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ARTICLE

# Microfoundations of innovation capability creation in organizations: the role of learning, cognition, and routine

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*Abstract*

Scholars and managers have discussed the best ways to create organizational capabilities. This study engages in this discussion by examining the microfoundations of innovation capability creation through routine, cognition, and learning. The research consists of a systematic literature review on the issue and a multiple case study. The review analyzed 18 articles published between 2013 and 2022, identified through a search on the Web of Science and Scopus databases. The multiple case study was prepared with data from five science-based startups, collected through 14 interviews with their founders and managing partners. The systematic review of literature allowed us to identify the microfoundations of learning, cognition, and routine, establishing an organized view of the process of innovation capability creation and offering contributions to both the literature and practice. This study contributes to the discussion on innovation capability creation by clarifying which microfoundations are essential in this process, providing scholars with a useful framework, and offering practitioners a clear view of three microfoundations that support decision-makers interested in the issue. Furthermore, the research presents a set of microfoundations that reflect how technology-based companies create capabilities.

**Keywords:** Strategy. Microfoundation. Innovation capability creation.

## *Microfundamentos da criação de capacidades de inovação nas organizações: o papel da aprendizagem, cognição e rotina*

*Resumo*

Acadêmicos e gestores têm discutido as melhores formas para criar capacidades organizacionais. Portanto, para abordar este assunto, propomos a questão de pesquisa: Quais são os microfundamentos da criação de capacidades de inovação? Este estudo tem como objetivo compreender os microfundamentos da criação de capacidades de inovação por meio da rotina, da cognição e da aprendizagem. O método utilizado foi de revisão sistemática da literatura combinada com um estudo de casos múltiplos. Os autores revisaram a literatura para analisar a pesquisa existente sobre os microfundamentos da criação de capacidade de inovação. A amostra final do estudo incluiu 18 artigos publicados entre 2013 e 2022, utilizando as bases de dados Web of Science e Scopus. Para o estudo de casos múltiplos, coletamos dados de 5 startups de base científica, entrevistamos seus fundadores e sócios-diretores, totalizando quatorze entrevistas. Por meio da revisão sistemática de literatura encontramos os microfundamentos aprendizagem, cognição e rotina. Este resultado estabeleceu uma visão organizada sobre o processo de criação de capacidades de inovação, trazendo ao público reflexões sobre a contribuição para a literatura e a prática ao mostrar os microfundamentos. Este estudo contribui para a discussão sobre a criação de capacidades de inovação, procurando esclarecer quais microfundamentos são essenciais na criação de capacidades, fornecendo aos estudiosos uma estrutura útil e, para os profissionais, fornecemos uma visão clara de três microfundamentos que apoiam os tomadores de decisão para melhorar o processo criativo e inovador. Além disso, os autores apresentam um conjunto de microfundamentos que representam como as empresas de base tecnológica criam capacidades.

**Palavras-chave:** Estratégia. Microfundamentos. Criação de capacidade de inovação.

## *Microfundamentos de la creación de capacidades de innovación en las organizaciones: el papel del aprendizaje, la cognición y la rutina*

*Resumen*

Académicos y directivos han debatido las mejores formas de crear capacidades organizativas. Por lo tanto, proponemos la pregunta de investigación: ¿Cuáles son los microfundamentos para la creación de capacidades de innovación? Este estudio tiene como objetivo comprender los microfundamentos de la creación de capacidades de innovación a través de la rutina, la cognición y el aprendizaje. El método utilizado fue una revisión sistemática de la literatura combinada con un estudio de casos múltiples. Los autores revisaron la literatura para analizar la investigación existente sobre los microfundamentos de la creación de capacidades de innovación. La muestra final del estudio incluyó 18 artículos publicados entre 2013 y 2022, utilizando las bases de datos Web of Science y Scopus. Para los múltiples estudios de caso, recopilamos datos de cinco startups con base científica, y entrevistamos a sus fundadores y socios gerentes, totalizando catorce entrevistas. A través de la revisión sistemática de la literatura encontramos los microfundamentos del aprendizaje, la cognición y la rutina. Este resultado estableció una visión organizada del proceso de creación de capacidades de innovación, llevando al público reflexiones sobre la contribución a la literatura y la práctica mostrándole los microfundamentos. Este estudio contribuye a la discusión sobre la creación de capacidades de innovación al buscar aclarar qué microfundamentos son esenciales en la creación de capacidades, proporcionando a los académicos un marco útil, y a los profesionales les brindamos una visión clara de tres microfundamentos que apoyan a los tomadores de decisiones para mejorar el proceso creativo e innovador. Además, los autores presentan un conjunto de microfundamentos que representan cómo las empresas de base tecnológica crean capacidades.

**Palabras clave:** Estrategia. Microfundamentos. Creación de capacidad de innovación.

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## INTRODUCTION

As a movement, the microfoundations of organizational capabilities has attracted the attention of strategy researchers. We understand microfoundations to be decision-making processes and practices conducted by individuals and groups (Melin & Whittington, 2003). One stream of the literature on microfoundations aims to explain how companies create capabilities that drive superior performance (Morris et al., 2014). As a self-described peripheral stream, it claims that little attention is given to the microfoundations that drive or restrict organizational routines and capabilities (Eggers & Kaplan, 2013; Felin et al., 2015). Investigating the microfoundational level is essential in describing the interpretations, actions, and interactions at the individual level together with the structures that sustain organizational capabilities (Felin et al., 2012).

However, there is still no consensus on the specific microfoundations for the creation of innovation capability (Furr & Eisenhardt, 2021; Furr et al., 2020). Although there has been an evolution of understanding about the role of microfoundations in strategy (Foss & Pedersen, 2016; Furr et al., 2020), there has been no unified effort to identify what these specific microfoundations are. For example, some articles have analyzed the creation of internationalization capabilities (Bingham et al., 2019), and others the microfoundations of routine and cognition (Wojcik et al., 2022), but it is not clear what the specific microfoundations of innovation capability creation are. It is necessary to understand these particular microfoundations, as implementing new organizational strategies depends on innovation capabilities (Govindarajan & Trimble, 2015; Rajapathirana & Hui, 2017), as does the growth of an enterprise. Therefore, we set out to answer the following question: What are the microfoundations of innovation capability creation?

To address this question, we prepared a study in two stages: 1) a systematic review of the literature covering academic articles from the Scopus and Web of Science databases and b) a multiple case study with primary data collection. As the main results, the article identified three microfoundations of innovation capability creation: learning, cognition, and routine.

