Digital technologies and knowledge processes: new emerging strategies in international business. A systematic literature review

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Abstract

Purpose – *This study aims to focus on a key unanswered question about how digitalization and the knowledge processes it enables affect firms' strategies in the international arena.*

Design/methodology/approach – *The authors conduct a systematic literature review of relevant theoretical and empirical studies covering over 20 years of research (from 2000 to 2023) and including 73 journal papers.*

Findings – *This review allows us to highlight a relationship between firms' international strategies and the knowledge processes enabled by applying digital technologies. Specifically, the authors discuss the characteristics of patterns of knowledge flows and knowledge processes (their origin, the type of knowledge they carry on and their directionality) as determinants for the emergence of diverse international strategies embraced by single firms or by populations of firms within ecosystems, networks, global value chains or alliances.*

Originality/value – *Despite digital technologies constituting important antecedents and critical factors for the internationalization process, and international businesses in general, and operating cross borders implies the enactment of highly knowledge-intensive processes, current literature still fails to provide a holistic picture of how firms strategically use what they know and seek out what they do not know in the international environment, using the affordances of digital technologies.*

Keywords *Knowledge management, International business, Systematic literature review, Digitalization, Knowledge processes, International strategies*

Paper type *Research paper*

(Information about the authors can be found at the end of this article.)

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1. Introduction

Digitalization, i.e. the complex of "sociotechnical phenomena and processes of adopting and using [digital] technologies" (Legner *et al.*, 2017, p. 301), is increasingly attracting the attention of scholars, as it is profoundly changing the way companies orchestrate key resources and shape their strategies. Indeed, past literature reviews have underlined that, in the current globalized market, digitalization has become the core engine for the development of new businesses, having transformed how firms organize for value creation, delivery and capture (Autio, 2017; Autio *et al.*, 2021; Baskerville *et al.*, 2020; Yoo *et al.*, 2012).

By facilitating the connection among multiple and diverse actors inside and outside firms, digital technologies are also creating the conditions for the work to be accomplished across the boundaries of time, distance and functions (Banker *et al.*, 2006; Ettlie and Pavlou, 2006; Kohli and Grover, 2008; Rai *et al.*, 2012; Sambamurthy *et al.*, 2003; Straub and Watson, 2001; Subramaniam and Venkatraman, 2001; Tanriverdi and Venkatraman, 2005). Thus,

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digital technologies constitute an important antecedent and critical factor for the internationalization process and for international businesses in general (Bergamaschi *et al.*, 2020), especially as an enabling force accelerating the internationalization of firms (Oviatt and McDougall, 2005). Digital technologies permit the acquisition of relevant knowledge about foreign markets and access to business networks that span national boundaries (Verbeke *et al.*, 2018), resulting in a better understanding of different cultures (Monaghan and Tippmann, 2018) and incentivizing firms to experiment international business (Johanson and Vahlne, 2009; Vahlne and Johanson, 2017). Recently, about digital platforms, Nambisan *et al.* (2019) also summarized the impact of digitalization on firms reporting about the internationalization process as occurring through new ways of building knowledge and relationships and creating and delivering value to global customers leveraging digital technologies.

As knowledge is a critical resource for firms (Foss and Pedersen, 2004), and knowledge processes are crucial specifically for multinational companies (Foss and Pedersen, 2004), understanding how these processes, enforced through digital technologies, can transform value creation across borders, can bring a relevant contribution to the international business and knowledge management (KM) literature. In the international business research area, well-established studies are looking at how firms access knowledge from dispersed sources, such as those on international boundary spanning (Schotter *et al.*, 2017), global and virtual teams (Gibson and Cohen, 2003) and knowledge processes in multinational enterprises (MNEs) (Foss and Pedersen, 2004) or how they situate key knowledge and value creation activities closer to demand (see, e.g. Priem *et al.*, 2012). Some other papers have also analyzed how new business models in the digital economy rely on technologies and system elements and/or on external and even communally held sources of knowledge and technology that can support them (Sturgeon, 2021). For instance, several papers have discussed the link between digital platforms and the emergence of open innovation, which has generated new business strategies and business models connecting open knowledge flows to the economic activities of the firms (Gruber and Koutroumpis, 2013; Lashitew *et al.*, 2019; Savino *et al.*, 2017; Wang and Wang, 2012).

However, despite this multitude of studies, no single dominant theoretical framework exists (Birkinshaw, 2022) that highlights the interrelated relationships between knowledge processes and digital technologies and their impacts on emerging new strategies in the international business arena. Past reviews have mainly contributed to the discovery of central themes in digital transformation (Caputo *et al.*, 2021; Verhoef *et al.*, 2021; Vial, 2021; Zhu *et al.*, 2021) for instance, offering insights on the structural changes that the emergence of digital business ecosystems led to organizational designs (Menz *et al.*, 2021; Verhoef *et al.*, 2021; Vial, 2021). Thus, they failed to present a comprehensive view of the types of strategies firms use to leverage new digital technologies. Digital technologies are shifting the focus from where actors physically meet, even temporarily, to share information and generate new ideas (Furnari, 2014) to how they digitally connect to diverse sources of information and to the contexts (e.g. interfirm relations, internal to the focal firms and at the macro level) where firms make sense of the collected information and generate new knowledge. Therefore, it is important to develop an enhanced comprehension of the mechanisms through which firms make sense of new information from multiple sources, distinctly separate from the processes involved in digitally collecting information. In our study, we have designed a conceptual framework to explore the generation of new knowledge, specifically focusing on the emergence of novel strategies. This framework is designed to distinguish these knowledge-generation processes from those involved in simply collecting new information through the affordances provided by digital tools. Our conceptual framework is, therefore, described by two dimensions: the level at which the interplay between digital technology and related knowledge processes is observed, and the level at which the new strategies emerge, which can be either a single firm or a

