ARTICLES

Submitted 05-30-2023 Approved 01-26-2024

Evaluated through a double-anonymized peer review. Associate Editor: Mohamed Amal

Reviewers: Edmundo Inácio Júnior . Universidade Estadual de Campinas, Faculdade de Ciências Aplicadas, Campinas, SP, Brazil. The second reviewer did not authorize disclosure of their identity and peer review report.

The Peer Review Report is available at this link.

Original version | DOI: http://dx.doi.org/10.1590/S0034-759020240401

A (RE)VIEW OF DYNAMIC CAPABILITIES: ORIGINS AND FUTURE DEVELOPMENTS

(Re)visão das capacidades dinâmicas: Origens e desdobramentos futuros

(Re)visión de las capacidades dinámicas: Orígenes y futuros desarrollos

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ABSTRACT

This paper aims to map out how the field of dynamic capabilities has developed since the seminal studies by Teece et al. (1997) and Eisenhardt and Martin (2000). We identified 10,838 papers and used the Latent Dirichlet Allocation algorithm for topic modeling. We conducted two analyses: the first was based on the temporality and characteristics of the studies; the second was interpretative and based on the network of theoretical concepts. Results indicate an approximation between the ideas of the two seminal studies, which were initially viewed as opposite. We observe a movement to value relational issues, following a collective construction path, and paying less attention to the firm itself. Overall, we were able to understand the consolidation of the dynamic capabilities field; understand the core elements involved in the development of dynamic capabilities; set out the original and current concepts of dynamic capabilities; and indicate tendencies and a possible future research agenda.

Keywords: dynamic capabilities, topic modeling, innovation, uncertainty, performance.

RESUMO

Este artigo visa mapear como o campo das capacidades dinâmicas se desenvolveu desde os artigos seminais de Teece et al. (1997) e Eisenhardt e Martin (2000). Identificamos 10.838 artigos e usamos o algoritmo de alocação latente de Dirichlet para modelagem de tópicos. Realizamos dois tipos distintos de análise: a primeira foi baseada na temporalidade e características dos estudos, enquanto a segunda foi interpretativa e baseada na rede de conceitos teóricos estabelecidos. Os resultados indicam que há uma aproximação entre as ideias dos dois artigos seminais, que inicialmente eram vistas como opostas. Observamos um movimento de valorização das questões relacionais, seguindo um caminho de construção coletiva e de menor atenção à empresa isoladamente. A contribuição do artigo está em apontar a consolidação do campo das capacidades dinâmicas e suas tendências, ampliar a compreensão dos principais elementos envolvidos no desenvolvimento dessas capacidades e definir seus conceitos originais e atuais, bem como oferecer uma possível agenda para futuras pesquisas.

Palavras-chave: *capacidades dinâmicas, modelagem de tópicos, inovação, incerteza, desempenho.*

RESUMEN

Este artículo pretende mapear cómo se ha desarrollado el campo de las capacidades dinámicas desde los artículos de Teece et al. (1997) y Eisenhardt y Martin (2000). Identificamos 10.838 artículos y utilizamos el algoritmo de asignación latente de Dirichlet para el modelado de temas. Realizamos dos tipos de análisis: el primero, basado en la temporalidad y características de los estudios; y el segundo, en la red de conceptos teóricos establecidos. Los resultados indican que existe aproximación entre las ideas de dos artículos seminales que inicialmente se veían como opuestas. Observamos un movimiento hacia la valoración de las cuestiones relacionales, siguiendo un camino de construcción colectiva y prestando menos atención a la empresa de forma aislada. El artículo contribuye a: señalar la consolidación del campo de las capacidades dinámicas; comprender los principales elementos involucrados en el desarrollo de las capacidades dinámicas; definir sus conceptos originales y actuales; e indicar las tendencias en el campo y una posible agenda para futuras investigaciones.

Palabras clave: *capacidades dinámicas, modelado de temas, innovación, incertidumbre, desempeño.*

INTRODUCTION

The dynamic capabilities approach has been used in different contexts and purposes. Since the seminal papers by Teece et al. (TPS) (1997) and Eisenhardt and Martin (EM) (2000), the approach has been reshaped to answer numerous questions that involve a context of uncertainty and constant change. Uncertainty and change are still the consensual elements in the literature, and they have remained aligned with this same approach since the late 1990s when dynamic capabilities emerged as an alternative to resource mobilization in the search to consolidate competitive advantage. This study retrieves the origins of the concept of dynamic capabilities and analyzes its evolution by emphasizing history as a field construction. The research question is: How has the dynamic capabilities field been built up and consolidated over the years?

This paper aims to map out the development of this field, from the seminal studies by TPS (1997) and EM (2000) to 2020. Thus, we identified papers published on dynamic capabilities from 1997 to 2020, in which we looked for theoretical affinities with the papers by TPS and EM. Based on the 10,838 papers identified, we used the latent Dirichlet allocation (LDA) algorithm for topic modeling and natural language processing, a resource available in the broad scope of techniques understood as artificial intelligence. We conducted two types of analysis: the first was based on the temporality and characteristics of the studies, and the second was an interpretative analysis of the theoretical concepts network. We created two analysis groups: TPS followers and EM followers. Publications citing both articles were considered part of both groups simultaneously and were incorporated into the analysis. This allowed us to understand the process of integrating the initially disparate concepts of the TPS and EM authors.

Consolidation of the dynamic capabilities field points to an approximation between the approaches used by TPS and EM, initially two distinct visions of dynamic capabilities and their core elements, as Peteraf et al. (2013) pointed out. Initial discussions about dynamic capabilities that highlighted the idea of sustainable competitive advantage (TPS) and an emphasis on processes and best practices (EM), which point to apparently opposite paths for the approaches, end up finding common spaces among several authors who are referenced in this paper and provide the opportunity to develop and consolidate the theoretical field of dynamic capabilities. Following this common path, the development of dynamic capabilities indicates a search for innovation and better performance based on procedural and collective construction, observing cooperation rather than competition but still focused on risk prevention and a search for answers to uncertainties.

