Lean Startup Practices: Operationalizing the Technological Business Planning Process in an Academic Environment

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Abstract: The generation of innovation in the academic environment involves the development of technology/product, technological transfer and business, which together make up the Technological Business Planning Process (TBPP). This process can be divided into three stages: world of technology (initial stage), world of transition from technology to product and business (intermediate stage), and world of business (final stage). In this context, there is the Lean Startup (LS) methodology, which comprises a set of potential practices to facilitate the operationalization of these stages of development. However, the existing literature is incipient and lacks guidance on the LS practices with the greatest potential to contribute to each of these stages, which constitutes a theoretical gap. Thus, this research aims to identify the LS practices most used by researchers-entrepreneurs in the different stages of the Technological Business Planning Process. The methodological approach used was the case study in an important Brazilian public university. In this context, nine innovation projects in the process of generating technological business were analyzed. The results show four main contributions: i) the practices contributed mainly to the intermediate phase of the TBPP; ii) BMC and MVP were considered the most important practices to operationalize TBPP; iii) the LS practices contributed significantly to the knowledge management between team projects; and iv) the combined implementation of the practices highlighted the benefits for TBPP. This study contributes to technology innovation management in the academic environment and provides some gaps that can be developed in future works in technological projects context.

Keywords: lean startup practices, technological business planning process, technology innovation management, technology transfer, academic spinoffs

1. Introduction

Technological projects developed in the academic environment play an important role in generating wealth and social development (Boguszewicz-Kreft *et al*., 2021; Aguiar *et al*., 2019; Still and Satell, 2017; Vohora, Wright and Lockett, 2004). These projects are expected to result in innovations, technologies and products that can be commercialized via technology transfer to established companies or startups (Diánez-González, Camelo-Ordaz and Fernández-Alles, 2021; Boh *et al*., 2016; Reis *et al*., 2014).

The realization of these innovations in the academic environment is conditioned on three subprocesses: i) technological product planning process (Cooper, 2008; Ajamian and Koen, 2002), ii) business planning process (Vohora, Wright, and Lockett, 2004) and iii) technology transfer process (Ravi and Janodia, 2022; Siegel *et al*., 2004). These three processes result in the Technological Business Planning Process (TBPP) (Majdouline, El Baz and Jebli, 2022; Reis, Fernandes, Armellini, 2021; Fernandes *et al*., 2017) that give rise to the New Technology-Based Ventures (Leitão, Pereira and Gonçalves, 2022). The TBPP is used as a guiding instrument for entrepreneurial actions, by systematizing the stages of innovation, from the world of technology to the world of business.

In this context, the Lean Startup (LS) methodology emerges with a set of practices that can contribute to the generation of technological businesses (Fernandes *et al*., 2017; Still and Satell, 2017), and consequently, to support technological innovation. However, the literature points out that TBPP deserves a clearer and more detailed definition (Fernandes *et al*., 2017). Another point highlighted in the literature is that the technology transfer process is fraught with several challenges (Fasi, 2022; Ravi and Janodia, 2022; Takata *et al*., 2022; Wulandari and Subriadi, 2022; Boguszewicz-Kreft *et al*., 2021; Taouaf *et al*., 2021). Different failures are observed in the initial business development plans due to the lack, for example, of a minimum viable product (MPV) (Wulandari and Subriadi, 2021). Thus, many of these challenges and difficulties come from the lack of knowledge, on the part of the technological development teams, about the Lean startup practices that are capable of contributing to each of the stages of the TBPP in the academic environment. Studies pointed that

future research should explore how LS practices contribute to the processes of technological and innovation projects, using the Lean Startup cycle of Build-Measure-Learn (Chesbrough and Tucci, 2020; Mansoori, Karlsson and Lundqvist, 2019), especially in academics spinoffs (Galli, 2019).

Assuming that LS practices can contribute to the operationalization of the TBPP, in its different stages, this research aims to identify the LS practices most used by researchers-entrepreneurs in the different stages of the Technological Business Planning Process. Based on the research, it is expected to elucidate the contributions of LS practices to TBPP and encourage entrepreneurial researchers to engage in strengthening technological innovations based on academic research.