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population of firms. Indeed, despite the increasing and pervasive use of digital technologies (e.g. big data analytics; robotic systems; additive manufacturing) is heavily affecting international business (Strange and Zucchella, 2017), the research in this field has, until recently, scarcely focused on how they foster the emergence of new firms' strategies, with some notable exceptions (Banalieva and Dhanaraj, 2019; Li *et al.*, 2019; Monaghan *et al.*, 2020; Nambisan *et al.*, 2019; Shaheer and Li, 2020; Stallkamp and Schotter, 2021). Along this line, Ghauri *et al.* (2021) analyzed the impact that digital technologies have on firms' strategies, specifically emphasizing the strategies enacted within global value chains (GVCs). Nevertheless, these studies miss understanding how firms use what they know and seek out what they do not know in the international environment, using the affordances of digital technologies. There have been several conceptual and case-based studies focusing on "internet businesses" and "e-business" (Alcácer *et al.*, 2016; Brouthers *et al.*, 2016) that considered "digital businesses" as a special category (Rong *et al.*, 2022), while rarely the implications of digitalization have been considered for international businesses and global strategies (Autio *et al.*, 2021). More broadly, a more critical reading of the key literature directly and indirectly related to the study of international businesses and their linkages to new digitally-enabled knowledge processes is needed. To approach this relevant issue, it is worth considering that the presence of digital technologies can activate "multi-level social and economic processes through which knowledge is sourced, diffused, and integrated across member firms and between MNEs and their global customers" as Nambisan *et al.* (2019, p. 1476) claim referring to digital platform ecosystems (DPEs). Therefore, an important research question is: How do digital technologies and knowledge processes interact at different levels in the international business arena, opening up new challenges and enabling new strategies for companies competing internationally? Accordingly, our literature review, which is time-framed 2000–2023, aims to answer this research question by analyzing contributions from different streams of literature, including KM, digital technologies and international business. This review aims to build a unifying multidisciplinary framework that brings together diverse perspectives and sensitivities on this complex topic, identifying gaps and future research avenues. The proposed framework consists of three analytical domains of analysis – macro, meso and micro – to consider the multilevel social and economic processes through which knowledge processes may be enacted in the international business context using digital technologies and two possible units of analysis where the strategic implications are observed, i.e. single firms or populations of firms united by a common strategic intent.

The purpose of this article is to provide a unifying representation of the extant literature in terms of the emerging relationships between the knowledge processes enabled by digitalization occurring at different levels and the strategies embraced by a firm or a population of firms, which may have disrupted traditional paradigms in the international business context. By representing these relationships in the developed framework, we provide the shifting makeup of international business research in the digitalized era. Moreover, we hope that the proposed research agenda will stimulate new and exciting research on the strategic implications of digitalization on international business, focusing on digitally enabled knowledge processes.

The remainder of the paper is organized as follows. Section 2 provides an overview of the theoretical foundations of our research, including our assumptions and the boundaries of our study. Section 3 offers an analytical view of the methodology of our systematic literature review (SLR). Section 4 thoroughly presents the results of the review in terms of descriptive statistics of the revised body of knowledge. Section 5 provides an in-depth qualitative description of the findings and discusses the results in the light of new research avenues and emerging strategies with respect to new developments in digital technologies and the knowledge processes they enable. Section 6 offers concluding remarks while acknowledging the inevitable limitations of our research.

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2. Impacts of the digitalization/knowledge processes interplay on new emerging international strategies

Digitalization has challenged the key assumptions of the international business field and induced to reanalyze its basics (Eden, 2016). Accordingly, Luo (2020) argues that the key assumptions behind international businesses have been largely shifted due to:

- the replacement of tangible flows of physical goods with intangible flows of knowledge and data;
- the increasing relevance of consumers more strongly participating to global businesses and having instant access to some critical information;
- the digital infrastructure becoming equally important as the physical infrastructure, which was determinant for the selection of a location in the past; and
- a higher number of new ventures, entrepreneurial businesses and small and medium enterprises (SMEs) having joined globalization, especially through digital platforms with global reach.

Thus, against the classical firm's advantages and strategies (ownership, location and internalization), new benefits have been recognized (e.g. open resources, linkages and integration) and heightened as motivational forces for engaging in international businesses. At the same time, digitalization has also challenged the importance of traditional benefits. Indeed, past studies report the adoption of advanced technologies associated with greater access to international markets and increased international opportunity recognition (Dillon *et al.*, 2020; Sinkovics *et al.*, 2013). Others have also indicated a reduction in transaction costs as the effect of using advanced technologies (Chen and Kamal, 2016), an alteration of the geographic span and density of GVCs (Hannibal and Knight, 2018; Laplume *et al.*, 2016), facilitation in the international collaboration of firms (Autio *et al.*, 2021), user network economies, speed and scalability (Brouthers *et al.*, 2016; Kotha *et al.*, 2001; Singh and Kundu, 2002). Big data analytics, three-dimensional (3D) printing, advanced robotic systems, cloud computing, augmented and virtual reality, and blockchains have been cited as technologies reshaping international businesses (Ahi *et al.*, 2022). Scholars have also noticed that digitalization has influenced internationalization, securing relevant advantages such as reduced transaction costs.

Additionally, for international businesses, crossing borders – whether by products, ideas or services – implies the enactment of knowledge-intensive processes. These processes are heavily affected by digitalization, which has caused enormous changes in the availability, search and cost of knowledge (de la Torre and Moxon, 2001). With digitalization, flows and sharing of knowledge are markedly easier, and thus, the firms' ability to exchange and exploit cross-national knowledge has become vital for maintaining competitive advantages (Ghezzi and Cavallo, 2020; Gupta and Bose, 2019; Huesig and Endres, 2019; Nagy *et al.*, 2018; Pappas *et al.*, 2018; Raut *et al.*, 2019; Tian, 2017). The home-based sources of knowledge and "ownership advantages" which had previously secured firms to compete effectively in international markets (Dunning, 1980) appear to be inappropriate today. Emerging business models are characterized by "open" platforms, oriented toward the free exchange of information and knowledge, allowing firms to exploit their internal knowledge and to absorb external one from the dynamic environment (Del Giudice and Maggioni, 2014; Ferraris *et al.*, 2017; Santoro *et al.*, 2018). The higher availability of data, information and knowledge, and better business intelligence techniques, have also brought unprecedented challenges and opportunities to managers, opening the path to new possible strategies (Monaghan *et al.*, 2020). Along this line, Rong *et al.* (2022) argue that firm-specific advantages, in the extreme case of digital firms relying on the internet for their production, operating and delivery processes, are largely based on underlying intangible assets such as technology, business models and knowledge. Despite the advocated

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changes induced by digitalization on the nature of the firm, and related advantages on internationalization and internationalization process, there is still a lack of holistic understanding of how new digital technologies, with the knowledge processes they enable, the new knowledge they help create, and the new knowledge domain they constitute, make new business strategies emerge in the international arena.

