful construct in strategic management? *International Journal of Management Reviews*, *11*(1), 29-49. https://doi.org/10.1111/j.1468-2370.2008.00251.x

Ambrosini, V., Bowman, C., & Collier, N. (2009). Dynamic capabilities: An exploration of how firms renew their resource base. *British Journal of Management*, *20*(S1), S9-S24. https://doi.org/10.1111/j.1467-8551.2008.00610.x

Aragón-Correa, J., & Sharma, S. (2003). A contingent resource-based view of proactive corporate environmental strategy. *Academy of Management Review*, *28*(1), 71-88. https://doi.org/10.5465/amr.2003.8925233

Araújo, E. F., Barbosa, C. M., Queiroga, E. D. S., & Alves, F. F. (2010). Propriedade intelectual: Proteção e gestão estratégica do conhecimento. *Revista Brasileira de Zootecnia*, *39*(suppl spe), 1-10. https://doi.org/10.1590/S1516-35982010001300001

Arend, R. J. (2015). Mobius' edge: Infinite regress in the resource-based and dynamic capabilities views. *Strategic Organization*, *13*(1), 75-85. https://doi.org/10.1177/1476127014563051

Baglieri, D., Baldi, F., & Tucci, C. L. (2018). University technology transfer office business models: One size does not fit all. *Technovation*, *76-77*, 51-63. https://doi.org/10.1016/j.technovation.2018.05.003

Barreto, I. (2010). Dynamic capabilities: A review of past research and an agenda for the future. *Journal of Management*, *36*(1), 256-280. https://doi.org/10.1177/0149206309350776

Bartlett, C. A., & Ghoshal, S. (2000). Going global: Lessons from late movers. *Harvard Business Review*, *78*(2), 132-142. Retrieved from https://hbr.org/2000/03/going-global-lessons-from-late-movers

Basso Júnior, A. F., Persch, L. L., Kiekow, A., Seben, P. S., Gubert, F., & Tondolo, V. A. G. (2016). Triangulação: Uma ferramenta de validade e confiabilidade. *SINERGIA-Revista do Instituto de Ciências Econômicas, Administrativas e Contábeis*, *20*(1), 19-28. Retrieved from https://periodicos.furg.br/sinergia/article/view/5441

Bejinaru, R. (2017). Dynamic capabilities of universities in the knowledge economy. *Management Dynamics in the Knowledge Economy*, *5*(4), 577-595. Retrieved from https://www.managementdynamics.ro/index.php/journal/article/view/250

Bengtsson, L. (2017). A comparison of university technology transfer offices' commercialization strategies in the Scandinavian countries. *Science and Public Policy*, *44*(4), 565-577. https://doi.org/10.1093/scipol/scw086

Bercovitz, J., & Feldmann, M. (2006). Entrepreneurial universities and technology transfer: A conceptual framework for understanding knowledge-based economic development. *The Journal of Technology Transfer*, *31*(1), 175-188. https://doi.org/10.1007/s10961-005-5029-z

Berbegal-Mirabent, J., Gil-Doménech, D., & Torre, E. M. (2020). Examining strategies behind universities' technology transfer portfolio: How different patterns of resource consumption can lead to similar technology transfer profiles. *Competitiveness Review: An International Business Journal, 31*(3), 571-593. https://doi.org/10.1108/CR-01-2020-0013

Berger, P. L., & Luckmann, T. (2004). *A construção social da realidade: Tratado de sociologia do conhecimento* (24 ed.). Petrópolis, RJ: Vozes.

Blyler, M., & Coff, R. W. (2003). Dynamic capabilities, social, capital, and rent appropriation: Ties that split pies. *Strategic Management Journal*, *24*(7), 677-686. https://doi.org/10.1002/smj.327

Boehm, D. N., & Hogan, T. (2014). 'A jack of all trades': The role of PIs in the establishment and management of collaborative networks in scientific knowledge commercialisation. *The Journal of Technology Transfer*, *39*(1), 134-149. https://doi.org/10.1007/s10961-012-9273-8

Burawoy, M., Burton, A., Ferguson, A. A., & Fox, K. J. (1991). *Ethnography unbound: Power and resistance in the modern metropolis*. Los Angeles, CA: University of California Press.

Burawoy, M. (2009). *The extended case method: Four countries, four decades, four great transformations, and one theoretical tradition*. Los Angeles, California: University of California Press.

Burrell, G., & Morgan, G. (2006). *Sociological paradigms and organizational analysis.* Aldershot, UK: Gower.

