

EXPLORING THE MICROFOUNDATIONS OF INNOVATION: WHAT THEY ARE, WHERE THEY COME FROM, AND WHERE THEY ARE GOING

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Abstract

Microfoundations have received increasing attention in several management disciplines. We aim to outline the uniqueness of microfoundations research in innovation, look at where it comes from and where it is going, and provide rich opportunities for future work. To advance research in this area, we conducted a systematic literature review combining mixed methods and creating a mapping framework to take stock of progress in the innovation microfoundations research field. We show how distinct subfields have formed around key ideas expressed in subsets of seminal articles, shedding light on the relational nature of knowledge creation—uncovering these subfields’ characteristics, evolution, and future trajectories. We then develop a framework that reflects a critical analysis of the microfoundations of innovation within three research levels—individual, process and

interaction, and structure—and highlight research gaps and potential research questions for future research that reflect the broad spectrum of approaches in the microfoundations of innovation literature.

Keywords: microfoundations; innovation; dynamic capabilities; absorptive capacity; ambidexterity

1. Introduction

When we use the microfoundations approach, we think of collective phenomena that need explanation, specifically the creation and development and the reproduction and management of collective constructs, such as firms' innovative activities (Felin et al., 2012). The microfoundations approach thus explains collective phenomena that require study at lower levels, such as individuals or processes and interactions in organizations (Felin et al., 2015).

Felin et al. (2012) define microfoundations as a theoretical explanation, supported by an empirical examination, of a determined phenomenon located at the analytical level N at time t (N_t). In the simplest sense, a baseline microfoundation for the N_t level is located at the N_{-1} level at time t_{-1} , where the time dimension reflects a temporal ordering of relationships with phenomena at the N_{-1} level phenomena before the N level. Individuals, processes, and/or structures at the $N_{-1}t_{-1}$ level may interact, or operate alone, to influence phenomena at the N_t level.

The microfoundations approach argues that organizational contexts define or enable interactions between individuals in knowledge sharing that gives new organizational phenomena (Felin et al., 2012; Foss & Pedersen, 2016; Tran et al., 2019). Thus, the impetus for microfoundational research is essential to unpack collective concepts to understand how individual-level factors impact organizations (Felin et al., 2012). These factors can be the interaction of individuals that leads to different outcomes and consequently different performance, the collective and organizational behaviors, and how relationships between macro variables are mediated by micro-actions and interactions (Abell et al., 2008).

The literature highlights several studies that have been dedicated to the microfoundations of several research fields within management: organization and strategy (Felin & Foss, 2005; Gavetti, 2005), performance (Eisenhardt et al. 2010; Foss & Lindenberg, 2013), absorptive capacity (Lewin et al., 2011; Volberda et al., 2010), R&D firm (Paruchuri & Eisenman, 2012), ambidextrousness (Rogan & Mors, 2014; Hughes et al., 2020), networks (Ahuja et al., 2012), Resource-Based View (Foss, 2011), organizational capabilities (Kemper et al., 2013), R&D capabilities (Paruchuri & Eisenman, 2012), human resources (Minbaeva et al., 2012), and dynamic capabilities (DCs) (Argote & Ren, 2012; Hodgkinson & Healey, 2011; Teece, 2007). However, we find that only Grigoriou & Rothaermel (2014) and Ryan et al. (2018) have devoted their studies to the microfoundations of innovation. Grigoriou & Rothaermel (2014) developed empirical research applied to pharmaceutical companies in which they argued that the focus on individual productivity alone presents an under-socialized view of human capital. The authors emphasized the importance of relationships embedded by individuals to perform knowledge-generating activities effectively. They concluded that there are two types of relational stars: integrators (outliers in centrality) and connectors (outliers in bridging behavior).

On the other hand, Ryan et al. (2018), in a qualitative study, used Felin et al.'s (2012) approach to study the microfoundations of firms' capabilities in innovation activities in university partnerships (triple helix model). The authors concluded that using a microfoundational lens allows a deeper understanding of how triple helix programs can influence firms' capabilities in exploratory innovation. However, no study has addressed the phenomenon of innovation in all its multidisciplinary breadth through the microfoundations lens. The microfoundations view is not a theory per se but a movement and way of thinking that has spread to understand the origins of outcomes observed at higher levels of analyses (Felin et al., 2015). Supporting our findings and concerns, we can refer to existing systematic review studies that focus on specific dimensions that are parts of microfoundations of innovation (Appendix A).

Despite this significant body of theoretical research presented above, the field of innovation microfoundations is fragmented and lacks consistency. Specifically, there is

little attempt to synthesize the field by conducting a study based on SLR methodology and content analysis techniques only focused on specific areas.

Consequently, there remains a need to systematically review the published literature and provide a holistic perspective on the microfoundations of innovation by complementing previous theoretical studies. We know that innovation is a process that integrates diverse actors (CEOs, employees, stakeholders, technology, and others) within the organization. It will only have the expected performance and impact if they are all coordinated. It is possible to make the diagnosis and the respective adequate prescription by knowing the anatomy of all the gears. Not knowing the microfoundations of innovation as a whole is effectively a risk. If we do not know all the factors involved in the company's innovation process, we risk making a shallow analysis, while we may even try to solve one problem by causing another.

To respond to the needs identified through the developed SLR, we set as our goal to perform an inductive ontological analysis of articles to learn about the microfoundations of innovation and create a mapping framework that includes the different, but aggregated, levels of the microfoundations identified by Felin et al. (2012): individual, process and interaction, and structure. Our research thus aims to provide a refined ontological lens capable of reshaping what is already known about the microfoundations of innovation.

Our study comprises several contributions to literature. First, we present a systematic review on the microfoundations of innovation that makes it possible to identify what previous literature has analyzed about the microfoundations of innovation and set the stage for a second wave of research on this topic by synthesizing key knowledge gaps and directions for future studies. Second, we contribute to revealing the internal structure of the field of innovation microfoundations by exploring trends, patterns, and trajectories, culminating in a future research agenda. In addition, we present a framework that allows us to take stock of the field-of-study progress. While we find several studies on the microfoundations of innovation, several areas remain under-researched. At the subfield level of the microfoundations of innovation, we show how distinct research trajectories, each with different characteristics, have formed around central ideas expressed by subsets of seminal articles.

The paper is organized as follows. After the introduction, we will describe and justify the research methods applied in this study. Next, we present our findings structured around our organizational framework of the microfoundations of innovation. Before concluding, we discuss the main trends and patterns derived from our analysis, both at the level of the overall field and its subfields, and present an agenda for future lines of research.

2. Methodology

We conducted a systematic review through an inductive ontological analysis of articles to learn about the microfoundations of innovation. Greenhalgh (1997) argues that an SLR is an overview of major studies containing an explicit statement of objectives, materials, and methods conducted according to an explicit and reproducible methodology.

Littell et al. (2008) and Naveen et al. (2021) define SLRs as research that addresses a question using organized, transparent, and replicable procedures at each step of the process. Given the different types of systematic literature that exist (Paul and Rialp-Criado, 2020), our SLR is positioned as a method-based review, as it aims to synthesize and extend a body of literature that uses an underlying methodology (quantitative or qualitative).

We follow the protocols suggested by Thorpe et al. (2005) and Tranfield et al. (2003) to perform this method. Our analysis is achieved by inductively reading and rereading the articles while cycling them to identify and categorize concordant themes that ensure consistency within and across categories of those themes (Jones et al., 2011; Andreini et al., 2019; Ferreira et al., 2021). The review was limited to including articles published in peer-reviewed journals, as they are a validated source of knowledge and strongly impact the research field (Ordanini et al., 2008). To identify the articles, we applied three search strategies, whose goal was to achieve each strategy to increase the number of papers.

Appendices B and C provide extensive details of our procedures to search, select, and analyze the papers. Adopting these protocols allowed us to identify many papers that had not been included in previous literature reviews. The final database consisted of 50 articles. A closer look at the 50 articles revealed a clear preference for quantitative empirical studies (38 articles). Several authors argue that depending on the degree of detail

desired, the number of publications to study the evolution and trends in a field of study can be limited to 50-100 articles (Walsh and Renaud, 2017; Walsh and Kalika, 2018; Ananad et al., 2021).

Of the 50 articles, 12 are literature reviews. This can be explained by the fact that this field of research is relatively new, and the measurement scales still need to be refined (Volberda et al., 2010; Chandler & Hwang, 2015; Černe et al., 2016). The systematic review and ontology analysis of the 50 selected papers were grouped into different groups using two criteria. First, we distinguished the papers based on whether the main focus of the empirical investigation (qualitative or quantitative, $n = 38$) was the microfoundations of innovation or whether they were systematic literature reviews ($n = 12$). Second, we categorized the papers based on three levels of analysis i) Individual-level, ii) Processes and Interactions, and iii) Structures-level) and interactions within and across components - the interactions of individuals, processes, and structures that contribute to the aggregation and emergence of the collective constructs (Felin et al., 2012).

i) Individual-level components such as characteristics, skills, or cognition are one of many important building blocks for understanding phenomena such as innovation. Individuals may have different beliefs, goals, and interests that inform and affect their choices and bring other skills (abilities, knowledge, experience, cognitive abilities) and characteristics to an organization.

ii) Processes and Interactions, such as the emergence, maintenance/reproduction, change and/or displacement of innovation. A process is a sequence of interdependent events; this baseline definition maps directly to the definition of routines. Putting processes into action requires the intervention of individuals. Thus, the interactions between individuals and organizational processes can provide insights into how innovation processes emerge.

iii) Structures-level, whether at the organizational level, inside or outside an organization, structures specify the conditions that enable and constrain individual and collective action and set the context for interactions within an organization.

