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Startup innovation capability from a dynamic capability-based view: A literature review and conceptual framework

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ABSTRACT

While there is a rich body of literature on innovation, the concept of innovation capability (IC) is barely identifiable as a distinct construct. Startup IC is tacitly covered in innovation management, entrepreneurship, or small business literature. We suggest a dynamic capability (DC) approach to study innovation as a distinctive capability of startup firms. A semi-structured literature review of 125 articles combining various theoretical backgrounds is discussed, including the IC conceptualizations and operationalization that we extracted and clustered into a comprehensive yet synthetic framework. This paper suggests an IC construct as a higher order DC composed of three DCs—sensing, seizing, and transforming—and three layers of foundations—core IC, supporting IC, and startup entrepreneurial capabilities. This work adds to the emerging capability-based view of the innovation stream by addressing the specific case of startups. It recognizes their entrepreneurial nature and the important role of the entrepreneur's capabilities and behaviors. It also contributes to the entrepreneurship theory by identifying the capabilities contributing to opportunity sensing and seizing and the capabilities required for transforming and shaping new opportunities. For practitioners, the IC framework offers a practical tool to assess startup ICs and identify strengths, weaknesses, and external complementarities.

Introduction

Innovation has been associated with entrepreneurship since the seminal work of Schumpeter (1934) and work from recognized management scholars such as Drucker (1985) along with studies in entrepreneurship theory (Stevenson & Jarillo, 1990). Additionally, there are overlapping boundaries and multidisciplinary approaches to both concepts (Zhao, 2005). The success of startups, as new entrepreneurial ventures, is dependent on their ability to innovate (Alvarez & Busenitz, 2001; Pellegrino, et al., 2012; Velu, 2015).

Much has been said in the psychological school of entrepreneurship regarding the motivations, traits, and profiles of entrepreneurs as drivers for innovation or entrepreneurial success, but this perspective cannot explain, in an isolated manner, entrepreneurial behavior (Stevenson & Jarillo, 1990; Venkataraman, 1997). In the innovation management field, several measurements of innovation and its determinants at the firm level have been studied (Adams et al., 2006; Becheikh et al., 2006; Hult et al., 2004; Romijn & Albaladejo, 2002), and innovation audits (Björkdahl & Börjesson, 2012; Chiesa et al., 1996) have been devised. But while startup innovation capability (IC) definitions and components are often implicitly addressed in different research fields, IC is barely identifiable as a distinct construct (Lawson & Samson, 2001).

Explicit accounts conceptualizing IC often adopt a capability-based view, building on organization capability theories and the strategic management field (Christensen & Overdorf, 2000; Crossan & Apaydin, 2010; Narcizo et al., 2017; O'Connor, 2008; Smith et al., 2008). However, an emergent stream of research applies a dynamic capability (DC) perspective (Barreto, 2010; Helfat, 2011; Helfat & Peteraf, 2009; Teece, 2007) to address IC (Forsman, 2011; Kindström et al., 2013; Lawson & Samson, 2001; Lin et al., 2016; Salunke et al., 2011; Wu, 2016).

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Moreover, most research on IC, and DC as well, concern large or established firms with existing resources and organizational capabilities. Startups, with their newness and small size, have received less attention, with scarce and often exploratory studies (Zahra et al. 2006). Thus, knowledge about capability development in new ventures is still limited (McKelvie & Davidsson, 2009).

The objective of this review is to contribute to the emerging capability-based approach to IC by applying a DC lens and developing a comprehensive IC construct considering the idiosyncrasies of startups. At the intersection of innovation management, strategic management, and entrepreneurship research, this paper seeks to advance our understanding of the IC required for startup firms.

In this paper, we will review the literature for definitions and extant conceptualizations of IC to understand its nature and components. We then discuss the congruence of DC as a framework for studying IC, and we identify startup characteristics and challenges for IC capability building. After this narrative, we describe a more structured method for building a startup IC framework, outlining its components, and then discussing its implications and further research agendas.

Literature Review

Innovation Capability (IC) Definitions

IC is often addressed implicitly in the literature, but an emerging stream attempts to offer an explicit definition. Narcizo et al. (2017) reviewed 19 definitions addressing IC from three different perspectives: innovation results, processes, and the organizational capabilities involved. IC is seen as a firm's aptitude to turning market opportunities into real advantages (OECD/Eurostat, 2005), identifying new ideas (Aas & Breunig, 2017a) and transforming them into new products, services, or processes with economic value (Noordin & Mohtar, 2013) or a benefit to the firm (Aas & Breunig, 2017a) and its stakeholders (Lawson & Samson, 2001). Accordingly, IC is defined as the aptitude to permanently transform knowledge, ideas, technological conditions, and market conditions into new products, processes, or systems (Lawson & Samson, 2001; Lazonick, 2000). Rajapathirana and Hui (2018) viewed IC as the ability to identify current and future customer needs and to respond appropriately while applying internal organizational conditions and supporting culture. Fernez-Walch and Romon (2006) coined the term "innovation potential" to refer to the set of knowledge and know-how that an enterprise can leverage to launch innovations. In sum, IC explains why "some firms prove to be better at reproducing innovation success than others" (Aas & Breunig, 2017a, p. 8).

As such, IC is not a single event but rather an organizational capability that can be fostered in a dynamic and sustainable manner through a continuous and conscious learning process, allowing for a robust and repeatable innovation process or an innovation engine (Aas & Breunig, 2017a; Albort-Morant et al., 2016; Camisón & Monfort-Mir, 2012; Cheng et al., 2016; Christensen et al., 2002; Forsman, 2011; Lawson & Samson, 2001). IC has been addressed from several perspectives, with no dominant theory (Lawson & Samson, 2001) to date, but through these definitions, we can see an agreement on the existence of a tacit intrinsic organization ability, aptitude, potential, or capability to continuously innovate. However, an emerging body of research adopts a capability-based approach to the study of IC (Aas & Breunig, 2017a, 2017b; Lawson & Samson, 2001; Narcizo et al., 2017; Salunke et al., 2011; Tesfaye & Kitaw, 2018; Ukko et al., 2016; Vicente et al., 2015), with the increasing use of a DC perspective. In the following, we provide a brief literature review on DC and explain its relevance as a framework for studying IC.