Buzzao, G., & Rizzi, F. (2021). On the conceptualization and measurement of dynamic capabilities for sustainability: Building theory through a systematic literature review. *Business Strategy and the Environment*, *30*(1), 135-175. https://doi.org/10.1002/bse.2614

Cadori, A. A. (2013). *A gestão do conhecimento aplicada ao processo de transferência de resultados de pesquisa de instituições federais de ciência e tecnologia para o setor produtivo: Processo mediado pelo Núcleo de Inovação Tecnológica* (Doctoral dissertation). Universidade Federal de Santa Catarina, Programa de Pós-Graduação em Engenharia e Gestão do Conhecimento, Florianópolis, SC, Brasil. Retrieved from https://repositorio.ufsc.br/handle/123456789/107018

Carvalho, I. V., & Cunha, N. C. V. (2013). Proposta de um modelo de transferência de tecnologia para as universidades públicas brasileiras. *Anais do Congresso Latino-Iberoamericano de Gestão de Tecnologia (ALTEC)*, Porto, Portugal, 15.

Chais, C., Ganzer, P. P., & Olea, P. M. (2018). Technology transfer between universities and companies: Two cases of Brazilian universities. *Innovation & Management Review*, *15*(1), 20-40. https://doi.org/10.1108/INMR-02-2018-002

Chesbrough, H. W. (2006). Open innovation: A new paradigm for understanding industrial innovation. In H. W. Chesbrough, W. Vanhaverbeke & J. West (Orgs.). *Open innovation: Researching a new paradigm* (1-27). New York: Oxford University Press.

Collis, D. J. (1994). Research note: How valuable are organizational capabilities? *Strategic Management Journal*, *15*(S1), 143-152. https://doi.org/10.1002/smj.4250150910

Collis, D. J., & Anand, B. N. (2021). The virtues and limitations of dynamic capabilities. *Strategic Management Review, 2*(1), 47-78. http://dx.doi.org/10.1561/111.00000017

Connor, T. (2007). A consideration of strategic assets and the organizational sources of competitiveness. *Strategic Change*, *16*(3), 127-136. https://doi.org/10.1002/jsc.789

Cozzi, A., Judice, V., & Dolabela, F. (2007). *Empreendedorismo de base tecnológica*. *Spin-off: Criação de novos negócios a partir de empresas constituídas, universidades e centros de pesquisa*. Rio de Janeiro: Elsevier.

Della-Corte, V., Aria, M., Del Gaudio, G., Barney, J. B., Cobanoglu, C., & Sepe, F. (2021). The relevance of relational capabilities in collaborative decisions. *International Journal of Contemporary Hospitality Management*, *33*(12), 4391-4417. https://doi.org/10.1108/IJCHM-01-2021-0037

Dias, A. A., & Porto, G. S. (2013). Gestão de transferência de tecnologia na Inova Unicamp. *Revista de Administração Contemporânea*, *17*(3), 263-284. https://doi.org/10.1590/S1415-65552013000300002

Dias, A. A., & Porto, G. S. (2014). Como a USP transfere tecnologia? *Organizações & Sociedade*, *21*(70), 489-507. https://doi.org/10.1590/S1984-92302014000300008

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, *21*(10-11), 1105-1121. https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E

Fernandes, C. R., & Machado, A. G. C. (2019). Technology transfer capability: Development dynamics in higher education institutions. *Brazilian Business Review*, *16*(1), 1-15. https://doi.org/10.15728/bbr.2019.16.1.1

Ferreira, J., Coelho, A., & Moutinho, L. (2020). Dynamic capabilities, creativity and innovation capability and their impact on competitive advantage and firm performance: The moderating role of entrepreneurial orientation. *Technovation*, *92-93*, 102061. https://doi.org/10.1016/j.technovation.2018.11.004

Garcia, M., & Gava, R. (2012). Gestão da propriedade intelectual como suporte à inovação tecnológica: O caso do núcleo de inovação tecnológica da universidade federal de Viçosa. *Revista de Design, Inovação e Gestão Estratégica*, *3*(3), 1-24.

