Inter-organizational collaboration and SMEs' innovation: A systematic review and future research directions

Abstract

Inter-organizational collaboration (IOC) has gained increased attention in research and practice given its documented influence on the innovation of small and medium-sized enterprises' (SMEs). Regardless of the growing number of studies, there is still lack of research that scrutinizes and synthesizes this body of knowledge. This paper undertakes a systematic review of 113 studies from 2000 to 2019 to analyze research trends and findings on the nature and dynamics of IOC-innovation relationship in SMEs domain. Based on this analysis, we develop a framework grounded in selected theoretical lenses and empirical findings to advance our understanding of key antecedents, mediators, moderators and outcomes. We highlight that extant theories are deployed and illustrated but rarely extended in a manner that significantly informs subsequent work. Furthermore, we identify that innovation is a complex process that involves different mechanisms. On that basis, we have identified several research gaps and provided a future research agenda that we mapped into four dimensions: theory, phenomenon, methodology and context.

Keywords: Inter-organizational collaboration; Innovation; Collaborative innovation; SMEs; Systematic review

Highlights. 1) There is growing research interest in inter-organizational collaboration (IOC) and innovation of SMEs. 2) This paper systemically reviews the knowledge on dynamics of the IOC-innovation relationship. 3) We identify the main antecedents, mechanisms and outcomes of IOC and, through this analysis, pave the way for future research efforts.

1 Introduction

Small and medium-sized enterprises (SMEs) have a substantial influence on the economy of most countries (Agostini & Nosella, 2018; Wright et al., 2015). However, they are typically characterized as having resource limitations, informal strategies, flexible structures (Konsti-Laakso et al., 2012; Qian & Li, 2003), which reduce their resilience and put them at risk from increased competition (Chen et al., 2014). In response to these challenges, innovation becomes a strategic option for this sector (Rosenbusch et al., 2011). Yet, due to the liabilities of smallness (Rogers, 2004), the literature shows that SMEs rely less on internal development to drive their innovation and more on inter-organizational collaboration (IOC) to overcome resource constraints and drive innovation (Classen et al., 2012).

Arguably, IOC has become one of the most significant concepts in the field of SMEs' innovation in recent years (Acheampong & Hinson, 2019; Camps & Marques, 2014), which has led to a consequent growth in empirical work investigating IOC and innovation relationships in SMEs (Inemek & Matthyssens, 2013). However, at least two key issues can be recognized in this body of literature. First, while there is a proliferation of studies investigating the different components of SMEs' IOC and innovation relationships, there is lack of consensus on the core mechanisms involved in this relationship, its antecedents and outcomes (Howard et al., 2016; Popa et al., 2017). This lack of consensus can be due to fragmentation of research into various several disciplines (e.g., innovation management, entrepreneurship, and strategic management) or theoretical strands (Klewitz & Hansen, 2014; Voorberg et al., 2015). Yet, this in turn, has led to richness of the field in concepts and empirical research. Although that richness, the literature on this phenomenon requires systematic structuring and integration, whereby several calls have been made to evaluate and synthesize what we already know on IOC-innovation in order to make substantial theoretical and practical development in this field (Agostini & Nosella, 2018; Poorkavoos et al., 2016). Specifically, there is a need to decode more holistically the building blocks of this relationship (i.e., IOC-innovation) by addressing its antecedents, mechanisms and outcomes. Second, empirical research investigating the innovation performance of SMEs through IOC has yielded mixed results (e.g., Rothaermel et al., 2006). To some extent, this is due to the use of single-country samples (Kim & Shim, 2018), lack of a sophisticated methodological approach (Gupta & Barua, 2016), and different construct operationalization (Romijn & Albaladejo, 2002). Yet, to date, there has been no systematic review that brings together and synthesizes the evidence-base relating to IOC and innovation in SMEs. Indeed, there is a need to delve more deeply into the literature to understand the specific role of IOC in shaping and determining innovation (Brunswicker & Vanhaverbeke, 2015; Tomlinson, 2011).

To fill in these gaps, this paper aims to systematically and critically review the literature on IOC and innovation relationship, setting our main inquiry as: how can IOC influence innovation in SMEs? In addressing this question, we systematically identified and analysed 113 articles published between 2000 and 2019 that considered SMEs as their empirical setting. Based on this, we integrated the fundamental themes in SMEs' IOC and innovation literature and explicated how different types of innovation are realized.

By doing so, this study makes two key contributions. First, we reviewed the broad and fragmented empirical literature on SME IOC and innovation relationship (Nijssen et al., 2012; Sarpong & Teirlinck, 2018), which offers a unique perspective in comparison to prior work (Hagedoorn, 2002; Perkmann & Walsh, 2007; Pittaway et al., 2004). Specifically, by focusing on the context of SMEs, we advance the literature on the impact of IOC on innovation by incorporating the effect of organization size (Popa et

al., 2017). Since SMEs have unique characteristics, and thus, have idiosyncrasies in developing and managing IOC (Gentile-Lüdecke et al., 2019; Martínez-Costa et al., 2019), our review offers new insights into this phenomenon by developing a much needed framework that maps and logically links the key components of SMEs IOC-innovation relationship: antecedents, moderators, mechanisms and outcomes. Second, we draw on our analysis and synthesis to set an overarching roadmap for an informed research agenda, proposing four specific dimensions for future research: theory-centric (directions for better theory utilization and development); phenomenon-centric (directions for extending the existing base of empirical evidence at different levels of analysis); methodology-centric (directions for new methods applications); and context-centric (directions for exploring new opportunities in regional and comparative studies).

This paper is structured in the following manner. The next section describes the methodology used to perform the review. Following this, the status of empirical research on the IOC-innovation linkage is discussed. Next, the findings of empirical research on the IOC-innovation linkage in SMEs are presented. After that, a discussion of the research findings is provided, including suggestions for future research directions. Finally, the conclusion is provided, with a statement of the review's limitations.

2 Methodology

This section explains our approach in conducting an SLR of the scholarly field. Both co-authors were involved in the process of designing and conducting the study. To ensure the transparency, rigor, and objectivity of our study, we followed the method recommended by Tranfield et al., (2003) and Denyer and Tranfield (2009), which has been applied widely in the literature (e.g., Ceipek et al., 2019; Pilbeam et al., 2012). Specifically, our approach involved four key steps, as outlined in Figure 1.

Insert Figure 1 About Here

2.1 Review question and conceptualization

The SLR process started with the statement of the review question and setting of conceptual boundaries. Initially, we set our main review question: how can IOC influence innovation in SMEs? To operationalize our research question, we broadly followed previous studies (Pilbeam et al., 2012; Pittaway et al., 2004) to break down the main review question into three sub-questions with their own themes.

RQ1: What is the current status of empirical research on IOC innovation?

- Publications spectrum
- Research methodologies and settings
- Theoretical paradigms underpinning the IOC-innovation linkage in SMEs

RQ2: What factors influence outcomes related to IOC innovation in SMEs?

- Antecedents of IOC-innovation linkage in SMEs
- Underlying mechanisms for IOC-innovation relationship in SMEs
- Outcomes of IOC-innovation relationship in SMEs
- Moderators of IOC-innovation relationship in SMEs

RQ3: What are the implications of our review findings for future research?

- Key insights
- Avenues for future research

Next, we set the conceptual boundaries of the study by identifying its concepts (as informed by the above questions), which include SMEs, IOC, and innovation. First, with respect to SMEs, we encountered difficulties in defining the term 'SME', given the range of definitions in the literature. Reflecting this inconsistency, the term 'SME' has been defined differently in the literature using variable structural characteristics such as the number of employees (Raju et al., 2011), and performance characteristics, such as annual revenue (Freel & Robson, 2017) or both (Maduku et al., 2016). Also, there is lack of agreement on the number of employees to define an SME. According to the European Union (2015), SMEs are those firms employing between 1 to 250 employees. In the East and Far East, SMEs are those firms with fewer than 500 employees (Paul et al., 2017). In the USA, Small Business Administration provides common size standards based on industries and set a threshold of 500 employees to be classified as an SME. As no universal definition of SME exists, we used 500 employees as the cut-off criteria to ensure an exhaustive review sample. This size limit for SMEs has been used by previous researchers in the innovation management domain (Klewitz & Hansen, 2014; Mayer-Haug et al., 2013).

Second, we defined the IOC concept as "a commercially oriented connection between a small business and other organizations" (Street and Cameron, 2007, p. 240-241). The rationale for adopting Street and Cameron's (2007) definition is twofold. Firstly, it focuses on SMEs that link with other organizations (e.g., contractually or through interpersonal relationships) to pursue a specific goal. Secondly, this definition is broad to incorporate the various forms of inter-organizational relationships, including the most prominent forms in the literature: alliance and network. While the former refers to "short or long-term voluntary relations between organizations concerning one or more areas of activity—such as market entry, skill acquisition, or technological exchange" (Dacin et., 2007, p. 170), the latter concerns a set of nodes that link a group of organizations together (Gulati, 1998).

Finally, innovation (our third concept) has been used widely and defined differently in the literature. Arguably, the first definition was coined in the late 1920s by Schumpeter (Hansén & Wakonen, 1997), who stressed that innovation is novel outputs: a new market; a new source of supply; or a new organizational structure. The definition based on Schumpeter's perception has been a reference point for subsequent scholars, who have added more aspects. For example, Tushman and Nadler (1986) suggested 'new products' as a new element when defining innovation. Van de Ven and Angle (1989, p. 20) described innovation as the "generation, accumulation and implementation of ideas, processes, products or services", where others added the inflow and outflow of knowledge as important aspects of innovation (Chesbrough et al., 2006; Chesbrough, 2003). Building on prior studies, we have defined innovation as 'the exploitation of ideas into new or modified products, services or processes, and therefore it is critical for business performance and growth' (Camisón-Zornoza et al., 2004; Pittaway et al., 2004). Importantly, this broad account enabled us to accommodate different forms of innovation, and also to reduce potential selection biases rooted in terminology definition-related inconsistencies. With regard to our innovation definition, two points need to be considered: 1) we are interested in technological innovation in the form of product and process. Therefore, other types of innovation (e.g., administrative, organizational and so on) are not covered by our study; and 2) an innovation implies both a new product/process and modifications to an existing product/process.

2.2 Review scope

We set the review scope by clearly stating the inclusion/exclusion criteria (see Appendix 1). We focused only on peer-reviewed articles published in international journals in English (Khosravi et al., 2019; Ordanini at al., 2008). Accordingly, we omitted other sources (such as books, book chapters, conference papers, and other non-peer reviewed publications). The rationale for this choice is threefold. First, by including only peer-reviewed journals we have minimized quality-related concerns, as these articles have been subject to rigorous review process by peers in the field (Calabrò et al., 2019; Natalicchio et al., 2017). This is an important issue as some of the books/book chapters/conference papers are published without critical evaluation (Sivarajah et al., 2017). Second, focusing only on articles was useful to keep our sample within a manageable size without the risk of omitting important/relevant work (Calabrò et al., 2019; Reinhardt et al., 2018). This is because the vast majority of researchers would typically publish their scholarly work in academic journals before integrating such work into books/book chapters (Bhimani et al., 2019). For example, the contributions of books, such as Vanhaverbeke (2017), have been largely presented in earlier articles (Brunswicker & Vanhaverbeke, 2015; van de Vrande et al., 2009) that are included in our sample. Indeed, this is a common practice in systematic review studies in innovation management field (Piitaway & Cope, 2007; Sandberg & Aarikka-Stenroos, 2014). Finally, by focusing only on articles published in electronic databases, we ensured that we had systematic access to all the sources within our sample (i.e., all are publicly available, Bhimani et al., 2019).