Dynamic Capabilities (DC) as an Innovation Capability (IC) Framework

DC is defined as a "firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. DCs thus reflect an organization's ability to achieve new and innovative forms of competitive advantage" (Teece et al., 1997, p. 516). For DC scholars, competitive advantages do not rely solely on the possession of resources and capabilities but build on them to develop specific new capabilities to seize opportunities in order to respond to changes in dynamic environments and even to shape the environment (Teece, 2007).

As a relatively new branch of the literature, DC research has suffered from heavy criticism for its ambiguity, presumed link with success, poor operationalization, and lack of empirical evidence (Barreto, 2010). To overcome such criticisms, Teece (2007) proposed one of the most influential models of DC, outlining its nature and detailing its micro-foundations. In this model, DC is described as three groups of interrelated capabilities: (a) sensing opportunities, (b) seizing opportunities, and (c) transforming capabilities.

We selected DC as the theoretical framework for studying IC for two main reasons. First, DC is a conceptualization of a firm's intrinsic capabilities in relation to a desired state. Second, we find that DC thinking is strongly linked with the innovation concept not only because innovation contributes to competitive advantage (Kay, 1995) but also for the emphasis DC scholars put on continuous renewal

and innovation (Brown & Eisenhardt, 1995; Eisenhardt & Martin, 2000; Helfat, 1997; McKelvie & Davidsson, 2009).

While innovation is central to DC, the relationship between IC and DC is not explicitly stated, and they often overlap (Aas & Breunig, 2017a). An increasing number of authors agree on a strong association between IC and DC (Aas & Breunig, 2017b; Chen & Jaw, 2009; Dixon et al., 2014; Kindström et al., 2013; Lawson & Samson, 2001; Lin et al., 2016; Michailova & Zhan, 2015; Narcizo et al., 2017; O'Connor, 2008; Pavlou & El Sawy, 2011; Salunke et al., 2011; Strønen et al., 2017; Wu et al., 2016), but they consider this relationship in different ways. In the first perspective, DCs support and explain innovation (Teece, 2014). As a collection of competences and capabilities, DCs support the creation of new products and processes as well as responses to dynamic market conditions (Helfat, 1997; Zahra et al., 2006). This relationship has been established in some exploratory empirical studies (Kindström et al., 2013; Lin et al., 2016; Salunke et al., 2011; Wu et al., 2016). A second perspective views IC as a component of DC, where IC is seen as an ordinary capability (Winter, 2003), or a first-order capability, that is acted upon and reconfigured through DCs (Pavlou & El Sawy, 2011). In this case, IC is described as the processes of product development rather than as a comprehensive construct of IC.

With the third perspective, IC is considered to be a DC. Innovation is, per se, a DC that integrates with, modifies, and extends other DCs (Breznik & Hisrich, 2014; Dixon et al., 2014; Eisenhardt & Martin, 2000; Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece, & Winter, 2007; Kay, 1995; Lawson & Samson, 2001; O'Connor, 2008; Strønen et al., 2017). In this case, IC is conceptualized as a higher order capability integrating and configuring key resources and capabilities to achieve innovation (Lawson & Samson, 2001; Michailova & Zhan, 2015). Michailova and Zhan (2015) present IC as a third-order DC consisting of second-order DCs, which are, in turn, composed of basic or first-order organizational routines and processes. We will adopt this view because we are interested in finding an explanation of IC and identifying its lower order components.

While we confirm the congruity between the DC framework and the IC concept, its applicability for the case of startups could be questioned since the DC approach was initially rooted in large, established firms with existing resources and capabilities. Some scholars have, however, bridged the gap between DC and entrepreneurship by addressing the DC of new ventures (George et al. 2004; McKelvie & Davidsson, 2009; Newbert, 2005; Zahra et al., 2006). For McKelvie and Davidsson (2009), the resource flow, or the changes in resources, is more important than the stock of resources in new ventures. According to Zahra et al. (2006), new ventures have few, simple, and rapidly changing DCs versus the many, complex, and resistant to change DCs in established firms. A new venture's DCs are based on improvisation and trial and error, versus the planification and accumulated learning of an established firm's DCs. New ventures develop and reconfigure their DCs to overcome limitations and seek growth opportunities, whereas established firms leverage and stretch their existing capabilities. Startup characteristics in relation to IC and capability development will be discussed later in this paper.

IC Conceptualization and Dimensions

Several scholars, drawing on numerous research perspectives and on the field of innovation management, in particular, have identified different overlapping and complementary sets of IC dimensions (Christensen & Overdorf, 2000; Crossan & Apaydin, 2010; Forsman, 2011; Lawson & Samson, 2001; O'Connor, 2008; Smith et al., 2008; Tidd er al., 2006). This includes innovation processes, technological capabilities, culture and leadership, managerial capabilities, knowledge and learning, organizational structure, resource management, external linkages, strategies, and marketing capabilities (see Table 1). Forming an integrated system supporting innovation (O'Connor, 2008), these interrelated capabilities (Smith et al., 2008) illustrate the multidimensional aspect of IC and the difficult task of separating it from its supporting practices (Lawson & Samson, 2001).

An emergent stream of research applies a DC perspective to address IC as a capability (Forsman, 2011; Kindström et al., 2013; Lawson & Samson, 2001; Lin et al., 2016; Salunke et al., 2011; Wu et al., 2016). In Table 2, we identify 11 conceptual models where IC is considered to be a DC, is a result of DCs, or is an ordinary capability interacting with DCs. In all cases, DCs related to innovation have been identified, including (a) sensing capability, opportunity-recognizing capability, and exploration capabilities; (b) seizing capability, opportunity capitalization capability, and exploitation capabilities; (c) reconfiguring, integration, combinative, and coordination capabilities; (d) knowledge capability, learning capability, and absorptive capacity; (e) relational capability, and (f) entrepreneurial capability. Lower order capabilities have also been identified from the listed models, forming an interrelated set of micro-components of IC.