The article's contributions lie at the intersection between the literature on innovation capability creation and on microfoundations. The three microfoundations of creation capabilities conceptualized in this study complement previous studies that explain the process of the creation of internationalization capabilities (Bingham et al., 2019). The present study's results also provide a structure for the microfoundations of creating capabilities (Wojcik et al., 2022), organizing them into the elements of learning, routine, and cognition. In addition to operationalizing the creation of innovation capabilities, our conceptual framework contributes to strategy research interested in the role of microfoundations (Foss & Pedersen, 2016; Furr et al., 2020) by making it possible to theorize how microfoundations act in the creation of innovation capability. Through this lens, it is possible to study the different configurations between the three identified microfoundations.

Moreover, we contribute to practitioners by describing how the microfoundations of creating capabilities work in practice, reducing the risk of innovations becoming obsolete because they are not integrated into organizational routines. This article thus helps managers identify which elements are needed to transform innovation projects into established capabilities and avoid the valley of death.

## OVERVIEW OF THE MICROFOUNDATIONS OF INNOVATION CAPABILITIES

The concept of the microfoundations of capabilities has gained strength in studies on strategy, resources, and capabilities investigating how companies create or develop capabilities at the micro level. For Felin and Foss (2005), capabilities at the micro level represent the actions of individuals and groups that create and shape capabilities that can lead to superior performance.

The concept of microfoundations has been used to describe interpretations at the individual level that underpin a company's capabilities (Felin et al., 2012). Microfoundations are a central subject of strategy research because they explain the creation of capabilities (Bingham et al., 2019). In this sense, we understand that organizational analysis must be fundamentally concerned with how individual factors are added to the collective level (Barney & Felin, 2013). In the resource-based view (RBV) (Barney, 1991) and its extensions in the capabilities-based view (CBV) (Teece et al., 1997; Helfat et al., 2007), capabilities


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are the central element that promotes a sustainable competitive advantage. In this context, capabilities are understood as the skill to manage the fusing of resources and processes with a specific purpose (Helfat et al., 2007). Capabilities are created in firms through the influence of individuals' cognition within the routine actions of the organization (Bingham et al., 2019). Given this conceptualization, microfoundations can explain why and how capabilities are created.

The central premise of RBV is the heterogeneity of resources and capabilities. The source of competitive advantage stems from the heterogeneity of resources and capabilities because of path dependence, the complexity of the arrangement of resources, and access to resources (Barney, 1986). Thus, if we want to deeply understand this heterogeneity, we need to look at the microfoundations. In the sense that people matter, it is possible to contextualize how microfoundations act in the context of companies' strategies; however, it is necessary to clarify that microfoundations should not be classified mistakenly as psychology, human resources, or a study of micro-organizational behavior (Barney & Felin, 2013). Rather, microfoundations are a matter of understanding the nature, choices, and motivations of people and groups to formulate and execute strategies (Felin & Foss, 2005). This means that from a RBV and CBV perspective, microfoundations can explain capability creation in an organization.

In the literature, the effort to map the microfoundations of capabilities is diverse and is not necessarily oriented toward explaining the creation of innovation capabilities. There are studies aiming to better understand the microfoundations of capabilities, such as the work of Helfat and Peteraf (2015), who studied the microfoundations of managerial cognitive capabilities. In the same vein, Felin and Foss (2005) explained the microfoundations of competitive advantage. In the stream of literature more focused on application, there are studies discussing the impact of microfoundations on learning capabilities (Greve, 2013), adaptive capabilities (Aggarwal et al., 2017), absorptive capabilities (Messina et al., 2022), crowdsourcing capabilities (Lüttens & Piller, 2019), and internationalization capabilities (Bingham et al., 2019). Of that range of applied studies, only the last (Bingham et al., 2019) is strictly focused on the creation of capabilities. The contribution of Bingham et al. (2019) is especially important in explaining the phases of creation capabilities and the role of microfoundations. However, the lack of a structure around which to organize microfoundations prompts us to investigate the microfoundations of creating innovation capabilities.

## METHODOLOGY

This research was carried out in two stages. First, we prepared a systematic review of the literature, and second, we carried out a multiple case study approach with primary data collection. The triangulation of the literature review data with the data obtained in the case studies made it possible to establish the credibility of the results.

### Systematic review of the literature

Unlike a traditional narrative review, a systematic review is the subject of comprehensive research (Tranfield et al., 2003) and must be transparent. Furthermore, since the focus of the review may change over time, it is essential that the authors explain how and why the topic is addressed. In this sense, a review plays a key role in supporting later studies (Hart, 1998). Therefore, in the following we describe the steps taken to conduct the literature review.