In addition to this introductory section, the second section will present a literature review, with the LS approach and theoretical frameworks of Technological Business Planning Process. The third section will present the research method. The fourth section we present the case study, a table of frequency of using LS practices in different TBPP stages. The fifth section discusses the contributions of using LS practices. Finally, in the sixth section is presented the conclusion, limitations e future research.

2. Literature review

2.1 Technological Business Planning Process (TBPP)

TBPP (Fernandes *et al*., 2017) is the result of three subprocesses: i) technology planning process (TPP) (Cooper, 2008; Ajamian and Koen, 2002) which aims to help the integration of the technology-product-market triad, for crossing the Valley of Death (Takata *et al*., 2020; Fernandes *et al*., 2017), ii) technology transfer planning process (TTPP) that represents the phases and legal aspects of protecting the commercialization of technologies and academic research products (Ravi and Janodia, 2022; Siegel *et al*., 2004) and iii) business planning process (BPP) (Majdouline, El Baz and Jebli, 2022; Vohora, Wright, and Lockett, 2004) which includes the definition of the business model, logistical, financial, organizational and production strategies (Reis *et al*., 2014).

The three subprocesses start with the development of scientific research and technological development. In sequence, the first subprocess details the development of the technology on a laboratory, pre-commercial and, finally, commercial scale. The second comprises the phase of identifying patenting possibilities, the patenting phase itself, and market prospecting. At this point, the patent can be traded to an established company or a nascent company, when the transfer is formalized and the transfer performance is verified. The third presents the identification of business opportunities, opportunity structuring, prototype company, technology-based nascent company and new technology-based company.

From the literature (Fasi, 2022; Boguszewicz-Kreft *et al*., 2021; Taouaf *et al*., 2021; Takata *et al*., 2020; Fernandes *et al*., 2017) it was possible to structure Figure 1 to represent the intergration of the three subprocesses. The integration of the three processes is possible from three distinct stages: i) World of technology (*initial*): the researcher is immersed in the academic environment in order to identify theoretical problems with real practical needs; ii) world of transition from technology to product and business (*intermediate*): the three processes become distinct, and the first approximations with the market begin; iii) World of business (*final*): represents the insertion of the business in the market through a commercial product.

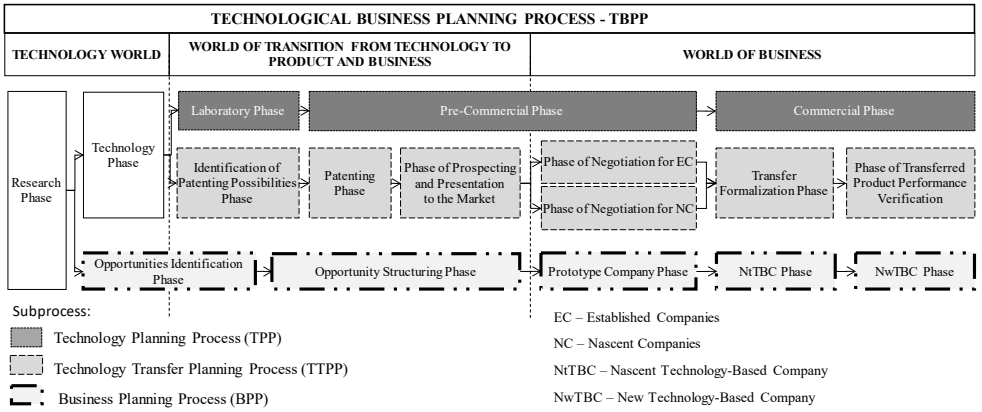

Figure 1: Technology Business Planning Process (TBPP)

To help operationalize the TBPP stages, there are practices based on lean thinking, with academic and professional value, representing a way of specifying value and minimizing applied efforts (Reis *et al*., 2021). The LS brings a set of practices capable of contributing to this operationalization (Fernandes *et al*., 2017; Still and Satell, 2017).

