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TECHNOLOGICAL CAPABILITY AND THE PERCEPTION OF ENVIRONMENTAL (SINGLE OR MULTIDIMENSIONAL) UNCERTAINTIES OF UNDERGRADUATE STUDENTS FROM THE BUSINESS MANAGEMENT COURSES

A CAPACIDADE TECNOLÓGICA E A PERCEPÇÃO DA INCERTEZA AMBIENTAL (UNI-MULTIDIMENSIONAL) DE UNIVERSITÁRIOS DA ÁREA DE GESTÃO

CAPACIDAD TECNOLÓGICA Y LA PERCEPCIÓN DE INCERTIDUMBRES AMBIENTALES (UNI-MULTIDIMENSIONAL) DE UNIVERSITARIOS DE LA CARRERA DE GESTIÓN

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ABSTRACT

Technological Capability (TC) has been analyzed by decision-makers from different organizations as strategy drivers due to Environmental Uncertainties (EU). The purpose of this study is to correlate the TC and the perception of both single and multidimensional EU to verify the strategy and its coherence with the environmental perception. A survey was carried out through quantitative research. The sample was conducted with a total of 123 undergraduate students from the business program at a federal university. The data collection was carried out on-site using a laid-out questionnaire. The data were analyzed using the Kolmogorov-Smirnov test and Spearman's correlation developed in the PASW Statistics software. The outcomes showed that the TC has a one-dimensional and multidimensional positive and significant association with (EU) perception, as well as demonstrating harmonization with what the seminal theory advocates. Likewise, it was possible to verify that the strategies aimed at the use of information technology provide the opportunity to collect more information and, consequently, gain a higher comprehension about factors and events that may threaten the organization (EU) caused by dynamic and complex environments.
Keywords: Technological capability. Environmental uncertainties. Capability. Strategy. University.

RESUMO

Capacidade Tecnológica (CT) tem sido explorada por tomadores de decisões de diferentes organizações como potencializadora de estratégias, em função das Incertezas Ambientais (IA). O presente estudo objetiva correlacionar a CT com a percepção de IA, unidimensional e multidimensional, para verificar a estratégia e a sua congruência com a percepção do ambiente. Foi realizada uma pesquisa quantitativa, via *survey*. A amostra foi caracterizada por 123 acadêmicos dos cursos de gestão de uma universidade pública federal. A coleta dos dados foi realizada *in loco,* com o uso de questionário estruturado. Os dados foram analisados via teste de Kolmogorov-Smirnov e correlação de Spearman's, desenvolvidos no *software* PASW Statistics. Os resultados apontaram que a CT possui de maneira uni e multidimensional associação positiva e significativa com a percepção (IA), assim como demonstram harmonização com o que preconiza a teoria seminal. Neste mesmo sentido, foi possível verificar que as estratégias direcionadas ao uso de tecnologia da informação oportunizam agregar maior número de informações e, consequentemente, maior compreensão sobre fatores e eventos que podem ameaçar a organização (incertezas ambientais), geradas por cenários dinâmicos e complexos.
Palavras chave: Capacidade tecnológica. Incerteza ambiental. Capacidade. Estratégia. Universidade.

RESUMEN

La capacidad tecnológica (CT) ha sido explotada por los tomadores de decisiones de diferentes organizaciones como potenciadores de la estrategia, debido a la incertidumbre ambiental (AI). El presente estudio tiene como objetivo correlacionar la CT con la percepción de IA, unidimensional y multidimensional, para verificar la estrategia y su congruencia con la percepción del medio ambiente. Se realizó una investigación cuantitativa a través de una encuesta. La muestra se caracterizó por 123 académicos de las carreras de gestión de una universidad pública federal. La recopilación de datos se realizó in situ utilizando un cuestionario estructurado. Los datos se analizaron mediante la prueba de Kolmogorov-Smirnov y la correlación de Spearman, desarrollada en el software PASW Statistics. Los resultados mostraron que el TC tiene una asociación uni y multidimensional positiva y significativa con la percepción (IA), así como también demuestra la armonización con lo que defiende la teoría seminal. Del mismo modo, fue posible verificar que las estrategias dirigidas al uso de la tecnología de la información permiten agregar más información y, en consecuencia, una mejor comprensión de los factores y eventos que pueden amenazar a la organización (incertidumbres ambientales), generados por escenarios dinámicos y complejos.
Palabras clave: Capacidad tecnológica. Incertidumbres ambientales. Capacidad. Estrategia. Universidad.

