

Characteristics of Brazilian scientific research on diffusion of innovations in business administration

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Abstract

The aim of this paper is to analyze the characteristics of Brazilian scientific research in diffusion of innovations in administration. A bibliometric research was conducted with network analysis in scientific papers about diffusion of innovations in Spell database. The papers were analyzed from descriptive, bibliographic, methodologic, results and citation characteristics. The authors concluded that Brazilian publications are coherent with the international research considering the adoption of diffusion of innovations frameworks. Still, it has a trait of considering government support in diffusion frameworks, an absent parameter in the original frameworks; therefore, representing a development potential for diffusion of innovations researchers in Brazil.

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Keywords: International innovation; Diffusion of innovations; Brazilian scientific production

Introduction

Diffusion of innovations has been studied since the end of the forties, but from the sixties, with Rogers (2003) and Bass (1969) researches, it was spread. Considering the technological development in the last decades, innovation diffusion frameworks have been updated to approach the phenomena in a more complex way. However, it is possible to note parameters suggested by Bass (1969) that remain relevant in contemporary frameworks, such as the influence of communication.

Due to the comprehensiveness of diffusion of innovations subject, two main approaches are found in the literature: communication and administration. According to Peres, Muller, and Mahajan (2010), little is known about the history of the scientific

research in diffusion of innovations in administration, mainly in the Brazilian research.

Due to the development of international research in the subject and the lack of knowledge about Brazilian research, the aim of the paper is to analyze the characteristics of Brazilian scientific research in diffusion of innovations in administration. To do so, a bibliometric research was conducted in Spell database searching the terms “*difusão de inovação*” and “*difusão de inovações*” in the abstracts. After the exclusion criteria, 30 papers were analyzed.

The papers were analyzed according to descriptive (year of publication, authors and journals), bibliographic (diffusion framework) and methodologic (research method) characteristics; besides their results (parameters suggested) and citations. They were also categorized in research trends described by Peres et al. (2010) to compare the Brazilian sample and the international research.

The paper is relevant due to the comparison between Brazilian and international research and the identification of exploitable Brazilian specificities to maximize the scientific research in administration.

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Literature review

The diffusion of innovations research field has several approaches and paradigms developed in the last decades. The most comprehensive and widespread definition is in Rogers (2003, p. 5), presented as “the process by which an innovation is communicated through certain channels over time among the members of a social system”.

The research on diffusion of innovations in administration comprehends the analysis of three main perspectives: sociology, social psychology and technology (Van de Wijn-gaert & Bouwman, 2011). Each perspective is divided in different research fields according to the analysis scope and parameters. Despite the perspectives not being directly related to administration, the frameworks have been used as references to understand the diffusion of innovations in administration.

Diffusion of innovations in sociology

The diffusion of innovations concept in sociology comprises two fields: Innovation Diffusion Theory and Perceived Characteristics of Innovating.

The *Innovation Diffusion Theory (IDT)* is divided in three main frameworks: Bass, Moore and Roger. Bass (1969) proposed a mathematical model to describe the process of diffusion of innovations. It presents five innovation adoption categories and two main communication channels: mass media and “word-of-mouth” (Martinez, Polo, & Flavian, 1998).

G.A. Moore (1995) used Bass as basis, but presented the discontinuity process in the diffusion of innovations, focusing in organizations and their needs of technological innovation. However, Rogers (2003) has a wider impact in the scientific research, also using the five categories proposed by Ryan and Gross (1943), but adding other parameters to the framework.

The *Perceived Characteristics of Innovating (PCI)* framework, published by G.C. Moore and Benbasat (1991), develops on Rogers’ framework with a specific focus. It complements the perceived characteristics of innovations, persuasion components and adoption rates drivers. It may be considered an IDT complement, reorganizing its parameters and inserting aspects such as Voluntariness. The interaction between IDT and PCI is pictured in Fig. 1.

Diffusion of innovations in social psychology

In the social psychology approach, two research fields are used as complements to the diffusion of innovations research. They are focused on understanding human behavior regarding innovations: Theory of the Reasoned Action and Theory of Planned Behavior.

The *Theory of the Reasoned Action (TRA)*, presented by Ajzen and Fishbein (1980), assumes that the human being is rational and decisions are made according to the information provided regarding the phenomena. Besides the rationality, it assumes that each person has full control over the decision-making process. Therefore, the human behavior is influenced

by the behavior intent (or the adoption of an innovation). Such intent is influenced by two aspects: attitude and subjective norm.