2.2 Lean Startup (LS) approach: Better practices to develop business modeling

Lean Startup (LS) is a movement dedicated to understanding and supporting innovative businesses that operate in high-risk environments (Hinz and Eisenbart, 2019). The LS practices make it possible to identify the target audience, foster the relationship with the customer, add value to the product or service, identify market trends, map the competitors, as well as other critical factors that can assist in the success of the business model, its flexibility and adaptability (Harms and Schwery, 2020).

Observing the reality experienced by startups, we need to develop ways to guide the process of developing products and business models in order to reduce the barriers of entry of these startups to the market, reduce risks and uncertainties, with less waste of resources (Araújo, Reis and Morais, 2021; Reis *et al*., 2021; Borseman *et al*., 2016). In the context of the TBPP, LS stands out as a relevant approach to improving the efficiency of skills at all stages: i) in the world of technology (initial stage), it helps for the ideation and research processes (Chesbrough and Tucci, 2020) and in the reduction of uncertainties (Hinz and Eisenbart, 2019); ii) in the world of transition from technology to product and business (intermediate stage), it contributes in the structuration of business model projects (de Faria, Santos and Zaidan, 2021; Chesbrough and Tucci, 2020; Hinz and Eisenbart, 2019; Mansoori, Karlsson and Lundqvist, 2019) and to facilitate the learning process among entrepreneurs (Mansoori, Karlsson and Lundqvist, 2019) and; iii) in the world of business (final stage), the LS practices contribute with some activities of the technology transfer processes, experimentation and adjustments to the market (Chesbrough and Tucci, 2020; Omelyanenko *et al*., 2018).

The LS practices contribute to a significant adjustment of technological ideas, minimizes research time, contributes to design and development, and facilitates contact with consumers, allowing the testing of technological ideas (Omelyanenko *et al.*, 2018). Furthermore, lean practices contribute mainly to the initial stages of radical innovations and pivoting as a mechanism to maintain a moderate level of risk associated with product and business development (Yoo, Huang and Arifoglu, 2016).

Table 1 explains the five LS practices that were identified in the literature review: i) Business Model Canvas, ii) Validation Board, iii) Minimum Viable Product, iv) Empathy Map and v) Value Proposition Canvas.

Table 1: LS practices concepts

PRACTICE	CONCEPT	AUTHOR
Business Model Canvas (BMC)	It is a visual map of the company, divided into nine elements that helps with visualization, conception, and experimentation of business models. It describes an objective and logic of how an organization creates, delivers, and captures value.	Hidayat, Hendrix and Hidayat (2018); Marin *et al* . (2017); Fulga *et al* . (2016); Marin *et al.* (2015); Osterwalder and Pigneur (2010)
Validation Board (VB)	It is a tool to test customer viability, of the problem, and the adequacy of solutions for each customer segment. It allows to test the assumptions of a business.	Peralta *et al.* (2020); Ries (2012)
Minimum Viable Product (MVP)	It seeks to create a prototype, with the lowest possible investment, for testing and ensuring that the business is able (or not) to enter the market, thereby clarifying points to be adjusted and strengthened, and eventually, a decision of whether to proceed.	Maludin *et al* . (2021); Zimmermann *et al.* (2021); Gbadegeshin (2018); Blank, Dorf (2012); Ries (2012)
Empathy Map (EM)	It provides to capture the insights of customers and try to find new solutions to old issues, or rediscover old solutions to new issues.	Staniec and Pilawa (2020); Osterwalder and Pigneur (2010)
Value Proposition Canvas (VPC)	It helps outline customer segments and the value proposition and contributes to structure the way that the product or service connect directly to customer desires.	Puurtinen and Pohjola (2021); Päivi and Helena, (2020); Tzavidas, Enevoldsen and Xydis (2020); Fechtelpeter, Kuehn and Dumitrescu (2018); Blank, Dorf (2012); Ries (2012); Cooper, Vlaskovits (2010); Osterwalder and Pigneur (2010)

Source: Based on literature review.