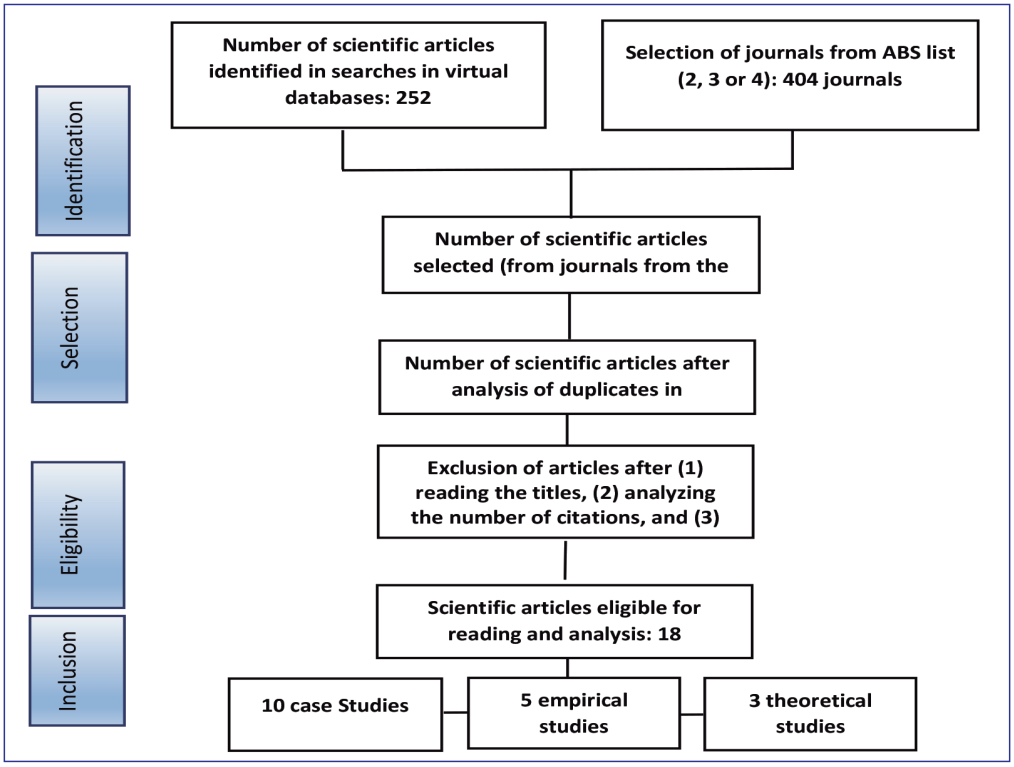
In the first stage of the systematic review, only journals on strategy and innovation with a classification of 2, 3, or 4 according to the Chartered Association of Business Schools (ABS) list were selected. This yielded a total of 404 journals to be used as the basis for selecting articles. In the second stage, the Web of Science and Scopus databases were consulted, as they are known for great reliability in the quality of scientific production for the researched theme. For the database research, the following keywords and Boolean operators were used: "capabilit*" and "microfoundation*" and "creation" or "formation" or "shaping" or "development" or "constitution" or "build." The database searches were limited to articles published since 2011. As a result, 84 documents were found in the Scopus database and 252 in the Web of Science database. In both databases, the search was limited to the areas of "business," "management," "accounting," "economics," "finance," and "social science."

After removing articles from journals not on the ABS list, 39 articles from the Scopus database and 97 from the Web of Science database remained. This amount was further reduced after eliminating duplicates between the two databases, resulting in 119 articles. However, not all articles were aligned with the theme of this study, so the authors performed a series of steps to obtain a final corpus of texts: 1) we read the titles of the articles to evaluate their alignment with the theme; 2) we analyzed the relevance of each article in terms of the number of occurrences it was cited; 3) we analyzed the summaries of the articles and their alignment with the systematic review; and 4) we read all selected articles and removed any non-aligned articles.

The final corpus contained 18 selected articles, including 10 case studies, 5 theoretical-empirical articles, and 3 conceptual (theoretical) articles. These articles were classified and archived in a digital folder. The result of this structuring is summarized in the figure below, which follows the orientation steps of the PRISMA protocol. Later in the review process, we performed content analysis based on themes and topics where, based on the reading of different texts on related content, we could triangulate the findings, allowing us to find patterns in the theory and form our conceptual model.

**Figure 1**

**Flowchart of identification and selection of articles for the systematic review**




Source: Elaborated by the authors.

The content was analyzed qualitatively, with a focus on the trends of the publications on the theme of interest. Through the initial analysis of keywords, it was possible to verify the evolution of publications over time, including terms, proposed models, and the most studied categories in the capabilities field. From reading the articles, categories of capabilities were identified that illustrate how the creation of innovation capabilities has been analyzed in the literature, highlighting trends and opportunities for future research.

Microfoundations studies provide inputs for various aspects of resource and capability research. After fully reading and analyzing the 18 articles, the authors identified three microfoundations of innovation capability creation: learning, cognition, and routine. All the selected articles addressed at least one of these microfoundations. The following table summarizes the microfoundations of creating capabilities identified in the literature. The analysis of each microfoundation is reported below.

**Box 1**
**Microfoundations of innovation capability creation in the studied literature**

| Author/ Year | Learning | Cognition | Routine |
|---|---|---|---|
| Morris et al. (2014) | • Transfer of knowledge from contacts outside the organization<br>• Sources of codified knowledge<br>• Documented and archived information<br>• More tacit social interaction<br>• Adaptation of knowledge | | • Process coding<br>• Coordinated activities at the team level<br>• Standardized routines<br>• Higher order routines |
| Zeng et al. (2017) | • Capability development<br>• Knowledge coding<br>• Skills and knowledge<br>• Unlearning to renew knowledge | • Cognitive reframing | • Capabilities take higher precedence than routines |
| Messina et al. (2022) | • Previous experiences<br>• Development of entrepreneurial behavior<br>• Accumulation and transformation of knowledge<br>• Continuous learning routines | • Cognitive reformulation | • Entrepreneurial routines<br>• Searching knowledge routines |
| Ford and Friesl (2019) | • Interactions at the individual level<br>• Coordinated interaction | • Cognition of capability level<br>• Managerial cognition<br>• Individual abilities | • Development and orchestration of routines<br>• Assembly of routines |
| Aggarwal et al. (2017) | • Learning based on individual performance feedback<br>• Interdependent individuals in an organizational environment<br>• Tacit knowledge | | • Constancy<br>• Organizational memory<br>• Construction of routines<br>• Coordination of individuals' actions |
| Wojcik et al. (2022) | • Engagement by a company as a stimulating factor for the acquisition of knowledge<br>• Creativity and innovation<br>• Stakeholders as a source of useful complementary tacit knowledge<br>• Experiential learning<br>• Vicarious learning<br>• Acquisition, codification, and knowledge integration | • Cognitive abilities and motivations<br>• Emotional stability | |
| Azzam (2018) | • Cooperation within the company<br>• Empirical communication<br>• Knowledge accumulation | | • Managing interactions with multiple stakeholders<br>• Interaction mechanisms |
| Dixon et al. (2014) | • Knowledge acquisition<br>• Knowledge internationalization<br>• Knowledge dissemination<br>• Learning by experimentation | | • Exploration of routines<br>• Implanting routines<br>• Involvement of routines |