The *Theory of Planned Behavior (TPB)* does not present a new framework, but refines TRA. Ajzen (1991) recognizes the importance of TRA to foresee human behavior, but highlights its limitation to situations when the person has full control over the decisions made. Therefore, the authors propose TPB, focusing on human behavior when the person has partial control over the decision-making process, mainly in Attitudes and Behavior parameters. Both theories are pictured in Fig. 2.

Diffusion of innovations in information technology

Theories and frameworks on technology acceptance have been used to understand the diffusion of innovations. Technology Acceptance Model (Davis, 1989) and Unified Theory of Acceptance and Use of Technology (Venkatesh, Morris, Davis, & Davis, 2003) are examples of such frameworks.

Both framework approach the technology acceptance process, presented by Venkatesh et al. (2003) and formed by: (i) individual reaction on information technology usage; (ii) information technology usage intent; and (iii) information technology usage.

The Technology Acceptance Model (TAM), presented by Davis (1989), focuses on foreseeing a technology adoption in a group or company, especially regarding how a technological innovation may increase productivity. The authors are based on TRA to create the framework with two main parameters: perceived ease of use and perceived usefulness.

11 years after the publication of TAM, Venkatesh and Davis (2000) updated the framework with detailed external parameters that influence both main parameters of the previous one; naming it *The Extension of the Technology Acceptance Model (TAM2)*.

TAM and TAM2 may be used to analyze the information technology adoption process from a personal or organizational point of view, but Venkatesh and Bala (2008) considered there was a gap to be filled. They presented the *Technology Acceptance Model 3 (TAM3)*, focusing on how corporate managers decide on adopting new technologies to enhance productivity. The three frameworks are described in Fig. 3.

The *Unified Theory of Acceptance and Use of Technology (UTAUT)*, created by Venkatesh et al. (2003), focuses on analyzing organizational environments as a tool, comprehending eight previous frameworks in four parameters: performance expectancy, effort expectancy, social influence and facilitating conditions.

Such as in TAM2 and TAM3, Venkatesh, Thong, and Xu (2012) identified a gap from the customers point of view. Therefore, created the *Extended Unified Theory of Acceptance and Use of Technology (UTAUT2)* that preserves the parameters from UTAUT and includes parameters regarding the understanding of customers’ environment and point of view. The interactions between both versions are described in Fig. 4.

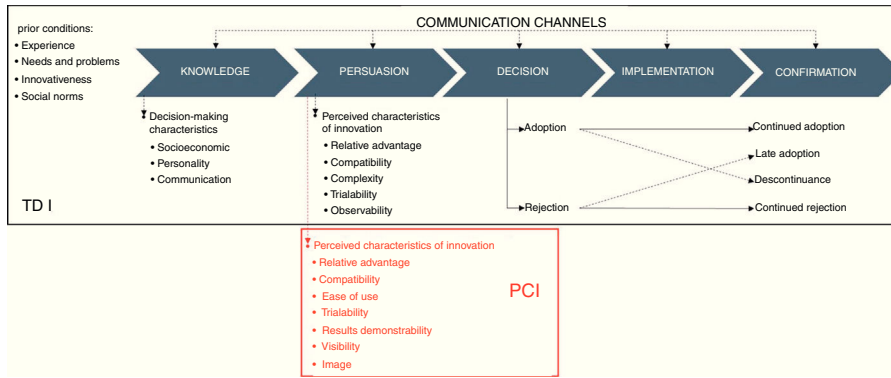


Fig. 1. IDT and PCI frameworks.

Source: Adapted by the authors from Rogers (2003) and G.C. Moore and Benbasat (1991).

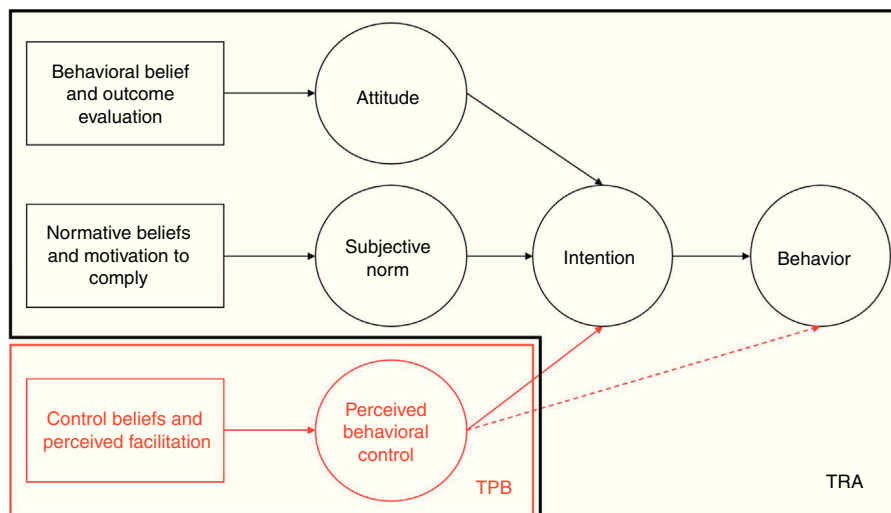


Fig. 2. TRA and TPB frameworks.