It is observed that these practices contribute to the development of technology, product and business, as they focus on structuring the value proposition and validating the client segment (De Faria, Santos and Zaidan, 2021; Hinz and Eisenbart, 2019). The LS practices encourage interaction between team members, allows the exchange of information, improves organizational knowledge, and allows them to manage resources effectively while generating value (Toro-Jarrin *et al*., 2016).

Specifically, for TBPP processes, the BMC is used in the exploration of knowledge-based opportunities, in the technical validation of knowledge-based opportunities, in the commercialization of Research and Development

results and in the visualization of business strategies (Hidayat, Hendrix and Hidayat, 2018; Marin *et al.,* 2017; Fulga *et al.,* 2016; Marin *et al.,* 2015). The VB is used to assist entrepreneurs in implementing the LS process, and to present a product to consumers and test its acceptance (Peralta *et al.*, 2020). The MVP allows examining the functionality of the technology and its main business and commercialization potentials, in view of the benefits for the customer and the user (Maludin *et al.*, 2021; Zimmermann *et al.,* 2021; Gbadegeshin, 2018). The EM allows to define the problem and specify the goals and benefits of solving the problem (Staniec and Pilawa, 2020). And the VPC allows to create a systematic and strategic vision of the project, translating and mapping intangible value propositions into desirable offers, to later be prototyped and shared with partners and users with the intention of modeling and co-creation (Puurtinen and Pohjola, 2021; Päivi and Helena, 2020; Tzavidas, Enevoldsen and Xydis, 2020; Fechtelpeter, Kuehn and Dumitrescu, 2018).

3. Methodology

The methodological approach used in this paper was a case study, as it allows an understanding of the real world, acquiring knowledge to draw conclusions (Yin, 2008). For the selection of the units of analysis, nine technology projects of the Innovation Incentive Program (IIP) were explored, developed at the Federal University of Ouro Preto (Universidade Federal de Ouro Preto, UFOP) (Brazil). These nine projects (Table 2) were selected by the university committee and by government institutions to participate in the IIP program and to promote innovation. The program in its 16th edition aims to foster innovation in the academic environment.

Table 2: Characterization of the studied projects

Projects	Knowledge	Application
Case 1	Pharmaceuticals	Male infertility in case of low count and / or motility of sperm.
Case 2	Mechanical and organic chemistry	Manufacture of organic electronic devices, conductive tracks, resistors, capacitors, and inductors plans, and then diodes, transistors and OLEDs.
Case 3	Mobile and cloud computing	Document management and cloud storage.
Case 4	Applied Mechanics	Detection of fractures in sleepers made of steel.
Case 5	Computer and Cytology	External quality monitoring for cytopathology of tipoII.
Case 6	Food and Chemical	Quality Monitoring and deterioration of real-time meat.
Case 7	Clean Energy	Economic and sustainable energy generation.
Case 8	Food and Chemical	Intelligent packaging with natural preservatives.
Case 9	Blockbuster Games - Technology and Innovation	Social inclusion of visually impaired people through assistive technology in the gaming market.

For data collection (Table 3), the case study involved some sources of evidence (Yin, 2008), such as questionnaires, semi-structured interviews, online meetings, consultation of documents, in addition to direct observation, which allowed follow the implementation of LS practices during a period of six months. This data collection allowed an intimate connection with the empirical reality, providing the validation of the theory. The implementation conducted by the project teams was carried out based on templates created in electronic spreadsheets containing the standard theoretical structure of LS practices. For that, 18 people were interviewed, two representatives of each project. The interviews were conducted based on 11 questions to find out which practices have the greatest potential to contribute to each stage.