METHODOLOGICAL PROCEDURES

The paper was designed based on a literature review using topic modeling analysis techniques. Therefore, we obtained a comprehensive map of the knowledge structure involved in consolidating the dynamic capabilities field.

Selection of papers and database construction

In phase 1, we conducted a literature review with the theme of dynamic capabilities. We identified the main concepts and the relationships established by authors since the first publication by TPS in 1997. In the Scopus database, we identified the papers that shaped discussions and debates about dynamic capabilities and cited the seminal works by TPS and EM.

We searched the database between March and August 2020, using the following criteria: a) Document type: paper; b) Publication stage: final; c) Area: business, management, and accounting. We did not restrict the period of the search and found papers published between 1997 and 2020 that cited TPS and between 2001 and 2020 that cited EM.

We identified a total of 10,838 papers in our research. Among these, 4,724 papers exclusively cited TPS, while 1,322 papers exclusively cited EM. Additionally, 2,396 papers cited both authors, which were incorporated into the sets of exclusive citations: TPS was cited in a total of 7,120 papers (4,724 + 2,396), while EM was cited in 3,718 papers (1,322 + 2,396).

Therefore, some papers were considered in both groups. We chose to keep the articles that cited both in our database since they enable us to assess how these papers followed those by the seminal authors and what core elements link the TPS and EM approaches. Thus, this integration of the papers was carried out to (1) obtain a comprehensive view of the impact of each initial paper on the field; (2) clarify the common concepts of the two initial approaches, and (3) demonstrate the subsequent research effort to reconcile the approaches.

In line with our purposes and method, the scope of this research is determined by assessing the number of papers, and the natural acceleration of production in a fertile field of research. We composed subgroups with similar numbers of papers but different time windows for this production. The result of this criterion was the generation of a total of six groups of articles: four referring to papers based on TPS (1997) and two referring to papers based on EM (2000).

Content analysis

The latent Dirichlet allocation (LDA) algorithm for topic modeling and data analysis was applied to the abstracts of the articles retrieved, offering a systematic analysis of a substantial number of papers. Previous studies on dynamic capabilities often relied on limited systematic literature reviews, resulting in potential bias by selecting only representative papers, impacting broader research questions (Madzík & Falát, 2022). Discovering the evolution of a research field and being able to specify the latest theories and required developments are the researchers' most basic needs (Holzinger et al., 2014; Tandjung & Fudholi, 2022).

Topic modeling is the task of identifying topics that best describe a set of documents. Employing an algorithm based on the Dirichlet distribution, the topics emerge from an analysis of the latent content of the documents. This technique can systematically identify content or group papers (Blei & Lafferty, 2006). LDA employs mathematical and computational resources to group the set of words that compose texts into topics, each containing a subset of mutually

consistent words. It is based on establishing the probability that each document belongs to a particular topic. This probability is expressed by:

(1) $P(\theta_{1:M}, \boldsymbol{z}_{1:M}, \beta_{1:k} \mid D, \alpha_{1:M}, \eta_{1:k})$, where:

θ is the topic distribution for document *i*;

M denotes the number of documents;

Z_i is the number of topics for each document *I*;

β is the Dirichlet parameter for the topic word distribution. The beta parameter can be understood intuitively as the adherence of a specific word to the topic in which it was included. In parallel with quantitative models, beta could be equivalent to item-construct correlation;

D is all the data (the corpus);

α is the Dirichlet parameter for the document to topic distribution;

η is the number of words in a given document.

LDA aims to map out all documents simultaneously and assign each text to a topic that best describes its content. Following directly from the equation, P depends on the number of documents and the number of words in each document. As scientific articles are of relatively stable size, the variable number of documents per D corpus is the most relevant aspect for establishing a value of P compatible with several D_i corpora.

The set of words found in a document is reduced to its meaningful content by excluding stop-words, selecting meaningful grammatical categories, and reducing terms to their radicals (lemmatization). Based on the word frequency criterion, texts with similar significant content are grouped into a specific topic. We defined the number of topics in each group to include at least 9.5% of the papers we analyzed in this group. By giving meanings to terms frequently found in grouped texts, we can succinctly describe (in topics) the subjects they address (Zhang et al., 2016).

Therefore, considering both the effects of time and the search for a number that, if not equal, is at least of the same order of magnitude in the set of documents of each corpus, we defined the number of groups to contain a balanced number of papers as being between 1640 and 1953 articles (Table 1). We justify this methodological choice on the grounds that in topic modeling, fragmentation into smaller groups with fewer papers could generate a large number of topics that would not reflect the overall picture of the literature, according to the seminal authors. In short, for models generated from LDA to be meaningful, i.e., to generate results that make sense and are coherent, document sets (corpora) must be produced using similar documents and produced within a given historical context. Considering these criteria simultaneously, we constructed the set of databases by author influence and period.

The quality of the generated model is gauged by employing two measures: perplexity and coherence. Perplexity is widely employed in language modeling (Chen & Goodman, 1998). For a test set of M documents, perplexity is defined as:

(2) $$perplexity\,(D_{test}) = \exp\,\{-\frac{\sum_{d=1}^{M}\log p(W_d)}{\sum_{d=1}^{M}N_d}\}.$$ (Blei & Lafferty, 2006)

Intuitively, this measure assesses the probability that the model (or part of it) will generate nonsensical sentences, for example, "we will have cement for dinner." This type of sentence will perplex those trying to interpret it and indicate the model's inadequacy. A small amount of perplexity is desirable, although no absolute minimum acceptable value can be established. Due to the non-convex nature of perplexity, different initial parameters lead to distinct local maximums (Zhao et al., 2015). The results of calculating them may be employed only to compare models that are similarly generated.