Similar to previous studies (e.g. Adams et al., 2016; Loureiro et al., 2019), we chose to target journals listed in the academic journal quality guide of the Association of Business Schools (ABS).[1] While we acknowledge the potential limitation of this choice (Mallett, Wapshott, & Vorley, 2019; Wieland, 2018), using this list provided a valuable focus for our review to ensure robustness and quality in the sources included (Nolan & Garavan, 2016). Also, the list has a wide scope which allowed the inclusion of an extensive range of disciplines and fields within social sciences (Soundararajan et al., 2018).

For the review timeframe, we included articles published between 2000 and 2019 (the first two quarters of 2019, due to availability of articles). The year 2000 was chosen as the cut-off point because few review studies on this topic can be found before this period (e.g., Leonidou, Katsikeas, & Piercy, 1998; Nooteboom, 1999). However, given the cumulative nature of the field, the risk of "omitting earlier major contributions will be mitigated by recent papers that build on the findings of earlier ones" (Ankrah & Al-Tabbaa, 2015, p. 389).

Next, we identified the search keywords based on the conceptualization of the three terms: SME, innovation, and IOC (as explained in the previous sub-section). In specific, both co-authors relied upon the conceptualization of the three terms when reviewing and discussing the relevant articles to compile a rich list of keywords. Overall, a total of 31 keywords were identified (see Appendix 2). To create a combined search string (as shown in column D in Appendix 2) for the database search, the keywords from column A were iteratively combined with the keywords in columns B and C. As such,

[1] The main alternatives for ABS journal ranking are impact factor by Thomson Reuters, citation reports by journals, the journal quality list by the Australian Business Deans' Council (ABDC), and the Financial Times list of the top 50 business journals. Notwithstanding, Theuβl, Reutterer, and Hornik (2014) noted that ranking the top-tier journals is consistent in alternative ranking lists.

each potential article should match a combination of keywords from columns A, B, and C. In other words, the articles must address the relationship between IOC and innovation of SMEs.

To build a comprehensive database, we explored databases including EBSCOhost Business Source Complete, Science Direct, Emerald, SAGE Journals, ISI Web of Knowledge, and Wiley Online Library. The scope of databases helped our interdisciplinary objectives to cover the literature on innovation, IOC, and SMEs. Moreover, we conducted a further investigation using the Google Scholar search engine to ensure the robustness of our search process (De Menezes & Kelliher, 2011; Schlachter et al., 2018), which enabled us to identify a small number of potential papers.

2.3 Study identification, screening and selection process

We conducted the identification, screening and selection of articles in three steps, as summarized in Figure 1. First, the keywords search was conducted by one of the researchers. Using the advanced search option, we applied the filters 'academic journals', 'peer-reviewed', 'language- English', 'field-title, abstract, and/or keywords', and 'time frame' to the selected databases. This search yielded a total of 1169 potentially relevant articles. To reduce the risk of overlooking papers, the search was repeated in Google Scholar, which yielded an additional 18 articles. The other researcher conducted the same search, which led to similar results. This search process ensured the robustness of our review search and reduced the risk of overlooking papers (Boiral et al., 2018). After excluding duplicates (n = 36) and articles not listed in the ABS list (n = 284), a total of 849 articles were identified, which were subjected to a staged review (i.e., reading the abstracts to determine suitability for inclusion).

Second, consistent with prior studies (Sweeney et al., 2019), we reviewed the abstracts of 849 retrieved articles based on explicit inclusion/exclusion criteria (see Appendix 1 for more details). In particular, we included empirical studies (i.e. quantitative, qualitative, and mixed-method) of the relationship between IOC and innovation of SMEs from 2000 to 2019 (Sweeney et al., 2019). We excluded non-empirical studies (i.e. conceptual and review studies) from the review sample because our SLR is limited to empirical research. However, non-empirical studies would typically offer important contributions; therefore, we refered to these studies in our discussion of the definitional and theoretical foundations of the field (Ceipek et al., 2019). In addition, we narrowed the subject to SMEs, thereby excluding the large enterprises. Moreover, we specifically focused on empirical articles focusing on the relationship between IOC and innovation. Within this area, there are some articles that concern IOC and firm performance (e.g., increase in assets, or international performance), which does not involve any type of innovation, and hence have been excluded. After using these criteria, 165 (20%) relevant articles were identified; this percentage is consistent with prior review studies (Laaksonen & Peltoniemi, 2016).

Third, the 165 articles were thoroughly scrutinized using quality criteria to ensure the rigor of studies (Tranfield et al., 2003), including the theory, sampling, data collection, and data analysis. To follow a systematic approach, we scored the articles 0 if they had no relevance to objectives, 1 if they had poor relevance to objectives, 2 if they had basic relevance to our objectives, and 3 if they offered deep relevance to objectives (Dean et al., 2019). Both researchers agreed to include only papers with a score of 2 and 3 because the papers scoring 0 or 1 had no/poor relevance to our review objectives (Dean et al., 2019). This step provided a more complete analysis of the studies; for example, articles were dropped where the methodology was not clearly described, or analysis lacked sufficient details. In this step, both researchers worked closely together in order to compare and discuss the results. This screening process resulted in 113 articles, which constituted our final sample. The proportion of

papers in each of the three stages is similar to that observed in other SLR papers (Nolan & Garavan, 2016; Thorpe et al., 2005).

2.4 Analysis and synthesis

Since avoidance of undue emphasis on one study relative to others requires a transparent synthesis process (Mulrow & Cook, 1998; Tranfield et al., 2003), we considered narrative synthesis to combine the findings from the 113 studies. Narrative synthesis gives reviewers the flexibility to thematically explore the relationship between and within studies with the aim to tell the story of findings from a diverse body of literature (Bailey et al., 2017; Nijmeijer et al., 2014). Briner and Denyer (2012) argue that narrative synthesis is a flexible approach that allows the researchers to not only critically identify themes in different studies, but also adopt fit-for-purpose approach by taking into account the review question. Consequently, it allows to provide a comprehensive review of heterogenous research area, including both qualitative and quantitative studies. Our approach to narrative synthesis is guided by Popay et al.'s (2006) recommendations as follows.

First, the articles were deductively analysed to summarize the most important characteristics and findings (Parmigiani & King, 2019). A worksheet was designed to record this information, which was carefully scrutinized for potential errors (Eduardsen & Marinova, 2020). This worksheet allowed us to create a map of the field in terms of description (i.e., year, journal, title, and purpose), methodology (article type, theory, context, industry, method, sampling, data collection, and data analysis), and main findings across four overarching themes (antecedents, mediators, moderators and outcomes). These themes are in line with our review objectives and are also consistent with many systematic review studies that focus on organizational phenomena in general (e.g., De Massis et al., 2018), and innovation and inter-organizational relationships in particular (e.g., Ceipek et al., 2019; Wang & Rajagopalan, 2015). Moreover, this deductive coding system (i.e., the four themes) fits nicely with Crossan and Apaydin's (2010) multi-dimensional framework of organizational innovation, which clusters innovation-related research into three fundamental dimensions: 1) determinants of innovation ('antecedents'), 2) innovation mechanisms ('mediators' and 'moderators'), and 3) innovation outcomes ('outcomes'). In fact, considering Crossan and Apaydin's (2010) framework, our study's uniqueness and contribution become more evident. While their framework addresses innovation in network settings marginally (i.e., as part of the bigger phenomenon of organizational innovation), our study offers a comprehensive and "fine-grained" analysis of the extant literature that focuses primarily on the relationship between IOC and innovation.

Second, we used the inductive logic to analyse all articles and group them on similarities in terms of purpose. A 'within study' analysis was performed by looking at the findings of each article (Rousseau et al., 2008). This analysis allowed us to not only derive middle-level factors (environmental, relationship and firm-level) but also identify bottom-level factors. For instance, under 'antecedent' theme, 'relationship-level' factors were one of the 'middle-level' antecedents and were disaggregated into bottom-level factors: IOC characteristics, IOC types, collaboration management capability, and social capital. By employing an iterative process, we constantly revised and compared the themes and sub-themes to avoid potential conceptualization issues/conflicts. The disaggregation into top, middle and bottom-level factors was frequently discussed among the two researchers.

Finally, a 'cross-study synthesis' was produced by comparing and contrasting all studies based on the four key themes (De Vries et al., 2016). We also examined variations in the findings of the articles and explored the reasons behind those variations to identify unresolved issues (Petticrew & Roberts,

2006). A similar approach is also followed in previous review papers (e.g., Martineau & Pastoriza, 2016; Niesten & Stefan, 2019). While the articles were coded by one of the two researchers, both of them met regularly to discuss, modify, and agree on the coding process.

In the next three sections, we present and discuss the findings of our SLR, where each section addresses one of the three study sub-questions.

3 Status of empirical research on IOC-innovation linkage in SMEs

This section provides the answer to our RQ1 ('What is the current status of empirical research on IOC-innovation?') by encompassing the spread of publications in different journals and articles, contexts and research methods, and theoretical paradigms.

3.1 Journals and time of publication

We mapped the selected 113 articles in terms of where and when they were published (see Appendix 3). Most of the articles were published in Technovation (n=16), Research Policy (n=13), the Journal of Small Business Management (n=8), and R&D Management (n=7). Our analysis reveals that the topic of IOC and innovation linkage has received less attention in leading journals in the field of entrepreneurship and small business. Consequently, it is an important area of research, which requires theoretically enriched research in the future. In addition, the synthesized results of selected articles show that the number of publications has increased over the years, but the topic of IOC-related innovation has gained prominence since 2010 (see Appendix 3 for details): 67% of articles were published between 2010 and 2019, and the remaining 33% between 2000 and 2010.

3.2 Contextual and methodological orientations

Our analysis revealed heterogeneity in our selected studies in terms of context (i.e., countries and industry). With respect to countries, the main geographic source of the empirical studies was the Europe (n = 83), and the remaining studies were conducted in Australia (n = 7), the USA (n = 6), China (n = 6), Korea (n = 6), Taiwan (n = 2), Turkey (n = 1), India (n =1), and Iran (n = 1). This confirms that the context of developing countries remained overlooked – possibly because of the concept of innovation. Consequently, this might impact the external validity of the previous findings by raising the question as to the extent to which these findings are applicable to developing contexts. Another finding was that most of the studies were conducted in a single country (n = 106), thereby resulting in a lack of cross-country comparison. In terms of industry, while manufacturing industries were over-represented (n = 65), service industries appeared to receive less attention (n = 4). Moreover, some studies considered the agriculture industry (n = 3), manufacturing and service industries (n = 24), or multiple industries (n = 17). This reflects a bias towards the manufacturing context despite the changes in the structure of developed countries, with a pronounced focus on the services sector (Alexandersson, 2015; Cimoli & Katz, 2003).