Table 3: Research techniques used to data collection

Research Technique	People Involved	Application Detail	Time spent collecting data (for all projects)
Semi structured interview	Researchers-entrepreneurs, project fellows, program coordinator, program consultants	Semi-structured interview initially held for 30 minutes with each project leader.	270 minutos
		For the interview eleven questions was used and the average duration of the interview was 90 minutes	2.100 minutes
Document Analysis	SECTES representatives and program consultants	Analysis of documents prepared for the projects and technical Reporting Program Analysis (435 pages)	2.160 minutes
Meeting via video conference	Researchers-entrepreneurs, master's degree student, graduation student	36 meetings (each involving a researcher/master's degree student with a graduation student - an average duration of 90 minutes over 6 months)	19.440 minutes

For data analysis, the interviews were transcribed. The analysis of the information collected by the different sources of evidence used, allowed a triangulation of the data (Yin, 2008), allowing to identify the existence of patterns, similarities and divergences in each of the technological projects. From these collected data, a table was structured that presents the different LS practices used in each case, in the different phases of the TBPP subprocesses. Although the research deals with nine cases, there was no attempt to create generalizable models in the context of technological projects from public universities, but to understand, in depth, the challenges and limitations involved in the process of generating technological businesses

4. Data presentation

From the interviews with the researchers-entrepreneurs, it was possible to identify the practices that contributed in specific stages of the three subprocesses of the TBPP. In percentage terms, it was identified the frequency with which the teams of the 9 projects used the practices to operationalize each stage of the TBPP (Table 4).

Table 4: Relation between process and LS practices

		Technological Business Planning Process (TBPP)										
		Technology world (INITIAL)			World of transition (INTERMEDIATE)				World of business (FINAL)			
Technological Planning Process (TPP)	LS Practices	Research phase	Technology phase	Freq.	Laboratory phase	Pre-commercial phase		Freq.	Pre-commercial phase	Commercial phase		Freq.	General Freq.
	Business Model Canvas	7	3	55,56	2			0,00				0,00	28,00
	Validation Board		3	16,67	7			0,00				0,00	
	Minimum Viable Product	7	3	55,56	1			0,00				0,00	
	Empathy Map		1	5,56	1	9		50,00	9	4		72,22	
	Value Propostion Canvas			0,00	7	4		22,22	4	4		44,44	
	TPP Frequence	31,11	22,22	**26,67**	40,00	28,89		**34,44**	28,89	17,78		**23,33**	
Technology Transfer Planning Process (TTPP)	LS Practices	Research phase	Technology phase	Freq.	Identification of patenting possibilities phase	Patenting phase	Phase of prospecting and presentation to the market	Freq.	Negotiation phase: established or nascent company	Transfer formalization phase	Phase of transferred product performance verification	Freq.	General Freq.
	Business Model Canvas	7	3	55,56	7	3		37,04				0,00	21,39
	Validation Board		3	16,67		9		33,33				0,00	
	Minimum Viable Product	7	3	55,56	7	3		37,04				0,00	
	Empathy Map		1	5,56			3	11,11	9			33,33	
	Value Propostion Canvas			0,00			3	11,11	9			33,33	
	TTPP Frequence	31,11	22,22	**26,67**	31,11	33,33	13,33	**25,93**	40,00	0,00	0,00	**13,33**	
Business Planning Process (BPP)	LS Practices	Research phase	Opportunities identification phase	Freq.	Opportunities identification phase	Opportunity structuring phase		Freq.	Prototype company phase	Nascent Technology Based Company (NtTBC) phase	New Technology Based Company (NwtBC) phase	Freq.	General Freq.
	Business Model Canvas	7	7	77,78	7	1		44,44	2			7,41	22,96
	Validation Board			0,00		9		50,00				0,00	
	Minimum Viable Product	7	7	77,78	7	1		44,44	2			7,41	
	Empathy Map			0,00				0,00	9			33,33	
	Value Propostion Canvas			0,00		1		5,56	9			33,33	
	BPP Frequence	31,11	31,11	**31,11**	31,11	26,67		**28,89**	48,89	0,00	0,00	**16,30**	
	General Frequence	28,15			29,21				16,94				