Source: Adapted by the authors from Ajzen and Fishbein (1980) and Ajzen (1991).

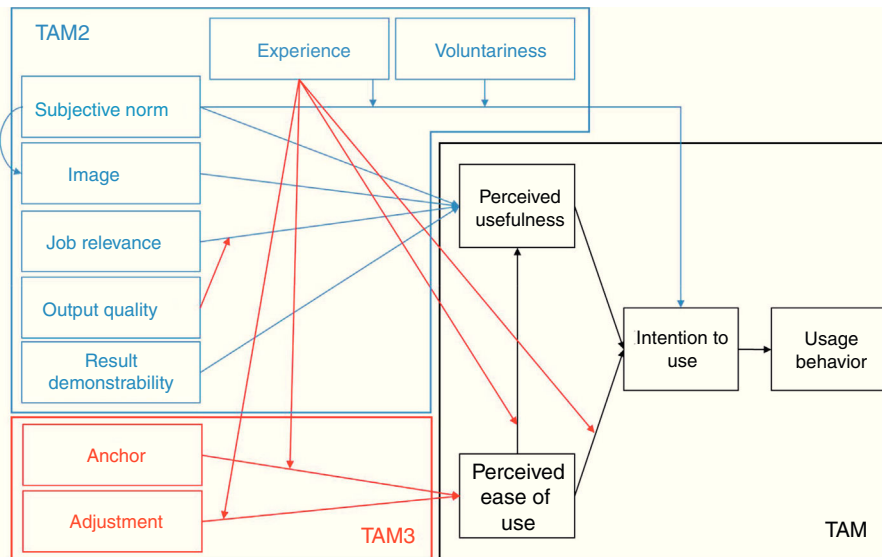


Fig. 3. TAM, TAM2 and TAM3 frameworks.

Source: Adapted by the authors from Davis (1989), Venkatesh and Davis (2000) and Venkatesh and Bala (2008).

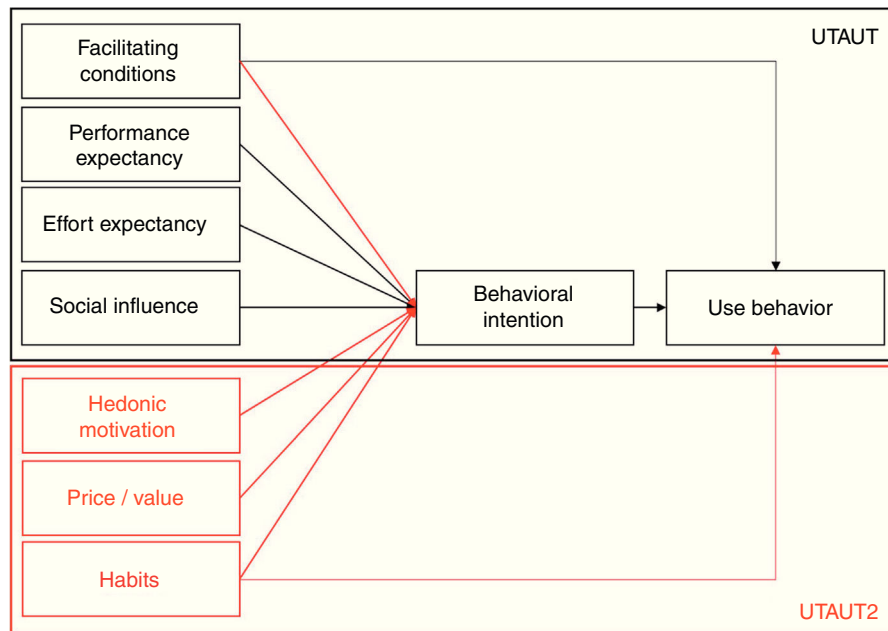


Fig. 4. UTAUT and UTAUT2 frameworks.