Topic coherence is the measure (average or median) of the relative semantic distance of the most frequent words in a specific topic. The assumption is that the higher the coherence of a topic, the easier it is for human intelligence to interpret it. Semantic similarity is supported by external databases, independent of the model being evaluated (Aletras & Stevenson, 2013). Experimental studies (Syed & Spruit, 2017) report coherence values ranging from 0.392 to 0.494 for LDA models conducted using article abstracts.

Table 1 shows the total period we analyzed: 1996 to 2020. The time windows were defined to include similar numbers of articles in each period. It was expected that earlier time intervals required more years to accumulate the number of articles needed to obtain a balanced distribution across the entire period. For example, the oldest period, from 1996 to 2008, covers 12 years and produced 1640 articles, while the most recent, from 2017 to 2020, includes 1851 works carried out in just three years. The perplexity values (variance = 0.002) in this table show the computational equivalence of the sets of articles, which attests to the comparability of the results found between the various groups and the suitability of the criteria established for this specific configuration of six groups of articles. The coherence values (between 0.3085 and 0.3539) indicate room to improve the model in the search for the value of 0.392, as indicated by Syed and Spruit (2017).

Table 1. Perplexity and coherence

	Period	Number of papers	Number of topics	Perplexity	Coherence
TPS (1997)	1996 to 2008	1640	4	-7.2688	0.3314
	2009 to 2012	1670	3	-7.1873	0.3311
	2013 to 2016	1953	4	7.2501	0.3085
	2017 to 2020	1857	3	-7.2394	0.3539
EM (2000)	2001 to 2013	1851	3	-7.1622	0.3408
	2014 to 2020	1867	3	-7.1669	0.3111

Furthermore, we represent the results obtained by LDA modeling as a network of theoretical concepts connected by the relationships established by the authors. This representation was prepared using the free, open-source software GEPHI.

THEORETICAL DISCUSSION

We examine two distinct moments to demonstrate how the dynamic capabilities field is developing. First, we emphasize the time dimension of the publications, which we call the analytical phase, where we describe the pattern of publications and highlight the central ideas that characterize the temporal periods and the papers that follow TPS and EM. Then, we present the relational dimension of the publications, which we call the interpretative phase.

The time dimension - analytical phase

TPS (1997); followers from 1997 to 2008

This group includes four topics. Topic 1 contains 689 papers (42%). It reflects scientific research efforts (research, β=.012; paper, β=.015) in the area of strategic (strategic, β=.018; strategy, β=.012) management (management, β=.014). It proposes a model (model, β=.011) that explains the processes (process, β=.012) of the organizational development (organizational, β=.010) of capabilities (capability, β=.012). Because it fundamentally comprises the words "strategic" and "management," we labeled this topic "strategic management."

Topic 1 indicates that a significant number of the studies on dynamic capabilities are in the area of strategic management. Specifically, they explore how firms remain competitive even in uncertain environments (Aragón-Correa & Sharma, 2003). The research sought to understand the organizational processes that enabled the adaptation, integration, and reconfiguration of the organization's internal resources. When aligned with other capabilities, these processes responded to environmental changes and generated a sustainable competitive advantage (Wright et al., 2001).

Topic 2 contains 536 papers (32.7%). The topic considers studies (study, β=.013) on the performance (performance, β=.016) of the firm (firm, β=.018), taking as its factors the dynamics of the industry (industry, β=.013), and its capabilities (capability, β=.011), and involving technology management (technology, β=.014; technological, β=.009), and/or the ability to innovate (innovation, β=.012), or new (new, β=.012) products (product, β=.011). Because the topic involves the concepts "firm" and "performance," we labeled it "firm performance."

Industry dynamics driven by innovation and technology are core elements of this topic. The papers recognize that firms must be innovative to survive in a volatile environment. They need a set of capabilities that enable timely responses and a rapid and flexible structuring of the innovation portfolio (Ambrosini & Bowman, 2009). Publications in this group emphasize competition less and the company's performance more.

Topic 3 contains 253 papers (15.4%). This topic considers theories (theory, β=.009) for using resources (resource, β=.044), capabilities (capability, β=.010), and the creation of value (value, β=.008) for the market (market, β=.023), including the international market (international, β=.009) in the search for an advantage (advantage, β=.011) over competitors and an improvement in the performance (performance, β=.008) of the firm (firm, β=.023). The greatest weight of this topic is the concepts "firm" and "resources," and was labeled "firm resources."

This topicrepresents the moment when a static view of resources gives way to mobilizing resources to respond to the dynamism of the market. In this group, the emphasis is on creating value for the market and leveraging competitive advantage. This group of authors indicates that effectively managing, combining, and mobilizing resources allows the company to create value and competitive advantage (Makadok, 2001). This topic also represents the starting point of discussions about the role of dynamic capabilities in the international expansion of companies (Luo, 2000).

Topic 4 contains 162 papers (9.9%). This topic addresses the processes (process, β=.012) of transferring (transfer, β=.013) knowledge (knowledge, β=.089), learning (learning, β=.022; learn, β=.018), partnering (alliance, β=.025; relationship, β=.008, collaboration, β=.007) and networking (network, β=.022; partner, β=.017). The topic is based on the concepts "knowledge" and "network", so we labeled it "knowledge network". This group emphasizes the importance of knowledge development and the learning process (Argote & Ingram, 2000; Zollo & Winter, 2002) and shows an interest in the relational and collective dimensions translated into partnerships and alliances (Ireland et al., 2002).