Garrido, I. L., Kretschmer, C., Vasconcellos, S. L., & Gonçalo, C. R. (2020). Capacidades dinâmicas: Uma proposta de medição e sua relação com o desempenho. *Brazilian Business Review*, *17*(1), 46-65. https://doi.org/10.15728/bbr.2020.17.1.3

Gebauer, H. (2011). Exploring the contribution of management innovation to the evolution of dynamic capabilities. *Industrial Marketing Management*, *40*(8), 1238-1250. https://doi.org/10.1016/j.indmarman.2011.10.003

Godfrey, P. C., & Hill, C. W. (1995). The problem of unobservables in strategic management research. *Strategic Management Journal*, *16*(7), 519-533. https://doi.org/10.1002/smj.4250160703

Grant, R. M., & Verona, G. (2015). What's holding back empirical research into organizational capabilities? Remedies for common problems. *Strategic Organization*, *13*(1), 61-74. https://doi.org/10.1177/1476127014565988

Griffith, D. A., & Harvey, M. G. (2001). A resource perspective of global dynamics capabilities. *Journal of International Business Studies*, *32*(3), 597-606. https://doi.org/10.1057/palgrave.jibs.8490987

Harreld, J. B., O'Reilly III, C. A., & Tushman, M. L. (2007). Dynamic capabilities at IBM: Driving strategy into action. *California Management Review*, *49*(4), 21-43. https://doi.org/10.2307/41166404

Heaton, S., Siegel, D. S., & Teece, D. J. (2019) Universities and innovation ecosystems: A dynamic capabilities perspective. *Industrial and Corporate Change*, *28*(4), 921-939. https://doi.org/10.1093/icc/dtz038

Helfat, C. E. (1997). Know-how and asset complementarity and dynamics capability accumulation: The case of R&D. *Strategic Management Journal*, *18*(5), 339-360. https://doi.org/10.1002/(SICI)1097-0266(199705)18:5<339::AID-SMJ883>3.0.CO;2-7

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, S. G. (2009). *Dynamic capabilities: Understanding strategic change in organizations*. Hoboken, NJ: John Wiley & Sons.

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal*, *24*(10), 997-1010. https://doi.org/10.1002/smj.332

Helfat, C. E., & Peteraf, M. A. (2009). Understanding dynamics capabilities: Progress along a developmental path. *Strategic Organization*, *7*(1), 91-102. https://doi.org/10.1177/1476127008100133

Holzmayer, F., & Schmidt, S. L. (2020). Dynamic managerial capabilities, firm resources, and related business diversification: Evidence from the English Premier League. *Journal of Business Research*, *117*, 132-143. https://doi.org/10.1016/j.jbusres.2020.05.044

Jagoda, K., Maheshwari, B., & Lonseth, R. (2010). Key issues in managing technology transfer projects: Experiences from Canadian SME. *Management Decision*, *48*(3), 366-382. https://doi.org/10.1108/00251741011037747

Kanter, R. M. (1989). Swimming in newstreams: Mastering innovation dilemmas. *California Management Review*, *31*(4), 45-69. Retrieved from https://www.hbs.edu/faculty/Pages/item.aspx?num=10092

Laaksonen, O., & Peltoniemi, M. (2018). The essence of dynamic capabilities and their measurement. *International Journal of Management Reviews*, *20*(2), 184-205. https://doi.org/10.1111/ijmr.12122

Lavie, D. (2006). Capability reconfiguration: An analysis of incumbent responses to technological change. *Academy of Management Review*, *31*(1), 153-174. https://doi.org/10.5465/amr.2006.19379629

Lawson, B., & Samson, D. (2001). Developing innovation capability in organisations: A dynamic capabilities approach. *International Journal of Innovation Management*, *5*(03), 377-400. https://doi.org/10.1142/S1363919601000427

Lee, J., Lee, K., & Rho, S. (2002). An evolutionary perspective on strategic group emergence: A genetic algorithm-based model. *Strategic Management Journal*, *23*(8), 727-746. https://doi.org/10.1002/smj.250

Lei n. 10.973, de 02 de dezembro de 2004. (2004). Dispõe sobre incentivos à inovação e à pesquisa científica e tecnológica no ambiente produtivo e dá outras providências. Diário Oficial da União. Brasília, DF: Presidência da República.

Lei n. 12.527, de 18 de novembro de 2011. (2011). Regula o acesso a informações previsto no inciso XXXIII do art. 5º, no inciso II do § 3º do art. 37 e no § 2º do art. 216 da Constituição Federal; altera a Lei nº 8.112, de 11 de dezembro de 1990; revoga a Lei nº 11.111, de 5 de maio de 2005, e dispositivos da Lei nº 8.159, de 8 de janeiro de 1991; e dá outras providências. Brasília, DF: Presidência da República.

Lei n. 13.243, de 11 de janeiro de 2016. (2016). Dispõe sobre estímulos ao desenvolvimento científico, à pesquisa, à capacitação científica e tecnológica e à inovação e altera a Lei nº 10.973, de 2 de dezembro de 2004, a Lei nº 6.815, de 19 de agosto de 1980, a Lei nº 8.666, de 21 de junho de 1993, a Lei nº 12.462, de 4 de agosto de 2011, a Lei nº 8.745, de 9 de dezembro de 1993, a Lei nº 8.958, de 20 de dezembro de 1994, a Lei nº 8.010, de 29 de março de 1990, a Lei nº 8.032, de 12 de abril de 1990, e a Lei nº 12.772, de 28 de dezembro de 2012, nos termos da Emenda Constitucional nº 85, de 26 de fevereiro de 2015. Diário Oficial da União. Brasília, DF: Presidência da República.