1. INTRODUCTION

Researchers and managers involved in the strategy development process for improving decision-making processes frequently set their agendas to know/understand the best decision to be made. There is no difference among small, medium, or large organizations or their legal composition – whether private or public - in this context. However, researchers (such as Botiglieri, Borges & Rothen, 2017; Santos & Roxo, 2017) highlight that there is a wide number of studies related to private organizations. Therefore, it can be understood that there is a demand for research focusing on public organizations and their management processes.

The concept of dynamic capabilities arises amidst this decision-making support scenario. This concept is understood as the internal organization's competence towards a given action/sector, aiming at amplifying the decision-making process in a positive way and thereby enhance the competitive advantage. Among such dynamic capability typologies, the technological capability addresses the information technology resources aiming at the improvement of the managerial processes. As foreseen by the dynamic capabilities concept, these constructs (technological capability) aim at predicting, or even better managing, the daily environmental inconstancies that affect decision-makers (Ribeiro, Rossetto, & Verdinelli, 2010; Bento, Urpia, Bortolozzi, & Massuda, 2017).

Along these lines, technological capability is defined as a set of information that includes practical and theoretical knowledge, as well as methods, procedures, experience, physical devices, and equipment. It covers the company's higher and diversified professional assets and is related to product technologies, design technologies, process technologies, and information technologies (Jin & Zedtwitz, 2008; Ercan, 2019). Reichert, Zawislak, and Pufal (2012, p. 10) point out that "technological capability is addressed in different ways by the literature, whereby some authors work on defining it, and others seek to describe it, yet some others are dealing with it through a series of indicators".

Researchers Reichert, Zawislak, and Pufal (2012) have additionally pointed out that the comprehension of technological capability according to its concept is sometimes complex. Thus, the development of experiments that facilitate the understanding of its features and its effects and connections becomes significant. However, Duncan (1972), Damanpour (1996), Cochia and Machado-da-Silva (2004), Barella and Bataglia (2008), Carvalho and Rossetto (2014), among others, emphasize that environmental uncertainty consists of a complex and dynamic environment, which impose a high degree of pressure on fast and effective decision making. In line with this, Silveira-Martins and Rossetto (2018, p.1) point out that environmental dynamism subordinates company segments of the most varied sizes, "which eventually forces managers to take their decisions in real time with great accuracy under the risk of losses, which are often irreversible".

The information processing and technology for uncertain environments is essential for Amorim, Penz, Nascimento, and Rossetto (2016), as it can assist in the process of identification of opportunities and interpretation of threats. In that context, this study aims at matching the technological capability of a public Higher Education Institution (HEI) to the perception of environmental uncertainty in a single and multidimensional way (complexity and dynamism). For this purpose, the authors seek to answer the following questioning: What is the current correlation between technological capability and environmental uncertainty, complexity, and dynamism?

This topic is justifiable due to the lack of studies in this framework, as well as the empirical need to verify the technological capability according to the identification of the environmental volatility. In addition, it must be emphasized that the purpose will be defined to gather data based on the perspective given by the users of the system (university students) in the management field. The research is performed with the aim of reducing data bias, which is likely when managers evaluates themselves. The chosen subject is associated with a research project that has the purpose of mapping the different perceptions in different HEIs and different locations (national and international).

Thus, this research paper will be divided in six sections. As previously presented, the first section consists of the research preamble. Following this, the theoretical support, with subsequent presentation of the methodological procedures. The fourth section presents the data analysis and the key findings. And to complete the paper, the final remarks and the references employed in the entire investigation are presented.

2. THEORETICAL FRAMEWORK

This section displays the research aspects related to the technological capability and environmental uncertainty. It also addresses the environmental uncertainty under the dimensions of complexity and environmental dynamism. The hypotheses and conceptual model will be contextualized based on these lessons.

2.1 TECHNOLOGICAL CAPABILITY

The dynamic capabilities are an enhancement of the resource-based view (RBV) theory. One of the justifications for the need to increase the RBV positioning lies in the fact that it cannot adapt to fast-moving and/or uncertain environments (Ensiernhardt & Martin, 2000).