The resource-based view (RBV) and the initial idea behind dynamic capabilities of considering the company as the focus of analysis are gradually giving way to the idea that competitive advantage is consolidated through networks and relationships (Chen & Paulraj, 2004). For example, Dyer and Nobeoka (2000) suggest that companies with the ability to learn faster than their competitors have a sustainable advantage. However, they emphasize that this notion needs to be extended beyond the company's boundaries to integrate other network members, thus leading to greater diversity of knowledge.

To summarize, from 1997 to 2008, the publications highlight the strategy field, and complementary themes include performance, resource mobilization, and knowledge management (which involves discussions about learning and strategic alliances).

TPS (1997); followers from 2009 to 2012

The group includes three topics. Topic 1 contains 800 papers (47.9%). It deals with the relationship (relationship, β=.011) of the firm (firm, β=.043) with its market (market, β=.009). It considers the firm's resources (resource, β=.019) and capabilities (capability, β=.012), as well as the effect (effect, β=.009) on its performance (performance, β=.019) and its products (product, β=.008). The topic brings together two important concepts, "firm" and "capability," and therefore received the label "firm capability."

This group highlights the firm's performance, focusing on its resources and capabilities, albeit with less weight. It also looks at its relationship with the market. In the previous period, we found that some studies contained discussions about the role of the firm's relationships and the importance of value creation. As studies evolved between 2009 and 2012, these discussions became more accentuated and advocated the importance of market-related knowledge and capabilities to enable firms to strategize, significantly boosting their performance (Ngo & O'Cass, 2012).

Topic 2 contains 605 papers (36.2%). This topic deals with knowledge (knowledge, β=.025), management (management, β=.009), organizational (organizational, β=.010) processes (process, β=.014), and innovation (innovation, β=.012) as a capability (capability, β=.009).

The topic brings together the concepts of "knowledge" and "management," and we label it "knowledge management." This group emphasizes knowledge management from a procedural viewpoint and stresses innovation. At this point, attention is on the organization's own capabilities, unlike Topic 4 in the previous period, which emphasized knowledge considering alliances and partnerships. Despite this difference, the debate about alliances is still emphasized in this period, as we see below. We also observed an improvement in research that brought together the concepts of dynamic capabilities and knowledge management, indicating the need for a systematic knowledge management approach to develop capabilities that transform knowledge into a key organizational resource (Sandhawalia & Dalcher, 2011).

Topic 3 includes 265 papers (15.9%) influenced by TPS (1997) and published between 2002 and 2012. It focuses on management (management, β=.017) and control (control, β=.007), strategic (strategic, β=.008) alliances (alliance, β=.009), and theory building (theory, β=.013, literature, β=.005).

Because it includes the concepts "alliance" and "strategy," we labeled this topic "strategic alliances." Although it is not one of the most widely-discussed topics, we recognize an influence from the discussion on alliances presented in Topic 4 from the previous period. Furthermore, the focus of the papers in this group is on research and theory building, the concern being to consolidate the field. The group of analyzed papers between 2009 and 2012 confirms the consolidation of the knowledge management field and the concept of networks/alliances. It shows the area's concern with consolidation and theory building.

TPS (1997); followers from 2013 to 2016

The group includes four topics. Topic 1 contains 679 papers (34.8%). The topic addresses the effects (effect, β=.012) of the firm's (β=.053) relationship (relationship, β=.010) with the market (market, β=.016), product innovation (innovation, β=.008), capabilities (capability, β=.008), and resources (resource, β=.013) on the firm's performance (performance, β=.031). Combining the concepts "firm" and "performance," we label the topic "firm performance." These papers indicate a strengthening of the discussion on the firm's performance (Lin & Wu, 2014), which was discussed previously in Topic 2, from 1997 to 2008. This topic balances the discussion

between factors related to the firm's external (market) and internal (resources and capabilities) environments. This group attempted to understand how external and internal factors interact to influence the relationship of dynamic capabilities with a firm's performance (Takata, 2016). A further aspect refers to the recurrence of the word "effect." This term appears frequently in this group and suggests an increase in quantitative studies into the effects of variables or factors related to dynamic capabilities (Takata, 2016).

Topic 2 contains 639 papers (32.7%). This topic highlights the role of theory (theory, β=.009; paper, β=.021; research, β=.015, study, β=.009) as guiding (approach, β=.011) the processes (process, β=.012) of managing (management, β=.018) knowledge (knowledge, β=.020) in organizations (organization, β=.009; organizational, β=.012). With the keywords "knowledge" and "management," we labeled the topic "knowledge management." Discussion of knowledge management was highlighted previously in Topic 2, from 2009 to 2012; even the label is the same. Now, however, our concern is with consolidating theory, and so we stress the keywords "theory," "article," "research," and "study" that guide the knowledge management process (Schneckenberg et al., 2015).

Topic 3 includes 387 papers (19.8%) that were influenced by TPS and published between 2002 and 2012. It addresses innovation (innovation, β=.033; new, β=.013) in networks (network, β=.026) as a promoter of technological change (change, β=.015) (technology, β=.012), especially in small and medium-sized businesses (SMEs) (small, β=.013, company, β=.010). It also considers the acquisition (acquisition, β=.008) processes of knowledge (knowledge, β=.012) by the organization (organizational, β=.007). Involving the concepts "innovation" and "network," we labeled this topic "innovation network". These papers highlight the role of innovation in a collective approach, emphasizing technology networks. This approach differs from the previous one when innovation was associated with the firm's performance (in Topic 2, from 1997 to 2008) and knowledge management (in Topic 2, from 2009 to 2012). We noticed an orientation of this group of authors toward studying the interactions between organizations and their alliances, especially technological alliances, to optimize existing knowledge and generate innovation (Weng et al., 2014).

Topic 4 includes 248 papers (12.7%). This topic focuses on developing (increase, β=.006) the cooperation (cooperation, β=.007) of firms (industry, β=.014), the alliances (alliance, β=.015), and the inherent risks (risk, β=.009). It also considers control (control, β=.010) and trust (trust, β=.006) related to knowledge management activities (activity, β=.006).