Lei Complementar n. 131, de 27 de maio de 2009. (2009). Acrescenta dispositivos à Lei Complementar n. 101, de 4 de maio de 2000, que estabelece normas de finanças públicas voltadas para a responsabilidade na gestão fiscal e dá outras

providências, a fim de determinar a disponibilização, em tempo real, de informações pormenorizadas sobre a execução orçamentária e financeira da União, dos Estados, do Distrito Federal e dos Municípios. Diário Oficial da União. Brasília, DF: Presidência da República.

Leih, S., & Teece, D. (2016). Campus leadership and the entrepreneurial university: A dynamic capabilities perspective. *Academy of Management Perspectives*, *30*(2), 182-210. https://doi.org/10.5465/amp.2015.0022

Lotufo, R. D. A. (2009). A institucionalização de núcleos de inovação tecnológica e a experiência da Inova Unicamp. In M. E. R. Santos, P. T. M. Toledo & R. A. Lotufo (Orgs.). *Transferência de tecnologia: Estratégias para a estruturação e gestão de Núcleos de Inovação Tecnológica* (Chap. 2, pp. 41-74). Campinas, SP: Komedi.

Makadok, R. (2001). Toward a synthesis of the resource-based and dynamics-capability views of rent creation. *Strategic Management Journal*, *22*(5), 387-401. https://doi.org/10.1002/smj.158

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. San Francisco, CA: Jossey-Bass.

Ministério da Ciência, Tecnologia & Inovação. (2015). *Política de propriedade intelectual das instituições científicas e tecnológicas do Brasil:* Relatório FORMICT 2014. Brasília: Ministério da Ciência, Tecnologia e Inovação.

Moliterno, T. P., & Wiersema, M. F. (2007). Firm performance, rent appropriation, and the strategic resource divestment capability. *Strategic Management Journal*, *28*(11), 1065-1087. https://doi.org/10.1002/smj.630

Necoechea-Mondragón, H., Pineda-Domínguez, D., & Soto-Flores, R. (2013). A conceptual model of technology transfer for public universities in Mexico. *Journal of Technology Management & Innovation*, *8*(4), 24-35. http://dx.doi.org/10.4067/S0718-27242013000500003

O'Reilly, N. M., Robbins, P., & Scanlan, J. (2019). Dynamic capabilities and the entrepreneurial university: A perspective on the knowledge transfer capabilities of universities. *Journal of Small Business & Entrepreneurship*, *31*(3), 243-263. https://doi.org/10.1080/08276331.2018.1490510

O'Reilly III, C. A., & Tushman, M. L. (2008). Ambidexterity as a dynamic capability: Resolving the innovator's dilemma. *Research in Organizational Behavior, 28*, 185-206. https://doi.org/10.1016/j.riob.2008.06.002

Pablo, A., Reay, T., Dewald, J. R., & Casebeer, A. L. (2007). Identifying, enabling and managing dynamic capabilities in the public sector. *Journal of Management Studies*, *44*(5), 687-708. https://doi.org/10.1111/j.1467-6486.2006.00675.x

Pimentel, L. O. (2005). *Propriedade intelectual e universidade: Aspectos legais*. Florianópolis: Fundação Boiteux.

Pimentel, L. O. (2006). Propriedade intelectual e desenvolvimento. In P. L. Carvalho (Org.). *Propriedade intelectual* (pp. 41-59). Curitiba: Juruá Editora.

Pimentel, L. O. (2010). *Manual básico de acordos de parceria de PD&I: Aspectos jurídicos*. Porto Alegre: EDIPUCRS.

Pitsakis, K., & Giachetti, C. (2020). Information-based imitation of university commercialization strategies: The role of technology transfer office autonomy, age, and membership into an association. *Strategic Organization*, *18*(4), 573-616. https://doi.org/10.1177/1476127019850098

Rindova, V., & Taylor, M. S. (2002). Dynamic capabilities as macro and micro-organizational evolution [Working paper]. *University of Maryland, Robert H. Smith School of Business*, College Park, Maryland.