3. Microfoundations of Innovation

The literature is systematized based on the different levels of analysis identified and by the nature of the papers selected for the SLR (see Table 1 and Appendix D).

The open innovation (OI) approach is commonly mentioned to the individual, process and interactions, and structure (individual and process) levels. The absorptive capability approach is common to the individual and structure (individual and process) levels. The dynamic capabilities and ambidexterity approaches are present at the individual, structural, and process levels. Finally, the technology transfer approach is only present at the process and integration level.

Table 1 - Variables for the study of microfoundations on the three levels

Level Approach	Microfoundations of innovation			
	Individual	Process and Interactions	Structure	
			Individual	Process
Open Innovation	• CEO attitude • Entrepreneurial orientation of CEO • Innovation climate	Intermediary Capabilities (Co-creation capabilities) i) Individual capacity ii) Relational Capability iii) Developmental Capability iv) Empowered Capability v) Ethical capability vi) Concerted capability	• Access to new ideas and know-how • Access to CSET expertise (Centers for Science, Engineering and Technology) • Opportunity to interact with partner companies • Outcomes achieved by firms • Access to new ideas, know-how, technology • Increased interaction with other partner firms • Improvements to a product • Improved technical information for customers	• Level of openness • Choice of external partner • Choice of OI mechanism • Formalization of the collaboration process and internal practices of the company • External knowledge resources: (suppliers; customers; research organizations; society) • Internal capabilities: recognize; assimilate; exploit)
Authors	Mazzucchelli et al (2019); Najar & Dhaouadi (2020); Ahn et al. (2017); Santoro et al (2020); Bogers et al (2018)	Di Paola & Russo Spena (2019); Patroni et al (2020) E Randhawa et al (2018)	Frenken & Boschma (2007); Ryan et al (2018); Locatelli et al (2021)	Bagherzadeh et al (2021); Gurca et al (2021); Ghassim & Foss (2018); Gianiodis (2018)
Technology transfer		• Perceived behavioral control • Belief • Intention • Governance and market • Intellectual property and licensing • Existing collaborations • Perceived value of goals		
Authors		Scuotto et al (2020); Tippmann et al (2012)		
	• Individuals with a high prior knowledge diversity • Individuals with a high external • Individuals with a high internal network diversity • Individuals with a high bisociative cognitive • Individuals with a high associative cognitive • Individual ACAP (absorptive capacity) • Individual core knowledge employees		• Patent counts • Patent citations • Patent claims • Firm merged • Exploration • Exploitation alliances • Acquisitions • Network density • Average coinventors	Internal ACAP routines • Facilitating variation • Managing internal selection regimes • Sharing knowledge and superior practices • Reflecting; updating; replication • Managing adaptive tension External ACAP routines • Managing adaptive tension • Identifying and recognizing value of externally

Absorptive capacity	• Higher an individual's learning orientation • Relationship between individuals' absorptive capacity and innovative collective performance • Cognitive perspective-taking • Affective perspective-taking • Perceptual perspective-taking • Innovative work behavior • Perceived time pressure • Employee silence • Flow at work • Internal knowledge resources • External knowledge resources • Experience of the CEO • Management competencies • Employees' prior need knowledge • Employees' prior solution knowledge • Employees' need absorptive capacity • Employees' solution absorptive capacity		• year inventors • Annual inventors • Productivity stars • Integrators–power • Integrators–reach • Connectors • Star integrators–power • Star integrators–reach • Star connectors	generated knowledge • Learning from and with partners, suppliers, customers, competitors, and consultants • Transferring knowledge back to the organization
Authors	Lowik et al (2017); Yao & Chang (2017); Emre Yildiz et al (2021); Litchfield & Gentry (2010); Hodgkinson & Healey (2014); Maqbool et al (2019); Nuruzzaman et al (2019); Badir et al (2020); Kim (2017); Schweisfurth & Raasch (2018)		Cohen & Levinthal (1990); Grigoriou & Rothaermel (2014)	Zahra & George (2002; Volberda et al. (2010); Lewin et al. 2011; Lakshman & Akhter, 2015); Chalmers & Balan-Vnuk (2013)
Dynamic capabilities	• Dynamic Organizational Capabilities (Fitting Resource Dynamization: The organization implements the approach to resource dynamization that fits best with the specific strategic event, given current environmental dynamics) • Dynamic Interpersonal Capabilities (Intense Participation: The interpersonal relationships between managers allow them to both advance and accept changes in the current resource base) • Dynamic Managerial Capabilities (High Integration: The individual manager can recognize whether the specific action s/he is confronting requires “business-as-usual” or “change” in the current resource-based			• Resources • Dynamic capabilities • External technological resources (technological diversification; In-house R&D) • Central R&D department • Configuration of innovation projects • Technology transfer units • Business service unit communities of practice • Share platform as knowledge management • Share Platform expert networks • Share platform network cluster • Share platform semantic search • Signaling functionality • Innovation strategy • Key account management • Invention phase of innovation • Continuous workforce education • Communities of practice • Corporative innovation process

				• Innovation benchmarking • Ideation competition
Authors	Salvato & Vassolo (2018)			Teece (2007); Kindström et al (2013); Černe et al. 2016; Li-Ying et al. 2016; Warner & Wäger, 2019; Linde et al. 2021; Ren et al (2016); Schneckenberg et al (2015) e Chandler & Hwang (2015)
Individual ambidexterity	• International alliance portfolio diversity • Adopting individual financial incentives • Adopting individual non-financial			Exploration 1) Your organization looks for novel technological ideas by thinking ‘outside the box’ 2) Your organization bases its success on its ability to explore new technologies Exploitation 1) Your organization commits to improve quality and lower cost 2) Your organization continuously improves the reliability of its products
Authors	Iammarino & McCann (2006); Rogan & Mors (2018); Ardito et al. (2019)			Venugopal et al (2020)

3.1. Individual-Levels Approaches

Individual Open Innovation

Little is known about how individuals' characteristics lead to firms' innovative capacity (Mazzucchelli et al., 2019). Nevertheless, this topic has been abundantly debated in the business context. To fill this gap, the authors adopted a microfoundations perspective to propose a conceptual model to investigate whether and how individual characteristics for innovation (individual attention to detail, creativity, and openness), as well as individual-level knowledge sharing behaviors (individual motivation, control, and capability), affect firm-level strategic innovation capabilities. The authors found that individual motivation is crucial in effective and frequent knowledge sharing and innovative capabilities.

Najar & Dhaouadi (2020) studied the impact of CEO personality on OI strategies and the mediating effect of innovation climate. The authors found that entrepreneurial orientation (EO) and CEO attitude in promoting innovation climate impact OI strategies. For Ahn et al. (2017), OI processes in small and medium-sized enterprises (SMEs) are strongly influenced by the characteristics of their CEOs since the decision-making process is highly centralized. The authors thus draw our attention to the importance of strategic leadership in the OI strategies of organizations. The authors found that CEOs' positive attitude, EO, patience, and education are important in facilitating OI in SMEs. However, the authors also found that depending on the level of uncertainty of OI also impacts the previous characteristics.

Santoro et al. (2020) aimed to understand whether the characteristics of entrepreneurs and managers of small firms influence the tendency toward OI. The authors concluded that the characteristics of the entrepreneur, the employees, and the company impact the propensity to engage in OI. Regarding the entrepreneur, delegation, trust in internal and external partners, individual ties, and risk-taking approach increase the approach to OI. Associated with this finding, they also found that these characteristics of the entrepreneur contribute to employees establishing OI strategies. Thus, the authors suggest that OI should be understood as a broad spectrum of innovation and, to increase its chances of success, CEOs should compensate for its missing characteristics by recruiting top managers who complement them at that level.

Bogers et al. (2018) consider that although OI has received substantial attention in the literature, its “human side” is still poorly understood. The authors concluded that the educational diversity of employees is positively associated with the level of openness of the firm, whereby the higher the educational level, the higher the level of openness of the firm. The authors thus consider that we must understand the role of employee characteristics in the level of openness of the firm.

Individual absorptive capacity

For Lowik et al. (2017), individual absorptive capacity is the ability of individuals to recognize, assimilate, transform, and exploit external knowledge. These individual absorptive capabilities are a fundamental foundation of knowledge management for an organization’s OI practices. The authors concluded that diversity of prior knowledge, diversity of the external network, and a bisociative cognitive style explain the differences in individual absorptive capacity. The authors further found that individual absorptive capacity mediates between its antecedents and individual innovation performance and is relevant in capturing value from external knowledge sources.

Yao and Chang (2017) and Emre Yildiz et al. (2021) adopted the microfoundations perspective. They studied how employees’ goal-specific orientation affects their absorptive capacity at the individual level, shaping collective innovation performance. For the authors, since absorptive capacity reflects an organization’s ability to extract innovative ideas from its environment, it plays a critical role in promoting intrapreneurship and innovative performance in existing firms. The authors found that individuals’ learning orientation is important predictor of their absorptive capacity. They also found that the aggregate absorptive capacity of individuals leads to positive innovation outcomes.

Litchfield & Gentry (2010) and Hodgkinson & Healey (2014) suggest perspective-taking as an organizational capability that facilitates knowledge integration, leading to organizational innovation. Building on the study of the psychological profile of employees, the authors study how perspective-taking can be scaled to the organization and concluded that perspective-taking ability increases firms’ absorptive capacity, thus contributing to strategic innovation management.