Analyzing Table 4, we have:

a) Among the TBPP subprocesses (Technology Planning Process – TPP; Technology Transfer Planning Process – TTPP; Business Planning Process - BPP), the TPP was the one in which the researchers-entrepreneurs most used the LS practices. The TPP presents 225 possibilities for using the LS practices (9 cases* 5 phases of the TPP*5 practices=225 possibilities). Of this total, 63 possibilities were explored, which results in a 28% frequency of use of LS practices. This demonstrates that the LS practices served as a basis for the development of academic innovations. In second place is BPP (22.96%) and, finally, TTPP (21.39%). The results show that despite the contribution of LS practices being more concentrated in the TPP, they also help researchers-entrepreneurs and their teams to convert their technological projects into business models with market potential. In addition, it is observed that LS practices are still incipient for the transfer process, demonstrating that universities have many opportunities to explore the use of LS practices in this context. The researchers-entrepreneurs claim that the university needs to develop policies and strategies that can favor transfer processes, which cannot be achieved only with the use of lean practices.

b) Analyzing the combined use of practices, it was observed that they were more used in the intermediate stage (World of Transition) (29.21%) and in the initial stage (Technology World) (28.15%). Considering that in the intermediate stage there are 315 possibilities for using the LS practices (9 cases*5 practices*7 phases=315 possibilities), it is observed that 92 possibilities were fulfilled, that is, 29.21%. Similarly, for the initial stage, of the 270 possibilities, 76 were fulfilled, which corresponds to 28.15%. The LS practices showed low utilization at the final stage, with only 16.94% of the possibilities fulfilled.

c) Comparing the three stages (initial, intermediate, final) and the three subprocesses (TTP, TTPP, BPP), it was observed that the researchers-entrepreneurs judge that the LS practices became more useful in the intermediate stage, especially for the TPP subprocess, which resulted in 34.44%.

To evaluate the LS practice that most contributed to the operationalization of the processes, table 5 was prepared.

Table 5: Relation between Process *versus* LS Practices

LS Pratices	Technology world	World of transition	World of business
Business Model Canvas (BMC)	62,96	31,75	2,78
Validation Board (VB)	11,11	39,68	0,00
Minimum Viable Product (MVP)	62,96	30,16	2,78
Empathy Map (EM)	3,70	20,63	43,06
Value Propostion Canvas (VPC)	0,00	23,81	36,11

Analyzing table 5, it appears that the most used practice was the BMC and MVP with 62.96% applied to the initial stage, followed by the EM practice to the final stage (43.06%). For the intermediate stage, the most used practice was the Validation board (39.68%).

5. Results and discussion

From the application of LS practices in the nine technological projects, it was possible to identify the contributions of the LS practices to the different stages of the TBPP (initial, intermediate, final). As a result, four research findings were identified.

Finding 1 - The practices contributed mainly to the* TPP *subprocess* and *to the intermediate stage of the TBPP

As demonstrated in the fragments of interviews in cases 3 and 7, it can be seen that at the beginning of the technology development, those involved have little knowledge about the product, business and market. In this way, the practices help to reduce the uncertainties related to technological development, especially in the incorporation of technology into a commercial product.

> *[...] "We could not see the various possibilities of applying our technology to the customer… At the beginning, we did not have much information, which generated great anxiety in the team. From what was analysed using these tools, we reviewed everything we had discussed, and ended up making adjustments that allowed us to go a few steps further." (Case 3).*

> *[...] "I can say that the practices helped me and my team to evaluate the characteristics of the technology compared to other technologies in the market,-which contributed to the elaboration of strategies for managing what we are developing in the face of new technologies." (Case 7).*

Finding 2 - Among all practices, BMC and MVP were considered the most important to operationalize TBPP

The Business Model Canvas mainly contributed to define the target market and select the most appropriate technological solution configuration to serve it. As the interview fragment of case 4 shows, this was enough to guide the development of the technology, carry out laboratory tests and ensure the functionality and applicability of the prioritized solution.