Source: Adapted by the authors from Venkatesh et al. (2003) and Venkatesh et al. (2012).

Methodology

With a bibliometric analysis, it is possible to classify and map the scientific research on a given subject and time frame. With such classification, the main characteristics and themes may be highlighted. The methodological steps in the paper are guided by Souza and Ribeiro (2013): (i) create a research problem that guides the research; (ii) choose the aspect to be analyzed in the literature; (iii) filter the data collected according to its relevance to the research problem; and (iv) analyze and interpret the data.

Spell database was chosen because it pertains to the “Associação Nacional dos Programas de Pós-Graduação e Pesquisa em Administração”, is exclusive in the administration, accounting and tourism fields and comprehends the most relevant Brazilian journals in administration (Peçanha & Iizuka, 2014; Schmitt, Hayde, & Dreher, 2013). There was no time frame in the research, but the authors collected only publications with a peer blind review process.

The authors used “difusão de inovação” and “difusão de inovações” in abstracts to collect data to achieve the most publications on the subject. 75 scientific papers published between 1989 and 2015 were found. The authors excluded papers that only cited the term or did not use diffusion of innovations frameworks. With the exclusion criteria, 30 scientific papers published in Brazil between 2003 and 2015 were found, with 1160 total citations.

The papers were classified according to descriptive (year of publication, authors and journals), bibliographic (diffusion framework) and methodologic (research method) characteristics; besides the results (parameters suggested) and citations. Even with a sample of 30 papers, it is possible to create citation network dense enough to present clusters in themes and methods (Moretti & Figueiredo, 2008).

The authors used Pajek software to create the citations network. The citations regarding method and research subject were eliminated from the paper, focusing on citations regarding the diffusion of innovations and methods. To visualize the interaction between network nodes, the labels were substituted by numbers; therefore, the most relevant nodes were detailed in the text.

The research sample achieved through the exclusion criteria is displayed in Table 1.

Results and discussion

Considering the research scope, the data collection presents five Brazilian journals as the main publishers on diffusion of innovations in administration (Fig. 5). The relevance of *Revista de Administração e Inovação (RAI)* is highlighted with most publications, focusing on applied social sciences. The journal released in 2004 is related to research groups in *Universidade de São Paulo* and is the most relevant Brazilian scientific hub on diffusion of innovations in administration.

Of the 70 authors in the research, 58 have one publication, 11 have two and only one author has three publications. In general, there is no prevailing author with a relevant number of publications on the subject. The homogeneity in the amount of publications of Brazilian authors and low annual publications show an opportunity to expand the field in Brazil with theoretical and empirical researches.

Qualitative researches are mostly used to explore and discover aspects of a given phenomenon; whereas quantitative researches are mostly used to verify and validate such aspects. The international research, according to Peres et al. (2010), is focused on quantitative approaches to validate and refine diffusion of innovations frameworks.

Table 1
Papers from research sample.

Code	Paper
A1	Pádua Júnior and Prado (2006)
A2	Machado, Bellini, and Leite (2012)
A3	Rodrigues, Chimenti, and Nogueira (2014)
A4	Bezerra and Silva (2013)
A5	Andrade, Dias, Ramos, and Sousa Neto (2015)
A6	Moraes Sobrinho, Silva Filho, Vasconcelos, and Furlanetto (2014)
A7	Gutman, Joia, and Moreno (2014)
A8	Leal and Albertin (2015)
A9	Barboza and Arruda Filho (2014)
A10	Moura, Cunha, Porto, Moura, and Pires (2015)
A11	Kimura, Moori, and Perera (2007)
A12	Brito and Cândido (2003)
A13	Furlanetto and Santos (2014)
A14	Farah (2008a)
A15	Farah (2008b)
A16	Popadiuk and Santos (2008)
A17	Lopes, Kniess, and Ramos (2015)
A18	Teixeira and Calia (2013)
A19	Romaniello and Amâncio (2005)
A20	Rodriguez, Diniz, and Ferrer (2007)
A21	Braga and Forte (2016)
A22	Ribeiro, Korelo, Silva, and Prado (2011)
A23	Pádua Júnior, Prado, Silva, and Souza (2010)
A24	Facó, Diniz, & Csillag (2009)
A25	Dias and Teodósio (2011)
A26	Freitas, Narducci, Dubeux, and Bertrand (2009)
A27	Kimura, Basso, and Martin (2008)
A28	Perez, Zilber, César, Lex, and Medeiros (2012)
A29	Romaniello, Amâncio, and Amâncio (2005)
A30	Andrade and Ramos (2013)

Source: The authors.