Combining the concepts "industry" and "alliance," we label this topic "industry alliance." The papers in this group summarize the discussion about alliances and cooperation based on minimizing risks, having relationships of trust, and knowledge enhanced by inter-organizational relationships. These studies enrich the debate on the importance of organizations' ability to establish networks based on trust to achieve better competitive positions in the market, as seen in Kiessling et al. (2014).

The group of papers analyzed from 2013 to 2016 revisits the discussion about the firm's performance. It also summarizes the idea of alliances and networks, thus providing a discussion about dynamic capabilities with a collective dimension.

TPS (1997); followers from 2017 to 2020

The group includes three topics. Topic 1 has 986 papers (53.1%). It includes the terms capability (capability, β=.016) and dynamic (dynamic, β=.010). It also considers research (research, β=.016; study, β=.012; paper, β=.011; approach, β=.009) into knowledge management (management, β=.011) and innovation (innovation, β=.009) from a process perspective (process, β=.009). Because it simultaneously includes the concepts "capability" and "dynamics," we labeled the topic "dynamic capability." This topic synthesizes the basic ideas related to dynamic capabilities and highlights process and knowledge-oriented concepts, research, papers, and approaches. We have observed a continuity in the research into knowledge management, but it is turning toward a more process-focused analysis, such as knowledge creation, sharing, and transfer (Zhang & Zhang, 2018). This implies that an organization's resources and capabilities include knowledge and the process of developing that knowledge.

Topic 2 contains 468 papers (25.2%). This topic emphasizes the firm (firm, β=.047) and industry's (industry, β=.006) innovation (innovation, β=.018), technology (technology, β=.006), with a focus on the market (market, β=.013), including the international market (international, β=.006) as a resource (resource, β=.007) for growth (growth, β=.006).

The words with the greatest impact on the topic were "firm" and "innovation," so we labeled the topic "firm innovation." The elements of this topic have been discussed previously and refer primarily to the firm, innovation, and the market. The studies focus on consolidating dynamic capabilities for adapting organizations to the dynamism of the market (Gómez et al., 2020).

Topic 3 includes 403 papers (21.7%) influenced by TPS (1997) and published from 2017 to 2020. The topic addresses studies (study, β=.022) focusing on the firm's (firm, β=.023) performance (performance, β=.025), the effects (effect, β=.015; impact, β=.009) of using (use, β=.011) its capabilities (capability, β=.025), and its relationship (relationship, β=.023) with the market (marketing, β=.010).

Considering the influence of the term "firm" and "performance, we labeled the topic "firm performance." The studies in this group reinforced the theoretical foundations of dynamic capabilities vis-à-vis the firm's performance, including its links with the market, as seen in Parnell and Brady (2019). These papers discuss performance, capability, and relationships.

From 2017 to 2020, the analyzed papers attempted to consolidate the concept of dynamic capabilities, combined innovation and performance, and reappropriated the notion of relationships.

EM (2000); followers from 2001 to 2013

The group includes three topics. Topic 1 contains 1009 papers (54.5% of group). It addresses the processes (process, β=.012) of managing (management, β=.013) knowledge (knowledge, β=.014) in organizations (organizational, β=.010; organization, β=.010, business, β=.010). The topic contains research (paper, β=.014; research, β=.011) into the resources (resource, β=.011) and capabilities (capability, β=.012) involved in this process. Based on the keywords

"management" and "knowledge," we labeled the topic "knowledge management." These papers address knowledge management with an emphasis on capabilities, processes, and resources.

Despite the distinction between the concepts of dynamic capabilities proposed by TPS and EM, this differentiation is not strongly evident in their followers. Different studies stressed that they followed the dynamic capabilities approach based on the research by TPS and EM but without highlighting the differences between these perspectives (Lin & Wu, 2014; Makkonen et al., 2014).

In analyzing this first group of papers by EM followers, the themes presented are the same as those already seen in TPS followers; specifically, TPS followers considered dynamic capabilities idiosyncratic and strove to obtain a sustainable competitive advantage. On the other hand, EM argue that dynamic capabilities lead to best practices and a temporary competitive advantage. However, among their followers, some of the topics, such as knowledge management, are common and permeated by both views, as seen in McKenzie et al. (2011) and Tan and Noor (2013).

Topic 2 contains 642 papers (34.7%). It considers the relationship (relationship, β=.015) with the market (market, β=.013), capabilities (capability, β=.023), technology (technology, β=.009) and innovation (innovation, β=.012), and their effects (effect, β=.010) on business (firm, β=.051) and product (product, β=.013) outcomes (performance, β=.024). With the greater weight of the terms "firm" and "performance," we labeled the topic "firm performance." This group emphasizes the relationship with the market and highlights the firm's performance, innovation, and technology. Once again, in this group, we notice a continuity in the topics addressed by TPS, focusing on those elements related to dynamic capabilities that can influence a firm's performance, such as its relationship with the market (Ngo & O'Cass, 2012), technology, and innovation (Lee & Kelley, 2008).

Topic 3 includes 200 papers (10.8%) influenced by EM (2000) published between 2001 and 2013. The topic deals with the growth (growth, β=.011) of small to medium-sized (SME, β=.008; small, β=.009) family firms/enterprises (firm, β=.023; venture, β=.010; entrepreneurial, β=.008). It also considers industries (industry, β=.010) and their international (international, β=.009) strategies (strategy, β=.009).