Silveira-Martins, Mascarenhas, and Muller (2016) emphasize that this construct takes many different approaches and methods, aiming at meeting the particularities of the chosen strategies based on the organization's specificity and/or managerial purposes. Figure 1 shows the capability categories and the researchers interested in those typologies.

Capability Typology	Researchers
Marketing	Carvalho (2011); Silveira-Martins and Tavares (2014); Vaz and Silveira-Martins (2016), Castro Junior, Gonçalo, Rossetto and Deluca (2016).
Innovation	Vicente, Abrantes and Teixeira (2015); Deluca, Gonçalo, Castro Junior, Pereira (2016), Paternolli, Cancellier (2017)
Resiliency	Nogueira (2012); Nogueira, Gonçalo, Verdinelli (2017)
Ambidexterity	Silveira-Martins (2012); Silveira-Martins, Rossetto and Añaña (2014); Vaz and Silveira-Martins (2016)
Management	Adner and Helfat (2003); Carvalho (2011); Vaz and Silveira-Martins (2016)
Tourism	Silveira-Martins and Zonatto (2015); Silveira-Martins, Zonatto and Mascarenhas (2016)
Technology	Ribeiro (2010); Ribeiro, Rossetto e Verdinelli (2010); Silveira-Martins, Castro Júnior, Miura, Deluca, & Pereira (2016)

Figure 1. Capability typologies
Source**:** Based on Silveira-Martins, Mascarenhas, and Muller (2016)

Aligned to the purpose of this research, only the last capability listed in Table 1 will be addressed. According to Graziadio (1998), technological capability is the ability to deal with the technology that is developed by the company due to environmental changes, which is associated with the rhythm of its evolution within its activity field. Additionally, Miranda and Figueiredo (2010) assert that these features were already present in the 1970s in several companies in Japan, South Korea, and Taiwan, where one of the results was greater competitiveness on the international scene, broadening the production scope to one of the first empirical experiments on innovative technological capabilities.

Miranda and Figueiredo (2010, p. 80) also emphasize that the concept of dynamic capabilities is a relation to "resources needed to generate and manage innovative activities in products, processes, and production organization, organizational systems, equipment, and engineering projects; indeed, technological change". For the authors, this capability must be considered as a cognitive resource of the organization. Jo and Lee (2014) intensify the discussion on the premise that this type of organizational capability, which generates and absorbs technological knowledge, can influence the company's choice of being located in a specific location/region.

In addition to Jo and Lee's (2014) positioning, Lin (2014) points out that technological capability, along with socialization mechanisms, has an influence on the quality level among the organization's partners, as well as the integration of the supply chain. However, as stated by Reichert and Zawislak (2014), organizations should take advantage of technological capabilities due to the positive generation of results in their structures. The strategy of deciding on these types of strategies provides increasing support over organizational frameworks, productive process settings, and even marketing actions.

Regarding the academic results, Silveira-Martins et al. (2016, p. 12), researching in a public higher education institution (HEI), emphasize that "the correlation between constructs is positive, and thus, the technological capability fosters the academic performance proportionally to the investment on it." Therefore, technological capability is considered an essential strategy that should be taken not only by private organizations in order to develop their financial products, but also by public organizations, aiming at obtaining benefits associated with the common well-being - the promotion of the entire society.

2.2 ENVIRONMENTAL UNCERTAINTY

There are three components to the definition of environmental uncertainty: (i) lack of information on the environmental factors associated with a given decision-making situation; (ii) lack of knowledge of the outcome of a specific decision in terms of how much the organization might lose if the decision is inaccurate; and (iii) lack of a capability to

attribute any likelihood with some level of confidence as regards to how environmental factors will affect the success or failure of the unit during the decision-making process (Duncan, 1972).

Therefore, the efficiency to notice the environments and their changes seems to have a direct (positive) influence on the organizational outcomes. In line with this analysis, Huber, O'Connell, and Cummings (1975) report that, if the perceived uncertainty of the environment – which probably influences the process, structure, and probably the performance – can be managed, it seems that the modification of this perceived uncertainty can be a device to modify many organizational characteristics and, consequently, their outcome.