The complexity of leveraging those technologies to develop new business strategies and their implications for many aspects of international business still need to be fully understood. Previous studies did not pay enough attention to the direct or indirect link between knowledge processes and new international business strategies in the digitalized global environment. They did not offer any conceptual means to investigate it, also considering the multilevel nature of the social and economic processes through which knowledge processes enact in digital settings. To address this gap, our study emphasizes that the differences in knowledge processes enabled by digital technologies among and within firms represent a core dimension along which international strategic initiatives differ. It is widely recognized in the economics literature that foreign direct investments by companies take place mainly in response to the desire to internalize knowledge transfers (Caves, 1996; Teece, 1976). Moreover, as previously said, in addition to capital and product flows, knowledge flows across firms are rising in relevance in the international arena. Therefore, it is expected that a relationship exists between firms' strategies and the emergence of specific knowledge processes enabled by digital technologies.

2.1 The conceptual framework of the systematic literature review

We develop a conceptual framework to detect how these differences in the knowledge processes enabled by digitalization are likely to be reflected in the mix of strategies that firms, individually or populations of firms in ecosystems, networks, alliances, etc., might use to shape their competitive position.

We have conceptualized international business in a digitalized setting as a multilevel phenomenon, described by two dimensions: the level at which the interplay of digital technology and related knowledge processes is observed, which we label macro, meso or micro, and the level at which new strategies in the international arena emerge, which we label a single firm or a population of firms.

Regarding the first dimension, at the macro level, the interplay between digital technologies and knowledge processes takes place in the environment outside the enterprise, in what has been called a "flat world" (Friedman, 2005), or a world in which digitalization leads to the "death of geography" (Morgan, 2004), i.e. the decreasing importance of physical distance in interorganizational knowledge processes. At the meso level, the interplay is observed in interfirm relationships in several contexts. For example, Nambisan *et al.* (2019) conceptualize DPEs as affording frictionless knowledge flows, easy knowledge recombination and reconfiguration processes among several types of participants, with important strategic implications for international business. At the micro level, now more than ever, firms have the opportunity, through new technologies [Internet of Things (IOT)], big data, AI, machine learning and cloud computing), to collect and process huge amounts of data about their processes, products, services and markets, thus generating new knowledge, sharing it internally and applying it to the development of their business strategies (Abrell *et al.*, 2016; Mathews *et al.*, 2016).

Regarding the second dimension of our conceptual model (i.e. the level at which new strategies emerge), the relevance of considering the single enterprise as the level at which the emergence of new international strategies is observed, we refer to relevant examples in past studies. This is the case, for instance, of firms that craft their new products and services relying on the new digital resources/assets (Rai *et al.*, 2012; Ray *et al.*, 2005). Within MNEs, the nature and structure of social interactions are transformed through social

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media and social networking (see, e.g. Susarla *et al.*, 2012), and knowledge transfer within and across teams is eased (Dossick *et al.*, 2015). MNEs' innovation increasingly leverages local and global knowledge integration (KI), creating conditions for a more systematic knowledge-based interaction between the main actors in the host country and those in the home country (Alcácer *et al.*, 2016).

As regards the importance of considering populations of firms is explained by past literature studies, which have emphasized that through digital platforms and networks, firms can be intertwined with other firms breaking traditional industry boundaries and operating in new spaces that were unknown before (D'Adderio, 2001; Klein and Rai, 2009; Rai *et al.*, 2012; Saraf *et al.*, 2007). Under this perspective, some studies have also reasoned about many businesses which have quickly moved toward the adoption of new business models leveraging on new digital networks or platforms (e.g. automotive, home appliance and logistics) and their affordances, including the possibility of relying on new forms of cooperation, not only along the supply chain (SC) but also with competitors, and, by doing so, they have changed the dynamics at the industry level (Nippa and Reuer, 2019).

In synthesis, our conceptual framework consists of a 3 × 2 matrix with two dimensions: the level at which the interplay of digital technology and related knowledge processes are observed and the level at which new strategies in the international arena emerge. This leads to six areas of observation of emerging international strategies, given by the intersection of the levels of observation of the interplay and the levels of strategy enactment (see Table 1).

3. Methodology

We conducted an SLR following the step method suggested by Tranfield *et al.* (2003). EBSCO® and Scopus® databases were selected as the main sources to collect relevant contributions to international business digitalization and knowledge processes. We choose EBSCO® as the primary database for its broad scope (it searches simultaneously on several databases such as Science Direct®, Blackwell®, the Sage® and Emerald®). We also searched on Scopus® as it is the largest abstract and citation database of peer-reviewed literature. Scopus® was preferred over Web of Science because of its wider coverage and over Google Scholar because it is more accurate and updated in the citation count (Falagas *et al.*, 2008; Mongeon and Paul-Hus, 2016). We created the string for the automatic search of papers considering that we focus on the impact of digitalization on international business, recognizing that knowledge processes, within and between firms, are the major scenarios of evolution opened up by digitalization in international business (Nambisan *et al.*, 2019). As several terms could refer to the topic of the review, we used different terms and Boolean combinations of these, excluding the terms that did not add results to the search each time. The resulting string is as follows:

TITLE-ABS-KEY [("knowledge") AND ("digit*" OR "platform") AND ("international*" OR "multinational" OR "global")].