Maqbool et al. (2019) also studied employee personality at the level of drivers of employee's innovative behavior. The authors concluded that too much silence and pressure within the company does not boost the innovative behavior of its employees. Employees can share knowledge among themselves without too much time pressure, encouraging their abilities and creativity, thus contributing to the company's innovative capacity.

Nuruzzaman et al. (2019) and Badir et al. (2020) argue that it is crucial for firms' innovation strategy to leverage internal and external knowledge sources, especially in emerging countries. In this sense, the authors concluded that employees' access to the firm's internal and external knowledge enables them to increase their output of innovative work (and, consequently, their performance in customer acquisition). The authors also found that manager characteristics are important moderators of this type of employee behavior. Finally, the authors conclude that this OI model is critical to the success of firms' innovation strategies.

For Kim (2017) and Schweisfurth & Raasch (2018), innovation occurs when knowledge about unmet customer needs intersects with knowledge about technological solutions. These two types of knowledge are usually located outside the firm and need to be absorbed for innovation to occur. The authors showed that the need absorptive capacity is theoretically and empirically distinct from the solution absorptive capacity and that both are positively associated with employee innovation capacity. This ability will contribute to the firm's ability to innovate.

Individual Dynamic Capabilities

Salvato & Vassolo (2018) developed a multilevel theory of dynamic capabilities (DCs). This theory explains resource dynamics by assigning a central role to people and interpersonal interactions rather than to abstract entities at the firm level. The approaches we know of DCs portray them as collective efforts but do not specify how they arise and operate within organizations. In contrast, microfoundational approaches illuminate actors' contributions but reduce a firm's DCs to the cognitions and actions of a few top managers. Thus, the authors propose an integrated theory in which they suggest that individual employees can leverage the interpersonal relationships that lead to innovative activities.

Individual Ambidexterity

Several authors wanted to study the impact of the decision of companies to establish relationships with various types of partners from different geographical locations on their ability to carry out radical and incremental innovations (i.e., innovation ambidexterity). To this end, the authors understood that it is essential to know how the ability and willingness of employees and the CEOs' characteristics allow leveraging these strategic alliances' opportunities. Thus, the authors found that the adoption of human resource management practices that enhance motivation, such as individual incentives (financial and non-financial), has a positive effect on the relationship between strategic alliances and ambidexterity for innovation (Iammarino & McCann, 2006; Rogan & Mors, 2018; Ardito et al., 2019). What is less clear, however, is how emotion and sentiment may affect individual behaviors and thus the microfoundations of organizational activities or outcomes. For instance, concerning technological innovation, Kiani et al. (2022) found that senior managers' entrepreneurial passion indirectly affects technological innovation by incubating an organizational entrepreneurial orientation to form and grow. Scholars have also found emotions such as fear to both motivate and constrain senior managers' innovation decision-making and subsequent organizational innovation behavior (Hu et al., 2022).

3.2. Process and interaction Approaches

Open Innovation

Di Paola & Russo Spena (2019) aimed to enlighten us on the interaction of different internal R&D resources, encouraging and implementing exploratory innovation openness. The authors concluded that diversity in R&D resources makes a multifaceted contribution to firms' exploratory openness to innovation and is determined by the interactions between different dimensions of diversity in those resources.

Patroni et al. (2020) and Randhawa et al. (2018) understand that OI can arise from analyzing consumer conversations on social media. This analysis may identify valuable insights from these conversations that can lead to successful innovations. The ability to convert these conversations into a greater capacity for organizational innovation.

Technology Transfer

For Scuotto et al. (2020), companies are increasingly concerned with managing innovation centrally or through decentralized business units. Thus, two needs emerge for the authors: i) ensure organizational efficiency and ii) effectively exploit market opportunities. This will always require integrating knowledge in technology transfer that can be accumulated through knowledge sharing between the parties.

Tippmann et al. (2012) developed their research at the level of multinational corporations (MNCs) and how subsidiaries strategically contribute to their performance. The results show how the problems are framed influences the activities of seeking knowledge transfer and finding solutions and how these different activities can result in local and global solutions. The authors concluded that there are four approaches to solving innovation problems: local model adaptation, superior technology creation, local model creation, and global principle creation.

3.3. Structure

3.3.1. Structure – Individual Level

Open innovation

For Frenken & Boschma (2007), each product innovation offers a growth opportunity for an existing or a new firm and an existing or a new city. One can then obtain the firm size and city size distributions as two aggregates resulting from a single evolutionary process.

Ryan et al. (2018) show how the triple helix model provides an organizing regime within which participating firms can extend their exploratory innovation capabilities through funded collaborations with academia. In the same vein, Locatelli et al. (2021) focused their research on OI and Megaprojects. For the authors, megaprojects require substantial R&D activities, which may involve the organization itself and others. This need for linkage with other organizations creates the ideal scenario for OI because it favors risk sharing, enables reliable collaboration, and facilitates the development of breakthrough innovations. The authors also found that the link between the characteristics of individuals and those of the firm in building OI at the level of this type of project has been neglected.

To this end, a key link to be studied is the university-industry. Thus, the authors examined the experience and outcomes of individuals involved in university-industry co-directed Ph.D. programs. The authors concluded that interpersonal interactions and intentional knowledge spillovers promote innovation outside the original boundaries of the doctoral program and spillover into the industry.

Absorptive capacity

Cohen and Levinthal (1990) argue that a firm's absorptive capacity translates into its competence to recognize the value of new external information, assimilate it, and apply it for business purposes is fundamental to its innovative capabilities. The authors begin their discussion on the cognitive basis for an individual's absorptive capacity, particularly related to prior knowledge and diversity of experience. They then characterize the factors that influence absorptive capacity at the organizational level. They address how an organization's absorptive capacity differs from that of its individual members and the role of diversity of expertise within an organization.

Grigoriou and Rothaermel (2014) emphasize the importance of relationships embedded by individuals to perform knowledge-generating activities effectively. To this end, the authors rely on intra-organizational knowledge networks emerging through individual collaboration to identify actors who can positively influence their organization's knowledge outcomes. In this regard, the authors formulated a model of firm investment in R&D, in which R&D contributes to the firm's absorptive capacity. The authors concluded that the presence of relational "stars" results in firm-level knowledge advantages, not only through their own efforts but also through their ability to make others around them more effective at recombining knowledge.

3.3.2. Structure – Process Level

Organizational Open innovation

Bagherzadeh et al. (2021) argue that OI has become a dominant phenomenon in the current business landscape. The authors found that most studies that aim to show how to manage

OI successfully have only considered firm-level characteristics (e.g., firm size and openness).

Thus, based on the assumption that innovation projects generally have different attributes (e.g., complexity and uncertainty), the authors offered us a cross-case analysis of innovation projects, in which they show how two key project attributes (i.e., complexity and uncertainty) are related to five factors for successful OI management: i) level of openness, ii) choice of an external partner, iii) choice of OI mechanism, iv) formalization of the collaboration process, and v) internal firm practices.

In the same vein, Gurca et al. (2021) found that knowledge sharing and system integration are two major challenges posed by openness to business partners in complex innovation projects. However, the authors also ascertained that the various research on this field of study is limited to the level of actions and practices that underpin the organizational capabilities needed to address these challenges. In this sense, the authors concluded that organizational capabilities are developed and eliminated in terms of corporate principles (e.g., hierarchical product architecture) and actions and practices (e.g., knowledge sharing by delegating).

For Ghassim & Foss (2018), the open approach to innovation is a challenge, as firms need to have sufficient absorptive capacity, i.e., the ability to ‘recognize’, ‘assimilate’ and ‘exploit’ external knowledge to develop their processes and products. However, the authors noted that the determinants of these three components of absorptive capacity for sustainability-oriented innovations are not yet fully understood. The authors concluded that to achieve uptake, firms must first be aware of the technological and market changes arising from the transition to sustainability, and secondly, increase their awareness of social issues.

Thus, assimilation depends on established routines to facilitate internal knowledge dissemination, while exploitation occurs by piloting new innovative solutions. In this follow-up, Gianiodis (2018) concluded that these practices tend to fall into two broad categories: inside-out OI and outside-in OI. The author argues that these two forms of OI are mechanisms to align global research at the innovation level.

Organizational absorptive capacity

Through a bibliometric study, Zahra & George (2002) and Volberda et al. (2010) aimed to advance the understanding of absorptive capacity, its underlying dimensions, its multilevel antecedents, and its impact on firm performance, and the contextual factors affecting firms' absorptive capacity. The authors found the following: i) tangible results of absorptive capacity; ii) organizational design and individual-level antecedents have been relatively neglected in the absorptive capacity literature; and iii) the emergence of absorptive capacity from the actions and interactions of individuals, organizations, and the inter-organizational antecedents remain unclear.

Following this research other authors have also found that the specific organization of routines and processes that constitute the resources of absorptive capacity remain understudied. In this paper, the authors propose a routine-based model. The authors thus proposed a model for operationalizing absorptive capacity and decomposed the construct of absorptive capacity into two components—internal and external absorptive capacity—and identified the configuration of meta-routines as underlying these two components.

Other authors have concluded that the ability of organizations to discover and implement complementarities between absorptive capacity routines explains why some firms succeed when they pioneer the adoption and new management practices (Lewin et al. 2011; Lakshman & Akhter, 2015). Bouguerra et al. (2021) also observed how absorptive capacity routines rely on market sensing and responsiveness which are endeavors also grounded in microfoundation roots.