It is important to note that, regardless of the size of the organizations, all of them are susceptible to the environmental uncertainties and the manager's perception of them. In addition to this statement, Alexander (1991) highlights that organizations with many departments systematically adapt their practices to environmental changes perceived by managers as significant. On the other hand, when small organizations are operating in mixed environment, with the presence of economic, competitive, technological, socio-cultural, and political factors, they are under pressure from contextual and contractual uncertainty (Luo, 1999).

Thus, organizations that manage to obtain a good knowledge of the environment (perception of uncertainties) in which they operate can take proactive actions and influence the evolution of the system (Jansen, Rotondaro, & Jansen, 2005). In addition, Nobre, Tobias, and Walker (2011) emphasize that in order to manage high levels of environmental uncertainty, organizations should prioritize the incorporation of a high degree of cognition into their strategies.

Thus, along the theoretical line that states that the more complex and dynamic the environment, the greater the perceived environmental uncertainty (Damanpour, 1996) and that demands from customers, competitors (Cochia & Machado-da-Silva, 2004), and technology (Barella & Bataglia, 2008) end up becoming increasingly dynamic and complex, both environmental dimensions will be addressed below.

2.2.1 Environmental Complexity

According to Kochan (1975), the environmental complexity is closely related to the power of the external forces to which organizations are submitted. Hence, it is possible to notice the complexity related to the impact of environmental factors on the organization, such as i) time and process; b) quantifiable status; and c) task attributes (Henderson & Nutt, 1978). Blau and McKinley (1979) state that even the best match between environmental complexity and organization will not necessarily result in an organization with positive outcomes.

However, environmental complexity should be considered as an intervening factor in decision-making. Miller and Friesen (1984), supporters of this idea, state that the organizational life cycle – understood as birth, growth, maturity, renewal, and decline – must also have to consider the environmental complexity. According to researchers, organizational growth and environmental complexity can cause significant changes in phases, which tend to follow a straight course through those five levels, from birth to decline.

On the other hand, organizational partnerships can help the management to overcome barriers imposed by environmental complexity. Reinforcing this thought, Gibbs (1994) highlights that the relation between environment and organization is a role that must be played by the managers, a role that must be clearly modified due to environmental complexity circumstances, demanding more from managers in the creation and development of intra- and inter-organizational partnerships. Overall, the environmental complexity covers the diversity (e.g., the extent of economic policies, the range of government authorities and customer sectors) and the heterogeneity (e.g., the differences among economics policies, inconsistencies in policies among different governments, and deviations in consumer behavior among consumer sectors) of many factors or issues in each environment segment (e.g., macroeconomic and political) and socio-cultural segment affecting the company operations (Luo, 2001).

Nevertheless, organizations usually perform badly in high complexity environments where opportunities involve many contingencies (Davis, Einsenhardt & Bingham, 2009). As a result, managers dealing with more complex environments need greater capacity to process information (Silva & Porto, 2009).

2.2.2 Environmental Dynamism

For Kochan (1975), the dynamic environment consists of the rate of change imposed on organizations and, consequently, the increased expense of managerial energy that is necessary to the adjustment of the company. In this scenario, Miller and Friesen (1983) state that organizations must be considered as data-processing systems, whose

feasibility depends on their capability to master the challenges imposed by their environments. Also, according to the authors, organizations must adapt their structures to deal with the additional data-processing needs created by dynamic environments or, in some level, they must control these environments.

In addition, Priem (1990) points out that based on the level of environmental dynamism, the group that is on the top management level of the organization will have to take over some features that will be measured through consensus during the decision-making process, according to Figure 2.

Environmental Dynamism	Top Management Group Factors	Consensus
Low	Homogeneous group; Structured group; Encouragement of disagreement during decision-making	**High**
High	Homogeneous group; Less structured group; Encouragement of disagreement during decision-making	**Low**

Figure 2. Priem setting offer
Source: Priem (1990).

In dynamic environments, according to Bajawa, Rai and Ramaprasad (1998), it is challenging for an organization to predict the movement of its competitors and the demands of its final consumers. In this context, the organization is forced to quickly change its strategies. Based on this assumption, the authors identified that organizations facing higher levels of environmental dynamism are prone to adopt the executive's use of data systems to support communication, coordination, control, and planning functions.