The review period was set from January 2000 to May 2023, thus including over 20 years of literature. To ensure the high quality of the reviewed articles, the search was restricted to only peer-reviewed high-quality journals, excluding books, editorials, reports and other nonpeer-reviewed publications (Donohue and Fox, 2000). To ensure that high-quality research is included in the review, we limited the search to articles published in English that appear in journals included in the EBSCO® Business Source Complete database and the Scopus® subject area "Business, Management and Accounting" and that are ranked by the Chartered Association of Business Schools (ABS) 2 and higher. While recognizing the fundamental role of digital technologies and platforms in involving individuals in business relationships, favoring companies' access to personal knowledge, innovation and financial resources (crowdsourcing, crowdfunding and open source), we have excluded articles focused on relationships between individuals or between companies and individuals.

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Table 1 Classifying existing literature on international business

Level of observation of the interplay	*Level of effect (emerging strategies)*	
	Single firm	*Population of firms*
Macro	Interplay at the macro level that impacts the emergence of single firms' new international strategies	Interplay at the macro level that impact on the emergence of new international strategies at a population of firms' level
Meso	Interplay at the meso level that impacts the emergence of single firms' new international strategies	Interplay at the meso level that impact on the emergence of new international strategies at a population of firms' level
Micro	Interplay at the micro level that impacts the emergence of single firms' new international strategies	Interplay at the micro level that impact on the emergence of new international strategies at a population of firms' level

Source: Authors' own creation

Similarly, we have excluded articles focused on the impact of digital technologies and knowledge processes on territories (smart cities, regional studies). In addition, we only included articles for which the full text was available in the databases to ensure the analysis's accuracy. Table 2 summarizes the inclusion/exclusion criteria.

In the first stage, an automatic search was performed, and a set of 327 papers was obtained from the two databases: 107 from EBSCO® and 220 from Scopus®. In the second stage, the authors applied the inclusion/exclusion criteria to the titles and abstracts of all selected articles from Stage 1, based on reading the abstracts. This stage resulted in the selection of 119 articles. In the third stage, all these articles were read in full by all the researchers in parallel (Secundo *et al.*, 2020) and checked for inclusion based on the consistency with the research questions. This stage was particularly challenging, and the authors have exerted a great effort in collaboratively making inclusion/exclusion decisions in the case of papers where the role of digital technologies was not central in the research question and/or the international context was only marginally related to knowledge processes. This exercise resulted in 66 papers included in the review. In the fourth stage, a manual search was used to complement the automatic search to avoid missing information by retrieving relevant articles and key authors cited in the body of literature extracted through the automated search. Performing a check

Table 2 Inclusion and exclusion criteria

Inclusion criteria	*Exclusion criteria*
Journals ranked by the Chartered Association of Business Schools, ABS 2 and higher	Non peer-reviewed publications, e.g. books, reports, project deliverables, working papers and PhD theses
	Overlapping articles between the two databases
	Books, tutorials or poster publications
Articles focusing on the impact of digitalization on knowledge processes in international business	Papers that came out of the automatic search but did not really focus on the impact of digitalization on knowledge processes in international business
	Papers on crowdsourcing, crowdfunding and open source.
	Papers on smart cities or regional development
Publications in English	Literature reviews
Time-span 2000–2023	Papers that do not focus on firms or populations of firms in the international business context
Papers that come from an automatic search on EBSCO® and Scopus® databases plus articles entered manually by the authors by searching in the references, which, however, respect the inclusion criteria	Publications whose full-text was not available

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against the inclusion criteria reported in Table 2, this stage led to adding seven articles. This resulted in a final set of 73 articles, the final body of knowledge included in the review. Once the data set was completed, we defined and extracted a set of metadata to perform the descriptive analysis, including years of publication, journals, authors, authors' affiliation, keywords, journal ranking, Scopus citations, methodology and industry (in case of empirical papers). Subsequently, we performed descriptive statistics in terms of (see, e.g. Secundo *et al.*, 2020):

- time evolution;
- geographical distribution, i.e. countries of affiliation;
- publication outlet; and
- common keywords and topics, using the occurrences of keywords provided by the authors.

For this analysis, we used the VOSviewer software (Castillo-Vergara *et al.*, 2018).

To conduct the content analysis, each author, based on the reading of the full text, proposed how to place each article in the proposed framework by eliciting the role played by the technology, the main knowledge processes enabled, the level at which the interaction between the two occurs, and the new emerging business strategy, specifying whether the actor enacting the strategy is a single firm or a population of firms united by a common strategic intent (e.g. within ecosystems, alliances, GVCs, etc.). The resulting tentative classifications have been extensively discussed and compared among the authors until convergence. Finally, the analysis and discussion of each category was carried out. The results are presented in the next sections.

Figure 1 shows the methodology and the research protocol.

4. Descriptive statistics

This section describes the selected papers in terms of: 1) Time evolution, 2) Geography of the articles, 3) Publication outlet, 4) Topics and common keywords and 5) Methodologies.

4.1 Time evolution

Regarding the time evolution of publications, we found an increasing trend over the years, as shown in the dotted line in Figure 2. This testifies that scholars are devoting a growing interest to the research topics at the crossroads of digitalization, KM and international business. After a rapid increase in 2019, a positive trend led to a new peak in 2022. Nonetheless, as the figure for 2023 is only partial, likely, the trend will increase again this year. Thus, we claim that this might constitute a novel issue worth more attention.

4.2 Geography of the articles

The distribution of the articles in the sample in terms of countries provides a proxy of the geographical development of the academic discourse on the topic under investigation (Massaro *et al.*, 2015). Following previous studies (Secundo *et al.*, 2020), analysis is based on counting countries of universities/research institutions according to authors' affiliation. For the articles written by coauthors of different countries, we counted each country. As regards the geographical distribution of the articles, Figure 3 shows that the predominant countries are USA and UK, with 44 occurrences, respectively, followed at long distances by Italy, China and Australia (20, 18 and 17). Although American and European research centers are predominantly represented, the geographical distribution spans all the continents, showing a wide and global interest in the theme.