This new stream is still at an exploratory stage, and there is a pressing need to reach a consensus about proper conceptualization and a comprehensive set of IC drivers (Aas & Breunig, 2017a; Narcizo et al., 2017). Startup ICs and DCs have gained less attention than those in large firms

Table 1
Organizational capabilities supporting innovation

Organizational Capabilities	Examples of Works
Resources	(Christensen & Overdorf, 2000; Crossan & Apaydin, 2010; Lawson & Samson, 2001; OECD/Eurostat, 2018; Salunke et al., 2011; Smith et al., 2008)
Innovation process	(Christensen & Overdorf, 2000; Crossan & Apaydin, 2010; Forsman, 2011; Kline & Rosenberg, 1986; Lawson & Samson, 2001; OECD/Eurostat, 2018; Smith et al., 2008; Tidd et al., 2006)
Technological capability	(Kline & Rosenberg, 1986; Lawson & Samson, 2001; OECD/Eurostat, 2018)
Culture & leadership	(Christensen & Overdorf, 2000; Crossan & Apaydin, 2010; Forsman, 2011; Hult et al., 2004; Lawson & Samson, 2001; O'Connor, 2008; OECD/Eurostat, 2018; Smith et al., 2008)
Knowledge & learning	(Alegre & Chiva, 2008; Calantone et al., 2002; Chesbrough & Appleyard, 2007; Crossan & Apaydin, 2010; D'Souza & Kemelgor, 2008; Forsman, 2011; Hult et al., 2004; Johannessen et al., 1999; Lawson & Samson, 2001; Smith et al., 2008; Tidd et al., 2006)
Organization	(Crossan & Apaydin, 2010; Forsman, 2011; Smith et al., 2008; Tidd et al., 2006; Yam, Guan, Pun, & Tang, 2004)
External linkages	(Chesbrough & Appleyard, 2007; D'Souza & Kemelgor, 2008; Evers et al. 2012; Forsman, 2011; Lawson & Samson, 2001; OECD/Eurostat, 2005)
Strategy	(Adams et al., 2006; Boly et al., 2014; Crossan & Apaydin, 2010; Lawson & Samson, 2001; Smith et al., 2008; Yam et al., 2004)
Marketing capability	(Evers et al., 2012; Forsman, 2011; Hult et al., 2004; Kline & Rosenberg, 1986; Leal-Rodríguez & Albort-Morant, 2016)

Table 2
Innovation capability (IC) models from a dynamic capability (DC) view

Authors	DCs and Their Micro-Foundations/Components	Research Setting
Lawson and Samson (2001)	**Dynamic IC:** Vision & strategy, harnessing the competence base, organizational intelligence, creativity & idea management, organizational structures & systems, culture & climate, & management of technology	Case study: Large high-tech firm Focus: Innovation management
O'Connor (2008)	**Major dynamic IC:** Organizational structure; interface with the mainstream organization, exploratory processes; talent development, governance, & decision-making; performance metrics; culture & leadership	Conceptual: Established firms Focus: Radical/significant innovation
Salunke et al. (2011)	Dynamic relational learning capability, dynamic episodic learning capability, dynamic client-focused learning capability, dynamic combinative capability, service entrepreneurship	Case studies: Service organizations Focus: Service innovation
Lin et al. (2016)	Relational capability, sensing capability, absorptive capacity, integrative capability	Quantitative: Chinese manufacturing firms Focus: Management innovation
Wu, Chen, and Jiao (2016)	**Opportunity-recognizing capability:** Customer's needs detection, competitor monitoring, cooperation with suppliers, technology monitoring, knowledge transfer **Opportunity-capitalizing capability:** Options selection, integration, learning, reconfiguring networks, operations redesign, organizational structure	Quantitative: Chinese multinationals Focus: International diversification
Kindström et al. (2013)	**Sensing:** Customer-linked sensing, system sensing, internal service sensing, technology exploration **Seizing:** Customer interaction & co-creation, delivery process, service development process, new revenue mechanisms **Reconfiguring:** Orchestration, balancing product & service innovation, service-oriented mental model	Qualitative: Established manufacturing firms Focus: Service innovation in product-centered firms
Michailova and Zhan (2015)	**Dynamic knowledge capabilities:** Generative capabilities, sourcing capabilities, integrative capabilities	Conceptual: MNC subsidiaries Focus: Knowledge capabilities driving innovation
Dixon, Meyer, and Day (2014)	**Dynamic ICs:** 1) Exploration processes: search, experimentation, risk taking; 2) Implementation processes: project selection, funding, project implementation	Case study: Russian oil company Focus: Innovation in a transitioning economy
Pavlou and El Sawy (2011)	**Sensing capability:** Generating, disseminating, & responding to market intelligence **Learning capability:** Acquiring, assimilating, transforming, & exploiting knowledge **Integrating capability:** Contribution, representation, & interrelation of individual input **Coordinating capability:** Resource allocation, task assignment, & synchronization; new product development (NPD) capability (as ordinary capability); technical capability, marketing capability, managerial capability	Quantitative: NPD business units Focus: NPD
Forsman (2011)	**IC:** Entrepreneurial capabilities, networking, utilization of knowledge, risk management, change management, business development, customer & market knowledge	Quantitative: Finnish small manufacturing & services firms Focus: Service vs. manufacturing comparison
McKelvie, Wiklund, and Short (2007)	**Absorptive capacity:** Market/technological knowledge acquisition, assimilation, transformation, exploitation	Quantitative: Swedish new tech ventures Focus: Absorptive capacity and innovation

and, in some respects, even those in small established firms. We argue that the construction of a comprehensive startup IC construct should consider the intersection of traditional innovation management (with the identified organizational capabilities), the DC view (with the higher order generic capabilities), and entrepreneurship theory to properly address the context of startup firms, with their challenges and entrepreneurial characteristics.

IC and Startup Characteristics

Since capability-based research focuses primarily on large established firms with an existing base of resources, organizational capabilities, and innovation processes (Zahra et al., 2006), we argue that the study of startup IC should draw from the entrepreneurship literature to identify startup characteristics in relation to IC.

Startups and the Liabilities of Smallness and Newness

We define startups as new innovation-driven entrepreneurial ventures seeking a scalable business model (Blank, 2013), that have been in business for less than 10 years, were created by individuals as a "stand-alone firm" (OECD/Eurostat, 2018), and are not a subsidiary of an established company (Hvide & Meling, 2019). At the birth of a new business, startups can be compared to small businesses due to similarities in terms of size and scarce resources: a simplistic organization with limited capital, few employees, and few, if any, alliances (Freeman & Engel, 2007). The relationship between firm size and innovativeness is controversial. Most empirical results see size as an advantage for large firms with access to more resources for R&D and marketing and more room for risk taking. However, other study results find a negative relationship explained by more efficiency with innovation development in smaller firms (Becheikh et al., 2006; Camisón-Zornoza et al., 2004). Yet other studies reveal no remarkable effect of size on a firm's IC (Becheikh et al., 2006; Saunila & Ukko, 2014). Reflecting a complex size–innovation relationship, these diverging results are explained by contextual factors, such as the country, the industry, or the innovation network (Becheikh et al., 2006), as well as by innovation operationalization as a quantitative outcome. But there is a lack of research on the relationship between size and the intangible IC concept (Saunila & Ukko, 2014). What we can conclude, however, is that there is a lack of resources and a need for effective management for startups, as small sized enterprises. This is referred to as the "liability of smallness" (Freeman & Engel, 2007).