A dynamic environment, in which the context is shifting, ambiguous, and unforeseeable, fails to provide managers with decent decision-making processes (Hough & White, 2003). The best -scenario performance designed by the decision-makers will depend on how they perceive their dynamic environments (Garg, Walters & Priem, 2003).

Notwithstanding the above, the decision-makers, whose personalities represent a higher core of self-assessments (capturing common elements built into self-esteem, spread self-efficacy, emotional adjustment, and locus of control), strongly influence the orientation of their organizations, especially in dynamic environments (Simsek, Heavy & Veiga, 2010).

According to Amorin et al. (2016), technological factors prove to be positive for the management of organizations operating under uncertain environments. From this scenario and based on Luo's (2002) position, in which he defends the need to broaden the analysis on dynamic capabilities, promoting strategies to enable organizations to achieve their goals. Also, Graziadio (1998) and Siggelkow and Rivkin (2005) state that finding the appropriate management tools to deal with situations imposed by the environment is one of the key organizational issues. Thus, the following hypotheses emerge to be evaluated in this study: H_1: there is a relation between technological capability and the perception of environmental uncertainty; H_2: there is a relation between technological capability and the perception about environmental complexity; H_3: there is a relation between technological capability and the perception about environmental dynamism. The model concept and the associations between the constructs, based on the presented hypotheses, can be observed in Figure 3.

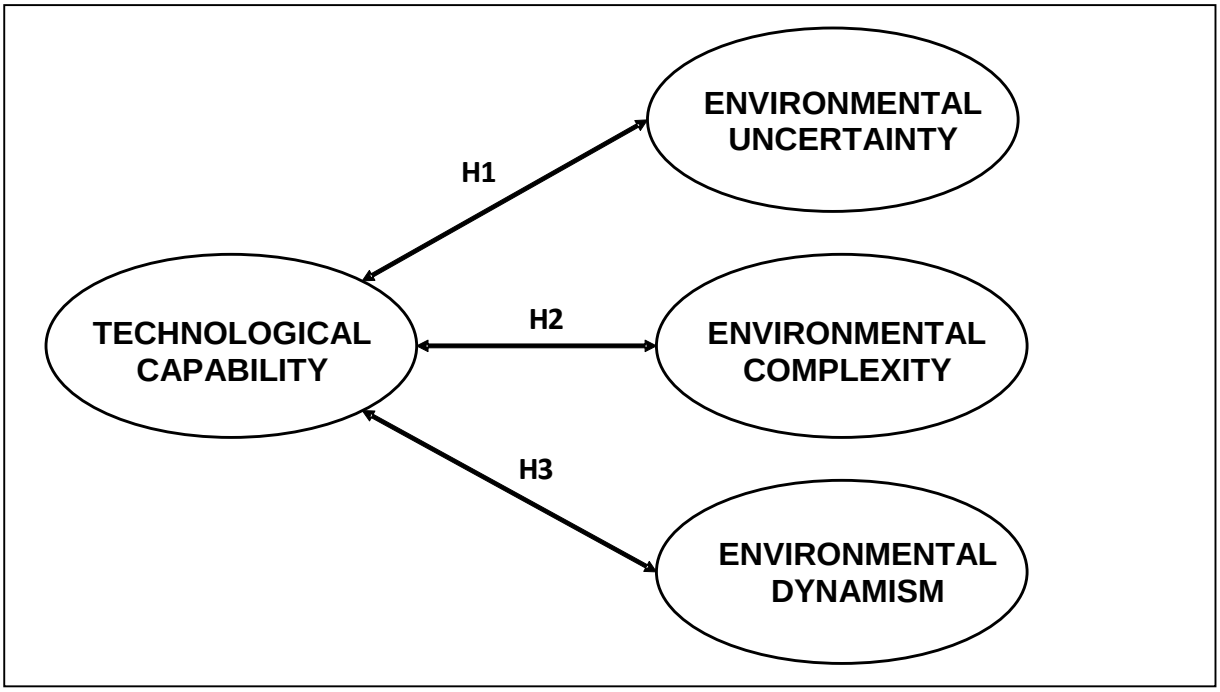

Figure 3. Conceptual model
Source: Research data

According to the structural organization research, as previously reported, the methodological procedures guiding the development of the research will be addressed in the following item.