Considering the research methods, the quantitative method was over-represented (n = 89), mainly adopting survey (60) or longitudinal data (29), where the method of analysis varied from simple descriptive analysis (n = 17) to regression analysis (n = 48) and complex structural modelling (n = 24). In addition, the response rate varied between the studies, from a low of 9% (Jones & De Zubielqui, 2017) to a high of 100% (Rojas et al., 2018). In relation to the key informant, only two studies collected data from multiple respondents (Leiponen & Byma, 2009; Mu & Di Benedetto, 2011), leaving other sample studies to rely on the single informant. This is surprising given the fact that the use of multiple

informants to collect data on firm variables is preferable on single informant, because it ensures greater measurement accuracy and promotes confidence in the findings (Mu & Di Benedetto, 2011). This small number is way below a satisfactory level because informant selection is critical for instruments like surveys. In contrast, the qualitative method was less common (n = 16), adopting a multiple (n = 6), longitudinal (n = 4) or single (n = 6) case study approach. Also, a small number of studies were based on both qualitative and quantitative methods (n = 8). Given the method bias (i.e., by adopting mainly quantitative approaches), the antecedents and underlying mechanisms of IOC-Innovation linkage have received significant attention.

3.3 Theoretical paradigms

Given the complex nature of the phenomenon (i.e., the connection between IOC and innovation), authors have applied various theoretical frameworks, from economics (e.g., transaction cost economics, game theory, and principal-agent theory) to networks (e.g., network theory, social network theory, social capital theory, and relational view) and strategic management or organizational theory (e.g., the resource-based view, the knowledge-based view, resource-dependence theory, and organizational learning theory). However, our analysis identified three dominant theories, namely the network (social network) theory (n = 21), the resource-based view (RBV) (n = 16), and transaction cost economics (TCE) (n = 16), which are discussed next.

The RBV focuses on internal resources to explain firms' competitive advantage (Barney, 1991). The fundamental thesis of the RBV is that resources are both heterogeneous across firms and imperfectly mobile. Firms with stocks of resources that are valuable, rare, inimitable and non-substitutable, have advantage over competitors (Barney, 1991). Adopting the RBV perspective, scholars highlighted that collaboration relations are resources that can provide small firms with access to more resources and increased economic value in the form of innovation (Ebersberger & Herstad, 2011; Lasagni, 2012).

Network theory assumes that the markets are systems of social and professional relationships among customers, suppliers, and competitors. Empirical evidence in our review sample indicates that the innovation of SMEs is not only contingent on firm-level factors, but also on personal and professional ties (Mei et al., 2019; Ceci & Iubatti, 2012). In this respect, several studies show that external relations have a high impact on SMEs' innovation due to identification of opportunities for learning and knowledge acquisition and reduction in opportunistic behaviour (Freel & Robson, 2017; Nordman & Tolstoy, 2016).

TCE suggests that companies can minimize their controlling and monitoring costs by choosing a certain organizational structure (Williamson, 1979). The studies that use TCE logic suggest that the SMEs' choice to use IOC for innovation largely depends on asset specificity (Saastamoinen et al., 2018). The central notion is that "the low asset specificity favors competitive bargains and leads to contractual solutions" (Bougrain & Haudeville, 2002, p.736). TCE-based studies examined the impact of cooperation with diverse partners (Diez, 2000; Tether, 2002) and objectives to form collaborations (Franco & Haase, 2015) for the innovation of SMEs. Further, these studies examined the role of vertical integration and strategic outsourcing to develop skills for tackling problems with other partners, thereby leading to the innovation of SMEs (Kaufman et al., 2000; Nieto & Santamaría, 2010).

Interestingly, several articles (n = 14) have adopted combinations of TCE, social network and RBV theories to study the complex linkage between IOC and innovation. These include studies on collaboration experience (Nieto & Santamaría, 2007), joint cooperation and competition (Quintana-

García & Benavides-Velasco, 2004), and the structural, relational and cognitive configuration of networks (Masiello et al., 2013).

4 Findings of empirical research on IOC-innovation linkage in SMEs

In this section, we present the findings from the narrative synthesis to answer RQ2 ('How does IOC influence innovation of SMEs?'). Traditionally, in most prior literature, scholars have relied on RBV and network theory to merely link antecedents with outcomes of SMEs. The general underlying assumption these studies posits is that IOC acts as a resource to promote innovation. Yet, the most recent decade of IOC-innovation research however is characterized by several important, and at the same time, distinguishing themes. By integrating insights from multiple-theoretical perspectives, research has started to investigate the underlying mechanisms (i., mediating factors) through which antecedents lead to outcomes (Langley et al., 2013). Research have also looked into the multi-level antecedents to influence outcomes (e.g., Martínez-Costa et al., 2019). Recently, some scholars have begun to explore more complex configuration by investigating how different level moderators affect the relationship between antecedents, mechanisms and outcomes (e.g., Santoro et al. (2018).

Figure 2 presents our integrated framework that we derive from narrative synthesis of empirical findings. The purpose of the framework is mainly to map the four key themes underlying RQ2 and identifies their relatedness: (1) antecedents of IOC-innovation linkage in SMEs, (2) underlying mechanisms for IOC-innovation relationship in SMEs, (3) outcomes of IOC-innovation relationship in SMEs, and (4) moderators of IOC-innovation relationship in SMEs. The antecedents theme encompasses articles on the forces and determinants that drive innovation. The mechanism theme embraces the articles on mediating factors that link antecedents with outcomes. The moderator theme considers articles that deal with contingent factor that strengthen or weaken the relationship. The outcome theme embraces articles on the performance effects that antecedents and mechanisms exert on the SMEs.

Our framework not only provides an overview of the constructs found in prior literature but also depicts the research linkages (i.e., relationships among constructs). The first research linkage concerns the impact of antecedents on mechanisms (1-2). The second research linkage reflects the relationship between mechanisms and outcomes (2-3). The third research linkage concerns the direct impact of antecedents on outcomes (1-3). Finally, some research linkages show the moderating effects for the relationships between antecedents and mechanisms (4x[1-2]), and between mechanisms and outcomes (4x[2-3]).

Insert Figure 2 About Here

Table 1 summarizes in detail the research linkage in our review sample articles (n = 113). The subsequent section identifies the most researched topics, explores the linkages, and notes the inconsistencies in the literature according to the research linkages displayed in Figure 2.

Insert Table 1 About Here

4.1 Research on outcomes (relationship 3a-3b)

Evidence from the review shows two broad categories of outcomes for IOC-innovation relationships in SMEs (see Figure 2). While the first category consists of innovation outcomes, the second category encompasses performance outcomes. Various studies showed that these outcome categories are related.

First, innovation outcomes have been a major subject in prior literature on SMEs. Studies on innovation outcomes have considered various types of innovation (as summarized in Table 2) Overall, the analysis shows that the literature seems to lean towards product innovation, which refers to the introduction of products that are new to the firm and/or market and changes in the design or components of existing products (Nieto & Santamaría, 2007). Process innovation, defined as the introduction of new or improved methods into the organizational system to develop a product or service, is under-represented (Hervas-Oliver et al., 2016; Jespersen et al., 2018). Similarly, service innovation, referring to the development of service processes and capability development, is under-researched outcome (Santoro et al., 2018). This bias can be due to the studies' excessive focus on manufacturing industries that are production-oriented (Subramanian et al., 2019; Tranekjer & Søndergaard, 2013). Also, the concept of service innovation is loosely defined, and therefore, make it less distinguishable from related concepts (Witell et al., 2016). Based on the novelty aspect, literature has also categorized innovation into incremental (i.e., changes to existing products, processes or services) and radical innovation (i.e., an entirely new product, process, or services) (Nordman & Tolstoy, 2016; Parida et al., 2012; Saastamoinen et al., 2018). While some studies in our review sample focused on marketing, organizational and administrative types of innovation, others did not specify the type of innovation, as the operational definition was missing.

Insert Table 2 About Here

Second, a group of studies focused on performance outcomes, including SME survival (Acheampong & Hinson, 2019), competitive advantage (Lasagni, 2012), sales growth (De Zubielqui et al., 2019), and profitability (Jones & De Zubielqui, 2017). A central premise that underlies this line of empirical research is that, as a result of external relationships, SMEs are able to achieve innovation outcomes, which in turn improve firm performance (Gronum et al., 2012; Popa et al., 2017).

4.2 Research on antecedents and outcomes (relationship 1-3)

The relationship between antecedents and outcomes has received the most attention in the literature (Van Hemert et al., 2013). The literature has focused on four broad level antecedents that enable innovation performance (and firm performance) in SMEs: individual-level, firm-level, relationship-level, and environmental-level antecedents (see Figure 2).

First, individual-level antecedents concern the managerial attributes. In particular, a discussion has evolved that entrepreneurial managers accept the risks and take advantage of every opportunity to enhance the innovation of their company (Bougrain & Haudeville, 2002). Some scholars argue in favour of training as a prerequisite for innovation because it helps to identify and resolve problems, and to take responsibility for product or service quality (Rogers, 2004; Whittaker et al., 2014). Also,

the manager's education emerges as a precondition to keep up the knowledge and skills level for product innovation in small firms (De Jong & Vermeulen, 2006; Rogers, 2004). Specifically, scholars suggest that managers need to develop technical knowledge regarding procedures and techniques relevant to technological innovation (Gupta & Barua, 2016; Lee et al., 2010; Muzzi & Albertini, 2015). By displaying technical know-how, market and economic knowledge, legal and contractual experience and partnership management understanding, SMEs can widen possibilities for radical innovation (Ritter & Gemünden, 2003; Sammarra & Biggiero, 2008). Furthermore, entrepreneurs' age and previous experience ensure innovative thinking and culture among managers, thereby promoting the SMEs' innovation (Gupta & Barua, 2016).