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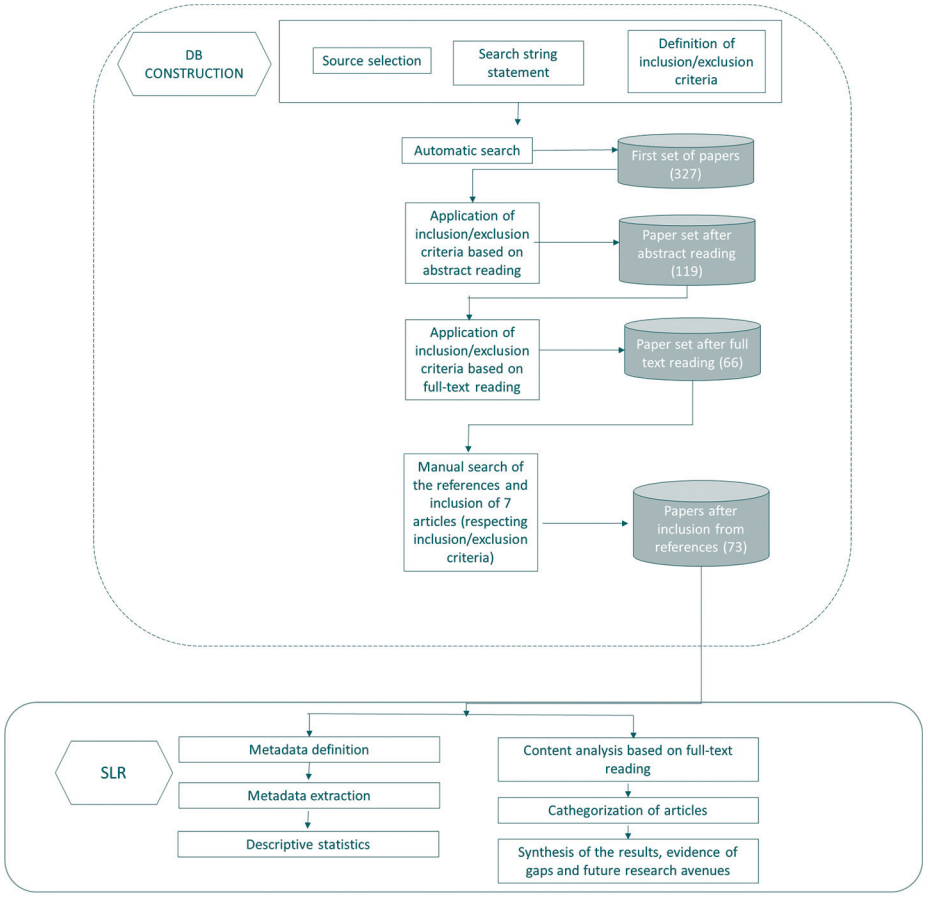
Figure 1 Research protocol and methodology



Source: Authors' own creation

Figure 2 Time evolution of the reviewed papers (solid line: frequency: dotted line: trend)

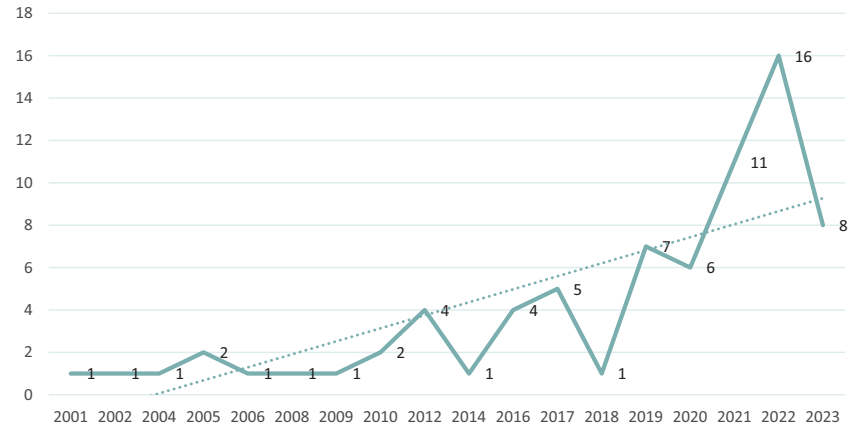


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Figure 3 Distribution of authors' countries