> *"We realized that we had good technology in our hands, however it was not clear which attributes we should focus on to serve the consumer market… With LS practices, especially Canvas, we started to work with more selectivity of information, evaluating not only a market, but several possibilities of application of the technology." (Case 4).*

The MVP represents an opportunity to validate the technology and the product and assist in the elaboration of market strategies, helping to minimize technological failures and structuring the business. Respondents in case 8 stated:

> *[...] "MVP provided rapid product validation. We tested it quickly and made the necessary adjustments, eliminating a few reworks." (Case 8).*

Finding 3 - Besides the practices contributing to improve the performance of the development process, they also contributed significantly to the knowledge management of the projects team

From the systematization of information about technology, product and market, the practices were useful to reduce uncertainties and improve the performance of the TBPP, allowing the improvement of communication and exchange of knowledge between those involved. As stated by the interviewee in case 5:

> *"[...] the process guides us, and the tool made clear the path to identifying the latent needs of each client and, with that, we gain time during the development." (Case 5).*

About knowledge management, LS practices played an important role in organizing information, explicitation, sharing and generating new knowledge within the team. They favored the improvement of the flow of information and the learning process among those involved. As shown in the interview fragment of case 7, the application of practices provided greater team integration and contributed to a discussion of the problems experienced throughout the processes.

> *"[...] I think the main contribution of the practices was to create an environment so that the involved in the project could discuss, exchange information... We increased the interactions between us... Now the information is documented, that is good." (Case 7).*

Finding 4 - The combined implementation of the practices highlighted the benefits for TBPP

In order for researchers-entrepreneurs to develop their innovations, to promote commercial products, it was important to integrate lean practices set. In the view of the interviewees, they contributed to the different phases of the TBPP and, together, allowed the product to get closer to the market. The result of this practices set was the definition of the business model and the specification of the product to meet the needs of the market, as shown in the report of case 3:

> *"So, we began to think more strongly about technology's appeal to the market and realized that we had wasted time in the beginning because of a lack of business direction or guidance. To achieve consistent results for the business it is necessary the combined use of several resources, but always through methods that allow us to minimize risks" [...] (Case 3).*

6. Implications, limitations, and conclusions

To identify the LS practices most used by researchers-entrepreneurs in the different stages of the Technological Business Planning Process, a qualitative approach was carried out through case study. It was observed that the TPP was the subprocess in which the entrepreneurial researchers most used LS practices, obtaining 28% of the possibilities. It was observed that the practices were more used in the intermediate stage (World of Transition) (29.21%). Among the practices analyzed, BMC and MVP were the most used practices, obtaining 62.96% of the possibilities, and their use was more concentrated at the initial stage (Technology World) of the TBPP. BMC contributing to the exploration of opportunities (Hidayat, Hendrix and Hidayat, 2018; Marin et al., 2017) and the MVP for product validation (Maludin et al., 2021; Zimmermann et al., 2021). It was noticed that the practices also contributed significantly to the knowledge management of the projects team corroborating the studies by Mansoori, Karlsson and Lundqvist (2019). In addition the combined implementation of the practices highlighted the benefits for TBPP. In the initial phase of TBPP, the entrepreneurial team is focused on the development of technology, when information is diffuse and with little knowledge about product, process and market configurations. So, there was greater applicability of LS practices in the intermediate phase of TBPP, in order to help the incorporation of technology into a commercial product and, consequently, define the business model of the projects (de Faria, Santos and Zaidan, 2021). The practices contributed mainly to technological and business planning and, to a lesser extent, to the technology transfer process. The researchers-entrepreneurs report that the university still needs to define policies and strategies for the transfer offices to support the technology transfer process, corroborating the studies by Ravi and Janodia (2022) and Boguszewicz-Kreft *et al.* (2021). It was observed that the implementation of practices not only contributes to gather and structure product, business and market information, but also generate, store and share important knowledge among the members of the entrepreneurial team (Bandera, Passerini and Bartolacci, 2020). Finally, the combined use of LS practices enhances the benefits for the TBPP, integrating the information, which corroborates the studies by Blank and Dorf (2012), Ries (2012) and Cooper and Vlaskovits (2010). As a limitation of this study, it was not analyzed whether LS practices influence the operational performance of teams and the delivery of results during the TBPP, from a quantitative perspective. Another limitation is that only nine cases were analyzed in the academic environment, whose resources were limited when analyzing the market perspectives. As opportunities for future work, it is suggested to explore a sample that includes the generation of technological businesses in other business contexts such as business accelerators, technology parks or involving cross country studies.

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