Rogers, E. M., Takegami, S., & Yin, J. (2001). Lessons learned about technology transfer. *Technovation*, *21*(4), 253-261. https://doi.org/10.1016/S0166-4972(00)00039-0

Romme, A. G. L., Zollo, M., & Berends, P. (2010). Dynamic capabilities, deliberate learning and environmental dynamism: A simulation model. *Industrial and Corporate Change*, *19*(4), 1271-1299. https://doi.org/10.1093/icc/dtq031

Rosenbloom, R. S. (2000). Leadership, capabilities, and technological change: The transformation of NCR in the electronic era. *Strategic Management Journal*, *21*(10-11), 1083-1103. https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1083::AID-SMJ127>3.0.CO;2-4

Schaeffer, V., Öcalan-Özel, S., & Pénin, J. (2020). The complementarities between formal and informal channels of university–industry knowledge transfer: A longitudinal approach. *The Journal of Technology Transfer*, *45*(1), 31-55. https://doi.org/10.1007/s10961-018-9674-4

Silva, A. V., & Machado, G. B. (2017). Uma visita teórica à abordagem capacidades dinâmicas a partir da perspectiva dos autores seminais Teece, Pisano e Shuen (1997): Um ensaio teórico. *International Journal of Business Marketing*, *2*(1), 2447-7451. Retrieved from http://www.ijbmkt.org/index.php/ijbmkt/article/view/28

Silva, M., & Rossi, F. (2018). The effect of firms' relational capabilities on knowledge acquisition and co-creation with universities. *Technological Forecasting and Social Change*, *133*, 72-84. https://doi.org/10.1016/j.techfore.2018.03.004

Silva, V. A. B. D. (2018). A epistemologia de Michael Burawoy e seus desdobramentos metodológicos. *Revista Direito e Práxis*, *9*(3), 1503-1530. https://doi.org/10.1590/2179-8966/2017/28989

Szulanski, G. (2000). The process of knowledge transfer: A diachronic analysis of stickiness. *Organizational Behavior and Human Decision Processes*, *82*(1), 9-27. https://doi.org/10.1006/obhd.2000.2884

Takahashi, V. P., & Sacomano, J. B. (2002). Proposta de um modelo conceitual para análise do sucesso de projetos de transferência de tecnologia: Estudo em empresas farmacêuticas. *Gestão & Produção*, *9*(2), 181-200. https://doi.org/10.1590/S0104-530X2002000200006

Teece, D. J. (2007). Explicating dynamics capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*(13), 1319-1350. https://doi.org/10.1002/smj.640

Teece, D. J. (2012). Dynamic capabilities: Routines versus entrepreneurial action. *Journal of Management Studies*, *49*(8), 1395-1401. https://doi.org/10.1111/j.1467-6486.2012.01080.x

Teece, D., Peteraf, M., & Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. *California Management Review*, *58*(4), 13-35. https://doi.org/10.1525/cmr.2016.58.4.13

Teece, D., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509-533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Vieira, V. M. M., & Ohayon, P. (2006). Inovação em fármacos e medicamentos: Estado-da-arte no Brasil e políticas de P&D. *Revista Economia & Gestão*, *6*(13). Retrieved from http://periodicos.pucminas.br/index.php/economiaegestao/article/view/26

Wang, C. L., & Ahmed, P. K. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews*, *9*(1), 31-51. https://doi.org/10.1111/j.1468-2370.2007.00201.x

Winter, S. G. (2003). Understanding dynamics capabilities. *Strategic Management Journal*, *24*(10), 991-995. https://doi.org/10.1002/smj.318

Yuan, C., Li, Y., Vlas, C. O., & Peng, M. W. (2018). Dynamic capabilities, subnational environment, and university technology transfer. *Strategic Organization*, *16*(1), 35-60. https://doi.org/10.1177/1476127016667969

Zahra, S. A., Sapienza, H. J., & Davidsson, P. (2006). Entrepreneurship and dynamics capabilities: A review, model, and research agenda. *Journal of Management Studies*, *43*(4), 917-955. https://doi.org/10.1111/j.1467-6486.2006.00616.x

Zappellini, M. B., & Feuerschütte, S. G. (2015). O uso da triangulação na pesquisa científica brasileira em administração. *Administração: Ensino e Pesquisa, 16*(2), 241-273. https://doi.org/10.13058/raep.2015.v16n2.238

Zollo, M., & Winter, S. (2002). Deliberate learning and the evolution of dynamics capabilities. *Organization Science*, *13*(3), 339-351. https://doi.org/10.1287/orsc.13.3.339.2780

Zott, C. (2003). Dynamic capabilities and the emergence of intraindustry differential firm performance: Insights from a simulation study. *Strategic Management Journal*, *24*(2), 97-125. https://doi.org/10.1002/smj.288

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Data Availability

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