Chalmers & Balan-Vnuk (2013) opened the discussion of the absorptive capacity of nonprofit firms. The results showed that these organizations have a unique mediating role in the social innovation process because they set up internal and external absorptive capacity routines to combine knowledge flows between user and technology.

Organizational dynamic capabilities

For Teece (2007), DCs are the skills, processes, procedures, organizational structures, decision rules, and distinct disciplines that underpin the capabilities for sensing, seizing, and reconfiguring at the enterprise level that are difficult to develop and deploy. Firms with strong DCs are intensely entrepreneurial, adapt to business ecosystems, and shape them through innovation and collaboration with other firms, entities, and institutions.

In this regard, Kindström et al. (2013) argue that essential microfoundations form the basis of the successful realignment of a firm's DCs to achieve a better fit with innovation activities. The authors were able to draw three key conclusions: i) they extended the existing literature on dynamic capabilities; ii) the study extends existing work on innovation in services to manufacturing industries; and iii) the research provides empirical evidence of DCs in practice, especially in product-centric environments where the service context is new.

Several authors have studied how companies build for digital transformation (using new digital technologies, such as mobile technologies, artificial intelligence, cloud, blockchain, and Internet of Things (IoT), to enable major business improvements to enhance customer experience) (Ghosh et al., 2022). Several authors have found that digital transformation is an ongoing process of using new digital technologies in everyday organizational life, which recognizes agility as the central mechanism for the strategic renewal of i) an organization's business model, ii) collaborative approach, and eventually ii) culture (Černe et al., 2016; Li-Ying et al., 2016; Warner & Wäger, 2019; Linde et al., 2021). Ritala et al. (2021) observed that the successful organizational implementation of a digital strategy relies on individual entrepreneurial orientation and relational capital among organizational members. In doing so, these authors directly connect organizational digitalization to microfoundation concerns.

Informal imitator-type firms in many emerging economies play an important role in the development of the economy. Ren et al. (2016) studied innovation-based DCs in informal imitator-type firms. The authors concluded that these firms should reduce innovation failures and damage to DCs by implementing consistent innovation and paying attention to innovation enhancement.

For Schneckenberg et al. (2015) and Chandler & Hwang (2015), DCs have become central strategy and innovation research concepts. The authors identified that the literature had not devoted particular attention to organizational learning and knowledge management. The authors found that collaborative technologies in a leading global industrial corporation leverage learning processes and knowledge sharing, fostering innovative capabilities within the firm.

Organizational Ambidexterity

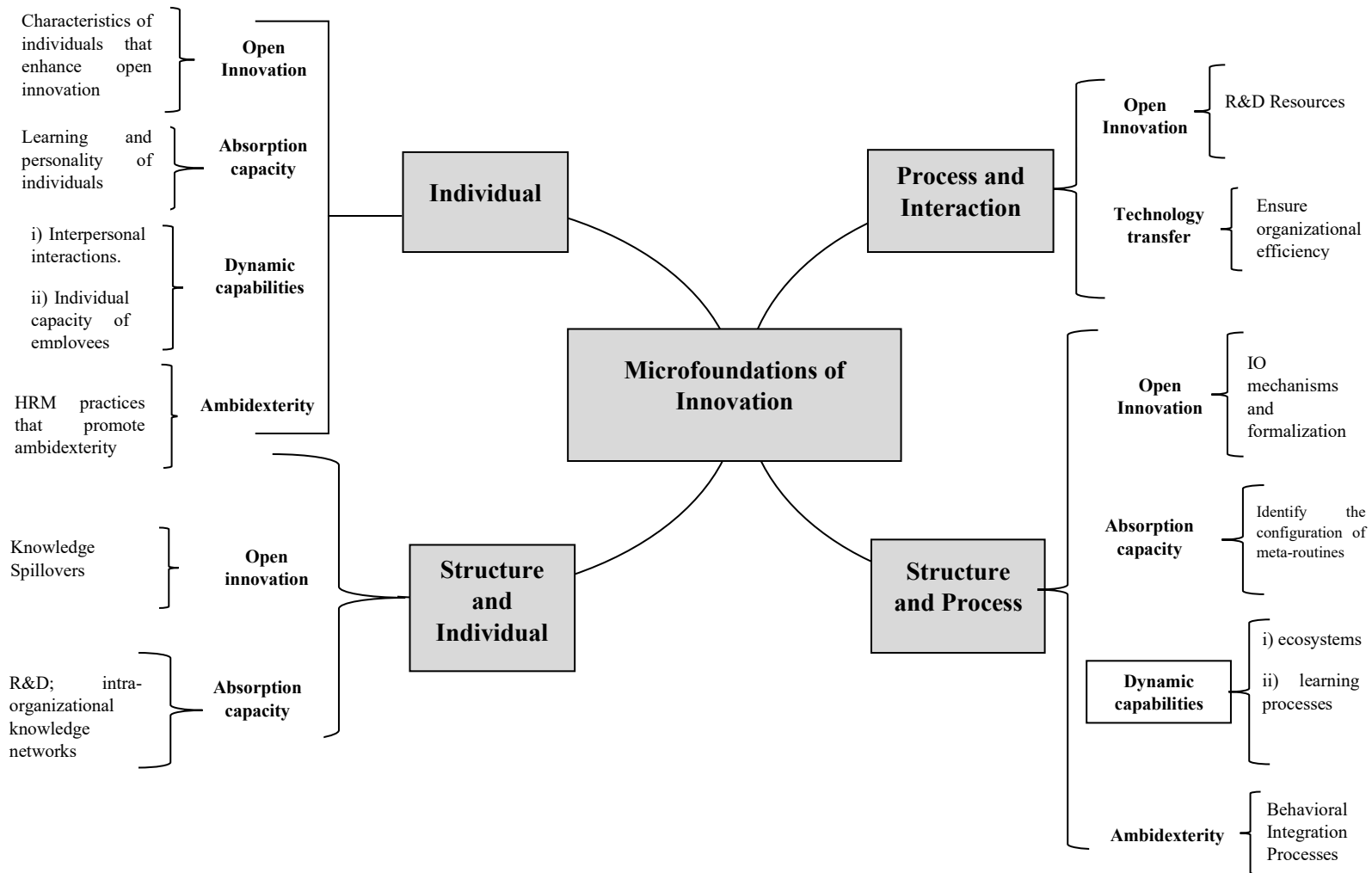
For Venugopal et al. (2020), organizational ambidexterity is significantly influenced by Top Management Team (TMT) behavioral integration. The authors argue that ambidextrous firms are associated with two dimensions of dexterity, balanced and combined. The authors concluded that behavioral integration processes mainly increase the combined ambidextrousness of a firm. They further concluded that combined ambidexterity completely mediates the relationship between behavioral integration and firm performance.

Hughes et al. (2020) argued that microfoundational approaches could enable firms to develop organizational ambidexterity critical to their long-term prosperity. Considering organizational ambidexterity from the point of view of exploratory innovation in mergers and acquisitions, the authors studied how behavioral contexts (corporate entrepreneurship) and structure (integration) regulate knowledge transfer activities. The authors concluded that: i) knowledge sharing between acquirers and acquired leads to organizational ambidexterity; ii) increased use of the acquired target's capabilities harms organizational ambidexterity; iii) in general, capability sharing is positively related to organizational ambidexterity; iv) corporate entrepreneurship has negative and positive moderating effects (on the acquired target's capability use and capability sharing, respectively), while integration positively moderates the effects of knowledge sharing on organizational ambidexterity.

3.3.3 Microfoundations of innovation Holistic Model

In Figure 1, we present our holistic model with the microfoundations of innovation for the three levels of analysis: individual, process and interaction, and structure.

Figure 1: Framework – Holistic model of microfoundations of innovation



4. Discussion

We find that a wealth of trends and patterns in innovation microfoundations emerged from our systematic review, both at the level of the overall field and the different subfields. This section explains the most pertinent trends and patterns before developing a future-oriented innovation microfoundations research agenda in section 5.

4.1. Overarching trends and patterns

Based on the organizational structure of innovation microfoundations research presented in Table 1, an encouraging finding is that we could identify research approaches that can fill each domain. Similarly, the field of innovation microfoundations generally shows a healthy balance of quantitative (n=18), qualitative (n=20), and conceptual (n=12) investigations. There is significant progress made in a short period and an impressive portfolio of contributions developed at various analysis levels. At the same time, although some areas have become intensively researched, some blind spots still remain.

The innovation process continues to represent a key theme in this field of study, as we found the level that contains the fewest studies (e.g., Warner & Wäger, 2019; Venugopal et al., 2020; Scuotto et al. 2020). While research on the characteristics of individuals that impact innovation activities has been widely studied (Iammarino & McCann, 2006; Rogan & Mor, 2014; Bogers et al., 2018; Scuotto et al., 2020), the study of the individual characteristics of entrepreneurs and the leadership characteristics that best foster innovation processes remain understudied (Beckert, 2013; Ahn, 2017; Maqbool et al., 2019; Najar & Dhaouadi, 2020).

However, a modest number of starting points can be identified, such as concern for environmental issues. Sustainable innovation is increasingly a challenge posed to companies, and in this sense, Ghassim and Foss (2018) draw our attention to this field of study.

4.2. Subfields of Microfoundations research

Crucially, our study's systematic literature review methods allow us to discover the relational nature of knowledge creation in the microfoundations of innovation. One

characteristic imbued in innovation microfoundations research is its multidisciplinary nature, spanning multiple disciplinary boundaries.