*(Continue)*

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| Author/ Year | Learning | Cognition | Routine |
|---|---|---|---|
| Bingham et al. (2019) | • Experiential knowledge<br>• Heuristics learned through experience | • The influence of individual cognition affects the company's capability performance of mental activities such as perception, attention, and problem solving | • Routines as a pattern of actions<br>• Variation reduction with routine – repeatability<br>• Task performance<br>• Formation of routines |
| Eggers and Kaplan (2013) | Experiential learning | • Experience encoded and selected in organizational memory<br>• Cognitive dynamics of construction, maintenance, and matching capabilities | • Environment interpretation; routines as building blocks of capabilities |
| Felin and Powell (2016) | • Individual knowledge<br>• Experience meeting<br>• Experience<br>• Conversion of individual knowledge into collective knowledge | | • Formal processes as routines |
| Liu et al. (2023) | • Experience<br>• Knowledge exploration<br>• Implicit knowledge<br>• Recombination of knowledge<br>• Stored knowledge | • Norms of tacit decisions<br>• Microfoundations of dynamic capabilities<br>• Analytical and tacit mental processes<br>• Norms of decision-making for cognitive abilities | • Transformation of inputs into outputs (process) |
| Mazzuchelli et al. (2019) | • Knowledge sharing at the individual level<br>• Engagement<br>• Experience | • Individual creativity<br>• Individual skill | • Generation of routines |
| Pollok et al. (2019) | • Articulation of knowledge<br>• Knowledge sharing<br>• Individual knowledge<br>• Experience<br>• Knowledge coding<br>• Tacit knowledge | | |
| Schriber and Lowstedt (2015) | • Integration of knowledge<br>• Accumulation of knowledge | • Generation of ideas<br>• Validation of ideas | • Organizational routines that constitute capabilities;<br>• routines for the generation of ideas; |
| Davies et al. (2019) | • Experiential learning | • Cognitive learning (generating and evaluating analyses)<br>• Prospective rationality (evaluation of alternatives) | • Creation of new routines<br>• Adequacy of existing routines<br>• Changing routines |
| Felin et al. (2015) | • Set of processes<br>• Tasks<br>• Systematic behavior | • Management cognition<br>• Rationality<br>• Individual differences<br>• Individual learning | • Competences<br>• Abilities<br>• Aggregated information |

*(Continue)*

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| Author/ Year | Learning | Cognition | Routine |
|---|---|---|---|
| Roscoe et al. (2019) | • Human interactions (source, development, and knowledge transfer)<br>• Learning routines<br>• Co-creation<br>• Troubleshooting | | • Operational routines<br>• Processes together with structure generating new operational routines |

Source: Elaborated by the authors.

## Multiple case study

In addition to the systematic literature review, we carried out a multiple case study approach. Although previous studies have set out to analyze the microfoundations of the creation of organizational capabilities (Furr & Eisenhardt, 2021; Furr et al., 2020), these studies did not comprehensively identify the specific microfoundations involved in this process. Therefore, given the scarcity of primary data on the creation of innovation capabilities from a well-defined microfoundations perspective, a qualitative research method was suitable for the present study (Eisenhardt, 2019; Gehman et al., 2018). Furthermore, we adopted a retrospective approach (Bingham et al., 2019), allowing data collection from past events and observations. We also adopted a multiple case study approach, analyzing both within and between cases (Eisenhardt & Graebner, 2007).

## Data selection

To conduct the case study, we carried out primary data collection. Consistent with previous studies, we sought to intentionally select science-based startups that could enlighten us about our research question (Bingham et al., 2019; Ott & Eisenhardt, 2020). We then selected a set of deep tech startups in which we could observe the phenomenon of the microfoundations of creating innovation capabilities. One of the criteria for the startups was that they were companies that were already systematically marketing their solutions, as that would enable the observation of how innovation capabilities were created. To establish a strong connection between our research question and conceptual framework, we also established other criteria for the selection of our sample.

**Box 2**
**Details of the cases**

| Cases | Description | Interviews | Founded in |
|---|---|---|---|
| Case 1 | Manufactures medical devices for non-invasive intracranial pressure monitoring | 4 | 2014 |
| Case 2 | Manufactures equipment and provides solutions for agribusiness, using pioneering technology in nuclear magnetic resonance | 3 | 2006 |
| Case 3 | Manufactures chemical products for coating surfaces using nanoparticle technology | 2 | 2015 |
| Case 4 | Provides space services for monitoring and predictability in agriculture | 3 | 2022 |
| Case 5 | Uses artificial intelligence to generate data in the field, support decision-making, optimize processes, reduce costs, and increase productivity | 2 | 2017 |

Source: Elaborated by the authors.

First, we selected organizations characterized as deep tech. Deep techs are organizations driven by scientific discovery and technological advancement (Rotolo et al., 2015). These companies are dependent on high investments in scientific research (Chaturvedi, 2015) and aim to produce technological solutions fraught with high uncertainty regarding their commercialization and impact (Siegel & Krishnan, 2020). Second, we selected a set of organizations where the phenomenon of invention and its subsequent commercialization was present, as well as cases in which the creation of innovation capabilities could be observed. Third, from these deep tech companies, we selected organizations that had actively undergone an incubation, acceleration, or training program focused on scientific business. Additionally, we focused on native science organizations, those founded by entrepreneurs guided by academic research or managing partners focused on producing discoveries arising from radical science.

Cases 1, 3, and 4 involved innovations founded by master's and doctoral students at the University of São Paulo, the Federal University of São Carlos, and the Aeronautics Institute of Technology (ITA). In one case, the CEO lived at his academic advisor's house for three years while earning a master's degree in mechanical engineering and was hired to help his academic advisor to create medical equipment that would help treat a serious illness that the advisor suffered from. His master's thesis had the specific objective of creating the equipment, describing the role of learning in the process of creating an innovation capability. To diversify the sample, we considered cases in which the founders had support from managing partners or shareholders who are not necessarily scientists; this allowed us to verify how managerial skills could play a role in creating innovation capabilities. Furthermore, we predominantly selected cases related to more radical innovations, something that is characteristic of the creation of innovative capabilities. Based on these criteria, we selected deep tech startups from different sectors and ranging in size from five to 60 people.

## Data collection

Regarding the interview methodology, we chose to use semi-structured in-depth interviews. The initial interview protocol was the same for all interviews but respected the individuality of each case and considered the specific characteristics of each organization. The interviews lasted 50 to 70 minutes, totaling approximately 840 minutes of recordings. When selecting interviewees, we chose the founders, as these individuals created and/or developed the observed innovations. Furthermore, we used the snowball technique, a common method in non-probability samples, asking the founders to suggest others who could provide more useful data on our research question. Following Creswell (2009) and Ott and Eisenhardt (2020), we triangulated the different data sources to obtain evidence to corroborate the credibility of the study, such as reading the doctoral theses of one of the interviewees.