Based on the terms "firm" and "growth," we labeled the topic "firm growth." In this topic, firm growth is associated with international and industry-specific strategies, including an emphasis on family-owned firms and small and medium-sized enterprises (SMEs). The composition of this group reflects a change in the perspective of EM followers compared to that of TPS. We notice a focus not only on larger, more mature companies but also on investigating the context of SMEs. Compared to larger firms, SMEs are usually more vulnerable because of their resource constraints, which can have an impact on their survival. Therefore, the study of dynamic capabilities is equally important in this context, but only among EM followers was this topic treated as the most important. We also observed that the topics we investigated are not necessarily related to competitive advantage but to other elements that can influence the performance of SMEs, such as their growth and internationalization strategies (Bingham & Eisenhardt, 2011).

The papers published between 2001 and 2013 highlight issues centered on knowledge management, performance, and the firm's growth, emphasizing both the importance of the process (when referring to knowledge management) and the result (a reference to the firm's performance and growth).

EM (2000); followers from 2014 to 2020

The group includes three topics. Topic 1 contains 913 papers (48.9%). It includes studies (study, β=.011; research, β=.016; paper, β=.011) on organizational processes (process, β=.009) related to dynamic capabilities (capability, β=.015), knowledge management (management, β=.012), and innovation (innovation, β=.010). Because it focuses on concepts of dynamic capabilities, we labeled this topic "dynamic capability." The main elements highlighted in Topic 1 refer to the idea of dynamic capabilities as related to management, knowledge, and innovation and emphasize the process. Considering the temporal evolution of the papers, we noticed again a certain similarity between the topics investigated, both in papers that cited TPS and those that cited EM.

Topic 2 contains 708 papers (37.9%). This topic includes studies (study, β=.017; finding, β=.008) into the relationships (relationship, β=.016) between firm (firm, β=.029) and product (product, β=.009) performance (performance, β=.029) as an effect (effect, β=.011) of capabilities (capability, β=.017), resources (resource, β=.009), and innovation (innovation, β=.016).

Considering the keywords "firm" and "performance," we labeled the topic "firm performance." The second topic involves discussions on performance and highlights both relationships and innovation. From these papers written by EM followers, we point to the predominance of studies that explore the role of dynamic capabilities in the performance of firms (Lin & Wu, 2014; Mikalef & Pateli, 2017).

Topic 3 includes 246 papers (13.2%) that were influenced by EM (2000) and published between 2014 and 2020. It highlights the growth (growth, β=.009) of the firm (firm, β=.046) in the market (market, β=.013), including internationally (international, β=.011), considering technology (technology, β=.009, technological, β=.006), strategy (strategy, β=.008), and resources (resource, β=.011). It also considers the industry context (industry, β=.011) and family business context (family, β=.007).

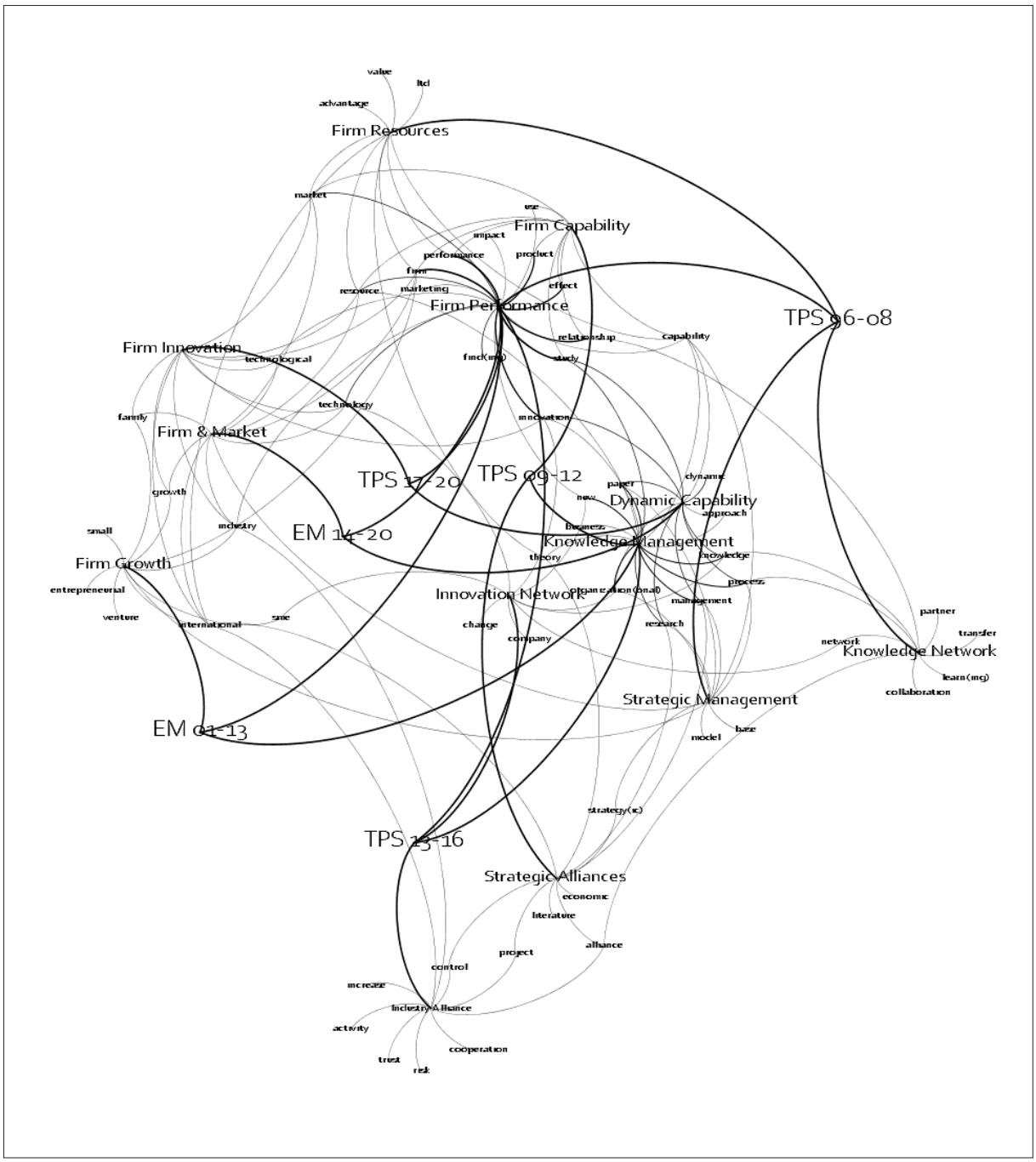
Since the topic is based on the concepts of the "firm" and the "market," we label it "firm and market." The market is the main component discussed in this topic and is associated with industry and growth (Dykes et al., 2019). We also note the emphasis on the international and family firm contexts. Studies in this phase that cited EM addressed organizational forms, such as family firms, which have not had as much representation in studies following TPS (Liu et al., 2017).