Therefore, it is no surprise that the research field is somewhat heterogeneous, with multiple subfields emerging, each with distinct characteristics and trajectories. For example, our SLR showed that different research groups in the microfoundations of innovation emphasized different parts of our organizational structure. That is, separate research trajectories have formed around key ideas developed in different seminal articles and continue to shape distinct trajectories within the innovation microfoundations literature. Thus, although the focus of research may change at the level, individual or structure, IO, DCs, absorptive capacity, and ambidexterity are present at all levels of analysis. Overall, research within these approaches emerges as quite diverse, exploring their considerations in many different contexts, concerning different organizational forms, analytical levels, and emphasizing different aspects of the entrepreneurial process. In contrast, with process and interaction level, which in common with the previous ones has the IO approach but comes to us with a new approach—technology transfer.

4.3. Managerial Microfoundations of Innovation

From a practical point of view, the study has interesting managerial implications. Its results are useful for understanding the main explanatory variables that contribute to improving companies' innovation capabilities. The microfoundational approach makes management professionals aware that not all individual traits and behaviors similarly affect a company's innovation. To promote the innovation capabilities of a company, managers must pay attention to the constant training of employees, adopting new programs that encourage the development and improvement of the capabilities (absorption and ambidexterity) of employees, leading them to be more creative. By adopting human resource policies that use performance-related rewards, training and learning, managers can effectively improve knowledge management and knowledge transfer practices and, consequently, innovation performance. In addition, managers must take steps to hire and retain employees interested in producing high-quality products and who have the skills to enhance product

functionality, as well as employees who can scan the external environment for new ideas and opportunities for collaboration.

Managers must work to create spaces and processes where the microfoundations of innovation can occur. These should include, for example, greater recognition of a role for projects that self-aggregate the microfoundations into interest groups. If this recognition exists, it will generate a greater sharing of knowledge in creating stronger units that can, in turn, develop capacities to trace the trajectory of microfoundations of innovation. Similarly, managers must clearly recognize that knowledge and capabilities reside in their organizations and must allow these to be optimized through the various processes of innovation microfoundations. This is clearly a management responsibility. Integration is thus vital for sharing knowledge that forms the basis of the microfoundations of innovation. However, corporate entrepreneurship has a trade-off when managers place only emphasis on using the company's capabilities; without any sharing of knowledge, it can lead to a negative effect on company performance. Thus, resource sharing is the practice that best supports innovation microfoundations, and it is further reinforced when corporate entrepreneurship is built into the organization. Managers should focus their corporate business efforts on sharing resources and capabilities. To nurture the context of innovation microfoundations, managers must, for example, generate projects and initiatives that tend to harmonize, synergize and integrate employees' cultures, values and beliefs. This practice can increase the knowledge sharing necessary for companies' best performance. The sharing of resources makes it possible to combine previously unrelated groups of resources and capabilities in new ways to stimulate innovation efforts that are critical to the innovation and performance of companies.

5. Towards a future research agenda

As avenues for future research, we direct some recommendations to the entire field of innovation microfoundations research. To this end, a critical analysis of the innovation microfoundations and the three levels drawn from the review allowed us to identify gaps in the literature. These gaps, categorized and highlighted in Table 3, provide a path for future research to assist in managerial decision-making on the microfoundations of innovation.

Table 3: Theme-based research questions

Levels	Approaches	Research gaps	Potential RQs for future research
Individual	Open Innovation	Study the characteristics of individuals (employees and CEOs) that foster individual OI.	What characteristics of individuals impact individual OI?
	Absorption capabilities	Study the role of the CEO in the processes of knowledge transfer and the consequent absorptive capacity of himself and his employees.	What impact does the CEO's personality have on employees' absorptive capacity?
	Dynamic Capabilities	To study the individual dynamic capabilities, composed of the characteristics of individuals, which lead to innovation in companies	What are the individual DCs that foster innovation?
	Ambidexterity	Understand the psychological microfoundations of individual ambidexterity that enable the better innovative performance of companies.	What is the impact of individual ambidexterity on innovation?
Process and Interaction	Open innovation	To study the R&D resources that impact the innovation processes of companies.	Which R&D resources are best suited to the innovation process of companies?
	Technology Transfer	Study the technological transfer processes that allow better innovative performance.	Which technology transfer processes impact innovation?
Structure and Individual	Open innovation	Study OI strategies, specifically in SMEs, given their characteristics and specificities.	What are the adequate OI strategies for SMEs?
	Absorption capabilities	Study the absorptive capacity of companies to "recognize", "assimilate," and "exploit" external knowledge when developing their processes and products.	What are the components of the absorptive capacity of companies that enable process innovation?
Structure and Process	Absorption capabilities	To study how companies deal with hyper-competition, which enables them to leverage innovations.	What is the impact of hyper-competition on innovation?
	Dynamic Capabilities	Study of the that enable sustainable innovation implementation processes.	What is the impact of DCs on sustainable innovation processes?
	Ambidexterity	Study inter-organizational knowledge transfer that enables organizational ambidexterity.	What is the effect of knowledge transfer on organizational ambidexterity?

Need for research on open innovation

There have been several authors who have devoted themselves to investigating OI at all three levels of microfoundations. However, there is a need for further research on how individuals' characteristics lead to firms' innovative capacity (Bogers et al. 2018; Mazzucchelli et al. 2019). In this regard, the study of CEOs' personality is also critical (Najar & Dhaouadi, 2020; Santoro et al., 2020). Given the specific characteristics of SMEs, as it is widely known that these companies have difficulties that large companies do not face, studying the strategies and options of IOs can help them have better innovative performance (Ahn et al., 2017). There is also a need for further research on the diversity of R&D resources, as well as their multifaceted contribution to the exploratory openness of firms to innovation and is determined by the interactions between the different dimensions of the diversity of these resources (Di Paola & Russo Spena, 2019; Locatelli et al. 2021).

Need for research on absorptive capacity

A wide range of authors has reached evidence on the positive effects of knowledge transfer on innovation diffusion (Grigoriou & Rothaermel, 2014), the impact of collaborative technologies on knowledge sharing (Lakshman & Akhter, 2015), and how individual characteristics contribute to absorptive capacity (Volberda et al., 2010; Yao & Chang, 2017). However, research on the role of the entrepreneur as a link between knowledge and innovation is still lacking. The individual absorptive capacity, the ability of managers and human resources to recognize, assimilate, transform and exploit external knowledge these individual absorptive capacities are fundamental foundations of knowledge management for an organization's OI practices.

It is indisputable that achieving sustainability in organizations requires a holistic approach to innovation that utilizes the breadth of knowledge found outside of these organizations. While offering a plethora of opportunities, this open approach to innovation is also challenging in that companies need to have sufficient absorptive capacity, that is, the ability to recognize, assimilate, and exploit external knowledge when developing their processes and products. Thus, the academic debate on how to deal with hyper-competition is crucial, in a dominant logic that shows that investing in dynamic sensing, capturing, and

transforming resources offers the organization the potential to initiate innovations repeatedly.

Need for research on dynamic capabilities

There have been several investigations on the relationship of DCs to innovation and organizational performance (Teece, 2007; Ren et al., 2016; Kim, 2017), on the importance of studying the internal and external factors that lead to innovation (Li-Ying et al., 2016; Linde et al., 2021), and on managers' characteristics focus, such as DCs (Salvato & Vassolo, 2018).

We see a need for further research to specify the microfoundations of the capabilities needed to sustain superior business performance in an open economy with rapid innovation and globally dispersed sources. OI and its implications for higher strategic alliance performance need more attention from researchers. More studies on the ability of firms to mold themselves to diverse business environments are critical. At the same time, it is fundamental to understand why, within the same sector, some can shape themselves to the markets while others cannot. Thus, it is crucial to understand the internal factors that lead to this ability and heterogeneity as they have implications for competitive advantage.

It is crucial to understand how DCs and marketing resource allocation are central contributors to innovation - influencing the sustainability of competitive advantage and, consequently, the ability of a company to create or respond to external shocks.

It is also critical that more research be devoted to the characteristics of managers and how these characteristics affect DC. Future research must focus on how leadership affects dynamic capabilities. The ability of managers to identify and interpret challenges in the external environment is one of the microfoundations of dynamic capabilities.

Today there is yet another challenge facing organizations: sustainable development. Sustainable innovation requires specific and new DCs related to a new form of collaboration with suppliers, customers, research centers, and other related partners. These external knowledge sources and competencies require new skills in relationship management and knowledge integration. It is thus fundamental to identify the knowledge-based DCs that influence the process of sustainable innovation development.

Need for ambidexterity research

Several researchers have devoted themselves to studying the positive effects of organizational ambidexterity for long-term firm performance (Rogan & Mors, 2014; Schnellbacher & Heidenreich, 2020; Kiss et al., 2020; Venugopal et al., 2020; Hughes et al., 2020). However, more research is needed that focuses on the individual's level to understand the psychological microfoundations of individual ambidexterity. It is thus critical to develop microfoundational approaches that can enable firms to build individual and organizational ambidexterity, which are essential for long-term prosperity.

Innovation is a critical source of competitive advantage in an ever-changing and globalizing environment, and knowledge management is at the core of a company's overall business strategy. Since most innovations occur at the boundaries of cultural systems, transferring knowledge across these boundaries is of primary interest to knowledge management. It is also of utmost importance to develop further studies on how socio-cultural barriers to knowledge transfer emerge and enable inter-organizational knowledge transfer to overcome these barriers.