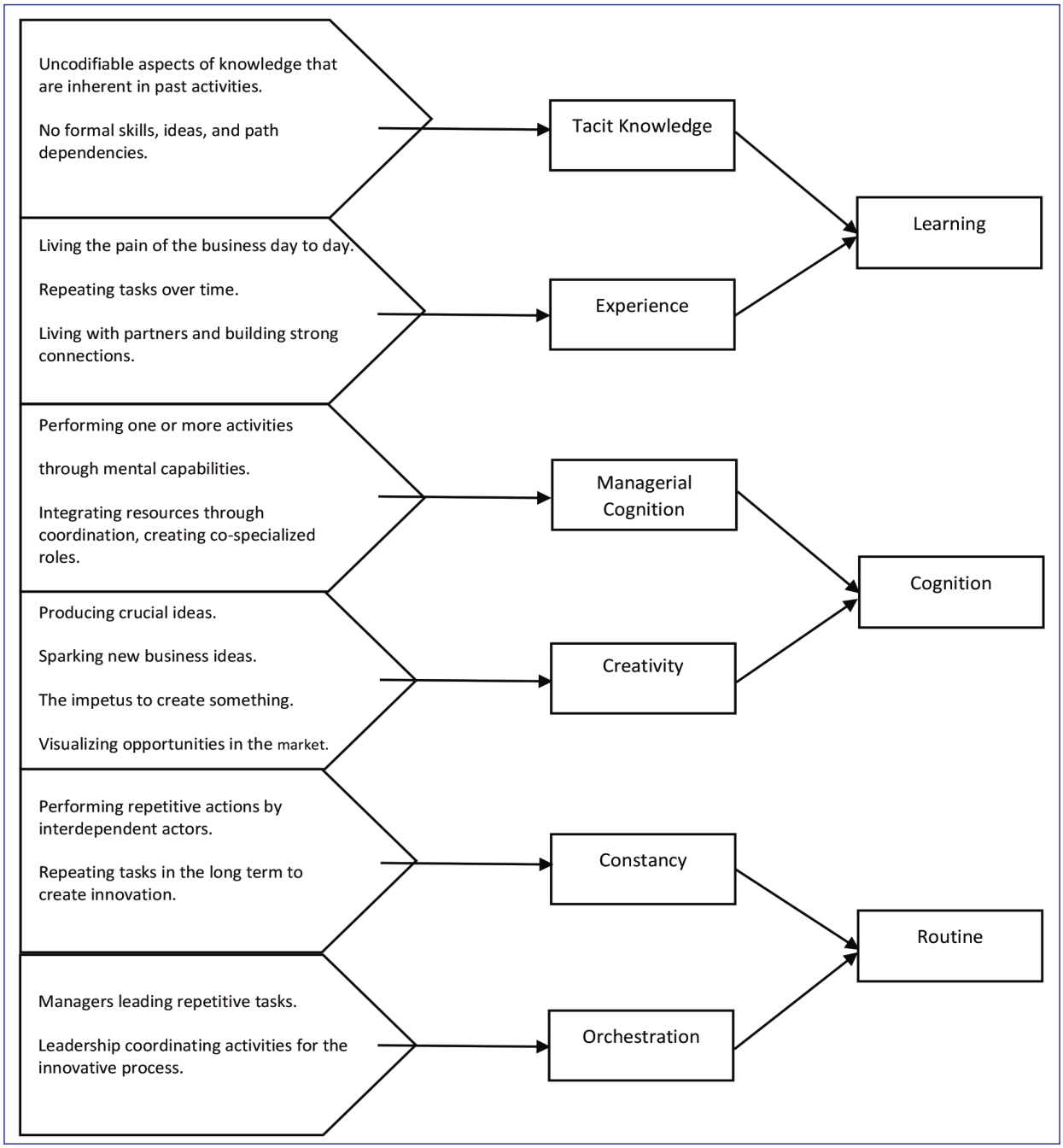
## Data analysis

In our data analysis, we adopted an analysis structure using different techniques. We first carried out a systematic review in which we analyzed secondary data, and then we carried out primary data collection and subsequent analysis, which brought greater robustness to the first analysis. In this sense, we carried out a multiple case study to code and analyze the data collected in the field. Our data analysis, therefore, consisted of three distinct stages: (1) carrying out the systematic literature review (as described earlier), (2) constructing each organization's case, and (3) coding and analyzing the interviews to corroborate the existence of the microfoundations found in the systematic literature review. The second stage comprised the synthesis of interview data and the construction of individual case stories. Such stories help to organize the narratives and integrate the cases, which allows for a more integrated and logical view.

Triangulating and combining different data sources allowed us to produce a more accurate account of the creation of innovation capabilities. We then used an open coding approach (Gehman et al., 2018). Open coding allows researchers to analytically decompose the data, generating an interpretative process (Strauss & Corbin, 1998). To conceptualize the events, acts, and results, we created the initial open codes by examining the phrases and words of the interviewees. After creating the first-order codes, we identified the correlation between our conceptual structure and the codes, linking each microfoundation to evidence found in the cases analyzed. Furthermore, we built a conceptual framework for each microfoundation, combining the data found in the systematic review with the primary data collected in interviews. Additionally, we structured a code tree with a robust set of constructs and their constitutive themes (Figure 2).


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**Figure 2**
**Code tree**




Source: Elaborated by the authors.

## FINDINGS

This study set out to address the research question, what are the microfoundations of creating innovation capabilities? To answer this, we present below the results based on the interaction of the systematic review and the case study. The results identify the three microfoundations of creating innovation capabilities: learning, cognition, and routine. We present how these microfoundations emerged from the combination of the literature review and case studies. Whenever we cite the literature, our results come from our coding of the literature review. In turn, we triangulated this finding with the case study results.

## Learning microfoundation

One of the microfoundations found in the literature was the construct of learning. We understand the microfoundation of learning in terms of two categories, namely tacit knowledge and experience.

Tacit knowledge is an uncodifiable aspect of knowledge (Nonaka & Takeuchi, 1996). It encompasses the skills, ideas, and path dependencies that people have in mind and are difficult to access (Wang & Chugh, 2014). It is a type of knowledge that is learned and difficult to transfer (Pollok et al., 2019). Once tacit knowledge is inherent to individuals and teams, it operates on the micro level, unpacking the macro regularities that are observed in the innovation capability literature (Morris et al., 2014). Tacit knowledge is useful for addressing claims and for problem solving (Wojcik et al., 2022).