The research sample in this paper has a large volume of qualitative approaches (Fig. 6) for two possible reasons: (i) the researches are still qualitatively exploring the field by identifying parameters of the phenomena and (ii) quantitative researches in Brazil as costly and hard to collect data when comparing to international environments.

The emphasis on qualitative approaches is strengthened considering that content analysis is the most used method in the research sample (Fig. 7). Nevertheless, factor analysis and structural equations are highlighted.

The other three methods in Fig. 7 represent two relevant aspects. The first one is regarding the potential of mathematical modeling to diffusion of innovations in administration, considering that there are two papers using it. This aspect represents the potential of methodological development in Brazilian research with such method.

The second aspect is how relevant purely descriptive methods (statistic or textual) are in the sample for data analysis. These methods, despite being relevant in researches such as bibliometrics, limit the analysis and exploration potential that the diffusion of innovation has. The comparison between modeling methods in international researches and the amount of descriptive methods in Brazilian ones reinforces the need to methodological improvement (Peres et al., 2010).

In the citations analysis, only publications that received four citations or more are presented. Besides the four publications about methodology in Table 2, three books are highlighted.

The first book (Tidd, Bessant, & Pavitt, 2008) is relevant in the sample because of its comprehensiveness, being a basic reading in the field. The second book (Schumpeter, 1982) contextualizes the environment where technological innovations impact, being a seminal publication in economics. The third book (Solomon, 2002) is focused on customer behavior, being a

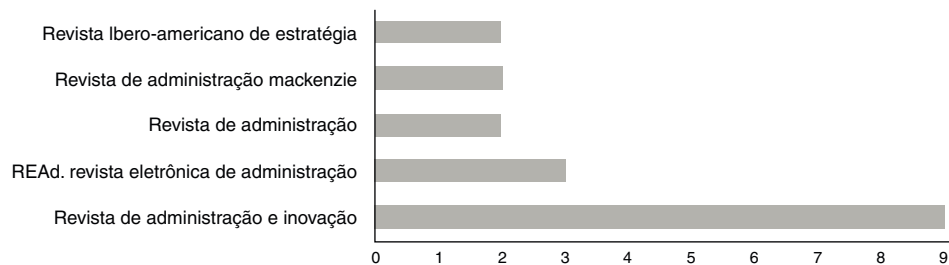


Fig. 5. Papers categorized by journal.

Source: The authors.

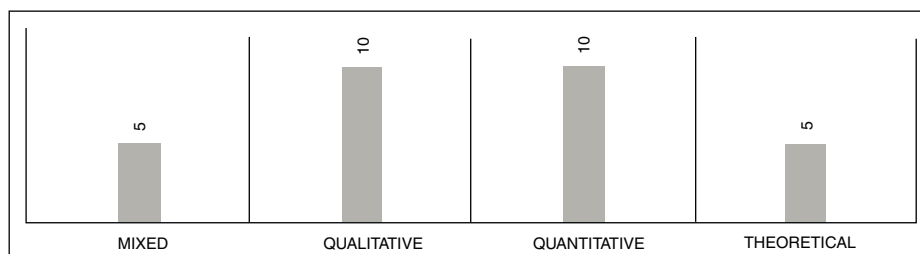


Fig. 6. Papers categorized by method.

Source: The authors.

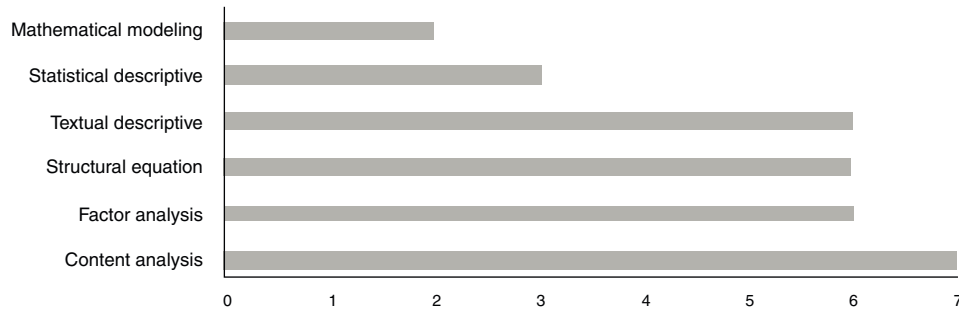


Fig. 7. Papers categorized by research technique.

Source: The authors.

Table 2
Citations per publications (4+).