6. Conclusions

In recent years, research on innovation has gained significant attention. Yet few studies have focused on the specific study of the microfoundations of innovation. While some studies have taken stock of this literature, a review demonstrating the relational nature of knowledge creation was lacking, given innovation's nascent, evolving, and multidisciplinary nature. A mixed-methods approach that combined a traditional systematic literature review with a thematic ontological analysis of 50 articles allowed us to shed light on the main aspects that led to the identification of a new approach to academic knowledge about the microfoundations of innovation and allowed us to define a new agenda for future research.

In contrast to the systematic literature reviews we have encountered, which focus mainly on analyzing articles, our research aimed at an integrated analysis of the three levels of microfoundations: individual, process and interaction, and structure. In this way, we sought to offer a holistic model that allows measuring the three levels of the microfoundations of innovation.

Our research makes two main contributions. First, at a methodological level, our SLR allowed us to understand better the relationships between ideas, authors, and research streams and how the research field is structured. Second, at the level of researching the microfoundations of innovation, the application of SLR techniques allowed us to discover subfields within the innovation literature and characterize them based on seminal articles. A systematic review was particularly useful because of innovation's multidisciplinary and heterogeneous nature, spanning multiple natural and social sciences disciplines. We show that distinct trajectories form around specific ideas developed in subsets of seminal articles in the field. Identifying trends, patterns, and trajectories at the field and subfield levels allowed us to develop a future research agenda at the microfoundations level of innovation.

We also acknowledge some limitations related to our research. Our research, like all research, has limitations. Although systematic literature review has provided us with robust, transparent, and replicable methods for systematic literature reviews, we had to make choices regarding sampling and keywords. Our review process sought to reduce biases related to selecting results and future analyses and thus find better methods to address this problem. We did not use an independent group of researchers to control and provide alternative thematic and ontological investigations. In the future, replicating the methodology used for this literature review is advisable to understand the main theoretical streams around the meanings related to the microfoundations of innovation.

The techniques applied to allow us to grasp the general directions in which the main field investigations of the microfoundations of innovation are gravitating. In this way, they provide powerful tools to characterize the field of study, understand its internal structure, highlight existing blind spots in the innovation microfoundations research agenda, and open promising avenues for future research. Future research based on our investigation can be positioned at the intersection of OI, dynamic capabilities, absorptive capacity, and ambidexterity. Based on the same research design, possibly combined with automated text mining techniques, it would be possible to explore how these different fields communicate, converge, or diverge.

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Appendix A

Literature reviews of microfoundations of innovation

Study	Journal	Key contributions
Teece (2007)	Strategic Management Journal	The authors found that the microfoundations of dynamic capabilities (skills, processes, procedures, organizational structures, decision rules, and distinct disciplines) are difficult to develop and deploy. Firms with strong dynamic capabilities are intensely entrepreneurial and innovative, as they adapt to business ecosystems and shape them through innovation and collaboration with other firms, entities, and institutions. They aim to help researchers understand the fundamentals of long-term business success while helping managers outline relevant strategic considerations and the priorities that should adopt to improve business performance and escape the zero-profit trend associated with operating in markets open to global competition.
Chandler & Hwang (2015)	Journal of Management	Despite recent interest in microfoundations in institutional theory, questions such as what, why, and when ideas spread remain with limited answers. Thus, it is unclear how firms decide what to adopt and how these decisions evolve in a population as innovations spread and become taken for granted. The authors created a model of adoption strategies that explains how firms identify which practices to adopt, drawing on local or distant knowledge to understand what works and what does not.
Černe et al. (2016)	Scandinavian Journal of Management	The authors intended to increase our understanding of the theoretical origins, intellectual structure, and perspective of non-technological innovation research to facilitate the development of this emergent field of research. From the bibliometric study, the authors found that the prospects for further development of this research field lie in: i) bridging the literature of creativity and innovation at the individual level and addressing employee-based non-technological innovations; ii) strengthening microfoundations and a multi-level (bottom-up) approach; iii) identifying potential pathways to position non-technological innovation vis-à-vis the field of innovation management and other building connections, and iv) consolidating the relationship between management innovation as the dominant research stream and non-technological innovation as the umbrella concept.
Cohen & Levinthal (1990)	Administrative Science Quarterly	The authors argue that a firm's ability to recognize the value of new external information, assimilate it, and apply it for business is fundamental to its innovative capabilities - this is the absorptive capacity. They created a model of investment based primarily on research and development (R&D) in which contributes to a firm's absorptive capacity.
Zahra & George (2002)	The Academy of Management Review	The authors used the construct of absorptive capacity to explain various organizational phenomena. Based on a systematic review of the literature, the authors found that in the view of the dynamic capabilities of the firm, we can distinguish between a firm's potential and realized capabilities. They offered us a model that describes the conditions under which a firm's potential and

		recognized capabilities can differentially influence the creation and maintenance of its competitive advantage.
Litchfield & Gentry (2010)	Strategic Organization	The authors propose perspective taking as an organizational capability that facilitates knowledge integration, and it is widely considered crucial for organizational learning and innovation. They demonstrated that capability is a useful concept for strategic management to examine how it enhances ambidexterity and absorptive capacity.
Volberda et al. (2010)	Organization Science	The authors aimed to deepen the understanding of absorptive capacity, its underlying dimensions, its multi-level antecedents, its impact on firm performance, and the contextual factors affecting absorptive capacity. They provided insights into the main discrepancies in the organizational field, that i) most attention so far has been focused on the tangible outcomes of absorptive capacity; ii) organizational design and individual-level antecedents have been relatively neglected in the absorptive capacity literature; and iii) the emergence of absorptive capacity from the actions and interactions of individual, organizational, and inter-organizational antecedents remain unclear.
Lewin et al. (2011)	Organization Science	The authors proposed a routine-based absorptive capacity model as a first step toward operationalizing the absorptive capacity construct. They intend to draw attention to the importance of balancing internal knowledge creation processes with the identification, acquisition, and assimilation of new knowledge originating in the external environment. The ability of organizations to discover and implement complementarities between absorptive capacity routines may explain why some firms are successful early adopters, and most are imitators.
Hodgkinson & Healey (2014)	Industrial Marketing Management	Drawing on insights from recent advances in social neuroscience, the authors demonstrate how theory and research rooted in the cognition era of human psychology has created microfoundations for practices intended to help address these challenges that are fundamentally unfit for purpose. The authors put emotion management center stage, arguing that companies must learn to nurture self-regulation capabilities at all levels to be truly dynamically capable.
Iammarino & McCann (2006)	Research Policy	The authors studied the relationship between location patterns, innovation processes, and industry clusters. To this end, the authors create a transaction cost-based classification into a knowledge-based cluster taxonomy along the lines suggested by a critical review of the key assumptions underlying most of the existing literature on spatial clusters. The authors show that the transaction cost approach and the structure of technological and innovation regimes are broadly consistent and that these classification systems can provide real insights into the microfoundations, nature, and evolution of clusters.
Frenken & Boschma (2007)	Journal of Economic Geography	The authors propose a framework that specifies the process of economic development as an evolutionary process of branching product innovations. Each product innovation provides a growth opportunity for an existing or new firm and an existing or new city. One can then obtain firm size and city size distributions as two aggregates resulting from a single evolutionary process. Gains

		from the variety at the firm level (economies of scope) and at the city level (Jacobs externalities) provide the central feedback mechanism in economic development, generating strong path dependencies in the spatial concentration of industries and the specialization of cities. The authors offer a micro-basis of economic geography regarding the interaction between industrial dynamics and urban growth.
Kindström et al (2013)	Journal of Business Research	The authors identify essential microfoundations that form the basis of successful realignment of a firm's dynamic capabilities to better fit with service innovation activities. The results make three main contributions to the body of knowledge: i) they extend the existing literature on dynamic capabilities by specifically discussing microfoundations related to service innovation; ii) the study extends existing work on service innovation to manufacturing industries by identifying key microfoundations in this context; and iii) the research provides empirical evidence of dynamic capabilities in practice, especially in product-centric environments where the service context is new.

Appendix B

Procedures for Sourcing, Search, Selection, and Exclusion

A. Source of information

Peer-reviewed journal articles in Scopus bibliographical database were considered.

B. Exclusion criteria

1. Research published in edited books and conference proceedings
2. Editorials
3. Case studies for teaching purposes
4. Material not written in English

C. Search method (first completed in April 2020)

- Articles across academic journals in Business, Management and Accounting, Economics, Econometrics and Finance and Decision Sciences areas published
- The following search strategies were performed as single searches (independent from one another) and not as consequential search steps.

••Search Strategy

(TITLE-ABS-KEY ("microfoundation*" OR "micro-foundation*") AND TITLE-ABS-KEY ("innovation*")) AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (SRCTYPE , "j")) (N = 188 papers)

Paper selection:

- a. Deleting repetitions and other documents included in the exclusion list
- b. The researchers (in pairs) read the abstracts and the introductions of all papers dividing them into A, B, or C categories (A-papers were relevant to the research objective, B-papers were studies of which relevance was not clear, and C-papers were not relevant).
- c. After reading each set of 20 papers, the two researchers compared and reconciled their categorizations.
- d. A third researcher reassessed any articles excluded by one researcher but included by the other.
- e. All the B-papers were rechecked to verify their inclusion in this category.
- f. Final check by two researchers to verify the match between papers' content and the systematic review's objectives. Only A-papers were considered for the thematic analysis ($n = 50$ papers).