In line with Barney and Felin (2013), we found examples of information and knowledge not being possessed by the company per se, but by the individuals acting within it. In Case 1, tacit knowledge was acquired at a given moment and remained inherent to the individual or team. The two partners interviewed in this case were executives from a large consulting company (commonly called the Big Four) who had worked for years on strategic management projects. They mentioned that after leaving the large consulting company, they implemented a management model for their startup that was inherent to them, drawing on their own knowledge to solve the problem they faced at the time, that is, managing the company itself. For example, one partner told us that "this management model that we used for our clients, we incorporated and had to adapt to the startup model." We observed the same pattern in Case 5, where we identified a similar process of creating knowledge that was difficult to codify. For example, the founding partner explained that "we started by starting our own business and learning, so there were no real frameworks until today. There aren't many frameworks for venture building, but now some are starting to emerge. So, we created ours, we actually created the method." The literature review findings, together with the tacit knowledge examples from the cases, show the importance of this non-formal aspect of knowledge and how it can be carried within individuals or teams to create innovation capability.

Experience is the second category of the microfoundation of learning. Experience is an instrument of organizational intelligence that allows individuals to learn through the repetition of tasks, allowing them to gain knowledge and transfer the lessons of experience (March & Levinthal, 1993). Experience is a fundamental category to assemble resources and capabilities within strategic management, as it is the source of the organizational capability building blocks (Bingham et al., 2019; Eggers & Kaplan, 2013). The absorption, adaptation, and reformulation of entrepreneurial behavior are all built with experience (Eggers & Kaplan, 2013). Additionally, previous experiences complement an extensive search for additional knowledge in the market and its transference (Messina et al., 2022).

Our data collection provided a range of examples of the microfoundation of learning via experience. Case 1 represents the success of a startup that was born out of the desire of a physics professor who suffered from an illness. As he was opposed to having his head evaluated with invasive methods, he hired an engineering intern and mentored an engineering student (now the CEO of the company) to develop equipment that could perform non-invasive analyses. In this case, the experience of spending 24 hours a day with both the problem (illness) and the co-creator of the process (professor) played a fundamental role in creating the startup's innovation capability. For example, when asked about his relationship with his advisor, the company's CEO told us that he lived in his advisor's house for three years. In Case 2, the founder explained that she studied biotechnology in the first biotechnology course in Brazil. Afterwards, she completed an internship in a federal university in the state of Rio de Janeiro involving a project on bone marrow transplantation. She spent 10 years working on this project and completed her master's degree in the process. This experience gave rise to her startup's main innovation capability.

Case 5 also provided evidence of the importance of experience in creating innovative capabilities, but together with the possibility of building strong connections with partners. Since one of the founders had a background in mechatronics engineering, he was bothered by the fact that the country did not have an area focused on innovation design and decided to study at an engineering school in France for a year and a half. It was a similar path taken by his partner, who took a course at the same time in social innovation design at MIT. Experience impacts not only technology but also connections in the establishment of innovation capability. Case 4 illustrates this aspect, too. In Case 4, the CEO mentioned, "The company emerged when I was actually working within the space center of the aeronautical technology institute. I previously worked on space missions,

so I had already worked on three Brazilian space missions (Alpha, Beta, and Gamma), which are still in progress." From this experience she also met her partner: "And then my partner, he was my intern at the space center." The literature review findings, together with the experience-related examples from the cases, clearly illustrate how experience is a fundamental tool in the learning process, where individuals learn from experience to foster the capability for innovation.

However, it is important to highlight that the two categories of this learning microfoundation (tacit knowledge and experience) can be analyzed both separately and in combination. Wojcik et al. (2022) addressed the importance of tacit knowledge and vicarious learning (experience) for the development of dynamic capabilities. In addition to citing tacit knowledge in capability development, Pollok et al. (2019) added the articulation of knowledge and experience as fundamental pieces in this process. In this way, the learning microfoundation can lead a company to develop innovation capabilities that create value not only for the company, but also for stakeholders and society (Pucci et al., 2020).

## Cognition microfoundation

Another of the microfoundations found in the literature was the construct of cognition. We understand cognition as a microfoundation that can be divided into two categories, namely managerial aspects and creativity.

The managerial aspect of cognition is the ability of an individual manager to perform one or more of the necessary mental activities (Helfat & Peteraf, 2015). The cognitive mechanism has a crucial coordinating role through which actors can anticipate outcomes, create co-specialized roles, and integrate resources. For Helfat and Peteraf (2015), innovation capability creation involves an assembly of resources supported by managerial cognition. Eggers and Kaplan (2013) emphasize the creation of managerial cognitive abilities, arguing that interpretations of the environment shape organizational responses.

Concerning managerial aspects, Case 2 suggested that the partners and founders coordinate the startup's decisions, saying, "Today strategic decisions are taken to the board and of course, we determine it." The CEO of this startup is the individual who developed the magnetic resonance equipment with nuclear technology; he is also the one who leads the team and coordinates the company's innovation. In Case 4, the CEO referred to the challenge of providing direction and motivation so that the "team doesn't get lost along the way."

On the other hand, Case 5 made an essential contribution to our theorizing on the managerial aspect of the cognition microfoundation. This company, a venture builder that creates startups in collaboration with researchers, informed us about the pitfall of scientists becoming comfortable just developing the technology, without worrying about issues underlying the company's management. One of the founders made it clear that for innovation to be successful, the partner scientist needs to understand that they are building a business because they are not just in the laboratory making technology; they are doing business. This corroborates the managerial aspect of the cognition microfoundation whereby the company, through individuals and their mental capabilities, perform one or more activities (Ford & Fiesl, 2019) that create innovation capabilities.

Creativity is another category of the cognitive microfoundation. Creativity plays a vital role in creating innovation capabilities. Therefore, we define creativity as the use of the mind (Taggar, 2002) to produce original and elegant solutions (Besemer & O'Quin, 1999) to ill-defined or ill-structured problems (Mumford & Gustafson, 2007). In the process of creating something new, the ability of individuals to produce ideas is crucial for the development of innovation (Mazzuchelli et al., 2019). In this sense, the role of managers is critical (Andreeva & Kianto, 2012), as it is necessary to nurture innovation via creativity. Bingham et al. (2019) examined how individuals affect the capabilities of a company, and Mazzucchelli et al. (2019) explored the role of individual creativity and skill in the cognition of individuals.