3. METHODOLOGY

The research is outlined as both quantitative and descriptive, and using the survey research technique. The sample, due to convenience, consisted of 122 university students from different management programs of a Brazilian public federal university that has a total body of approximately 400 students. The Higher Education Institute (HEI) that is being analyzed has over 20 years of history, being a reference in the development of professionals and researchers in the country. Students were previously asked about the semester they were enrolled in their courses, since being enrolled was one of the rules to participate in the investigation. Based on the curriculum, only students from the fourth semester on would be qualified to participate. Then, the objective of the survey and the invitation to respond the questionnaire were presented. In addition, the students had been selected due to the fact that most of them were inserted in local organizations and/or had/have experience in companies from different regions of the country and abroad as a result of their proximity to one of the Mercosur countries.

In this context, it should be pointed out that the data collection device concerning the technological capability construct was developed based on studies by Ribeiro (2010). It consisted of six questions, in which the respondents should answer in a scale from 1 (total disagreement) to 6 (total agreement) which level best described the University practices, according to their perception. Each statement presented to the participants was codified with the initials CT1 ┤ CT6, which can be found in Figure 4. The codes employed herein have the purpose of organizing the statistical analysis.

Code	Statement
CT1	The university can develop new products and/or services.
CT2	The university can keep up with the release of new products and/or services.
CT3	The university can foretell technological changes in the segment.
CT4	The university can deliver the services or products on time.
CT5	The university can deliver the service and or the products in proper conditions in a timely manner.
CT6	The university can provide a quality service.

Figure 4. Variables of the technological capability construct.
Source: Adapted by Ribeiro (2010).

On the other hand, in relation to the environmental uncertainty construct, the method employed was developed and certified by Carvalho and Rossetto (2014). Thus, a questionnaire with ten statements (four regarding the environmental complexity and six regarding the environmental dynamism) was developed in which the participants should indicate, on a scale of 1 (total disagreement) to 6 (total agreement), the level that best described their perception of the environmental uncertainty perceived by managers. The variables employed, codified with the initials COM1 ├┤ COM4 (for complexity) and DIN1 ├┤ DIN6 (for dynamism), can be seen in Figure 5.

Code	Statement
COM1	It is hard/difficult to understand how the market/society is progressing.
COM2	It is hard to obtain important information to make decisions about the educational sector.
COM3	Important decision-making factors are very scattered (diversity of information about the society, large number of competitors, suppliers, etc.)
COM4	It has been difficult to predict changes in the educational sector.
DIN1	The society's needs have changed a lot in the past three years.
DIN2	The competitors' performance has changed a lot in the past three years.
DIN3	Partners and suppliers have changed a lot in the past three years.
DIN4	The regulation of the sector has changed a lot in the past three years.
DIN5	The technology involved in educational activities has changed a lot in the past three years.
DIN6	Social and cultural aspects that influence society in general have changed a lot in the past three years.

Figure 5. Variables construct environmental uncertainty.
Source: Adapted by Carvalho and Rossetto (2014)

It is important to mention that, although the statements are generically introduced, before the questionnaires were filled out, the research goals were presented to the participants and the subject under analysis was the University where they were enrolled.

During the analysis, the central trend measure between the responses from COM1 ├┤ COM4 and DIN1 ├┤ DIN6 was considered as unidimensional. For the multidimensional analysis, only the responses related to each dimension (COM or DIN) were considered. In addition, different statistical procedures were used for the data analysis aiming at ensuring scientific accuracy of the processing and the collection of data. Thus, in the first analysis stage, the calculation of normality was performed in accordance with the Kolmogorov-Smirnov test based on Lilliefors' significance correction, pursuant to the teachings of Fávero, Belfiore, Chan & Silva (2009). Subsequently, Spearman's correlations were performed. These procedures were developed with the aid of PASW Statistics 18 software.

4. DATA ANALYSIS

After performing the Kolmogorov-Smirnov normality test based on Lilliefors' considerations of significance correction, it can be observed that the p-value presented a lower value of α=0.05 for all the constructs. According to these results, it is possible to reject H_0 stating that the sample does not come from a normal distribution. Those results are shown in Table 1.