Second, firm-level antecedents include incentives, internal R&D, innovation culture, and strategic factors. Considering incentives, prior literature argues that innovation is highly uncertain, and therefore requires incentives to develop innovations. In particular, long-term incentives (such as stock option schemes), and short-term incentives (such as performance-related pay) motivate firms not only to engage in innovation activities but also to promote strategic decisions, greater efforts in innovation efforts and team working (Fu, 2012). Other studies sought to establish the relationship between internal R&D and innovation in SMEs (Bougrain & Haudeville, 2002; Hadjimanolis, 2000). These studies suggest that SMEs can invest in internal R&D activities, instead of acquiring from external sources, to develop technological capabilities for technological product and process innovation (Brunswicker & Vanhaverbeke, 2015; Hervas-Oliver et al., 2016). Hadjimanolis (2000) considered not only the endowment of internal R&D to promote innovation, but also the implications of innovation for firm performance. Researchers also considered innovation culture as one of the fundamental aspects to incorporate new ideas in innovation production processes (De Mattos, Burgess, & Shaw, 2013). Prior findings demonstrate that innovation culture favours innovative behaviour and fosters the creativity to generate new ideas and knowledge and put them into practice (Martínez-Costa et al., 2019). In addition, prior research has regarded strategic factors, such as environmental technology scanning, market research, and a written strategy, as pre-conditions to realize the innovation performance of SMEs (Hadjimanolis, 2000).

Third, relationship-level antecedents dominate current research, where studies suggest that external collaborations can be beneficial for innovation performance due to access to different knowledge domains and exposure of decision-makers to different technologies (Baker et al., 2016; Martínez-Costa et al., 2019). However, other research suggests a more complex relationship between IOC and innovation to capture cost, benefit, and risk implications (Rothaermel et al., 2006). There are numerous antecedents at relationship-level that determine the innovation of SMEs, including strength of ties, partner diversity, IOC proximity, and collaboration management capability.

The strength of ties refers to the frequency of interaction and resource commitment to the relationship. Furthermore, Poorkavoos et al. (2016) associated the strength of ties with radical and incremental innovation: while strong ties provide rich customized information and reduce production costs for incremental innovation, weak ties can be a medium of new knowledge and a trigger to mix new ideas with radical innovation. Similarly, Partanen et al., (2014) considered the implication of the strength of ties with different collaboration partners to support innovation. They found that a mixture of strong and weak ties with research institutes and universities is important in innovation commercialization, as they provide resources of R&D input and convey the message that the firm is a credible actor. Since partnership with research institutes and universities creates dependency, this can create frustration with bureaucracy (Tranekjer & Søndergaard, 2013).

Partner diversity refers to the difference in the abilities of network partners in terms of experience, resources, and practices. Researchers found that partner diversity mitigates the risks of smallness by providing access to strategic and operational knowledge (Mei et al., 2019; Dooley et al., 2016). Specifically, much of the literature regards the need to collaborate with customers, suppliers, competitors, research organizations and universities to gain new insights about markets, to gain ideas for enhancing technology solutions and to gain access to new ideas (Brunswicker & Vanhaverbeke, 2015; Freel, 2000; Fritsch & Lukas, 2001), thereby leading to product and process innovation (Najafi-Tavani et al., 2018). However, there are some mixed findings in the literature. For example, while considering the role of competitors, Nieto and Santamaría (2007) find that collaboration with competitors is negatively linked with innovation because of fears concerning information leakage and learning races among SMEs. In contrast, some scholars argue that small firms frequently seek to collaborate with competitors to learn more about their rivals' competencies and introduce innovations (Tether, 2002; Tsai, 2009). Without a doubt, cooperation with competitors raises the suspicions, but Quintana-García and Benavides-Velasco (2004) suggest that SMEs need to maintain greater cognitive maps, behavioural routines and organizational resources to enhance proper equilibrium between cooperation and competition. Lately, scholars have become interested in developing an understanding of how networks and innovation contribute to SME performance (Saastamoinen et al., 2018). Findings from these studies suggest that stronger and more diverse collaboration helps SMEs to draw on additional external resources for innovative products and processes, thereby resulting in firm profitability and sales growth (De Zubielqui et al., 2019; Van Hemert et al., 2013). Nevertheless, additional empirical research that investigates this complex linkage in SMEs would provide additional valuable insights.

IOC proximity, as a relationship-level antecedent that comprises multiple dimensions (geographic, cognitive and organizational closeness), also influences innovation performance. Considering the role of geographic proximity, scholars find that domestic collaborations are more important for innovation performance due to shared culture and regulations (Cumbers et al., 2003; Weterings & Boschma, 2009). However, some scholars posit that domestic collaborations may create lock-in effects from the overlap of spatial knowledge (Jespersen et al., 2018), and therefore international collaboration allows small firms to increase their innovation performance through adjusting products or services to the requirements of customers in other markets (Sarpong & Teirlinck, 2018). Further, the existing literature suggests that cognitive proximity (i.e., similarities between partners' knowledge bases) allows the partners to establish mutual understanding and communication, thereby optimizing the technological competencies and innovation of SMEs (Gnyawali & Park, 2009; Jespersen et al., 2018). Besides, organizational proximity (i.e., similarity on organizational nature and mechanisms) allows partners to understand the tacit knowledge in a particular context and translate into their own firm's setting to realize innovation advantage. Rojas et al., (2018) further suggest that small firms need to form relationships within the same sector/industry because they are generally more similar in terms of product lines, technology, operating procedures, business norms, and managerial routines. Moving beyond this, Brink (2018, p. 77) shows that geographic proximity cannot 'stand alone', but SMEs need to develop several complimentary proximities (that is, geographic, cognitive and organizational proximity) to enable innovation. Further research is needed on complimentary proximities to draw generalizations of findings.

Collaboration management capability, referring to the ability of a small firm to create and maintain long-lasting relationships (Al-Tabbaa, Leach, & Khan, 2019), can promote innovation performance. In

this vein, researchers have emphasized the role of the special firm unit to specific organizational routines to identify and absorb knowledge from external sources, and to monitor the development of collaborative projects (Bougrain & Haudeville, 2002; Gentile-Lüdecke et al., 2019). In addition, empirical evidence suggests that prior collaboration experience promotes the joint innovation because previous experience allows the small firm to learn from past relations and lowers the risk of partner opportunism (Okamuro, 2007). Moreover, scholars find that communication between partners is a crucial capability to increase trust and decrease conflict among partners, resulting in product innovation of SMEs (Lee, 2007). Specifically, the immediate communication can simplify the production process and facilitate shorter production cycles, enabling both parties to achieve innovation gains (Subramanian et al., 2019). Also, the literature suggests that small firms need coordinating routines to assign tasks and synchronize activities between partners (Lee, 2007). To extend this stream of research, scholars have recently documented the role of virtual technologies (such as video conferencing and blogs) in allowing firms to interact and coordinate on mutual activities, and thus to promote collaborative innovation outcomes (Hardwick & Anderson, 2019; Petrick et al., 2016).

Finally, a handful of studies have examined environmental-level antecedents (Hadjimanolis, 2000; Martínez-Costa et al., 2019), indicating that environmental uncertainty creates a market pressure for small firms to survive by developing new products.

4.3 Research on mediation mechanisms (relationships 1-2 and 2-3)

Because of the field's maturity and the inconsistency in empirical results on the direct antecedents-outcomes relationship, many researchers suggest the need to move beyond the investigation of this direct relationship and open the 'black-box' of underpinning mechanisms through which antecedents lead to different innovation outcomes. Accordingly, several studies set out to explicate the role of mediators in SMEs' IOC-innovation relationship: see the central block in Figure 2. Two top-level mechanism categories emerged: relationship management, and strategic attitude and capabilities.

First, relationship management concerns the value-creation mechanisms in collaboration relationships. Importantly, our analysis revealed four mechanisms that underpin relationship management: trust development, knowledge enhancement, absorptive capacity, and organizational learning. When considering trust development, Hardwick and Anderson (2019) argue that coordination as a collaboration management capability allows firms to build trust due to strong relational ties (as an antecedent), which ultimately results in innovation performance of SMEs. Regarding knowledge enhancement mechanisms, studies show that social capital promotes the transfer of knowledge to sustain innovation performance (Camps & Marques, 2014; Masiello et al., 2013). Knowledge transfer is possible due to reduction in information asymmetry, long-term shared goals and interaction transparency (Masiello et al., 2013). Specifically, when firms form networks, they create a common vision about future joint action, which ultimately encourages knowledge transfer among partners (Konsti-Laakso et al., 2012). Research also suggests that quality knowledge transfer among collaboration partners not only enhances the degree of new products and processes, but also promotes firm performance (De Zubielqui et al., 2019). Similarly, diverse collaboration partners promote the absorptive capacity of SMEs, which is instrumental in facilitating innovation outcomes (Moilanen et al., 2014). Petrick et al. (2016) find that coordination allows SMEs to not only gain expertise from partnering firms but also to adopt their innovations, which ultimately leads to their innovation performance. Thus, absorptive capacity is a central mechanism that allows SMEs to take

advantage of networks for innovation performance. Organizational learning is also one of the core mechanisms to create innovation performance. For example, some studies suggest that partner diversity allows an SME to gather high-quality feedback and learn from partners, which in turn can enhance SMEs' innovation performance (Martínez-Costa et al., 2019; Mu & Di Benedetto, 2011).

Second, strategic attitude and capabilities relate to the mechanism of defining the organizational directions and making decision to pursue outcomes. Among those mechanisms, researchers acknowledge the risk-aversion attitude, internal collaboration, and innovation strategy. Specifically, the risk-aversion behaviour of SMEs mediates the relationship between social capital and innovation performance (Iturrioz et al., 2015). Social capital implies the existence of trust, reciprocity and commitment among partners, which are beneficial to reduce risk-aversion behaviour, thereby leading to knowledge transfer for innovation (Mohannak, 2007). In addition, the social interaction in IOC allows a small firm to gain confidence in creating internal collaboration to share ideas and develop innovations (Howard et al., 2016). Researchers also draw attention towards innovation strategy as a key mechanism. Popa et al. (2017) suggest that innovation climate, as a mediating mechanism, allows the firm-level antecedents (e.g., committed HR, centralized decision-making) to promote open innovation for firm performance. In a similar vein, studies suggest that diverse collaboration partners promote the innovation capabilities of SMEs that are strategically important in bolstering innovation performance (Najafi-Tavani et al., 2018; Van Hemert et al., 2013). In particular, strategic innovation capability acts as a system to position the firm it in an arena of modernism through developing innovative products and processes (Van Hemert et al., 2013).

4.4 Research on moderating effects (relationships 4x[1-2] and 4x[2-3])

Our analysis of the literature identified several factors that appeared to influence the collaboration-innovation relationship in small firms. Understanding the moderating effect of these factors is particularly useful to explain many of the mixed results pertaining to the impact of collaboration on SMEs' innovation and performance outcomes. In this respect, we classified three groups of moderating factors: firm-related, relationship-related and environmental-related (as shown in block 4 of Figure 2).