The papers published in the period between 2014 and 2020 show the search to consolidate dynamic capabilities, highlighting process, innovation, and knowledge, although concern about the firm's performance and its relationships remains. Therefore, we highlight the external environment and the attention paid to the international context and the industry but without ignoring the idea of resources.

The relational dimension – Interpretative phase

We present an interpretative analysis based on the network of theoretical concepts established by the authors in their papers and attempt to elucidate the evolution of the concept and the topics that started being discussed as the theory matured.

Figure 1. Network of theoretical concepts



   eISSN 2178-938X

When analyzing the pioneering publications of TPS followers, we observe some elements that are clearer in these discussions and peculiar to them, such as strategic management, knowledge network, and company advantage. The notion of dynamic capabilities emerged as a new perspective for strategic management as to how firms create and sustain competitive advantage (Makadok, 2001). TPS (1997) exposed the connection between these two themes in their seminal paper when they argued that economic approaches to strategies had thus far not explained how organizations survive and maintain a position of leadership in unstable environments.

The authors then proposed the dynamic capabilities approach as an emerging strategy for understanding how firms generate and maintain a competitive advantage in an uncertain and rapidly changing environment (Teece et al., 1997). On these grounds, TPS followers have adopted dynamic capabilities as a core stream of strategic management research (Ambrosini & Bowman, 2009; Wright et al., 2001).

Among the first followers of the TPS study, we also identified a strong focus on adopting the term "firm resources", as it relates to value. The dynamic capabilities approach was influenced by the RBV, which emerged as an alternative theory to competitive forces (Hernández-Linares et al., 2021). However, RBV neglects the dynamism of the market and disregards the fact that although having resources is an important aspect, distinctive capabilities need to be developed to use such resources better (Hernández-Linares et al., 2021).

Another point that TPS followers extensively discuss is the knowledge network. These studies emphasize networking; discussing collaborative efforts with partners to generate learning and knowledge transfer. We notice that knowledge network and company advantage elements were not linked with other topics discussed in subsequent works. Although these topics were explored extensively in initial discussions about dynamic capabilities, they reduced in intensity as the concept matured. Therefore, even though company advantage has not become more extensive in studies on dynamic capabilities, company performance emerged from these initial studies to modify competitiveness into something that focuses more on the company's internal context.

As TPS studies evolved in their second period from 2009 to 2012, we noticed new approaches being adopted. The knowledge network gives way to knowledge management discussions, which are associated with organizational change and innovation. Interestingly, in this period (2009 to 2012), there is greater proximity to the themes discussed by the followers of EM (2000). Although EM's article was published as a critique of TPS's concepts, the studies that cited them did not stress these contradictions. On the contrary, there is a degree of convergence between the topics, as exemplified by knowledge management and company performance, which were present throughout the evolution of publications on dynamic capabilities with both TPS and EM followers.

Observing Figure 1, we further note that while firm performance has been a timeless topic associated with dynamic capabilities since publications began, knowledge management was still related to dynamic capabilities until mid-2016, when it became less evident in papers by both TPS and EM followers.

Despite the convergence of some topics, there is a dissonance among the followers concerning industry cooperation. From 2009 until 2012, TPS followers focused on industry, which increased debate about cooperation, alliance, control, and economics. However, these discussions have not progressed among EM followers and, to some extent, not even among TPS followers. This suggests that although the dynamic capabilities approach originated and gained traction in technology-intensive industries, subsequent research addressed dynamic capabilities in other contexts. Papers between 2013 and 2016 also broadened the scope of investigation from a view of cooperation to innovation networks and industry alliances.

Unlike TPS followers, EM followers understood dynamic capabilities as a means of company growth and related these discussions to topics about entrepreneurship, family businesses, SMEs, and ventures. TPS's view of dynamic capabilities was based on large firms and looked to leverage sustainable competitive advantage, while EM's position was to demystify the idea of what dynamic capabilities were; seeking a more straightforward approach focused on best practices would not necessarily guarantee a sustainable competitive advantage. Flexibility in the concept of dynamic capabilities allowed them to be used in various fields. Interestingly, the use of the term "dynamic capabilities" became more pronounced among TPS and EM followers only after 2013 and related mainly to increased trust, control, and risk (Kiessling et al., 2014).

Despite some initial common ground between TPS and EM followers, we notice that the discussions have been diverging in recent years, with researchers who follow the work of TPS continuing to emphasize performance and capability. We also point to discussions about company innovation, including issues of impact, use, relationship, and marketing, with EM followers continuing to discuss company performance and adding market issues. While TPS followers focus more on understanding how dynamic capabilities develop in firms, EM followers are concerned with the impact they have on the market.