Table 1.
Kolmogorov-Smirnov normality test

Construct	Statistics	Degrees of Freedom	Significance
Technological Capability	0.210	122	0.000
Environmental Uncertainty	0.210		0.000
Complexity	0.197		0.000
Dynamism	0.193		0.000

Source: Research data

Due to the non-confirmation of H_0 in the Kolomogorv-Smirnov test, the Spearman's statistics (ρ) were used to conduct the association calculations. Therefore, it was observed that the technological capability construct has a correlation with the perception of environmental uncertainty (ρ=0.265; p-value=0.003<α=0.05), environmental complexity (ρ=0.237; p-value=0.008<α=0.05), and environmental dynamism (ρ=0.208; p-value=0.021<α=0.05). It is worth mentioning that all correspondences demonstrated statistical significance of at least α=0.05, as shown in Table 2.

Table 2.
Spearman's Correlation

Construct		Uncertainty	Complexity	Dynamism
Technological Capability	ρ (rho)	0,265**	0,237**	0.208*
	p-value	0.003	0.008	0.021
	N	122		

** significant at the level of 0.001 - * significant at the level of 0.005
Source: Research data

Therefore, the H_1 statement, in which technological capability and environmental uncertainty are related, can be confirmed. On the other hand, it was possible to identify the existence of a low positive correlation between technological capability and the perception of environmental complexity. This finding is consistent with H_2, and consequently it is considered the confirmation of the hypothesis. Regarding H_3, which states that there is a link between technological capability and environmental complexity, there is a low positive correlation between technological capability and environmental dynamism, and thus, the hypothesis is confirmed.

The findings identified herein are supported by Graziadio's (1998) statement that the technological capability shapes the environmental changes and shows that it is possible to predict external movements, which are considered by Bajawa, Rai, and Ramaprasad (1998) as a managerial activity with many obstacles and difficulties. Moreover, the results show a link with Eisenhardt and Martin's (2000) teachings. For those scientists, the dynamic capabilities can be interpreted and shaped with the environment, characterizing themselves as an evolution of a resource-based view.

Figure 6 presents the model with the associations between the constructions, as well as the correlation loads and significance indexes for each of these relations.

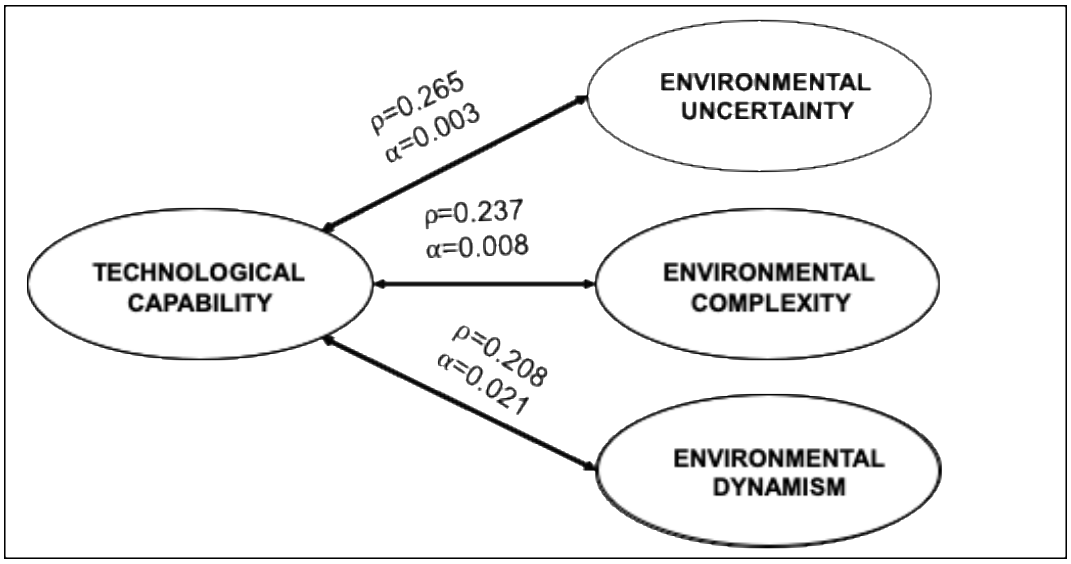

Figure 6. Model after the hypothesis test
Source: Research data.