Similarly, startups all suffer from a risk of failure or mortality in the first years due to low efficiency, lack of experience, nonexistent reputation, absence of innovation processes, need for cooperation and social relations with external actors, and dependence on the external macro environment (Abatecola, er al., 2012; Burns, 2016; Freeman & Engel, 2007; Liao, Welsch, & Moutray, 2008; Stinchcombe, 1965). Yet the chances of a startup's survival is influenced by their IC (Alvarez & Busenitz, 2001; Pellegrino et al., 2012; Velu, 2015), supported by learning from external sources, networking, and raising funding as a means of overcoming their liabilities (Becheikh et al., 2006; Burns, 2016; Irwin et al., 2019; Liao et al., 2008).

Startups as Innovative and Entrepreneurial Firms

New ventures and small businesses share several characteristics and constraints, but what differentiates startups is their entrepreneurial nature and their capacity to create, discover, and exploit opportunities to create new products, services, or business models (Alvarez & Barney, 2013; Burns, 2016; Foss & Klein, 2017; Shane & Venkataraman, 2000; Zahra et al., 2006). This capability is central to the entrepreneurial firm (Zahra et al., 2006), as is the role of the entrepreneur (Alvarez & Busenitz, 2001; Burns, 2016; D'Souza & Kemelgor, 2008; Venkataraman, 1997). For Shane & Venkataraman (2000) and Venkataraman (1997), entrepreneurship involves the "nexus" of entrepreneurs and opportunities. The cognitive and behavioral capabilities of the entrepreneur determine their ability to discover and exploit opportunities (Alvarez & Busenitz, 2001; Shane & Venkataraman, 2000). This includes innovativeness, risk taking, proactiveness (Naman & Slevin, 1993; Weerawardena, 2003), leadership, knowledge acquisition (Chang et al., 2015), education, experience (Baptista et al., 2007), intuition, and vision (Carland, 2015). An entrepreneur's role is also recognized in the creation and use of DCs through the perception of opportunities, willingness to embrace change, and ability to implement it (Zahra et al., 2006). Aside from these entrepreneurial capabilities, sensing, seizing, and transforming DCs are also supported by a founder's/manager's dynamic managerial capabilities (DMCs): perception, attention, problem solving, reasoning, communication, and social cognition (Helfat & Peteraf, 2014).

Another characteristic of entrepreneurial startups, as opposed to rent-seeking small conservative businesses, is their strong ambitions for growth and innovation by continuously spotting and exploiting opportunities (Burns, 2016; Carland, 2015; Carland et al., 2007; Murphy et al., 2019; Sonfield & Moore, 1990).

Startups go through several stages from inception to maturity, with different challenges for entrepreneurs at each

stage (Burns, 2016; Churchill & Lewis, 1983; Greiner, 1972; Scott & Bruce, 1987). This evolution in a firm's size and structure goes together with an evolution of the firm's IC (Christensen & Overdorf, 2000) and DC development (Zahra et al., 2006). The capabilities required at the early stages of startup are different from those needed for running the business over the long term (Freeman & Engel, 2007).

Startup Capability Development

While exploiting and reconfiguring existing capabilities is key to a DC view, the absence of formal capabilities can be a source of entrepreneurial advantage, according to entrepreneurship research (Autio et al., 2011). For Drucker (1985), entrepreneurship is about developing new capacity from limited resources, starting from what is available in a kind of "bricolage" to overcome a scarcity of resources (Baker & Nelson, 2005). This is in line with Sarasvathy's definition of effectuation, where the entrepreneurial process starts from given resources by opposition to managerial causation, which starts with an end state and select means to achieve it in a predictable manner (Berends et al., 2014; Chandler et al., 2011; Sarasvathy, 2001). In the early stages, a startup's IC and DC development follows an effectuation logic, leveraging the entrepreneur's own resources and individual capabilities in a creative way to identify opportunities, while collaborating with stakeholders for complementary external resources, to create and develop new capabilities (Alvarez & Busenitz, 2001; Autio et al., 2011; Baptista et al., 2007; Berends et al., 2014; Christensen & Overdorf, 2000; Evers et al., 2012; Freeman & Engel, 2007; McKelvie & Davidsson, 2009; Saiz-Álvarez et al., 2013; Zahra et al., 2006).

As they grow, new ventures, may turn to causation logic, with more planning, formalism (Berends et al., 2014; Read & Sarasvathy, 2005), structure, standardized activities, internal processes, planification, decision-making, coordination, and reconfigured capabilities (Christensen & Overdorf, 2000; Evers et al., 2012; Freeman & Engel, 2007), thus transforming an entrepreneur's individual resources into an organizational resource base and DCs (Alvarez & Busenitz, 2001; Brush et al., 2002). At the maturity stage, the startup transforms into an established business with capabilities becoming rooted in the enterprise values and culture, which can constitute rigidities and barriers to innovation (Christensen & Overdorf, 2000; Freeman & Engel, 2007) if the entrepreneurial orientation is not nurtured (Burns, 2016; Wiklund & Shepherd, 2003).