Appendix C

Procedures for Thematic Analysis and Ontological Organization

A. Data organization

1. Papers were organized in chronological order.
2. An Excel file was prepared to record and compare coding by researchers.
3. The Excel file had to contain the following information: title, abstract, authors, publication date, publication title, keywords, research question, theoretical perspective, sample, research context (sector or industry), research method, main results, major concepts related to intellectual capital measurement and personal notes by the readers about how and why the paper is relevant.

B. Theme identification

1. Two researchers individually analyzed each paper for objective, research questions, key arguments, research methods, major concepts and relative definitions, theoretical perspective, and outcomes.
2. Individually, the researchers wrote a statement describing the primary focus of each paper, and about how, according to the paper, intellectual capital is measure.
3. After 20 papers, the researchers compared their statements and discussed how to resolve any misalignments.
4. The statements were used to enable identification of at least three orders of thematic categories (T1, T2, and T3).
5. Preliminary names were given to the thematic categories.
6. Definitive category names resulted from discussions and interactions between authors, and these thematic categories were applied to the remaining papers in the Excel file.
7. Every 20 papers, the researchers aligned their results for consistency.

C. Ontological organization

1. The authors discussed and agreed on the three thematic categories (T1, T2, and T3) for each paper.

2. Using an ontological process, from the descriptive statements, the authors gathered the thematic categories by similarities (T1), and formed the second-order (T2) and major thematic areas (T3) to create a taxonomic (subtheme–supertheme) hierarchy (data structure available upon request).
3. The authors reviewed and checked for redundancy or duplication.

D. Interpretation and validation

1. The Excel file contained all the descriptive statements, the thematic (supertheme) category, and second-order and first-order themes for each paper.
2. For each theme, the authors wrote an explanation to check the fit between the paper's content and the themes, ensuring ontological consistency.

E. Quality checking

1. Each paper was codified by the authors providing the same attention to each paper.
2. The process was thorough, inclusive, and comprehensive (three thematic descriptors).
3. The interaction process implied a comparison of the selected themes, going back and forth to the original papers.
4. The authors checked for internal coherence, consistency, and distinction.
5. The authors interpreted the papers using their own meanings, maintaining the vocabulary expressed in the papers as much as possible.
6. Data and themes were combined iteratively.
7. The authors used ontology tables for consistency.
8. The authors had an active role in each phase.

Appendix D

Papers Included in the Literature Review.

Authors	Title	Year	Level	Object	Methodology	Study Description
Teece D.J.	Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance	2007	S&P	F	LR	Companies with strong dynamic capabilities are intensely entrepreneurial. They not only adapt to business ecosystems, but they also shape them through innovation and collaboration with other companies, entities and institutions.
Volberda H.W., Foss N.J., Lyles M.A.	Absorbing the concept of absorptive capacity: How to realize its potential in the organization field	2010	S&P	F	LR	The purpose of this article is to advance the understanding of absorptive capacity, its underlying dimensions, its multilevel antecedents, its impact on firm performance, and contextual factors that affect absorptive capacity.
Iammarino S., McCann P.	The structure and evolution of industrial clusters: Transactions, technology and knowledge spillovers	2006	I	F	LR	The authors investigated the relationship between location patterns, innovation processes and industrial clusters.
Lewin A.Y., Massini S., Peeters C.	Microfoundations of internal and external absorptive capacity routines	2011	S&P	F	LR	The authors propose a model based on the AC routine as a first step towards the operationalization of the AC construct.
Frenken K., Boschma R.A.	A theoretical framework for evolutionary economic geography: Industrial dynamics and urban growth as a branching process	2007	S&P	F	LR	They proposed a framework that specifies the process of economic development as an evolutionary process of branching out of product innovations.
Kindström D., Kowalkowski C., Sandberg E.	Enabling service innovation: A dynamic capabilities approach	2013	S&P	F	LR	The starting point for this article is the need for product-centric companies to compete in the market by adding services to their portfolio, which requires a greater focus on service innovation if they are to remain competitive
Warner K.S.R., Wäger M.	Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal	2019	S&P	F	Qualitative	They explored how companies established in traditional industries build dynamic capabilities for digital transformation.
Rogan M., Mors M.L.	A network perspective on individual-level ambidexterity in organizations	2014	I	F	Quantitative	Given the call for a deeper understanding of ambidexterity at the individual level, the authors propose that managerial networks are an important but understudied factor in balancing this trade-off between exploring new businesses and exploiting existing ones.
Bogers M., Foss N.J., Lyngsie J.	The “human side” of open innovation: The role of employee diversity in firm-level openness	2018	I	F	Quantitative	The authors studied the role of employee characteristics in opening the company to the outside world and specifically to open innovation
Grigoriou K., Rothaermel F.T.	Structural Microfoundations of Innovation: The Role of Relational Stars	2014	S&I	F	Quantitative	The authors emphasize the importance of relationships embodied by individuals to effectively perform knowledge-generating activities.
Salvato C., Vassolo R.	The sources of dynamism in dynamic capabilities	2018	I	F	Qualitative	The authors developed a multilevel theory of dynamic capabilities (DCs) that explains resource dynamics by assigning a central role to people and interpersonal interactions rather than

						abstract entities at the firm level.
Nuruzzaman N., Gaur A.S., Sambharya R.B.	A microfoundations approach to studying innovation in multinational subsidiaries	2019	I	F	Quantitative	The authors studied the antecedents of innovative performance for subsidiaries of multinational companies (MNEs) using the microfoundation approach.
Ahn J.M., Minshall T., Mortara L.	Understanding the human side of openness: the fit between open innovation modes and CEO characteristics	2017	I	F	Quantitative	In small and medium-sized companies (SMEs), where normally the decision-making process is highly centralized, important decisions, such as the adoption of open innovation (OI), are strongly influenced by the characteristics of their executive directors (CEOs)
Tippmann E., Scott P.S., Mangematin V.	Problem solving in MNCs: How local and global solutions are (and are not) created	2012	P&I	F	Qualitative	Building on a common focus on subsidiary role, contexts, and organizational MNC factors, this study explores the micro-level details of managers' actions and interactions.
Chalmers D.M., Balan-Vnuk E.	Innovating not-for-profit social ventures: Exploring the microfoundations of internal and external absorptive capacity routines	2013	S&P	F	Qualitative	This article looks at the ways in which non-profits seeking socially innovative activities develop the capabilities needed to innovate.
Schneckenberg D., Truong Y., Mazloomi H.	Microfoundations of innovative capabilities: The leverage of collaborative technologies on organizational learning and knowledge management in a multinational corporation	2015	S&P	F	Qualitative	The microfoundations of dynamic capabilities have become a central concept for strategy and innovation research. However, despite recent developments in information technologies that facilitate data flow and information management in companies, little is known about how organizational learning and knowledge management feed microfoundations of innovative capabilities.
Yao F.K., Chang S.	Do Individual Employees' Learning Goal Orientation and Civic Virtue Matter? A Micro-Foundations Perspective on Firm Absorptive Capacity	2017	I	F	Quantitative	The authors built from a microfoundation perspective and investigated how individual characteristics contribute to the development of a company's absorptive capacity.
Chandler D., Hwang H.	Learning From Learning Theory: A Model of Organizational Adoption Strategies at the Microfoundations of Institutional Theory	2015	S&P	F	LR	They developed a strategy adoption model that explains how companies identify which practices to adopt, drawing on knowledge to understand what works best.
Hodgkinson G.P., Healey M.P.	Coming in from the cold: The psychological foundations of radical innovation revisited	2014	I	F	LR	Drawing on insights from recent advances in the social neurosciences, the authors demonstrate how theory and research rooted in the era of human psychology's microfoundations of cognition for practices that purport to help address these challenges are fundamentally inadequate for the purpose.
Scuotto V., Beatrice O., Valentina C., Nicotra M., Di Gioia L., Farina Briamonte M.	Uncovering the micro-foundations of knowledge sharing in open innovation partnerships: An intention-based perspective of technology transfer	2020	P&I	F	Quantitative	The authors have built a consistent conceptual foundation for micro-level technology transfer collaborations and practices.
Gianiodis P.T., Ettlie J.E., Urbina J.J.	Open service innovation in the global banking industry: Inside-out versus outside-in strategies	2014	S&P	F	Qualitative	Despite significant academic research on the importance of open innovation to companies' R&D strategies, a deep theoretical understanding of the structure of open innovation remains elusive. This study contributes to this growing literature, providing new theoretical and practical foundations for the open innovation framework.