First, firm-related moderators consist of firm characteristics such as firm size, firm age, absorptive capacity, and entrepreneurial orientation (EO). The most commonly explored moderating factor is firm size, which has been explored in a variety of ways. Teirlinck and Spithoven (2013) found a difference in the relationship between internal R&D resources and external collaboration based on firm size. They found that the requirement for R&D experts for engagement in external relations decreases with the size of the firm because small firms need more R&D experts to facilitate the detection of relevant external knowledge. Tether (2002) considered a similar interaction, arguing from the conceptual perspective of cooperation as a determinant of SMEs' innovation performance. He suggested that increasing the size of a small firm helps to draw on the resources, security and prestige of its wider groups in seeking partners for innovation. Another line of research emphasizes the role of firm age in IOC-innovation linkage. In this regard, findings demonstrate that older firms develop rigid routines and organization practices that reduce the advantages of external relations for innovation performance (Fernández-Olmos & Ramírez-Alesón, 2017). Beyond firm age, absorptive capacity has also been considered as a moderator. For example, Tsai (2009) proposed and found that absorptive capacity enhances the effect of IOC on innovation performance because it facilitates the learning of new knowledge for innovation performance. This line of reasoning was corroborated by Gebreeyesus

and Mohnen (2013), Huang and Rice (2009), Najafi-Tavani et al. (2018) and Santoro et al., (2018). EO has also been regarded as a moderator. For example, the relationship between external cooperation and new product innovation is moderated by EO. Interestingly, firms with weak EO can benefit more from external relations in boosting their innovation performance than can those with strong EO (Baker et al., 2016). The studies reasoned that weak EO firms do not possess proactiveness, risk-taking and innovativeness traits, and thus, are subject to uncertainty-based inertia. Therefore, the utilization of external relations can help weak EO firms to identify the appropriate responses to market needs and reduce the perceived risks associated with innovation.

Second, relationship-related moderators include network size, frequent interactions, mutual trust, inlearning (internal learning of external knowledge), governance mechanisms and dependence. Prior findings demonstrate that network size negatively moderates the effect of relational capital and human capital for innovation performance because small networks have greater resource constraints (Wincent et al., 2010). Further, research suggests that face-to-face interaction strengthens the relationship between internet-based collaboration and product innovation performance by creating trust among partners (Wu et al., 2016). In a similar way, mutual trust positively moderates the effect of collaboration diversity for new products and process innovations, because trust allows the partners to act on opportunities that emerge from networks (Brunetto & Farr-Wharton, 2007; Hanna & Walsh, 2002). Furthermore, Bouncken and Kraus (2013) argued that inlearning moderates the positive relationship of coopetition and innovation performance by allowing the conversion of external knowledge to internal innovation opportunities (Santoro et al., 2018). Governance mechanisms also act as moderating factors. For example, Bouncken et al., (2016) examined the coopetition and product innovation linkage, which is contingent on governance mechanisms. They found that governance mechanisms cultivate trust in relationships with competitors and turn the focus towards achievement of joint goals.

Third, there are a variety of environmental-related factors (i.e., economic, market, industry) that influence how and when SMEs can innovate. For example, economic recession (as a moderator) places greater pressure on firms to choose the right collaboration partners for innovation performance (Fernández-Olmos & Ramírez-Alesón, 2017). In terms of industrial environment, Whittaker et al., (2016) suggested that industrial dynamism encourages small and young businesses to enhance innovation performance by embracing external collaboration. Others have focused on the influence of industrial characteristics (Fernández-Olmos & Ramírez-Alesón, 2017), suggesting that mature industries (e.g., automotive industries) are more likely to join collaboration networks for innovation performance. The underlying reason is that firms in less mature industries have limited internal capabilities to undertake all activities and firms in mature industries have to deal with demand contraction and strong competition. Similarly, Fukugawa (2006) discovered that the relationship between strength of ties and innovation performance is moderated by industrial characteristics; strong ties are beneficial for innovation performance in exploitative industries (like the steel industry), and weak ties are complementary to innovation performance in explorative industries (like the semiconductor industry). Considering market uncertainty as a moderator, Mu and Di Benedetto (2011) found that changes in market conditions strengthen the need for strategic actions (such as EO and collaboration) to promote new product performance. Finally, technology uncertainty moderates the relationship between partner diversity and innovation of SMEs. Studies state that, under high technological uncertainty, diverse partners (competitors, suppliers, customers, and so on) allow a

greater resource portfolio and risk-sharing to improve innovation performance (Bouncken & Kraus, 2013; Mu & Di Benedetto, 2011).

5 Discussion and future research directions

Our SLR focuses on the literature specific to SMEs' collaboration for innovation and synthesizes the specificities of the extant studies in terms of evolution and maturity in recent years. To this end, we reviewed a diverse body of literature that shares a mutual quest to understand the linkage between IOC and innovation. Through our review, we do not suggest that the identified themes are unique to SMEs; indeed, some appear in different ways in large firm IOC-innovation literature (c.f. Pittaway et al., 2004; West & Bogers, 2014). However, we show that SMEs' IOC-innovation research is distinctive in nature and that a systematic review is essential to understand it fully. We believe endeavour to be important because it supplements the IOC and innovation research on large businesses (e.g., Pittaway et al., 2004). By doing so, we also respond the call for multiple-level analysis of IOC and innovation relationship in SMEs' (e.g., Freel & Robson, 2017; Radziwon & Bogers, 2019). This section is designed to answer our RQ3 ('What are the implications of our review findings for future research?'). Based on the elements in the framework developed in Figure 2, we highlight knowledge gaps and suggest promising directions for future research, which we organized in into four key themes: theory, phenomenon, context, and methodology.

5.1 Theory-centric research directions

As revealed by our analysis, studies on SMEs IOC-innovation have been utilizing different theories to underpin their empirical investigation. Among these theories, we realized three of them as dominating the field, namely: RBV, social network, and TCE. The RBV, in general, perceives the inter-organizational relationship as a value-creation resource (Arya & Lin, 2007; Das & Teng, 2000), therefore this theory was applied as a framework to predict the firm-level capabilities and conditions under which firms can leverage their relationship uniquely (in comparison to their competitors). For example, Lasagni (2012) investigates the effect of relationship strength with diverse group of collaborators on SMEs' innovation capacity, whereas Ebersberger and Herstad (2011) identify a set of capabilities (e.g., information searching) and activities (e.g., scale of external R&D) that significantly shape SMEs' product innovation. On the other hand, articles that used the social network theory have deployed the social constructs of this theory (e.g., embeddedness, social capital dimensions) to understand how the characteristics of ties between the different network actors can influence SMEs capacity to appropriate value from their external collaborations. Examples include studies that sought to understand when and how the weak ties are more important than strong ties and vis versa (Partanen et al., 2014). Finally, TCE-based studies have typically deployed this theory to inform research that investigates the effect of relationship structure and control measures on the transaction costs and exploitive risk embedded in SMEs IOC-innovation relationships. Interestingly, this theory is particularly applied to understand the paradox of SMEs vulnerability when engaging in collaborative innovation (due to their liability of smallness) against their expected contribution to the relationship (Nieto & Santamaría, 2010), which a condition for triggering the collaboration. By tracking how, where and why these theories are adopted, we identify two fundamental issues and discuss possible future development in each of them.

First, the vast majority of researchers are using a single theory in a given study to investigate a particular aspect of the IOC-innovation relationship (as discussed above). This implies that the theory

is used mainly as an operational framework (i.e., a means to an end), therefore limiting the potential for SMEs-specific theory development. Whetten (1989) assert that theory development demands four key building blocks, that comprise the w*hat* (i.e., identifying new factors and their effect pertaining a phenomenon), *how* (i.e., explaining the connection between these factors), *why* (i.e., establishing the logic in selecting these factors and predicting their causality effect), w*ho*, w*hen*, and w*here* (i.e., mapping the contextual impact on the phenomenon). Therefore, making substantial theory development in SMEs collaborative innovation demands multiple perspectives (i.e., theoretical synthesis), which is different from the 'juxtaposition of theories' (i.e., including two of more theories in a single paper). Indeed, our review revealed some studies that are juxtaposing theories only, thus fall short to comply with Whetten's (1989) advice. In contrast, theoretical synthesis is useful to explain how two or more theories can be complementary (rather than just compatible with each other), and thus pave the way for a comprehensive understanding of the phenomenon. For example, further research is needed to understand more holistically the enablers of SMEs that drive and facilitate their engagement and benefit from external collaborations to boost their innovation capacity. Here, researchers can investigate the interaction between various enablers which are informed by the network theory (i.e., individual-specific factors such as managers' attributes, commitment, and experience), TCE (i.e., relationship-specific factors such as portfolio structure and power asymmetrical), and institutional theory (i.e., environmental-level factors such as the institutional systems and regulatory environment) (Geels & Schot, 2007; Nishii et al., 2017; Smith et al., 2010) to offer significant theory development/extension. Indeed, adopting this synthesizing approach has yielded important theory development to better understand the role of resource bundle at individual, dyadic, and network levels on collaboration outcomes (Arya & Lin, 2007).

Second, research on SMEs inter-organizational relationship has typically perceived theory as a vehicle to reach what can be described as 'one best way' for managing such relationship (Chowdhury, 2011). In specific, we noticed in our review that the researchers have been using these theories as perfectly transferable from their field which were originated within (i.e., large firms). However, research shows that SMEs are inherently different to large organizations (Dyer & Singh, 1998; Hood, 1991; Terziovski, 2010). They typically apply informal strategic planning process, have limited access to resources and capabilities, lack systematic performance tracking systems, and are reactive rather than proactive to environmental changes (Hardyman et al., 2014; Johnston et al., 2012; Van Looy et al., 2003). These characteristics stress the need to pay careful attention when borrowing theories from other sectors. Here we are not intending to reject the assumption of 'theory transferability', rather to highlight that if the idiosyncrasy of SMEs is carefully addressed while building a study conceptual framework, there is a scope for better theoretical development. One possible direction to push the theory boundary in this regard is to deploy the micro-foundations notion to perfectly understand the IOC-innovation relationship when evolving in SMEs setting. For example, this perspective could be specifically useful to uncover the effect of individual-level heterogeneity of SMEs on their firm-level performance (cf., Foss, 2011), or understand the fine-grain details of how collaboration-related capabilities can actually develop in SEMs (in terms of individual behaviors) as a collective skill (cf., Gavetti, 2005). Additionally, researchers can utilize this perspective to develop SMEs-specific theory on how strategic decision-making can be rooted in individual characteristics and behaviors (cf., Teece, 2007). Such attempt can be useful to go beyond the simple 'one-size fits all' to enact new research directions that are originated in the context of SMEs, thus capable to capture the true nature and dynamics of IOC-innovation in this sector (Agostini & Nosella, 2019).

5.2 Phenomenon-centric research directions

Phenomenon-centric direction focuses on the potential opportunities owing to the complex nature and content of IOC and innovation relationship. In this respect, we propose four sets of proposals for the future research including antecedents, mechanisms, moderators and outcomes.