Startups and External Dependence

To survive and to innovate, startups depend on access to external and complementary assets (Berends et al., 2014; Paradkar et al., 2015; Rajapathirana & Hui, 2018). They need financing to grow (Burns, 2016; Freeman & Engel, 2007), they must gain support and legitimacy from stakeholders (Cornelissen & Clarke, 2010; Zahra et al., 2006), and they have to absorb technical knowledge from external sources since they have no formal R&D activities (McKelvie et al., 2007; Pellegrino et al., 2012). Startups operate with cost-consciousness and risk-sharing with similar organizations and rely on research and financial institutions (Antolin-Lopez et al., 2015). To tackle all of these issues, it is a priority for startups to develop relationship capabilities, build their networks (Paradkar et al., 2015; Spender et al., 2017; Teece, 2010; van de Vrande et al., 2009), and adopt open innovation (OI) as a means of overcoming the liabilities of smallness and newness (Spender et al., 2017). As opposed to the traditional resource-based view (RBV), for the OI school, enterprises are not required to rely solely on their own resources to innovate; rather, they need to seek opportunities outside of their boundaries (Baranès et al., 2009; Chesbrough, 2003; Chesbrough & Appleyard, 2007). Initially targeted at large firms, the OI concept (Chesbrough, 2003) is also appropriate for startups to acquire knowledge from external networks (Spender et al., 2017; van de Vrande et al., 2009) and to form alliances, broadening their possibilities by leveraging external capabilities using an effectuation logic (Frederiksen & Brem, 2017; Sarasvathy, 2001) and tapping potential synergies with large companies (Burns, 2016). Based on the capabilities of exploration of the environment, opportunity identification, and opportunity exploitation (Baranès et al., 2009), OI is strongly adapted for entrepreneurship. Using DC terminology, we can state that OI consists of "sensing" and "seizing" opportunities and transforming a startup's capabilities by integrating internal and external capabilities.

Method: Building the Conceptual Framework

We used a semi-structured literature review on IC, combining: (a) a non-structured literature review, (b) a systematic review, and (c) an iterative search (Figure 1). In the non-structured literature review, we conducted searches in the areas of innovation management and DC using various sources such as Science Direct and Google Scholar, as well as innovation and entrepreneurship journals, applying backward and forward snowballing techniques (Jalali & Wohlin, 2012; Webster & Watson, 2004). The second step was a systematic search (Tranfield et al., 2003) in the Science Direct database, including journal articles in business, management, and accounting, ranging from 2001 to 2016. The search keywords were "innovation" and "capability" in title, abstract, and keywords: (innovat* OR "product de-

velopment") AND (capabilit* OR capacit* OR abilit* OR competenc*). We used these keywords initially to capture relevant work on IC in general before digging further and progressively combining them with startup-specific keywords to zoom in on startup ICs: (start*up, SME, "small business," "new venture," "young firm," entrepreneur*). This wide inclusion strategy of both startup and non-startup related publications is explained by the emerging nature of the IC construct in general (Aas & Breunig, 2017a, 2017b; Forsman, 2011; Lawson & Samson, 2001; Narcizo et al., 2017) and the scarcity of capability-based startup IC research. We also considered articles on small business, given the similarities with startups in terms of resource limitations and the overlapping entrepreneurship and small business research.

As a result of the combination of structured and non-structured searches as well as the inclusion of recent updates, we analyzed a total of 125 articles from various journals, including *Technovation, Journal of Strategic Management, Journal of Small Business Strategy, and Journal of Entrepreneurship Management and Innovation*, to name a few. Using a qualitative approach to suit the conceptual aim of this paper, the theoretical background, methods, research setting, and relevant findings were scrutinized. IC models and components were extracted and summarized. Idiosyncratic startup or small business capabilities were identified.

The following steps were followed for building the IC framework (Figure 2):

- Identifying all IC and DC components found in definitions, findings, or measurement variables from each article (Step 1).
- Clustering of all identified capabilities into the three DCs (sensing, seizing, and transforming) from Teece's (2007) framework. Each component was assessed against Teece's "micro-foundations" and mapped accordingly to one of the three DCs (Step 2). For example, customer needs detection is considered a component of the sensing capability, while problem solving is part of the seizing capability. Table 3 illustrates an example of capabilities clustered into the seizing DC.
- Clustering all of the capabilities identified in Step 1 into meaningful groups. Each item was examined through the dimensions outlined in Table 1 as a starting point for creating categories. Other dimensions emerged from the literature, such as learning capability, cited by 30% of authors in our sample. Other dimensions that are more relevant to large or established companies were reviewed and adapted with an entrepreneurship theory lens, generating new dimensions, such as the founder's entrepreneurial and managerial capability. After a few iterations, we obtained nine fundamental themes we call IC foundations (Step 3). Table 4 illustrates an example of capabilities clustered into relational capabilities as one of the identified IC foundations.
- Mapping capabilities belonging to the intersection of each DC and each IC foundation and constructing a 9 × 3 matrix (Step 4), where IC foundations form the first dimension (lines) and DCs the second (columns). For example, customer needs detection belongs to the intersection of sensing DC and marketing capability. Individual components of the matrix cells are called micro-components in the remainder of this paper.
- Several iterations were necessary to reach a synthetic view and reduce redundancies. As a result, a total of 111 micro-components were generated, constituting the lowest order of IC.
- For readability, the IC foundations were grouped into three capability domains, and the matrix was subdivided into three sub-matrices for each capability domain (Step 5) (cf. Findings section and Tables 5–7).

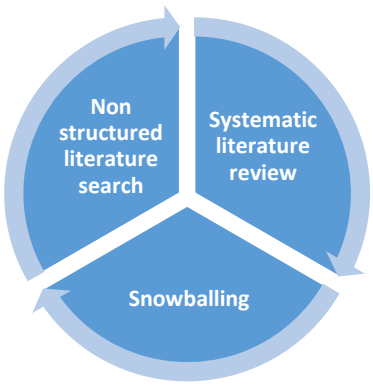

Figure 1. Hybrid Literature Review

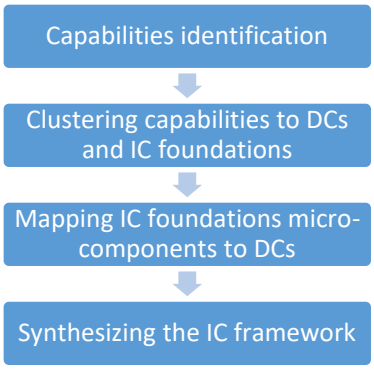

Figure 2. Conceptual Model Construction

Table 3
Excerpt of capabilities clustering into a DC—example of seizing capability