Publication	Subject	# Citations
Rogers Everett, M. (1995). <i>Diffusion of innovations</i> . New York Press.	IDT	30
Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (1998). <i>Multivariate data analysis</i> . Upper Saddle River.	Methodology	7
Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. <i>Information Systems Research</i> , 2(3), 192–222.	PCI	7
Malhotra, N. K. (2006). <i>Pesquisa de marketing: uma orientação aplicada</i> . Bookman Editora.	Methodology	6
Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. <i>Management Science</i> , 46(2), 186–204.	TAM-2	6
Tidd, J., Bessant, J., & Pavitt, K. (2008). <i>Gestão da Inovação</i> . 3 ^{ed} . Porto Alegre: Bookman.	Seminal	5
Yin, R. (2010). <i>Estudo de caso: planejamento e métodos</i> . Bookman: Porto Alegre.	Methodology	5
Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. <i>Management Science</i> , 35(8), 982–1003.	TAM	4
Schumpeter, J. A. (1982). <i>Teoria do desenvolvimento econômico: uma investigação sobre lucros, capital, crédito, juro eo ciclo econômico</i> . São Paulo: Abril Cultural.	Seminal	4
Solomon, M. R. (2002). <i>Comportamento do Consumidor: Comprando. Possuindo e Sendo</i> . Porto Alegre: Bookman.	Seminal	4
SPSS. <i>SPSS Regression Models 9.0</i> . SPSS Inc, 1999.	Methodology	4
Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. <i>MIS Quarterly</i> , 425–478.	UTAUT	4

Source: The authors.

relevant theme to diffusion of innovations as seen in the frameworks discussed.

One aspect to be considered when analyzing publications of diffusion of innovations frameworks is the fact that the citation does not necessarily mean that the paper adopted the given framework. Rogers (1995) is the main cited publication with most citations in one publication, being responsible for spreading the IDT framework.

The citation classification in Table 3 allows the authors to analyze which are the seminal authors for Brazilian research, with the results limited to authors of diffusion of innovations models with six or more citations in the sample. Rogers, Venkatesh and Davis are highlighted with most citations, representing IDT, TAM2/UTAUT and TAM respectively. Even though there are

Table 3
Citations per author (6+).

Authors	Subject	# Citations
Rogers, E.	IDT	35
Venkatesh, V.	TAM2UTAUT	15
Hair, J. F. Jr.	Methodology	13
Davis, F. D.	TAM	11
Moore, M.	PCI	9
Malhotra, N. K.	Methodology	7
Ajzen, I.	TPB	6

Source: The authors.

more recent frameworks about diffusion of innovations, the traditional ones are the most used in the sample.

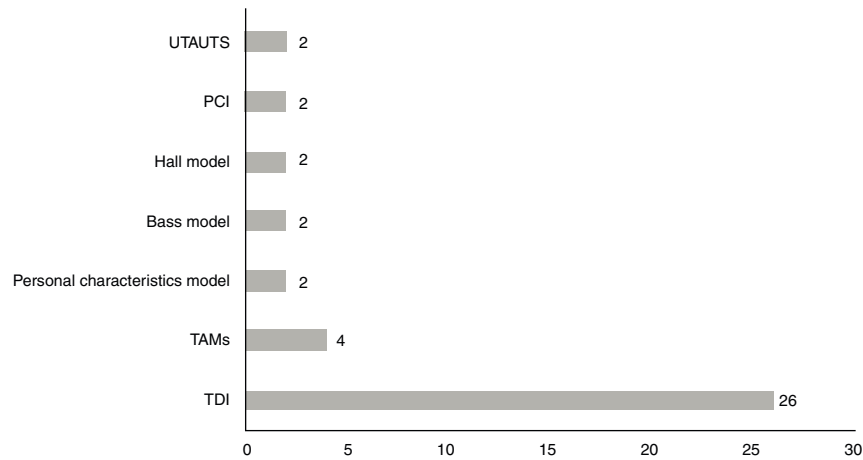


Fig. 8. Papers categorized by framework used (2+).

Source: The authors.

The first aspect to be analyzed is the framework used in the sample, considering only frameworks used at least two times are in Fig. 8. The industrial agglomeration (Silvester and Dalcol), social networks (Frambach and Schillewaert), organizational psychography (Wells), interpersonal influences (Solomon), TPB and TRA frameworks were also cited, but limited to one citation each.

IDT is the most cited framework, and also the most adopted in the sample. The main reason to it being the most adopted is because it is the only one that approaches exclusively the concept of diffusion of innovations; therefore, being used with complementary frameworks.