Antecedents: Research has highlighted the importance of studying the antecedents of innovation at different levels (as in block 1 in Figure 2), but future studies need to push further in two directions. First, the literature offers surprisingly little attention to individual-level antecedents to support innovation. Felin and Foss (2009) contend that to explore IOC outcomes, it is important to understand individuals' preferences and practices (i.e., micro-foundations), specifically their expectations, abilities, motivation, heterogeneity and nature. While our review found that managerial attributes can influence the innovation capacity of SMEs, there is a need to study further and more systematically the various meso-level phenomena, such as those manifested in managerial routines, behavioral strategies, and goal frames (Teece & Pisano, 2003; Winter, 2013). Such research can pay attention to SMEs' decision-makers (Salvato, 2009) and the relationship among employees at different organizational levels (Hodgson, 2012) in terms of their underlying values, norms, and sense-making (Felin & Foss, 2009; Santoro et al., 2018). Such understanding can help SMEs to create an appropriate organizational climate to facilitate innovation (Dixon, Meyer, & Day, 2014). It would also be interesting to consider the role of integrators and relational stars that hold together dense intra-firm collaborations and co-create knowledge for innovation (Grigoriou & Rothaermel, 2013; Kevill et al., 2017). Second, research on environmental-level antecedents requires investigation (Hadjimanolis, 2000; Martínez-Costa et al., 2019). Environmental changes, particularly from technological change and technological discontinuities, can affect new ventures' innovation and SMEs' competitive advantage (Sabatier et al., 2012). Furthermore, studies could explore the role of the competitive environment for innovation in SMEs with specific characteristics, such as size or age (Inemek & Matthyssens, 2013). It is also important to explore the impact of institutional factors (Kofler & Marcher, 2018) and the national system of innovation (Jones & De Zubielqui, 2017) to understand how differences in macro conditions between developed and developing economies can influence SMEs' co-innovation potential (Jespersen et al., 2018).

Mediating mechanisms: Research has recently begun to explore the importance of mediators, which is reflected in the central block of Figure 2. Although different mediating mechanisms were considered by earlier researchers, most of the mechanisms are only vaguely understood due to lack of studies and require further research. First, the researcher needs to explore whether and to what extent governance mechanisms (as a relationship management mechanism) can mediate the effect of antecedents on innovation performance (Masiello et al., 2013). Hardwick et al., (2013), for instance, suggest that involving collaboration partners in product development may involve the risk of information loss. They further suggest that trust as a relational governance mechanism can allow SMEs to share information and gain innovation advantage. In contrast, Bouncken and Kraus (2013) argue that transactional governance can define the partners' goals and obligations, which reduces the conflicts among partners for innovation. Nonetheless, previous research takes contrasting opinions towards governance mechanisms as antecedent for innovation. As a way forward, and by building on the relational view (Dyer & Singh, 1998; Dyer et al., 2018), researchers could investigate the indirect and interaction effects of relational and transactional governance mechanisms to exploit collaboration relationships for innovation in SMEs (Garcia-Perez-de-Lema et al., 2017; Najafi-Tavani et al., 2018).

Second, researchers have examined relationship management as a mediating mechanism to explain the relationship between antecedents and outcomes (Najafi-Tavani et al., 2018). In particular, the effect of SMES' absorptive capacity (Moilanen et al., 2014) and knowledge sharing (Masiello et al., 2013) has been well-documented. Additional research should enrich understanding of the IOC-innovation relationship by exploring the mediation effect of other factors. Importantly, future studies should consider other types of capabilities and organizational routines, and their implications for outcomes (Mu & Di Benedetto, 2011). For instance, researchers can examine the extent to which marketing capabilities can explain the relationship between collaboration and different innovation outcomes (Najafi-Tavani et al., 2018). Since marketing capabilities reflect the ability to differentiate products and service from competitors (Buccieri et al., 2020), SME can leverage such capabilities to strengthen relationship with industrial partners and government officials to respond to customer needs faster and promote innovation performance. In addition, research could investigate the role of managerial competencies to successfully invest in knowledge assimilation from collaboration partners for innovation (Muzzi & Albertini, 2015). For example, sensing, seizing and reconfiguring capabilities can help SMEs to develop and maintain IOC relationship, and gain the most relevant knowledge for innovation (Teece, 2014).

Moderators: As informed by our analysis of the literature, the role of moderators in SMEs' IOC-innovation relationship has received substantial scholarly attention, as summarized in block 4 of Figure 2. Our analysis shows that the 'relationship-related' moderators emerged as a prominent factor in the literature. We have identified several opportunities for new research that could focus on the critical moderating effect of various organizational and environmental factors.

First, future research can benefit from investigating the moderating effect of organizational characteristics. For example, while IOC provides valuable knowledge to enhance innovation, SMEs require appropriate organization structures to assimilate and absorb external knowledge (Inemek & Matthyssens, 2013). Future research therefore can address and explicate the moderating role of employees' diversity and human resource mechanisms to facilitate the relationship between IOC and innovation (Santoro et al., 2018). Relatedly, by drawing on research on diversification, it would be interesting to understand the contingent effect of international diversification and product diversification on the association between IOC and innovation because diversification allows SMEs to better use the available knowledge and promote learning for innovation (Lo, 2016).

Second, the role of environmental-related moderators in shaping the relationship between IOC and innovation has received limited scholarly attention (Bouncken & Kraus, 2013; Fernández-Olmos & Ramírez-Alesón, 2017). Future research is necessary to understand the role of external moderators. Specifically, the degree of technological turbulence, the stage of the technology life cycle, and the industrial structure can moderate the relationship between collaboration proximity and relationship enhancement (Tsai, 2009). Future studies might shed more light on the moderating role of external shocks (Fernández-Olmos & Ramírez-Alesón, 2017). Studying the interaction between the economic downturn and collaboration could provide new insights on how and to what extent collaboration enhances innovation in SMEs (Fukugawa, 2006). In addition, the role of intellectual property rights needs to be considered (Tsai, 2009). One possible explanation is that cross-national differences among countries shape the relationship between macro- and micro-economic conditions and innovation outcomes (Faber & Hesen, 2004; Love & Roper, 2015).

Outcomes: Despite the breadth of outcomes covered, this field of research needs additional work to inform and deepen initial findings. Our analysis revealed two remarks that need future attention. First, in spite of the strategic importance of process and service innovation (Gupta & Barua, 2016; Saridakis et al., 2019), the existing research focused primarily on product innovation, thereby leaving process and service innovation under-researched. The relative neglect of process innovation could be problematic because it is vital to reduce the cost of production and differentiate products and services from competitors (Lee, 2018; Markard, 2018). For example, Cherrafi et al. (2018) argue that "process innovation emerged as a major part of sustainability to support firms in becoming more competitive and sustainable in an ever more volatile and highly demanding market arena" (p. 80). It is therefore important to study the IOC activities in the development and diffusion of process and service innovations.

Second, for most researchers, innovation performance was the endpoint of their research quest. According to management scholars, innovation is an important determinant to create value and promote performance (Crossan & Apaydin, 2010; Kleinknecht, 2016). Indeed, this theoretical proposition is empirically supported by some studies in our review sample (Brink, 2018; Jones & De Zubielqui, 2017). Since the number of studies is very slim, it is difficult to generalize the effect of innovation for firm performance. More research that investigates innovation and firm performance outcomes would be welcome. Notably, in light of Garcia-Perez-de-Lema et al.'s (2017) assertion that a good understanding of partners and their actions helps to gain more knowledge about the different types of innovation to influence firm performance, it is important to acquire the understanding of various antecedents and processes to develop this field. Also, the alternative firm performance outcomes such as growth and profitability are used very little, which can have problematic consequences. For example, the lack of focus on firm performance can limit the understanding of firms' returns from innovations (Inemek & Matthyssens, 2013; Keupp et al., 2012). This line of research could be extended by considering not only existing performance outcomes but also alternative forms such as international performance (Stoian et al., 2017), sustainable development (Wu, 2017), or sales growth (Mawson & Brown, 2017).

5.3 Context-centric research directions

In terms of geographic context, most of the studies in our review sample focused on a single country, thereby lacking the cross-country comparison to highlight the varying influence of contextual conditions on IOC-innovation relationship. While a growing consensus that countries differ in their cultural and institutional context (Mu & Di Benedetto, 2011; Nijssen et al., 2012), the cross-country is still in the beginning stage. Cross-country comparison can enable the understanding of social, political and economic context to form and manage IOC for innovation in SMEs (Al-Tabbaa and Ankrah, 2018). This can also help understand mechanisms and strategies to transfer potential gains of IOC for innovation. Additionally, it is important to understand the similarities and differences in the antecedents and mechanisms of IOC-innovation relationship between European developed countries and other developing countries (Grama-Vigouroux et al., 2019; Wu et al., 2016). It is also worthwhile to investigate the variations between developing countries due to institutional environment, policy interventions and social norms (Acheampong & Hinson, 2019). In doing this, researchers can rely on institutional perspective and TCE to gain a deeper understanding of IOC-innovation relationship in different geographic contexts.

Furthermore, the consideration of SMEs' characteristics (i.e., industry, size, learning-orientation and so) remained limited. Based on these characteristics, SMEs can have different orientations in terms of their collaboration practices (Verbano et al., 2015) and the types of innovation they develop and launch (Mu & Di Benedetto, 2011). In order to take this further, it would be interesting to differentiate between SMEs' characteristics: for example, low-technology versus high-technology industries (Garcia-Perez-de-Lema et al., 2017; Poorkavoos et al., 2016), high learner versus low learner SMEs (Mu & Di Benedetto, 2011), or knowledge-intensive versus traditional SMEs (Nordman & Tolstoy, 2016). In additions, there has been limited research emphasizes on service industry despite the transformation of economies to knowledge and services (Sarpong & Teirlinck, 2018). Future research is needed to implications of IOC for innovation in services industry.

5.4 Methodology-centric research directions

In addition, the research methods of the articles have become gradually more quantitative, as evident in the increasing use of associations between antecedents and outcomes. Surveys were the most commonly used data collection method, indicating a preference for obtaining pragmatic knowledge about IOC-innovation association. However, one issue of concern relates to the heavy emphasis on cross-sectional design, which does not allow claims of causality (De Zubielqui et al., 2019). By employing longitudinal and case studies designs, researchers can track trends and gain in-depth understanding.

Moreover, collaboration entails the investment of resources, which can consume the resources needed for internal innovation. Therefore, it is necessary to explore the trade-off between collaboration investment and collaboration benefits (Mu & Di Benedetto, 2011) and the implications of the micro-foundation (individual characteristics of partner managers) to establish a collaboration that minimizes cost and maximizes benefits (Camps & Marques, 2014). To address these gaps, future research could adopt qualitative methods and use longitudinal case studies to gain more in-depth understandings of the collaboration processes.

5.5 Study limitations

Beyond the several advantages and contributions of our systematic review, the study has three main limitations that should be taken into account. First, the focus of our review has been limited to peer-reviewed journal articles in Chartered ABS ranked journals to maintain the quality of the reviewed contents. A limitation of this study is, therefore, that it excludes some other IOC-innovation related studies and books. Second, although our search strategy comprised an extensive list of keywords that were identified based on an iterative review of the literature, we might have missed a few sources, as researchers sometimes use different keywords interchangeably (e.g., customer-supplier integration instead of inter-organizational relationship). Finally, our review excludes literature on service innovation, notably new service development. However, this nascent research area can benefit in the future from a separate in-depth review of the mechanisms that drive new service development in SMEs.