In Case 1, the former intern (now CEO) of the startup reported that when his academic advisor hit his head in a fall and refused traditional methods of verifying his intracranial pressure, the advisor had the idea of creating equipment that could take the measurements he needed by non-invasive means. This notion led him to devise equipment that could measure, without drilling into his head, the pulsation in his skull, after concluding that "the skull expands." As one of the interviewees mentioned, the professor "in 2005 asked a question about a disease, and, in 2007, he discovered that he had hydrocephalus and not Parkinson's; he went after it to find out why and began to question the doctrine that the skull is rigid and does not expand." This spark of creativity was what allowed the then-student and intern, now CEO, to work on developing the equipment.

In Case 3, the founder of the startup that produces nanocoating told us that he and his academic advisor saw that there was an opportunity to produce nanomaterials to fill the industry's demand. However, they did not know what to do at first with the nanomaterials they were developing, until they came up with the idea of not selling nanomaterials but rather producing a more "market-ready" product. They carried out a test in the medical field and developed the startup's first product.

Similarly, in Case 4 creativity played an important role in the ideation and creation of innovation. The company's partner and the founder were very good friends. She was his laboratory advisor, and thanks to their good relationship, they decided to open a company based on "the impetus to create something new to bring innovation and our passion for the space area." It was within the Aeronautics Institute of Technology, immersed in technology and close to several professors with doctorates, that they were able to come up with the idea for the business. The idea arose from brainstorming, which culminated in the idea of the final application of the technology in the space area.

The cases above illustrate how the categories of managerial aspects of cognition and creativity make up the microfoundation of cognition. These categories allow individuals to produce ideas that play a leading role in innovation development.

## Routine microfoundation

Another microfoundation found in the literature was the construct of routine. We understand routine as a microfoundation composed of two categories: constancy and orchestration.

Constancy can be defined as repetitive, recognizable patterns of interdependent actions carried out by multiple actors (Feldman & Pentland, 2003). Research treats routines and capabilities as central constructs in management (Felin et al., 2012). Due to the heterogeneity of cognitive skills in the dynamics of companies (Helfat & Peteraf, 2015), routines play a prominent role in organizational and competitive analysis. Routine is presented, therefore, as a support for the firm through individual repetitive actions. In terms of microfoundations, the literature indicates that authors have given more and more attention to individual routines. Aggarwal et al. (2017) explain that routines come from constancy and the coordination of individuals' actions.

The constancy of individual actions for organizational purposes reflects the microfoundation of the routine. In Case 1, the business idea and the motivation to transition from the academic world to the business world with the creation of the startup arose from the constancy created by the partners. One of the partners went to the United States after the startup was selected in an acceleration program. He spent 12 weeks in San Francisco interviewing people, dedicating that time to a constant task that led to interviews with 100 people who structured the company. As he put it, "The basis of what our company is, was born there." Similarly, Case 3 illustrates how routine influenced the creation of innovation capability. The founder told us that they started by applying nanomaterials to a few pieces a day (20 to 30) until reaching an average quantity of 2,000 pieces a day, improving the processes and the technology itself. Regarding this development, the interviewee said, "The biggest challenge was how to expand this to several pieces a day, right? We made some validation pieces there, 20, 30 pieces a day and today we are making, as I said, two, three thousand pieces." In Case 2, constancy has helped in the process of radical innovation. The interviewee mentioned that when the company needs to increase the number or types of equipment in magnetic fields, managers seek to restructure the application areas, dividing responsibilities and trying to "rationalize as much as possible," maintaining strategic planning with a well-defined focus.

Orchestration is the other part of the microfoundation of routine. The literature defines orchestration as the repeatability of tasks and the performance of functions through the leadership of a manager (Helfat & Peteraf, 2003). Orchestration routines affect the creation of innovation capabilities, since it is an individual function of a manager to coordinate different tasks that culminate in obtaining innovative capabilities. For example, a task is orchestrated for innovation when a manager endowed with knowledge about the technology drives the team to develop a capability. Morris et al. (2014) researched the positive influence of routines and the coordination of activities at the team level under dynamic and transnational capabilities. Bingham et al. (2019) consider the coordination of routines as patterns of action that reduce variability by developing repeatability. These research perspectives suggest that orchestration is the lynchpin in developing and reinforcing organizational capabilities.

Regarding orchestration, the CEO of the startup in Case 4 is explicit: he sees himself "as an orchestra conductor," where he coordinates a team that he considers "the musicians." In his view, his role is to motivate and encourage them in the direction of the company. The interviewee in Case 1 told us that in their headquarters, they develop all aspects of research, development, electronic technology, mechanics, 3D prototyping, and experimentation, and in this process, the individual who had previously developed the equipment is now responsible for engineering. He is, therefore, the research and development director responsible for both scientific research and basic bench research, processes necessary to validate the technologies they produce. As the CEO mentioned, "As director of research and development, I am responsible for both the scientific research and the basic bench research that we carry out to validate our technology."

Regarding Case 2, the interviewee informed us that when they invested in the business, they had a fellow who worked with them on the team. This fellow was a physicist, and the investors decided to give him the project manager role to develop the equipment. Eventually, he was called to the company's membership board. Today the company supplies its products to dozens of other companies, including the Brazilian agricultural research company to which the CEO directs his products. As he described it, "We started to develop specific applications for equipment for the agroindustry. First, we went to agriculture, and we also discovered that the producer does not pay for deep tech technology like this. Then we found the agroindustry. We found the way. It was very good because we entered this palm oil line, took an agricultural application, and placed it within the industry."

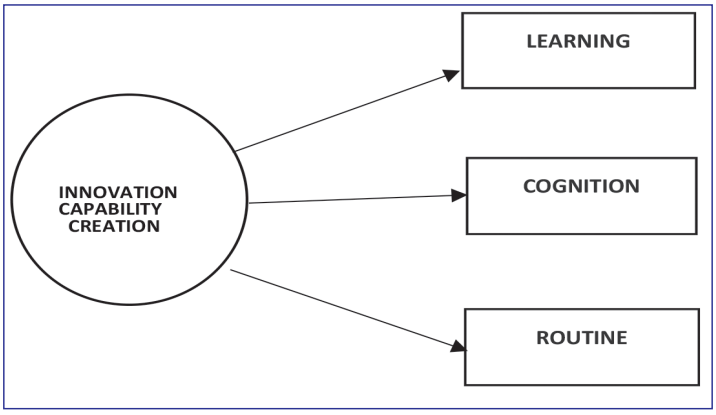
The two categories of the routine microfoundation – constancy and orchestration – can be analyzed both separately and in combination. There is a link between individual and group behaviors of managers and employees because routines are essential to the creation (Roscoe et al., 2019) and reconfiguration (Davies et al., 2018) of innovation capabilities.