According to Wilden and Gudergan (2015), organizational technological capabilities, as well as marketing capability, are the main drivers of company results, and therefore, topics of central interest to managers. Although organizational performance has not been measured in this research, the fact that there are positive associations of technological capability with the perceptions about environmental uncertainties points to the fact that there is a tendency towards an environment where the organization is settled. Thus, it seems consistent with the lessons by Wilden and Gudergan (2015).

5. FINAL REMARKS

The purpose of this research was to relate the technological capability of a Brazilian Public Higher Education Institution (University) with the perception of environmental uncertainty in unidimensional and multidimensional forms (complexity and dynamism). The outcomes made it possible to conclude that technological capability is consistent with the perception of uncertainty, dynamism, and environmental complexity. Furthermore, the research supports the seminal theory on dynamic capabilities when presented as an inner competence of the organization that seeks to track (or follow up on) the external environment instabilities.

The findings seem to be causally related to those identified by Garg, Walters, and Priem (2003), which states that managers who have not appropriately prioritize or analyze, both internally and externally, the sectors that describe the environmental situations will probably be affected during the development of effective judgments on the competitive situation of their organization. Even though the outcomes obtained in their study are related to a different country and context, they match the findings presented herein.

Accordingly, the decision makers that are dedicated to implementing practices related to dynamic capabilities will be able to improve their scenario projections since the research has identified that this capability corresponds to environmental uncertainties.

Another finding presented herein shows that the managerial practices associated to the use of information technologies tend to increase the amount of data and, consequently, the knowledge of potential threats to the organization – also referred to as environmental uncertainties – caused by dynamic and/or complex contexts that can put the formulated strategies at risk and, even, the continuity of some actions or the organization itself. Therefore, the investment, adoption, conservation/increase, and routine practice of the use of internal capabilities related to technology when strategically managing the organization seem to be beneficial to the management process.

From a theoretical perspective, it is clear that the seminal theory on dynamic and technological capabilities has been supported in this research, showing that there is similarity with the identification of environmental properties. From an empirical point of view, there is the recommendation of implementing such practices in the organizational management process, with the implementation of performance measurement systems (e.g., balanced scorecard or tableau de bord). Those processes should specifically monitor the program of the institutional development plan (IDP) and educational

projects of those programs (EPP). Another important aspect is the implementation and/or updating of technological processes related to the Internal Evaluation Committee (IEC) and/or other methods of measuring the qualitative characteristics of HEI, since it is a source of information and analysis of both micro and macro institutional environmental aspects.

Moreover, it is important to mention that the analyses and considerations presented herein are not frequent, especially due to the focus of the topic being addressed to private organizations. Hence, it is possible to conclude that there is another important contribution to this research. This is related to the fact that the study contributes to the progress of theory by presenting the types of uncertainty associated with the technological capability that, even if at first it seems theoretically evident, no such information was found in other studies. Thus, it is possible to corroborate the TC theory concerning its capability and efficiency in decision-making as it seems to be associated, regardless of the type of uncertainty.

However, the information presented here must be carefully considered, since it cannot be generalized, given that the study aim lacks such a scope, and the sample is restricted to a single public HEI. Another aspect that should be highlighted is the fact that the sample does not allow the application of more robust statistical techniques such as structural equation modeling, and from that point, analyze the effects of cause-effect. Furthermore, the fact that students from specialization programs are not part of the sample must be considered as a research restriction, in addition to the lack of information regarding the temporal evolution of the data. On the other hand, it is believed that this limitation does not produce research disadvantages according to its purpose.

As a suggestion for further research, a replication of this study in other Universities (Public and Private) is recommended in order to identify if the results are similar to the ones found here, in addition to other sectors of government organizations. Furthermore, this recommendation is in line with Graziadio's (1998) statement, who emphasizes that companies are different in terms of the perception and role of technological capability. According to this suggestion, the incorporation of other construct, such as environmental protection, is recommended, as well as the development of research also considering the perception of technical-administrative staff and professors. A final recommendation that is believed to be relevant for future research is to verify if there is the participation of the environmental uncertainty construct (uni- and multidimensional) as a variable actor in relation to technological capability and outcomes in government organization.

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