Capability	Description, Variations	Authors	Identified Components
Seizing	Opportunity capitalization	Teece (2007) Barreto (2010) Eisenhardt and Martin (2000) Teece (2018) Forsman (2011) Helfat and Petraf (2014) Tidd et al. (2006) Christensen and Overdorf (2000) Cooper and Kleinschmidt (2007) Rohrbeck and Gemünden (2011) Kindström et al.(2013) Chen and Jaw (2009) Wu et al. (2016) Adams et al. (2006) Forsman (2011) Sulistyo and Siyamtinah (2016) Boly et al. (2014) Branzei and Vertinsky (2006) Leal-Rodríguez & Albort-Morant (2016)	Solution & business model design Adopting new revenue mechanisms, defining boundaries and complements, building loyalty and commitment Decision-making protocols, timely decision-making, market-oriented decision-making, strategic decision-making, selecting options capability Commit resources; defend intellectual property Risk management capabilities, Business development capability Problem solving and reasoning Strategic alignment, product strategy, innovation strategy, strategic guidance, shared vision Technological concept creation through engineering and R&D Execution capability (NPD project management), implementation capability, product development process, project management, strategy Deployment capabilities: innovation, commercialization, differentiation Processes: patterns of interaction, coordination, communication, and decision-making) Managing innovation portfolio Service interactions: managing the service delivery process, structuring the service development process, aligning routes to markets Business development capability, commercialization Transfer external knowledge, integrate knowledge Empowerment: decision-making authority, information sharing, short- and long-term planning Design Market orientation

Table 4
Excerpt of capabilities clustering into an IC foundation—example of relational capability

Capability	Description, Variations	Authors	Identified Components
Relational Capability	Relationships and social capital Linkages Relational learning Networking capabilities	Lin et al. (2016) Christensen and Overdorf (2000) OECD/Eurostat (2005) Romijn and Albaladejo (2002) Urueña et al. (2016) Sulistyo and Siyamtinah (2016) Saunila and Ukko (2014) Paradkar et al. (2015) Rothaermel and Hess (2007) Chang et al. (2012) Lall (1992) Fan (2006) Salunke et al. (2011) Nassimbeni (2001) Kazadi et al. (2015) Eisenhardt and Martin (2000) Eisenhardt and Martin (2000) Caloghirou et al. (2004) Albort-Morant et al. (2016) Forsman (2011) Antolin-Lopez et al. (2015) Boly et al. (2014) Tidd (1997) Becheikh et al. (2006)	Relationships with suppliers, distributors, and customers Linkages: with institutions, private sector, universities, other firms External interactions Stakeholder networking Relational capital: relationships with customers, institutions, suppliers, shareholders, and investors External sources for information Access to complementary resources from alliances: distribution, finance, manufacturing, R&D capabilities, software, hardware components, brand Strategic alliances, firms' acquisitions Openness capability Linkage capabilities: use of knowledge from external sources External alliances Relational learning: from networks and external linkages Interorganizational relationships: cooperative supplier relationship, cooperative customer relationship, affiliation to consortia, external services utilization Stakeholders co-creation Stakeholders competence mapping, networking capability, relational capability, knowledge management capabiliAllianc-ing Leverage external networks Strategic alliances, collaboration, openness Relationship learning capability: information sharing capability, joint sense-making capability, knowledge integration capability Networking capabilities Cost-economizing and risk-sharing logic cooperation Network management, customer relations management Position within innovation networks Relationships with other organizations, networking

This representation offers an operationalization of the IC construct as a third-order DC (Michailova & Zhan, 2015), aggregating three second-order DCs—sensing, seizing, and transforming (Teece, 2007)—and nine first-order capabilities (foundations), in turn composed of micro-components as zero-order capabilities.

Findings

We analyzed the body of literature according to our operationalization of IC as a third-order capability. For the second order, we adopted the three DCs from Teece (2007), and for the first order, we built mainly on the previous research synthesized in Table 1 to cluster the identified capabilities in nine IC foundations. We also used entrepreneurship theory as an interpretive lens to identify startup-related capabilities and select or reformulate appropriate micro-components (zero order).

The sensing capability included all micro-components related to scanning the environment, opportunity recognition, and knowledge acquisition. The seizing capability covered all micro-components supporting implementation, opportunity capitalization, project execution, and so on. The transforming capability is concerned with micro-components involved in startup growth, scalability, business development, and profound transformations to adapt to and create change. In terms of foundations, we distinguished three capability domains: core IC, defining the ability to produce and manage innovations; supporting IC, constituting strong drivers and enablers; and startup entrepreneurial capabilities, which are specific to the startup context and entrepreneurial behavior.

Core Innovation Capabilities

Core ICs are directly involved in the creation of innovation outputs, considering the different and interrelated types of innovation: technology, product, process, and business model innovations (El Hanchi & Kerzazi, 2019). Drawing from the extensive literature on new product development and stretched to include different innovation typologies, this domain, which is synthesized in Table 5, includes the following IC foundations:

- Technology IC relates to all capabilities required for sensing technology, conducting research and development, seizing technological opportunities, exploiting new technologies, and managing technologies to respond to change and shape new technological situations.
- Product and process IC includes all capabilities allowing the detection of product/process opportunities; generating ideas; seizing opportunities through design, conception, development, and implementation of new products and processes; and transforming product strategy to respond to and shape new market conditions.
- Business model IC encompasses all capabilities supporting the identification, development, and transformation of new business models.

Supporting Innovation Capabilities

The learning perspective stands out as a common background for IC, particularly through the absorptive capacity concept supporting the knowledge acquisition, assimilation, and transformation required for innovation (Cohen & Levinthal, 1990; Zahra & George, 2002). Similarly, linkages and networking are present as main capabilities in several IC models and reported as priority for startups due to external dependencies. Marketing capability and market orientation are also acknowledged as important enablers of innovation and new market creation (Leal-Rodríguez & Albort-Morant, 2016; Weerawardena, 2003). Moreover, these capabilities are often interrelated in the literature, with some overlap. For instance, learning capability includes the ability to source (market) knowledge from external sources (partners), thus involving relationship capability and contributing to marketing capability. The interlay of these three capabilities offers a support base for the core ICs (Table 6).

Three IC foundations are covered in the supporting ICs domain:

- Learning capability includes all capabilities by which new knowledge is identified, acquired, exploited, and transformed.
- Relational capability refers to all capabilities involving networks and linkages. It goes from sensing opportunities and obtaining knowledge from the network, developing alliances, and accessing external resources to transforming and shaping the network.
- Marketing capability covers all capabilities geared toward the customer and the market. It starts from sensing the market and customers' needs to market experimentation, innovation, commercialization, and brand and social media capabilities, to reconfiguration of marketing strategies for developing barriers to competition and shaping market conditions.