6 Conclusion

Given the increasing embeddedness of SMEs in IOC for innovation, numerous stakeholders, such as researchers, policymakers and organization, long to know how to benefits of IOC can be maximized in the SMEs. This has resulted in large amount of empirical research but, due to lack of integration, evidence remained fragmented. The overarching aim of this study was to synthesize and evaluate the

empirical research on the IOC-innovation relationship in SMEs. Through a SLR of 113 articles, we develop an integrative framework that is helpful to synthesize theoretical and empirical research on IOC-innovation relationship by focusing on multi-level antecedents, mediating mechanisms, moderators and outcomes. This framework is used to position the contributions of the papers. Overall, the existing empirical research suggests that heterogeneity in innovation as an outcome arises due to two reasons: different enabling factors may be needed to establish IOC; and moderating and mediating mechanisms are required to capture the innovation benefits that are offered by SMEs. We propose an agenda for future research by delineating a number of suggestions that need to be considered if theories around IOC-innovation relationship, contents, contexts and methodology are to move forward.

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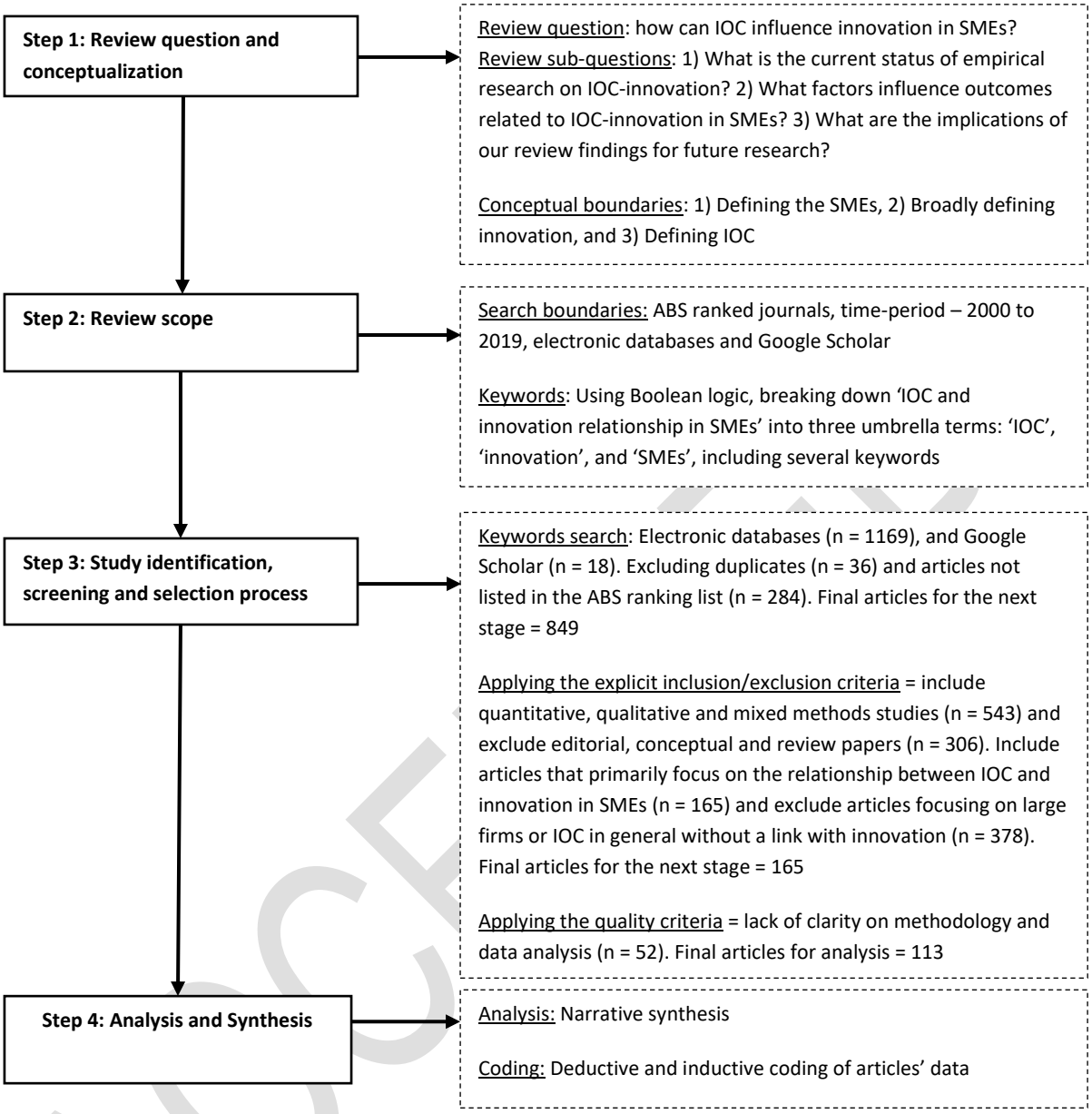

Fig. 1. Systematic review approach.

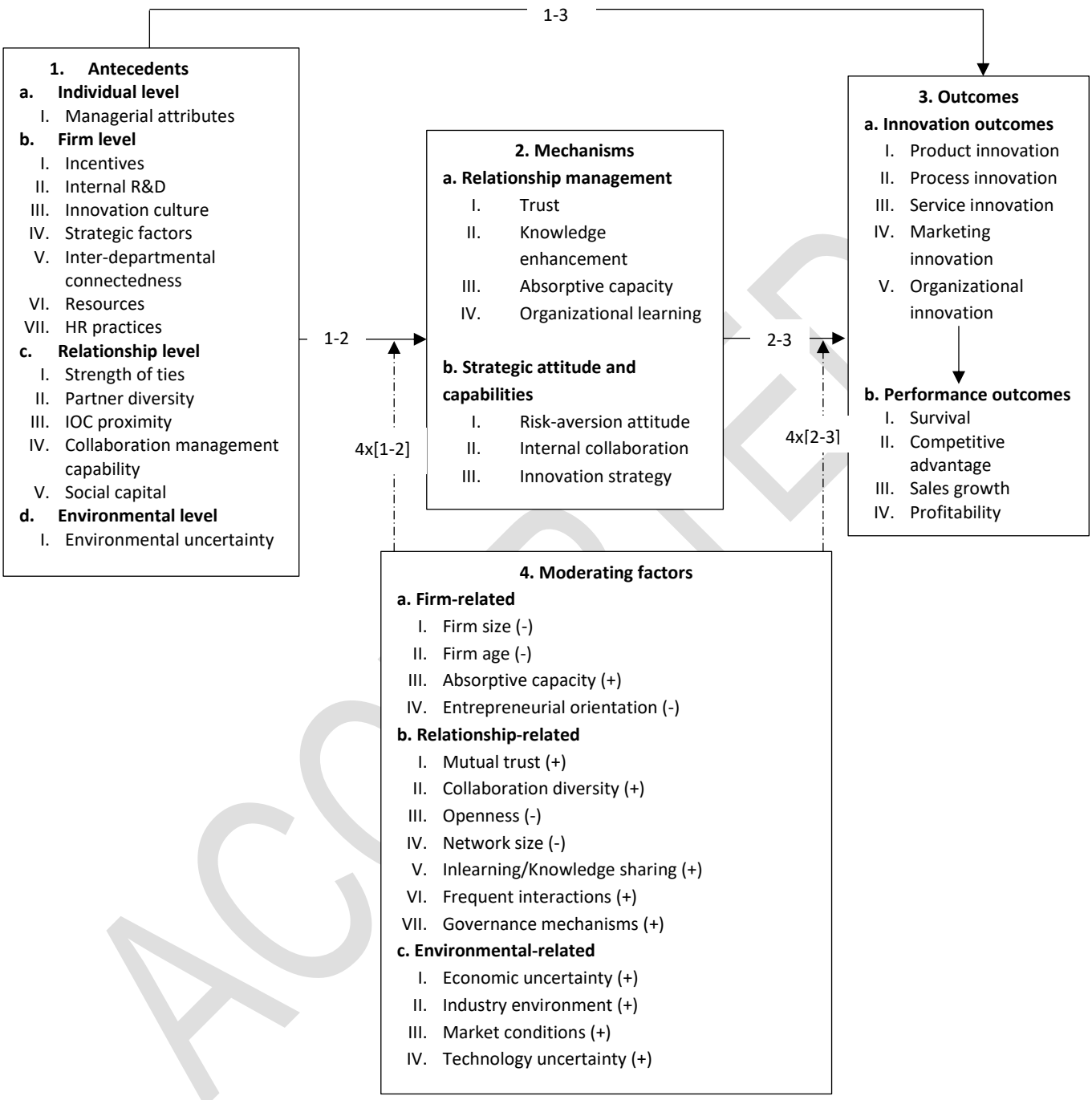

Fig. 2. SMEs' IOC-innovation research: an integrative framework.

Table 1. Article identification number and research linkage[a]