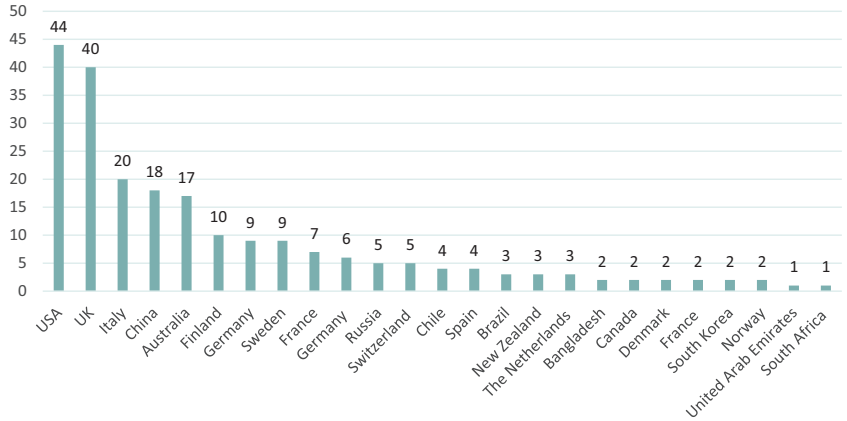

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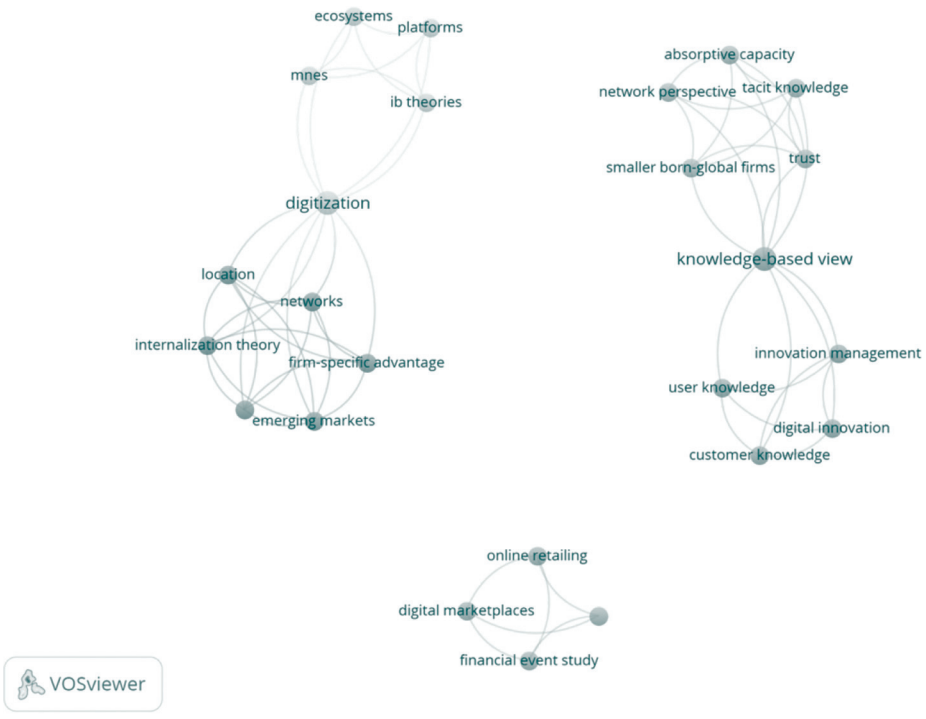
Figure 4 Keywords co-occurrence in clusters



Source: Authors' own creation through VOSviewer software

4.3 Topics and common keywords

We analyzed the co-occurrence of keywords intended as keywords that co-occur in at least two different papers. Figure 4 shows the results of the clustering provided by VOSviewer, based on fractional counting (Van Eck and Waltman, 2017). Five clusters of common keywords emerge from this analysis:

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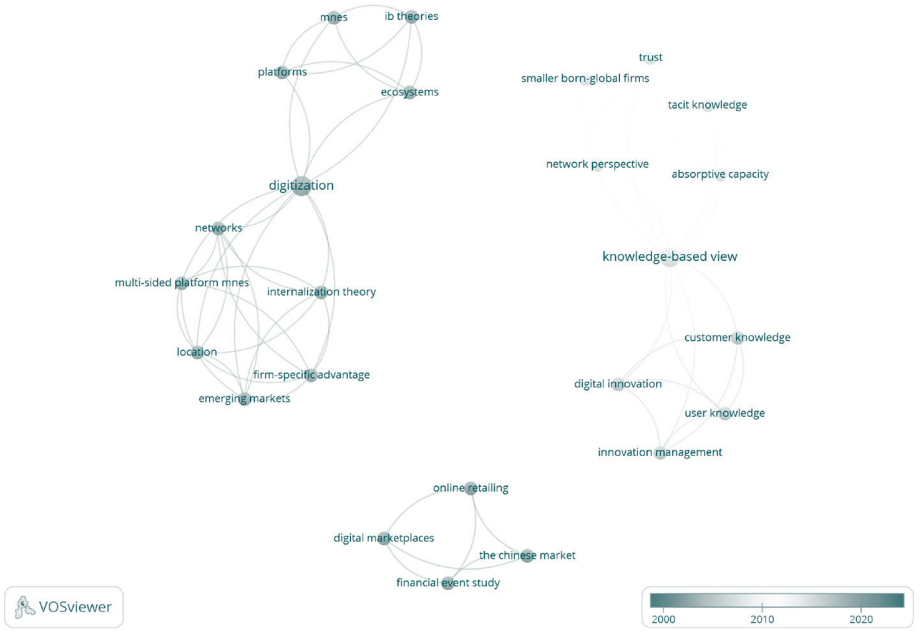
1. market knowledge (customer and user) and innovation;
2. trust, networks and knowledge;
3. location;
4. platforms and ecosystems; and
5. e-commerce and online trading.

These clusters show some degree of interconnectedness, and two prominent keywords bridge different clusters, such as digitization and knowledge-based view, indicating that the knowledge-based approach drives the studies on these topics.

It must be noted, though, that this body of knowledge has evolved, focusing on some keywords while putting less emphasis on others. Showing the time evolution of keywords co-occurrences, Figures 4 and 5 highlights that the term "knowledge-based view" tends to fade in recent years. While digitization has become a central keyword, other concepts like trust and absorptive capacity have lost their prominence in this field of study. This is also consistent with the findings discussed later in our paper. We show that a great emphasis is put on the concepts of digital platforms, ecosystems, and networks as related to digitalization and the role of digital technologies in both enabling and defining the knowledge dynamics at the intraorganizational or interorganizational levels (Liu *et al.*, 2023; e.g. Nambisan *et al.*, 2019). Additionally, the body of knowledge has evolved as regards the studies on knowledge, starting from the traditional concepts of tacit vs explicit in favor of a more fine-grained understanding of the types of knowledge that are related to digitalization, which may not only boost the knowledge capacity but also constrain the knowledge dynamics (Dossick *et al.*, 2015; Korbi and Chouki, 2017; Schleimer and Riege, 2009; Wormald *et al.*, 2021; Wukich *et al.*, 2017).

Figure 5 Keywords co-occurrence in clusters, time evolution



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4.4 Publication outlet

The scientific community discusses digitalization, internationalization and knowledge in different fields of specialization, as witnessed by the dispersion of the journals in our review (Table 3). Forty-four various journals are represented, of which just 11 have published more than one article on the topic under investigation. Moreover, these journals represent different perspectives on information systems, organization, economics, production, strategic management and knowledge, covering 14 ABS fields.