Startup Entrepreneurial Capabilities

In the case of startups and their "liabilities of newness

Table 5
Core innovation capabilities

	Sensing	Seizing	Transforming
Technological IC	Sensing technology Detecting emerging technology R&D	Exploiting technology Technical solution development Design Experimentation Acquisition of technology licenses	Technology management Defend intellectual property Focus on core technologies Manage technology portfolio
Product and Process IC	Detecting opportunity Ideation Understanding customer needs	Concept creation Solution design Product differentiation Experimentation Implementation Operation design Production capability Improvisation Imitation Outsourcing	Extending product range Product and process Flexibility
Business Model IC	Identifying new business models Customer needs sensing	Solution and business model design Adopting new revenue mechanisms Managing the service delivery process	Business development Reinventing business model

Table 6
Supporting innovation capabilities

	Sensing	Seizing	Transforming
Marketing Capability	Market sensing Competitor sensing Customer needs sensing	Experimentation Customer relationship management Go to market Innovation commercialization Market-oriented decision-making Customer service Brand innovation Product differentiation Advertising effectiveness Sales and distribution management Social media capability	Developing barriers to competition Internationalization and market extension
Learning Capability	Acquiring knowledge	Assimilating knowledge Exploiting knowledge Trial and error	Transforming knowledge Learning from past projects Improving the knowledge base and skills
Relational Capability	Acquiring knowledge from external sources Detecting opportunity from networks Identifying complementarities and synergies Information sharing Networking capability	Co-creation Alliancing, partnerships development Getting support from the ecosystem Information sharing Accessing external resources Risk-sharing cooperation Cost-economizing cooperation Customer and supplier involvement	Reconfiguring the network Network positioning Shaping the ecosystem

and smallness" (Abatecola et al., 2012; Freeman & Engel, 2007, p. 94), a startup's ability to construct a resource base including human capital and financial capital is fundamental for IC. Research on entrepreneurship focuses on the individual capabilities of the entrepreneur and the capability to transform the founder's resources into organizational assets through effectuation (Alvarez & Busenitz, 2001; Brush et al., 2002; Burns, 2016; D'Souza & Kemelgor, 2008; McKelvie & Davidsson, 2009; Shane & Venkataraman, 2000; Venkataraman, 1997). This capability domain builds on entrepreneurship theory and includes startup capabilities that are necessary for building and managing innovative and entrepreneurial startups (Table 7). This category replaces the widely recognized set of organizational capabilities of large, established firms consisting of organizational structure and resources, culture, and management team, with appropriate startup management capabilities and entrepreneurial individual capabilities. Three IC foundations are included:

- Innovation funding capability involves capabilities for identifying, attracting, and managing funding opportunities to finance innovation and startup growth.
- Resource management capability includes capabilities to identify, attract, and develop resources and to transform individual resources into organizational assets.
- Founder entrepreneurial and managerial capability builds on entrepreneurial behavior theory and the DMC and covers a set of entrepreneurial and managerial capabilities, competences, and attitudes of the startup founder.

The Startup Innovation Capability (IC) Framework

Finally, we present the startup IC as a bi-dimensional and multilayered framework (Figure 3). The IC construct consists of capabilities for sensing the environment for opportunities and knowledge, seizing opportunities through innovation development and commercialization, and transforming founders' individual capabilities into organizational assets through effectuation. These DCs are supported by a system of interdependent foundations: (a) Core ICs, including technological IC, product IC, and business model IC; (b) Supporting ICs, recognizing the role of marketing capability, learning capability, and relational capability; and

Table 7
Startup entrepreneurial capabilities

	Sensing	Seizing	Transforming
Founder's Entrepreneurial and Managerial Capability	Entrepreneurial orientation Risk taking Creativity Attention and perception Proactiveness	Decision-making Strategy Leadership Collaboration Problem solving and reasoning Communication Social cognition Management experience Industry experience Agility Entrepreneurial capability	Vision Values Flexibility
Innovation Funding Capability	Detecting opportunities Attracting investors	Startup funding Investment decisions Equity decision-making	Investor alignment Growth funding
Resources Management Capability	Attracting resources Identifying needed resources	Constructing a resource base Managing resources and competences Human capital development Integration of internal and external resources and competences Stakeholders' competence mapping Engaging resources	Transforming individual resources into organizational resources Transformation of competences New competence acquisition Evolution of resources

(c) Startup entrepreneurial capabilities, covering the founder's entrepreneurial and managerial capabilities, innovation funding capability, and resources management capability. Figure 3 shows a macro representation of the proposed capability-based IC, and Table 6 and Table 7 represent detailed views of the framework, mapping the IC foundations to the DCs.

Discussion and Implications

Theoretical Contributions

From a conceptual perspective, this paper has three contributions. First, it offers a theoretical background for studying IC from a capability-based view, recognizing innovation as a DC of the entrepreneurial firm and a higher-level construct aggregating and integrating different foundations and components (Lawson & Samson, 2001; Michailova & Zhan, 2015). This capability-based view conceptualizes IC as the internal innovation engine (Christensen et al., 2002) that transforms opportunities into innovation outcomes. We developed a comprehensive yet synthetic IC framework combining literature in the fields of DC, innovation management, and entrepreneurship and adding to the emerging capability-based stream of research on innovation (Forsman, 2011; Kindström et al., 2013; Lawson & Samson, 2001; Lin et al., 2016; Salunke et al., 2011; Wu et al., 2016).

Second, the paper adds to the entrepreneurship theory by focusing on startups as innovative and entrepreneurial firms. Startups generally start small with a strong growth mindset (Burns, 2016; Carland, 2015; Carland et al., 2007; Freeman & Engel, 2007; Murphy et al., 2019; Sonfield & Moore, 1990). While innovation management and DC research consider large corporations and involve organizational factors such as culture (Adams et al., 2006; Cooper & Kleinschmidt, 2007; Lawson & Samson, 2001), management team (Becheikh et al., 2006; Cooper & Kleinschmidt, 2007), and resource allocation (Yam et al., 2004), research on entrepreneurial firms focuses on the founder's individual capabilities and human capital (Alvarez & Busenitz, 2001; Baptista et al., 2007; Burns, 2016; D'Souza & Kemelgor, 2008; McKelvie & Davidsson, 2009; Romijn & Albaladejo, 2002; Shane & Venkataraman, 2000; Venkataraman, 1997), as well as on opportunity discovery, creation, and exploitation (Baranès et al., 2009; Zahra et al., 2006) and on the entrepreneurial process, allowing the firm to do more with less through effectuation (Baker & Nelson, 2005; Chandler et al., 2011; Sarasvathy, 2001). Our contribution to entrepreneurship theory is to combine ICs from both the enterprise level as a unit of analysis and the entrepreneur level, using entrepreneurship theory. At the early stages, IC will be mainly related to the founder's individual capabilities.