The complementary frameworks are the less relevant entries in Fig. 8, such as the TAMs and PCI. There is a pattern in the application of these frameworks, with IDT being the main one and several other frameworks being complementary according to the phenomena's specificity (such as customer behavior or a specific technologic innovation).

The citation network also allows insights about the Brazilian scientific publications. The network (Fig. 9) is composed by nodes in black (original papers from the sample) and nodes in orange (the publications cited). The network is displayed in a gravitational layout, meaning that the closer to the core a node is, the most connected it is to the core discussion on the topic. The diameter of the nodes represents the amount of citations received – from 1 to 30 per publication.

The first analysis is related to the research sample. Most papers have small independent clusters of citations that are isolated from the main discussion in the network core. Such papers are peripheral, while papers closer to the core share citations and represent the main discussions among authors.

Node 353 has the highest centrality, being cited by the whole sample and representing Roger's work in 1962, 1983, 1995 and 2003 editions. Therefore, Rogers is the core of the network as a seminal publication for the Brazilian scientific field of diffusion of innovations in administration. Rogers' centrality is maximized when considering the second most cited publication, with only seven citations and being G.C. Moore and Benbasat (1991) (node 311).

Besides Rogers, there are two clusters that represent two themes of research (outlined in red in Fig. 9). Cluster A is formed by theoretical publications on TAM and UTAUT and represented by Davis, Bagozzi, and Warshaw (1989) (node 157), Davis et al. (1989) (node 156), Venkatesh and Davis (2000) (node 406) and Venkatesh et al. (2003) (node 408). Cluster B is formed by empirical publications using TAM, focusing on innovation management and organizational environment.

Peres et al. (2010) typified the main international characteristics of different research trends on diffusion of innovations. Therefore, the authors categorized the research sample in such trends considering its characteristics. Peres et al. (2010) considered three trends with specific characteristics based on a bibliographic review and a research agenda proposal:

- Researches until 1990: consumer homogeneity, word-of-mouth communication as a growth driver, durable products, aggregated model with focus on product category;
- Researches since 1990: consumer heterogeneity, several growth drivers, focus on services, individual and aggregated models with focus on brand influence and adoption discontinuity;
- Future researches: unified models for heterogeneity, several growth drivers, focus on online services, individual and network models with focus on the influence of technological substitution.

Based on Peres et al. (2010) and their trends, the research sample was classified and compared (Fig. 10). The frameworks used by Brazilian researches are similar to the international ones, but the approach to the phenomena is different in more than half of the sample. Most Brazilian papers published since 2003 have the same characteristics as the international researches published until 1990.

The analysis show that the research sample, even though it uses the same frameworks as international researches, has two main aspects: (i) there is recurrence of descriptive methods, representing weak methodological performance and (ii) the Brazilian papers have a similar approach to older trends

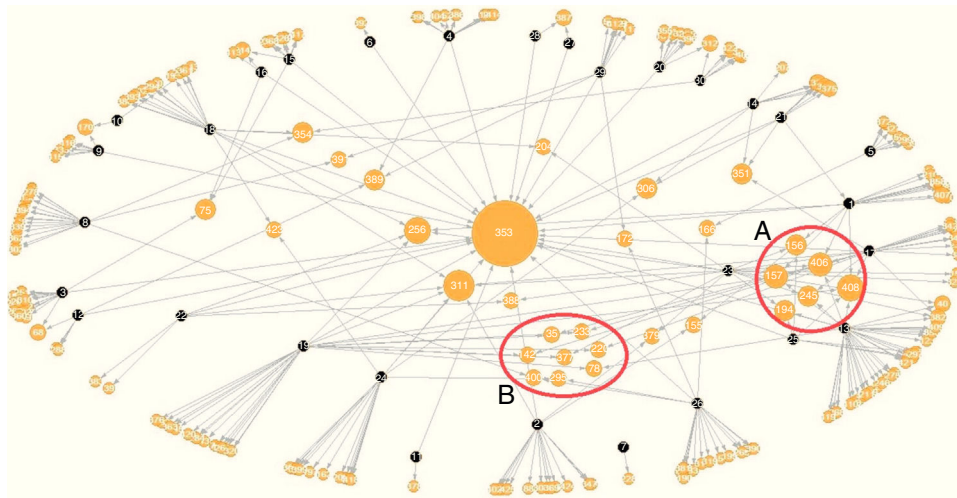


Fig. 9. Citation network.
Source: The authors.