To have a clearer picture of the publication outlet, we classified the journals following the *Academic Journal Quality Guide* developed by the (ABS, Version 4). The ABS is taken as a reference for the subject matter of academic journals and their relative quality of journals. Table 3 also shows the number of occurrences per journal and its classification as regards the subject matter and the journal quality (ranging from 2 to 4*, since we discarded the articles published in journals with a ranking lower than 2). The most represented subject areas are International Business and Area Studies (13 occurrences) and Operations and Technology Management (12), followed by Marketing (9) and Organization Studies (5). ORG also displays the highest percentage of the best-ranked quality papers (4*). Regarding the quality of the publication outlet, 48 articles out of 73 are published in top-ranked journals (combining the 3, 4 and 4* ranking), while 25 articles are medium ranked (2 ranking).

4.5 Methodologies

Although the articles in the review use a wide array of methodologies (as shown in Figure 6), a sort of bipartite clustering appears as almost half of the articles use qualitative research methods while nearly half use a quantitative approach, testifying a theorizing effort as well as a hypotheses-testing approach. It must be noted, however, that the revised articles are heterogeneous in their aims and scope and cover a wide time span. The methodologies adopted also reflect the level of maturity of the topics covered, moving from more exploratory stages to conceptualization. We will briefly discuss the methods within the discussion of the results.

5. Discussion of the results

In the following section, we present our in-depth analysis of the findings following a six-partite approach (see Table 4) to structurally and critically review the current micro foundations of digitally enabled strategy literature in the context of international activities. We report the strategies that emerged either at the single firm level or the population of firms level as a consequence of the observed interplay between digital tools and knowledge processes that occurred at macro, meso and micro levels.

In the following, we describe the strategies identified by reviewing the selected papers and summarize them in Table 4. We report the link between the observed interplay between digital tools and knowledge processes and the related strategies enabled at a firm or a firms population level. We also suggest possible future research avenues.

5.1 Interplay digital technology – knowledge processes observed at the macro level, strategies at the single firm level

This section discusses the strategies enacted by single firms that are enabled by the transformations at the macro level enabled by digitalization, such as free access to global sources of knowledge and technological innovations and the greater freedom of choice in the location of enterprises. The spread of digital technologies and the rising access to data and information have greatly impacted the knowledge dynamics at the firm level. The literature shows emerging firm strategies, especially for MNEs, on one side, and for smaller

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Table 3 Publication outlet per ranking (list of journals)

Subject area	*2*	*3*	*4*	*4**	*Total*
IB&AREA		*12*		*1*	*13*
International Business Review		4			4
Journal of International Business Studies				1	1
Journal of International Management		4			4
Management International Review		4			4
OPS&TECH		*11*	*1*		*12*
IEEE Transactions on Engineering Management		2			2
International Journal of Operations and Production Management			1		1
International Journal of Production Economics		1			1
International Journal of Production Research		4			4
Production Planning and Control		3			3
Supply Chain Management: An International Journal		1			1
MKT	*2*	*7*			*9*
Electronic Markets	1				1
Industrial Marketing Management		1			1
International Marketing Review		4			4
Journal of Business and Industrial Marketing	1				1
Journal of International Marketing		2			2
ORG STUD	*6*			*2*	*8*
Journal of Knowledge Management	5				5
Organization Science				2	2
Journal of Professions and Organization	1				1
INFO MAN	*3*	*2*		*1*	*6*
Decision Support Systems		1			1
Information and Management		1			1
MIS Quarterly				1	1
International Journal of Electronic Commerce	1				1
International Journal of Information Management	1				1
Journal of Enterprise Information Management	1				1
STRAT	*2*	*3*		*1*	*6*
Global Strategy Journal		3			3
Strategic Management Journal				1	1
Technology Analysis and Strategic Management	1				1
Strategic Change	1				1
SECTOR	*5*				*5*
Journal of Cleaner Production	2				2
Journal of Management in Engineering	1				1
Journal of Service Management	2				2
ETHICS-CSR-MAN	*2*		*1*	*1*	*4*
Business Horizons	1				1
Competition and Change	1				1
British Journal of Management			1		1
Journal of Management Studies				1	1
INNOV	*2*	*1*			*3*
Creativity and Innovation Management	2				2
Journal of Technology Transfer		1			1
ENT-SBM		*2*			*2*
Entrepreneurship and Regional Development		1			1
Journal of Small Business Management		1			1
SOC SCI		*2*			*2*
Technological Forecasting and Social Change		1			1
World development		1			1
PUB SEC	*1*				*1*
International Public Management Journal	1				1
ECON	*1*				*1*
Journal of Institutional and Theoretical Economics (JITE)	1				1
HRM&EMP	*1*				*1*
International Labor Review	1				1
Total	*25*	*40*	*2*	*6*	*73*

Source: Authors' own creation

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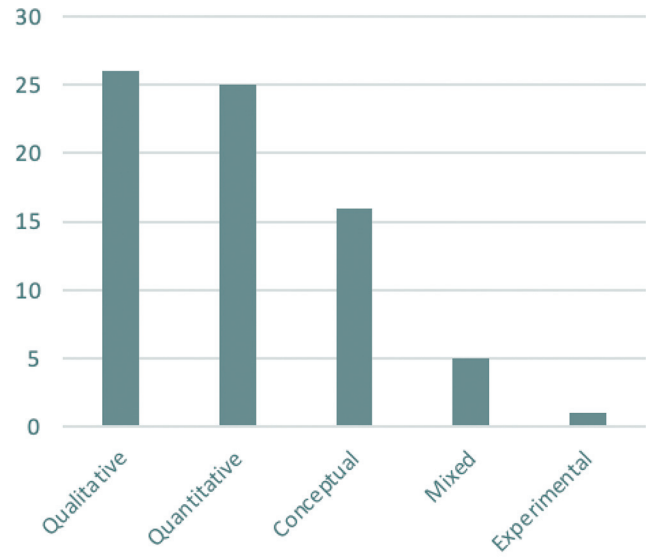
Figure 6 Methodologies



Source: Authors' own creation

Table 4 Emerging strategies by level of interplay

	Level of effect (emerging strategies)	
Level of observation of the interplay	*Single firm*	*Population of firms*
Macro	Sustainable development strategy Internationalization strategies Marketing strategies	International growth strategy Sustainability strategies
Meso	Internationalization strategies Marketing strategies Open innovation strategies New strategies in the GVC: governance, resource optimization and social sustainability	Collaborative innovation strategies Resource optimization strategies
Micro	Marketing strategies Innovation strategies Internationalization	

Source: Authors' own creation

companies located in emerging countries, on the other side. This gives impetus to conflicting evidence of the benefits and the challenges for single firms related to the interplay between digital technologies and knowledge dynamics at the macro level. The identified strategies are the following:

- sustainable development;
- internationalization; and
- marketing.