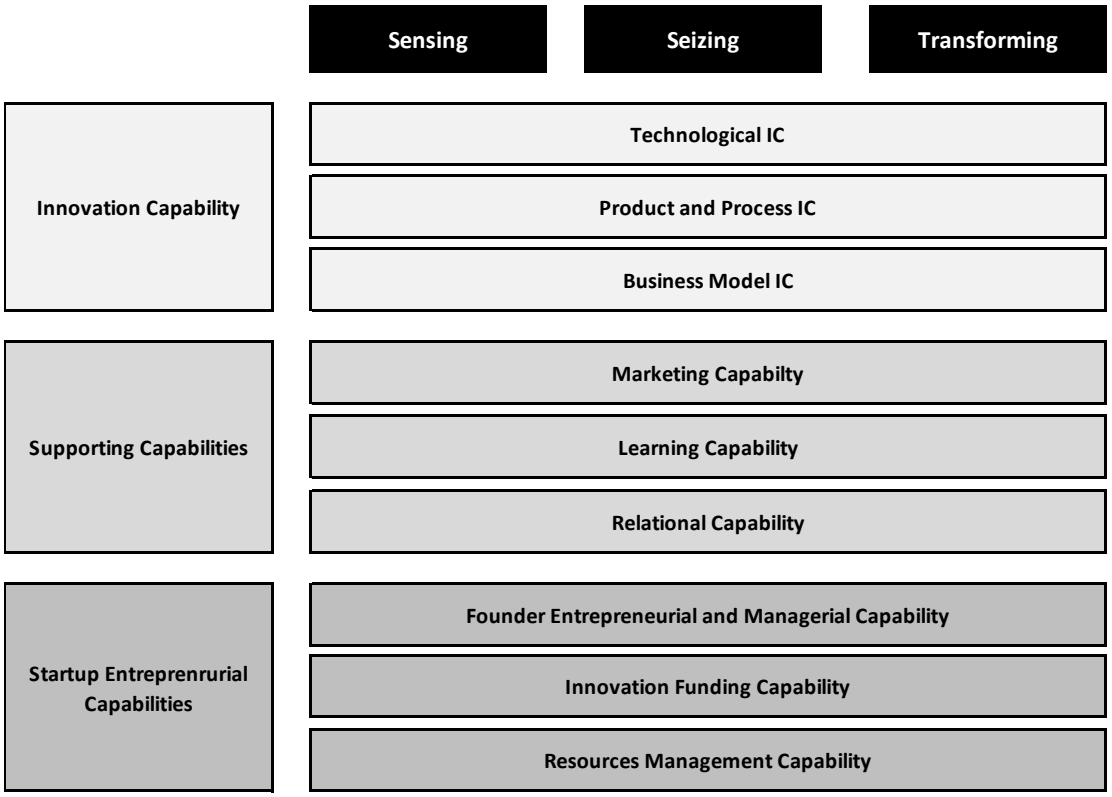

Figure 3. A Proposed Framework for Startup Innovation Capability (IC) from a Dynamic Capability (DC) Perspective

The growth will be dependent on the ability to transform the founder's resources and capabilities into startup DCs (Brush et al., 2002; McKelvie & Davidsson, 2009) by following an effectuation logic. In our framework, the founder's entrepreneurial and managerial capability, innovation funding capability, and startup resource management capability are considered building blocks for developing a firm-level capability, thus bridging the gap between DCs and entrepreneurship.

Third, the IC framework builds on, and adds to, the Oslo Manual guidelines for innovation surveys (OECD/ Eurostat, 2005, 2018). By considering startup-specific capabilities such as the founder's entrepreneurial and managerial capability and innovation funding capability, surveys on startup innovations would be more comprehensive and tailored to this category of firm. In addition to these conceptual contributions, this work has practical implications as discussed in the following.

Practical Implications

The IC framework offers a practical and simplified multidimensional tool for entrepreneurs to assess their startups' ICs and identify their strengths and weaknesses. It will also help them identify complementarities and the external support required to address the liabilities of smallness and newness. The framework also highlights the capabilities required to transform a startup for growth. In fact, by applying the three DCs, the focus is not only on how to detect (sense) and grasp opportunities (seize) for innovation but also on how to reconfigure (transform) on a continual basis to grow and maintain the IC of the startup at different stages of its development.

For ecosystem stakeholders, the IC framework provides a common ground to identify and close the gap between the current state and a desired startup IC in a given country or region. The IC framework can also be used as a basis to develop evaluation criteria considering the various and interrelated ICs for the selection of eligible startups for a given program or funding opportunity.

Future Research

This paper offers a conceptual contribution to the research on IC. It is based on a combination of a structured and a non-structured literature review. While this method reduces researcher bias, it presents some inherent limitations. Mainly, it does not guarantee an exhaustive collection of works will be included in the review. Although we selected the Science Direct database for its richness and its large span of subjects, and we also completed the search using Google Scholar and snowballing searches, we might have omitted a significant number of works. We are confident, however, about the comprehensiveness of the concepts because we have reached theoretical saturation (Glaser & Strauss, 1967) due to redundancy of the concepts encountered during the analysis. This review can be completed by including other databases and more entrepreneurship and new venture sources.

This work offers multiple venues for research. The framework offers a 9 × 3 matrix of ICs and their individual micro-components. Each element of the matrix offers a venue for specific research questions to study a well-framed aspect of IC and advance the knowledge about this construct. The IC framework can be used to conduct exploratory studies within startups to understand their ICs at different stages of their life cycle. It can also support qualitative research and detailed case studies.

Additionally, we have identified many relationships between the nine IC foundations during our analysis of the literature, but we did not include them in the present paper for reasons of length. The framework can be further developed by including these relationships to develop a detailed conceptual model and build hypotheses for conducting quantitative research on specific ICs and how they interact to shape a startup's overall IC.

Note

References include only authors cited in this paper. Other articles not directly cited in the present document were included in the hybrid literature review selection (as shown in the excerpt in Table 3 and Table 4).

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