Litchfield R.C., Gentry R.J.	Perspective-taking as an organizational capability	2010	I	F	LR	This article proposes perspective taking as an organizational capacity to facilitate knowledge integration.
Schweisfurth T.G., Raasch C.	Absorptive capacity for need knowledge: Antecedents and effects for employee innovativeness	2018	I	F	Quantitative	Innovation occurs when knowledge about unmet customer needs intersects with knowledge about technological solutions. Both types of knowledge are often located outside the company and need to be absorbed for innovation to occur.
Černe M., Kaše R., Škerlavaj M.	Non-technological innovation research: Evaluating the intellectual structure and prospects of an emerging field	2016	S&P	F	LR	This article aims to increase our understanding of the theoretical origins, intellectual framework, and perspective of research in non-technological innovation to facilitate the development of an emerging research field.
Randhawa K., Wilden R., Gudergan S.	Open Service Innovation: The Role of Intermediary Capabilities	2018	I	F	Qualitative	This study examines how intermediaries in general, and those with digital service platforms specifically, engage with customers to help them innovate their services within their service ecosystem.
Lowik S., Kraaijenbrink J., Groen A.	Antecedents and effects of individual absorptive capacity: A micro-foundational perspective on open innovation	2017	I	F	Quantitative	The article aims to understand how individuals differ in their individual capacity for absorption - their ability to recognize, assimilate, transform, and explore external knowledge.
Ryan P., Geoghegan W., Hilliard R.	The microfoundations of firms' explorative innovation capabilities within the triple helix framework	2018	S&I	F	Qualitative	In this article, the authors show how the triple helix model provides an organizing regime within which participating firms can extend their exploratory innovation capabilities through academic-funded collaborations.
Venugopal A., Krishnan T.N., Upadhyayula R.S., Kumar M.	Finding the microfoundations of organizational ambidexterity - Demystifying the role of top management behavioural integration	2020	S&P	F	Quantitative	Organizational ambidexterity in a company is significantly influenced by the behavioral integration of the Top Management Team (TMT). The researchers note that ambidextrous companies are associated with two dimensions of dexterity, balanced and combined dimensions.
Li-Ying J., Wang Y., Ning L.	How do dynamic capabilities transform external technologies into firms' renewed technological resources? – A mediation model	2016	S&I	F	Quantitative	This study proposes and tests a mediation model of how companies' internal technological diversification and R&D, as two distinct microfoundations of dynamic technological capabilities, mediate the relationship between external technology breadth and companies' technological innovation performance, based on resource-based and dynamic view.
Bagherzadeh M., Markovic S., Bogers M.	Managing Open Innovation: A Project-Level Perspective	2021	S&P	F	Quantitative	This article provides a quantitative cross-project analysis of how two key attributes of innovation design (i.e., complexity and uncertainty) are related to five factors for successful innovation management openness: 1) level of openness, 2) choice of external partner, 3) choice of open innovation mechanism, 4) formalization of the collaboration process and 5) internal company practices
Santoro G., Quaglia R., Pellicelli A.C., De Bernardi P.	The interplay among entrepreneur, employees, and firm level factors in explaining SMEs openness: A qualitative micro-foundational approach	2020	I	F	Qualitative	This article seeks to investigate the basic foundations of engaging in open innovation (OI) in the context of small and medium-sized enterprises (SMEs). More specifically, the study aims to understand the characteristics of entrepreneurs who manage small businesses and whether these influence the

						tendency towards opening.
Maqbool S., Černe M., Bortoluzzi G.	Micro-foundations of innovation: Employee silence, perceived time pressure, flow and innovative work behaviour	2019	I	F	Quantitative	The purpose of this article is to extend the current discussion on the drivers of innovative worker behavior (IWB), connecting the theories of flow (personal factor), employee silence (relational) and time pressure (contextual).
Gurca A., Bagherzadeh M., Markovic S., Koporcic N.	Managing the challenges of business-to-business open innovation in complex projects: A multi-stage process model	2021	S&P	F	Qualitative	Based on a case study of an electric vehicle manufacturer, the authors developed a multi-step process model showing how these capabilities are developed and eliminated in terms of organizational principles (e.g., hierarchical product architecture) and actions and practices (e.g., knowledge sharing by delegating employees to/from business partners).
Hughes P., Hughes M., Stokes P., Lee H., Rodgers P., Degbey W.Y.	Micro-foundations of organizational ambidexterity in the context of cross-border mergers and acquisitions	2020	S&P	F	Quantitative	Considering organizational ambidexterity from the point of view of exploratory and exploratory innovation, the authors studied how behavioral contexts (corporate entrepreneurship) and structure (integration) regulate knowledge transfer activities at the microfoundational level and at company levels within of an international M&A context.
Ren R., Yu L., Zhu Y.	Innovation-orientation, dynamic capabilities and evolution of the informal Shanzhai firms in China: A case study	2016	S&P	F	Qualitative	This article aims to study the evolution of dynamic capabilities based on innovation in informal imitator-type firms. As a type of informal economic organization, imitation companies in many emerging economies play an important role in economic development.
Badir Y.F., Frank B., Bogers M.	Employee-level open innovation in emerging markets: linking internal, external, and managerial resources	2020	I	F	Quantitative	This study investigates how individual employees rely on internal and external knowledge to increase their innovative work output (and, secondarily, their customer acquisition performance) and how the characteristics of their supervisory manager moderate these mechanisms.
Ghassim B., Foss L.	Understanding the micro-foundations of internal capabilities for open innovation in the minerals industry: a holistic sustainability perspective	2018	S&P	F	Qualitative	It is indisputable that achieving sustainability in the minerals industry requires a holistic approach to innovation that utilizes the breadth of knowledge found outside the industry. While offering a multitude of opportunities, this open approach to innovation would also be challenging, as companies need to have sufficient absorptive capacity, i.e., the ability to 'recognize', 'assimilate' and 'exploit' external knowledge when developing its processes and products.
Ardito L., Peruffo E., Natalicchio A.	The relationships between the internationalization of alliance portfolio diversity, individual incentives, and innovation ambidexterity: A microfoundational approach	2019	I	F	Qualitative	This article seeks to unravel the influence of the decision to ally with partners of different types and from different geographic locations (i.e., the internationalization of the diversity of the alliance portfolio) on the ability of companies to balance radical and incremental innovation efforts (i.e., innovation ambidexterity).

Mazzucchelli A., Chierici R., Abbate T., Fontana S.	Exploring the microfoundations of innovation capabilities. Evidence from a cross-border R&D partnership	2019	I	F	Quantitative	The present research adopts a microfoundation perspective to propose a conceptual model that investigates if and how individual characteristics for innovation (individual attention to detail, creativity and openness) and knowledge-sharing behaviors at the individual level (individual motivation, control, capacity, and engagement) affect strategic innovation capabilities at the firm level.
Locatelli G., Greco M., Invernizzi D.C., Grimaldi M., Malizia S.	What about the people? Micro-foundations of open innovation in megaprojects	2021	S&I	F	Qualitative	This article aims to address this gap by studying the microfoundations of OI in megaprojects and focusing on the experiences of people involved in university-industry co-led doctoral programs.
Lakshman C., Akhter M.	Microfoundations of institutional change: Contrasting institutional sabotage to entrepreneurship	2015	S&P	F	Qualitative	This article addresses the poorly understood microfoundations of institutionally driven organizational change and uses an institutional conflict-based approach to examine innovation in organizational forms.
Emre Yildiz H., Murtic A., Klostén M., Zander U., Richtner A.	Individual and contextual determinants of innovation performance: A micro-foundations perspective	2021	I	F	Quantitative	The authors take the microfoundations perspective and study how employees' goal orientations affect their absorptive capacity at the individual level, which, in turn, would shape collective innovation performance.
Najar T., Dhaouadi K.	Chief Executive Officer's traits and open innovation in small and medium enterprises: the mediating role of innovation climate	2020	I	F	Quantitative	This article aims to study the impact of CEO (CEO) personality traits on open innovation (OI) strategies and the mediating effect of the innovation climate through the mobilization of upper echelon theory and OI literature.
Patroni J., von Briel F., Recker J.	Unpacking the social media-driven innovation capability: How consumer conversations turn into organizational innovations	2020	I	F	Qualitative	By inductively developing a process model of how the entrepreneur managed to convert consumer conversations on social media into organizational innovation, the study sheds light on the microfoundations of this important capability.
Di Paola N., Russo Spina T.	What drives biopharmaceutical firms' exploratory openness? A comparative process tracing approach to the analysis of R&D microfoundations	2019	P&I	F	Qualitative	Responding to the call for a multidimensional approach in the domain of open innovation, this paper aims to clarify the interaction of different internal R&D resources as microfoundations through which exploratory openness is encouraged and implemented.
Kim I.-H.S.	Dynamic management view: logic of profit seeking based on adaptation to technological change and needs evolution through needs-focused innovation	2017	I	F	Qualitative	Examining well-known models/theories in strategic management, this article proposes a dynamic management view (DMV) on the premise that profit comes from adapting to technological change and needs evolution through innovation focused on needs in a dynamic world.
Linde L., Sjödin D., Parida V., Wincent J.	Dynamic capabilities for ecosystem orchestration A capability-based framework for smart city innovation initiatives	2021	S&P	F	Qualitative	This study investigates how companies can develop dynamic capabilities to orchestrate ecosystem innovation and thus gain from it. Through a multiple case study of smart city initiatives, this investigation offers insights into the specific microfoundations or subroutines underlying the ecosystem leader's detection, apprehension, and reconfiguration capabilities that are needed to orchestrate ecosystem innovation

Kim I.-H.S., Lee B.-Y.M.	Direct causal mechanisms of profit: dominant paradigm of profit seeking	2019	I	F	Qualitative	This article develops direct causal mechanisms of profit (DCMP) to meet the conditions / requirements normatively extracted from the conceptual, logical and methodological dimensions of profit seeking, direct causal mechanisms, holistic and inegalitarian approach and deductive inference, which maintains the causal mechanism close between technological change and the evolution of needs in micro foundations, and the final causal mechanism between innovation focused on needs and explicit needs in microfoundations.
Cohen W.M. & Levinthal D.A.	Absorptive Capacity: A New Perspective on Learning and Innovation	1990	S&I	F	LR	The authors argue that a company's ability to recognize the value of new external information, assimilate it and apply it for commercial purposes is critical to its innovative capabilities.
Zahra, S. A., & George, G	Absorptive Capacity: A Review, Reconceptualization, and Extension	2002	S&P	F	LR	This article is a literature review to identify the main dimensions of absorptive capacity and offer a reconceptualization of this construct

S&P = Strategic & Process; I = Individual; S&I = Strategic & Individual; P&I = Process & Individual; F = main focus; LR=Literature Review