## DISCUSSION

### Implications for the literature

The results of this article provide insights into the phenomenon of capability creation through the lens of microfoundations. Our results allow for a better understanding of the strategic choices made by people and groups that formulate and execute the creation of innovation capabilities.

**Figure 3**
**Conceptual framework of the microfoundations of creating capabilities**




Source: Elaborated by the authors.


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This article's main contribution is identifying the three microfoundations of innovation capability creation: learning, cognition, and routine (Figure 3). By aggregating these three microfoundations to explain innovation capability creation, we further our understanding of how microfoundations work, thus responding to the calls issued by Foss and Pedersen (2016) and Furr et al. (2020). Moreover, we expand the theoretical discussion of capability creation, complementing the research of Bingham et al. (2019) by showing specific microfoundations for the creation of innovation capability. We also expand on the work of Wojcik et al. (2022) by exploring the elements that form not only routine and cognition but also the learning microfoundation.

Our contribution resides in clarifying the fundamental elements of each microfoundation. We expand on current studies that conceive of learning as fundamental to creating innovative capabilities (Bingham et al., 2019; Eggers & Kaplan, 2013; Felin et al., 2015; Roscoe et al., 2019), bringing to the discussion two categories of learning: tacit knowledge and experience.

In the same vein, adding to the knowledge of cognition as a microfoundation of capability creation (Bingham et al., 2019; Ford & Friesl, 2019; Messina et al., 2022; Wocik et al., 2022), our findings expand on previous research by identifying the two elements that make up the cognition microfoundation: creativity and managerial aspects. Likewise, routine has been acknowledged as an important microfoundation of creating innovative capabilities (Aggarwal et al., 2017; Azzam, 2018; Bingham et al., 2019; Wojcik et al., 2022). We expand the knowledge of routine by identifying the two central elements of this microfoundation, namely constancy and orchestration.

## Implications for practice

This research has several implications for strategic leaders to drive actions through microfoundations. Our practical contribution is based on encouraging the use of the three microfoundations to create innovation capabilities.

Strategic leaders must articulate learning, cognition, and routine to create innovation capability. The capability for innovation is not limited to one innovation but to a continuous process of generating innovations. In this sense, the microfoundations should complement each other. In other words, strategic leadership must provide a process by which the company allows learning from experience and tacit knowledge. In addition, leadership must stimulate creativity and managerial cognitive capabilities to make strategic decisions in the process of creating innovation capabilities. The team, in turn, must be guided through the orchestration of routines so that the innovative cycle is constant and continuous. This complementary relationship between learning, cognition, and routine is what allows the creation of innovation capability. Below we delve into each microfoundation.

Leadership needs to continually keep the microfoundation of cognition active to sustain innovation capability. This can be accomplished by first giving space to the creativity of the team involved in innovation capability. This is not limited to space for creating new products but can include space for creating new ways of prospecting, formulating, and developing the innovation process. This happens from the moment the company combines creativity with cognitive management aspects, for instance by specifying who has the right to make decisions or defining which individuals will develop certain roles according to the intellectual apparatus or abilities of each person. This could also include identifying the most appropriate source of subsidy and financing for the innovation capability, or even directing which path the company's innovations should follow.

Leadership must also promote the microfoundation of learning so that the team creating innovation capability does not stagnate. Mechanisms for valuing and retaining experience allow previously traced paths to be supported (in the case of success) or avoided (in the case of losses). However, due to the dynamics of work, interaction, and change within a team, these mechanisms are better utilized if shared through tacit rather than explicit knowledge. This can be promoted through the one-on-one exchange of knowledge, working in teams or pairs, and offering ongoing constructive criticism to the team.

Finally, the microfoundation of routine enables the creation of innovation capability and not just innovation. Orchestration coordinates activities that involve the elements of creativity and learning so that they are carried out continuously within the company. The constancy of activities involving learning and creativity can be achieved through sprint-oriented projects, activity cycle evaluation, and change-oriented goals.

Thus, leadership has a central role in articulating the complementary relationship between the microfoundations of learning, cognition, and routine, not just for innovation, but for a continuous process of innovation in the company. That is, leadership must constantly create and recreate innovation capability.

## FINAL REMARKS

This article aimed to better understand the microfoundations of creating innovation capabilities, as well as the interplay of these microfoundations. As a result, we found three microfoundations of the creation of innovation capability: learning, cognition, and routine. Through systematically reviewing the microfoundations construct as it relates to creating innovation capabilities, we were able to develop an integrative conceptual framework built on the microfoundations of learning, cognition, and routine. We have shown how the creation of innovation capability can be achieved using these three microfoundations, but we believe that innovation capability can be developed from any one of them. From this starting point, we expect that future research will flourish, motivating other scholars to continue investigating this important topic.

### Limitations and future directions

While our conceptual framework presents a concise description of the microfoundations of innovation capability creation, it does have limitations. One limitation corresponds to our review method, which prevented the inclusion of other constructs or a more comprehensive analysis, which could include other keywords linked to the macro environment. A second limitation is that our findings concern individuals, whereas a scope at the firm level could perhaps bring to light new concepts. However, our study does not extend to this level because we consider the actions that a subjectively susceptible individual may take as an artifact (Felin et al., 2016). Future studies might extend the present research by relativizing how much each microfoundation matters in the creation of innovation capabilities. We also suggest further empirical studies to identify whether there are other essential microfoundations in this context.

We see other directions for future research as well. First, future research might delve into each microfoundation to discover how, in a specific context such as a deep tech startup, cognition shapes the environment and creates innovations. Such an analysis could be performed quantitatively. Second, future research might investigate the involvement of these microfoundations in innovation ecosystems, that is, how individuals, through microfoundations, create capabilities where firms are aligned with complementary offers (Adner & Kapoor, 2010; Jacobides et al., 2018; Shipilov & Gawer, 2020). Finally, the present research can open doors for empirical studies in companies, expanding the microfoundations agenda to the creation of innovation capability and investigating how microfoundations act in practice to create capabilities.


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**DATA AVAILABILITY**

The entire dataset supporting the results of this study was published in the article itself.

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