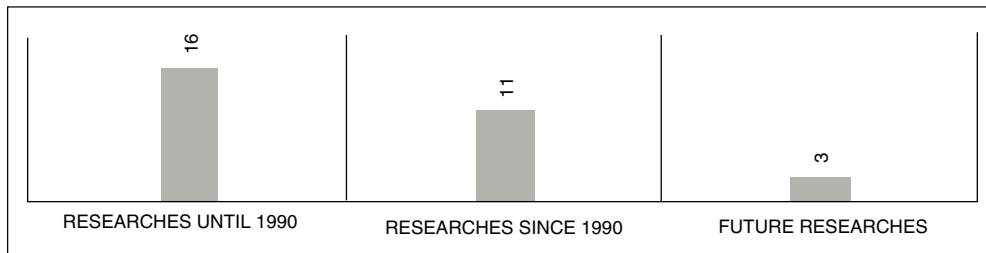


Fig. 10. Papers categorized by research trends (Peres et al., 2010).
Source: The authors.

from international researches, limiting the ability of Brazilian researches to keep up with the international state-of-the-art.

Table 4 was also based on Peres et al. (2010). It is possible to observe the framework adopted in the papers from the sample, but the main aspects are the new parameters proposed by them and their influence in the diffusion of innovations.

Presenting new parameters is relevant when there is a need to understand a specific characteristic of the phenomena, when there is lack of parameters in the framework used or a peculiarity in the environment where the phenomena occurs. Strategic environment and innovation culture are examples of parameters

suggested that have empirically proven influence (papers A3 and A21, for instance).

The main aspect on Table 4 is the recurrence of the “governmental support” parameter as positive and relevant to the diffusion of innovations (papers A6, A11, A13, A18, A20 and A21), according to the results in the sample. The highlight of such parameter in Brazilian researches may represent its relevance to the need for fostering mechanisms to generate innovative sustainability.

It also represents a potential to be explored in Brazilian researches, considering such parameter is absent in the literature

Table 4
Parameter suggested and influence in the framework.

Paper	Original framework	Parameter suggested	Influence
A1	IDT and Personal Characteristics Model	Difficulty of decision	Not Significant
A3	IDT, TAM, TRA and UTAUT	Strategic environment in the ecosystem	Positive
A6	IDT and Hall Model	Governmental support	Positive
A10	IDT	Customer involvement with the product	Not Significant
A11	IDT and Bass Model	Governmental support	Positive
A13	IDT and Hall Model	Governmental support and regulations	Positive
A18	IDT	Governmental support	Positive
A20	IDT	Governmental support	Positive
A21	Industrial Agglomeration Model	Governmental support	Positive
A21	Industrial Agglomeration Model	Innovation culture	Positive
A23	Personal Characteristics Model	Difficulty of decision	Not Significant

Source: The authors.

frameworks. Therefore, it allows the Brazilian research on diffusion of innovations in administration to understand the role of governmental support on the phenomena.

Final remarks

The main aspect to be considered in the results is the recurrence of the “governmental support” parameter in the research sample (A6, A11, A13, A18, A20 and A21). The governmental support seems to be relevant in emerging economies due to how fragile companies’ innovative capacity is. It also represents a development opportunity for the Brazilian research with the improvement of traditional frameworks from the literature.

Still, Brazilian approach to the diffusion of innovations is outdated. When comparing the research sample to international trends, the papers approach the phenomena considering aspects that were relevant in the international research in the nineties, even though they were published from 2003.

Another result to be highlighted is the difference between Brazilian and international method application. Diffusion of innovations frameworks have a mathematical background, and while international research focuses on quantitative approaches (such as computational modeling), the Brazilian research focuses on qualitative and descriptive approaches that limit the analysis potential of the phenomena.

One path to be explored is the interaction between Brazilian and international researchers to improve the methodological approach and consider intercultural aspects of the diffusion of innovations. Both paths represent a way of approximating the Brazilian research to the international state-of-the-art.

There is a concerning aspect in the research sample: 11 papers are not original, being adaptations to previous publications by the same author. It represents a harmful practice in the Brazilian research because, apart from being ethically reprehensible, does not allow an efficient and sustainable scientific knowledge development.

This paper has an academic contribution by allowing the comprehension of the Brazilian scientific research on diffusion of innovations in administration, mainly when comparing to the international research. A limitation to be explored in future researches is the expansion of databases, besides the deepening of how governmental support interacts with traditional frameworks in the literature.

Conflicts of interest

The authors declare no conflicts of interest.

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