No:	Author	Links	No:	Author	Links
1	Acheampong and Hinson (2019)	1c-3a,b	58	Kofler and Marcher (2018)	1c-3a
2	Baker et al. (2016)	1c-3a(4a)	59	Konsti-Laakso et al. (2012)	1c-3a
3	Bougrain and Haudeville (2002)	1b-2-3a; 1c-2-3a	60	Lasagni (2012)	1b,c,d-2-3a,b
4	Bouncken and Kraus (2013)	1c-3a(4b,4c)	61	Lee (2007)	1c-2-3a
5	Bouncken et al. (2016)	1c-3a(4b)	62	Lee et al. (2010)	1a,b,c-3a
6	Brink (2018)	1c-3a,b	63	Leiponen and Byma (2009)	1c-3a
7	Brunetto and Farr-Wharton (2007)	1b-2-3a; 1b-2(4a,b)	64	Marion et al. (2015)	1c-3a
8	Brunswicker and Vanhaverbeke (2015)	1b,c-3a(4b)	65	Martínez-Costa et al. (2019)	1b-2-3a
9	Buganza et al. (2014)	1c-3a	66	Masiello et al. (2013)	1c-2-3a
10	Caloghirou et al. (2004)	1a,b,c-2-3a	67	Mei et al., (2019)	1c-3a(4c)
11	Camps and Marques (2014)	1c-2-3a	68	Mohannak (2007)	1c-2-3a
12	Ceci and Iubatti (2012)	1c-3a,b	69	Moilanen et al. (2014)	1c-2-3a
13	Clifton et al. (2010)	1c-3a,b(4a)	70	Mu and Di Benedetto (2011)	1b,c-2-3; 1b,c-3a(4c)
14	Corral De Zubielqui et al. (2019)	1c-2-3a-3b	71	Muzzi and Albertini (2015)	1c-2-3a
15	Cumbers et al. (2003)	1c-3a	72	Najafi-Tavani et al. (2018)	1c-2-3a; 1c-2(3a)
16	De Jong and Vermeulen (2006)	1a,b,c-3a	73	Narula (2004)	1c-3a
17	De Mattos et al. (2013)	1a,b,c-3a	74	Ngugi et al. (2010)	1c-3a
18	Diez (2000)	1b,c-3a	75	Nieto and Santamaría (2007)	1c-3a
19	Dooley et al. (2016)	1b,c-3a	76	Nieto and Santamaría (2010)	1c-3a
20	Ebersberger and Herstad (2011)	1b,c-3a(4a,b)	77	Nijssen et al. (2012)	1b-2-3a; 2-3a(4b)
21	Eggers et al. (2018)	1b,c-3a	78	Nordman and Tolstoy (2016)	1c-2-3a
22	Fernández-Olmos and Ramírez-Alesón (2017)	1c-3a(4a,c)	79	Okamuro (2007)	1c-2-3a
23	Fliess and Becker (2006)	1c-3a	80	Parida et al. (2012)	1c-2-3a
24	Forsman (2011)	1b,c-3a	81	Partanen et al. (2014)	1c-3a
25	Fossas-Olalla et al. (2015)	1c-3a	82	Petrick et al. (2016)	1c-2-3a
26	Franco and Haase (2015)	1a,b,c-3a	83	Poorkavoos et al. (2016)	1b,c-3a
27	Freel (2000)	1c-3a	84	Popa et al. (2017)	1a,b-1b-3a-3b; 1b-3a(4c)
28	Freel and Harrison (2006)	1c-3a	85	Propris (2002)	1c-3a
29	Freel and Robson (2017)	1c-3a	86	Pullen et al. (2012)	1c-3a
30	Freel (2003)	1c-3a	87	Quintana-García and Benavides-Velasco (2004)	1c-3a
31	Fritsch and Lukas (2001)	1b-2-3a	88	Radas and Božić (2009)	1c-3a
32	Fu (2012)	1b-3a(4b)	89	Rese and Baier (2011)	1a,b,c-3a
33	Fukugawa (2006)	1c-3a(4b)	90	Ritter and Gemünden (2003)	1b-2-3a
34	Garcia-Perez-de-Lema et al. (2017)	1b,c-3a-3b;1b-3b	91	Rogers (2004)	1b,c-3a
35	Gebreeyesus and Mohnen (2013)	1c-3a(4a)	92	Rojas et al., (2018)	1c-3a(4a)
36	Gentile-Lüdecke et al. (2019)	1b-3a	93	Romijn and Albaladejo (2002)	1a,b,c-3a
37	Gronum et al. (2012)	1c-3a-3b	94	Rothaermel et al. (2006)	1c-3a
38	Gupta and Barua (2016)	1a,b,c-3a	95	Saastamoinen et al. (2018)	1c-2-3a
39	Hadjimanolis (2000)	1a,b,c-3a-3b; 3b-3a	96	Santoro et al. (2018)	1c-3a(4a,b)
40	Hanna and Walsh (2002)	1a,b,c-3a; 1c-3a(4b)	97	Sarpong and Teirlinck (2018)	1c-3a
41	Hardwick and Anderson (2019)	1c-2-3a	98	Subramanian et al. (2019)	1b,c-3a
42	Hervas-Oliver et al. (2016)	1b,c-3a	99	Suh and Kim (2012)	1b,c-3a

43	Hottenrott and Lopes-Bento (2016)	1c-3a(4a,b,c)	100	Teirlinck and Spithoven (2013)	1b,c-3a(4a)
44	Howard et al. (2016)	1c-2-3a	101	Tether (2002)	1c-3a(4a)
45	Huang and Rice (2009)	1b,c-3a(4a)	102	Tomlinson and Fai (2013)	1c-3a
46	Inemek and Matthyssens (2013)	1c-3a(4b)	103	Tranekjer and Søndergaard (2013)	1c-3a(4b)
47	Iturrioz et al. (2015)	1c-2-3a	104	Tsai (2009)	1c-3a(4b)
48	Jespersen et al. (2018)	1c-3a	105	van de Vrande et al. (2009)	1c-3a
49	Jones and De Zubielqui (2017)	1c-2-3a-3b	106	Van Hemert et al. (2013)	1c-2-3a
50	Jørgensen and Ulhøi (2010)	1c-3a	107	Westerlund and Rajala (2010)	1c-2-3a
51	Kaminski et al. (2008)	1c-3a	108	Whittaker et al. (2014)	1a,c-3a(4c)
52	Kang and Kang (2009)	1c-3a	109	Wikhamn et al. (2016)	1c-3a
53	Kang and Park (2012)	1c-2-3a	110	Wincent et al. (2010)	1c-3a(4b)
54	Kaufman et al. (2000)	1c-3a	111	Wu et al. (2016)	1c-3a(4b)
55	Keizer et al. (2002)	1c-2-3a	112	Xu et al. (2008)	1c-3a
56	Kim and Shim (2018)	1c-2-3a-3b	113	Zeng et al. (2010)	1c-2-3a
57	Kim and Park (2010)	1c-3a			

a. *Note: The numbers in the links column refer to the relationships used in Figure 2. For example, the link 1c-3a means the relationship between relationship-level antecedents and innovation outcomes; and 1c-3a(4a,c) indicates the relationship between relationship-level antecedents and innovation outcomes that is moderated by firm and environmental-related factors.*

Table 2. Types of innovation examined by 113 studies[a].

Innovation type		Number of times covered
1.	Product	65
	Radical	32
	Incremental	3
	Mix (radical and incremental)	20
2.	Process	4
	Radical	3
	Incremental	1
3.	Product and process	29
	Radical	9
	Incremental	16
4.	Others - service, organizational, administrative and marketing,	11
5.	Not specified	4
	Total	**113**

a. Note: Top level counts are exhaustive

Appendix 1. Inclusion and exclusion criteria.

Criterion	Inclusion	Exclusion	Rationale
Type of publication	Peer-reviewed journal articles	Books, book chapters, theoretical papers, reports, conference papers and proceedings, press articles, theses, working papers	To ensure adherence to minimum scholarly standards. Grey literature was excluded in the main review but used in the introduction and discussion.
Journal ranking	ABS journal ranking 2018	All other journals	The ABS list provides a comprehensive list of quality-ranked journals. The rankings are similar in other countries.
Language	English	All other languages	Knowledge of languages of research team.
Date of publication	January 2000 to 2019	Literature published before this date	Review has been conducted before 2000.
Explicit exclusion/inclusion criterion	Quantitative, qualitative and mixed methods Papers addressing the impact of the IOC on innovation of SMEs; looking at the antecedents and outcomes of the IOC and innovation relationship in SMEs; addressing the underlying mechanisms and contingent factors that may influence the IOC and innovation relationship in SMEs.	Papers examining the impact of IOC for overall firm performance of SMEs; impact of IOC for innovation of larger firms. Papers falling in category 0 and 1.	Capture all empirical evidence and provide information that helps to answer the review questions.
Quality criteria	Complete information about sample, data collection and analysis.	Lack of clarity about methods, context and/or sample.	To ensure the rigor of empirical findings.

Appendix 2. List of keywords and search strings.

A - SMEs	B- IOC	C- Innovation	D- Exemplary search strings
“Small firm” OR “Medium firm” OR “Small and medium-sized enterprises” OR “SMEs” OR “Small business” OR “Medium business” OR “Small and medium sized business” OR “Small enterprises” OR	"Inter-organisational collaboration" OR “Inter-organizational collaboration” OR "Inter-firm cooperation" OR “Inter-firm collaboration” OR "Strategic alliances" OR “Alliance” OR "Network" OR "Partnership" OR "Cooperation" OR “Consortia” OR	“Innovation” OR “Improvement” OR “Enhancement” OR “Product innovation” OR “Process innovation” OR “Technological innovation” OR “Process improvement” OR “Product improvement” OR “R&D” OR “Research and development” OR “Diffusion” OR “Radical innovation” OR “Incremental innovation” OR	“Small firm” OR “Medium firm” OR “Small and medium-sized enterprises” OR “SMEs” OR “Small business” OR “Medium business” OR “Small and medium sized business” OR “Small enterprises” AND "Inter-organisational collaboration" OR “Inter-organizational collaboration” "Inter-firm cooperation" OR “Inter-firm collaboration” OR "Strategic alliances" OR “Alliance” OR "Network" OR "Partnership" OR "Cooperation" OR “Consortia” AND “Innovation” OR “Improvement” OR “Enhancement” OR “Product innovation” OR “Process innovation” OR “Service innovation” OR “Technological innovation” OR “Process improvement” OR “Product improvement” OR “R&D” OR “Research and development” OR “Diffusion” OR “Radical innovation” OR “Incremental innovation”

Appendix 3. List of ABS list journals and number of publications from 2000 to 2019

No:	Journal	ABS Journal ranking 2019	2000-2004	2005-2009	2010-2014	2015-2019	Total
1	Research Policy	4	5	3	4	1	13
2	Strategic Management Journal	4*	1	1	0	1	3
3	Journal of Business Venturing	4	0	0	0	1	1
4	Journal of Product Innovation Management	4	0	0	2	2	4
5	Entrepreneurship Theory and Practice	4	0	0	1	0	1
6	Environment and Planning A	4	1	0	0	0	1
7	Entrepreneurship & Regional Development	3	2	0	0	0	2
8	European Management Review	3	0	0	1	0	1
9	Industrial Marketing Management	3	0	1	1	4	6
10	International Journal of Contemporary Hospitality Management	3	0	0	0	1	1
11	International Journal of Production Economics	3	0	0	1	1	2
12	International Small Business Journal	3	0	1	2	1	4
13	Journal of Business Research	3	1	1	2	3	7
14	Journal of Small Business Management	3	0	1	4	3	8
15	Long Range Planning	3	0	0	0	1	1
16	R and D Management	3	2	0	3	2	7
17	Regional Studies	3	0	1	0	0	1
18	Small Business Economics	3	1	1	1	3	6
19	Technological Forecasting and Social Change	3	0	0	1	6	7
20	Technovation	3	5	4	3	4	16
21	World Development	3	0	0	1	0	1
22	Journal of Small Business and Enterprise Development	2	0	1	2	0	3
23	Annals of Regional Science	2	0	0	1	0	1
24	Creativity and Innovation Management	2	0	0	2	0	2
25	European Management Journal	2	0	0	0	1	1
26	Growth and Change	2	0	0	1	0	1
27	Innovation: Management, Policy and Practice	2	0	0	1	0	1
28	International Journal of Innovation Management	2	0	2	0	0	2
29	International Journal of Technology Management	2	0	0	2	0	2
30	Journal of Business & Industrial Marketing	2	0	0	1	0	1
31	The Journal of Technology Transfer	2	0	0	0	1	1
32	Knowledge Management Research & Practice	1	0	0	0	1	1
33	Journal of Small Business & Entrepreneurship	1	0	0	0	3	3
34	European Journal of Innovation Management	1	0	1	0	0	1
	Grand Total		**18**	**18**	**37**	**40**	**113**