SUGGESTIONS FOR FUTURE RESEARCH

Designed initially to explain large firms in a domestic market, the theory has gradually been adapted to explain international markets, small and medium-sized enterprises (SMEs), family businesses, and other organizations. With technological advances, future research should examine how dynamic capabilities perform in new business models. Promising empirical studies include dynamic capabilities and their micro-foundations in new organizational forms (Hannah & Eisenhardt, 2018) and their respective strategies (Ott et al., 2017). In this regard, Teece (2020) points out that the problems faced by innovators in the digital age are different from those observed in the industrial age. Specifically, the author recommends studies to understand how dynamic capabilities are used for designing and implementing these new business models. More recently, technology governance and value have been discussed, which indicates the tendencies and the digital transformation context. Accordingly,

Steininger et al. (2022) suggest there is still a lack of knowledge about the impacts of innovation technology resources on dynamic capabilities. Specifically, the authors point out the lack of understanding with regard to how IT resources might be orchestrated and leveraged to enable dynamic capabilities.

We also realized that the theory has adjusted to incorporate relevant aspects of society in each period over these years. Thus, we suggest studying dynamic capabilities as a grounding theory for understanding how companies can absorb information technology based on big data and artificial intelligence into their operations (Teece, 2020).

Some contexts are still less explored, such as the circular economy and social movements. Lazonick (2018) suggested emphasizing their operations more in institutions and the social context; "A society needs economic growth to have the possibility of raising material standards of living. But it also wants the gains of growth to be equitably shared among economic actors" (Lazonick, 2018, p. 2). Insights into dynamic capabilities suggest new responses to social problems, indicating how social innovation might leverage social transformation.

We also suggest using dynamic capabilities to explain how firms can cope with adaptations to a post-pandemic society centered on remote working, service delivery, and resource concentration. Herrmann et al. (2017) stress that dynamic capabilities create the conditions necessary for organizations to act wherever surprises occur in profoundly uncertain times. Thus, future studies could address how dynamic capabilities contribute toward building resilience and agility in these uncertain environments, considering the current global context.

However, dynamic capabilities are primarily the basis of a theory of competition between firms. Hannah and Eisenhardt (2018) emphasize that firms are embedded in complex ecosystems, which requires them to focus not only on competition but also on balancing their competition and cooperation strategies. Field studies into how these strategies are formed can help explain why some firms take advantage of new opportunities while others fail to do so (McDonald & Eisenhardt, 2020).

While current research, as emphasized by Steininger et al. (2022), predominantly scrutinizes dynamic capabilities from the internal perspective of firms at an organizational level, the escalating competition that transcends organizational boundaries may prompt future studies to shift focus toward exploring these capabilities at a broader macro level. This shift in focus coincides with the persistent examination of firms' international expansion—a longstanding subject within dynamic capabilities research. Notably, recent studies have spotlighted the emergence of dynamic capabilities within "meta-multinational" firms, marking a significant development in the management field (Lessard et al., 2016).

Finally, we suggest extending the analysis of the concept of dynamic capabilities by considering other segments of published work. An interesting possibility would be to create three analysis groups: two for papers exclusively by the seminal authors and one for papers that cite both works to discriminate the differences between the two seminal papers. The extension of the scope could include the most recent articles and Brazilian databases such as Spell and SciELO.

CONCLUSION

This paper mapped out the development of the field of dynamic capabilities, starting with the seminal studies by TPS (1997) and EM (2000) and continuing up to 2020. Thus, we retrieved papers on dynamic capabilities published from 1997 to 2020 and looked for their theoretical affinities with the two studies by TPS and EM.

Articles inspired by the study by TPS published between 1997 and 2020 specifically emphasize discussions about dynamic capabilities, performance, and knowledge management (timeless topics for TPS followers). A micro-perspective is evident, focusing initially on the internal environment, and then is directed toward a macro-perspective centered on the internal and external environment, which emphasizes processes and relationships.

We examined a movement that started in microeconomics and was gradually appropriated by the management field, specifically by strategic management. This movement may have occurred, among other reasons, because of the complexity of current problems and the need to address them, considering the involvement of different dimensions and actors.

Regarding the articles following the study by EM published between 2001 and 2020, we highlight the discussions on knowledge, capabilities, and company performance. As complementary elements, we emphasize the firm growth, a focus on the market, and SMEs. We also observe the recurrent idea of processes and innovation as timeless elements.

The selected papers point to an approximation rather than a contradiction when it comes to the discussions proposed by TPS and EM, showing a complementary perspective. This reflects a maturing of the area, pointing to a direction still beset by a context of uncertainty and change. The most recent publications indicate a movement to value relational issues, following a path of collective construction and paying less attention to the firm in isolation. These collective strategies avoid risk and search for answers to uncertainties. We highlight studies on collaborative strategies, alliances, networks, learning, and knowledge management, which point to establishing relationships of trust among the different stakeholders. These studies focused more on cooperation than on competition.

In summary, our theoretical contribution is based on a discussion of the most relevant findings that enable scholars to (1) understand the consolidation of the field of dynamic capabilities based on the thoughts of the authors following both TPS and EM; (2) know the core elements involved in dynamic capabilities over the last years; (3) set out the original and current concepts referring to dynamic capabilities; and (4) indicate tendencies in the field and a possible future agenda.

In addition to the theoretical contributions, we also point out the methodological contributions attributable to artificial intelligence tools (LDA algorithm for topic modeling, data analysis, and natural language processing). These tools have effectively analyzed large volumes of information (in this case, published papers). We believe that using the proposed methodology may inspire future studies in management that seek to analyze the consolidation of the field, distinct groups of approaches, and theoretical paths.

Finally, there are limitations in how we approach the field. The research was guided by two seminal papers (TPS and EM) due to their unquestionable contribution and influence. However, other authors have contributed to the discussion on dynamic capabilities and created their own paths, which were not addressed in this study. Therefore, future studies on this topic should consider these other influences.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

AUTHORS' CONTRIBUTION.

Claudia Bitencourt: Conceptualization, data curation, formal analysis; Investigation; Methodology; Validation; Visualization; Writing – original draft; Writing – proofreading and editing.
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