5.1.1 Sustainable development. The open flow of knowledge and information derived by the usage of digital platforms allows the emergence of a novel social and economic process (hereafter labeled as democratization), which provides firms dispersed in international

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contexts with the possibility to secure an equal and sustainable strategic development, regardless of their geographical location (Grugel and Bishop, 2013; Spies, 2014; Tilly, 2007). The papers in this category critically approach the issue of democratization by pointing out the capabilities needed to take advantage of it (Paunov and Rollo, 2016; Steinmueller, 2001) and providing insights on the institutional conditions to make it effective (Dinwoodie, 2004; Rahman *et al.*, 2020). Focusing on firms in developing countries, Steinmueller (2001) points out that internet technologies, which provide an unprecedented possibility to distribute information and knowledge and to create a virtual cyberspace for knowledge transfer across countries, do not secure the implementation of a sustainable development strategy of "leapfrogging," i.e. "bypassing some of the processes of accumulation of human capabilities" (Steinmueller, 2001, p. 194) automatically. Indeed, this may depend on several other conditions, such as the building of absorptive capacity to use information and communication technologies (ICTs) and the capability to overcome the difficulty of achieving a knowledge transfer and meeting favorable conditions in the international markets. Paunov and Rollo (2016) also reported a similar result, showing that only firms with higher absorptive capabilities benefit from the widespread internet adoption. The authors adopt a quantitative approach to verify the role of the internet as a conduit of knowledge spillovers and, finally, on firms' economic sustainability through increased innovation performance and productivity. The results of an extensive survey in developing and emerging countries show heterogeneous knowledge spillover effects on firms' productivity and innovation performance from industries' adoption of the internet. A condition to benefit from those spillovers is to build adequate absorptive capacities. Another relevant capability to acquire relevant new insights from a digitalized work environment relates to the emergent need to have routines realizing the integration between different sources of knowledge (from data science and the current operative domain).

Other complementary functionalities are also required for data providers to express their potentialities across national borders fully. Rahman *et al.* (2020) develop a conceptual study and challenge the assumption that data providers are trustworthy for the data sharing cross-borders, and therefore, propose a platform for blockchain-enabled cross-borders IOT data. They offer a system aiming to address the challenge of cross-border data sharing by increasing trust in data providers and business services, which are made more accountable. Cross-border data sharing is also challenged by the need for an international copyright system (Dinwoodie, 2004). As the author underlines, the need to have an international copyright form is to incentivize the flow of knowledge and information across national borders and through internet service providers. The author also states the difficulty of delineating and governing it as the international system may generate copyright dilemmas when confronted with national-level norms. The complexity would derive from the evidence that any international rule must accommodate cultural and economic differences while seeking to maximize social utilities in different countries. The complexity might increase further as internet service providers, which acquire customers from other countries, may want to establish a unique policy for answering the alleged acts of copyright infringement (Dinwoodie, 2004).

5.1.2 Internationalization strategies. This category includes articles investigating how digital technologies, by largely freeing economic and business activities from geographical constraints, transform firms' global strategies and trigger internationalization strategies by enabling specific knowledge processes. These articles develop Autio *et al.* (2021)'s assumptions about the impact of digitalization as a general-purpose technology, like the steam engine, electricity and automobiles, on MNE's decisions to locate their business activities. Specifically, in line with Autio *et al.* (2021), the selected articles in this category underline that digital communication technologies favor the dispersion of firms' knowledge-intensive activities, thus exerting a centrifugal action that triggers the emergence of new internalization strategies, while digital in-situ technologies tend to concentrate firms' low knowledge activities. Moreover, when digital technologies are part of an offering that

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includes physical products, they can become location-bound, or when they are implemented as part of cross-border strategies, they may face institutional and legal restrictions by the host country.

More specifically, Barnard (2021) emphasizes the role of the internet and related opportunities to operate remotely, enabling internationalization modes compatible with the scarce resources of enterprises in emerging countries aiming to expand into lucrative, high-income countries. Indeed, Barnard (2021) explores several possible internationalization strategies and their feasibility depending on the host country's development level. The author proposes a typology of four strategic options, depending on the level of development of the host country and the company's strategic choice to direct the internationalization process toward a specific type of host country (either low/similar or high level of development). The author also finds that, among these four possible types of internationalization strategies, particularly those implemented by companies in mid-tier countries to highly developed countries, i.e. niche-filling strategy, tend to rely on digital or nonequity offerings to limit the use of human resources abroad and thus contain their costs.

Among the business internationalization strategies enabled by digital technologies, particularly by the global spread of the internet, is Web globalization, i.e. the innovative use of the Web to cross borders and inform, communicate and transfer knowledge to international markets. Along these lines, Benmamoun *et al.* (2021) focus on how social enterprises use the internet to internationalize. They find that social enterprises adopt a Web globalization strategy that differs profoundly from for-profit companies, not based on Web localization, i.e. on adapting contents to local language and culture but rather adopting an approach based on high standardization. In fact, Web globalization strategies of social enterprises aim to spread knowledge of the mission and the services provided by these organizations to mobilize, educate, advocate and recruit donors, influencers, and volunteers. Localization efforts are expensive and needless for these purposes, while standardization efforts prevail. On the contrary, other channels, such as in-person meetings, are used to reach service beneficiaries.

Finally, Lehrer and Almor (2022) specifically study process niche firms, representing an extreme case of born-global companies. These firms engage in international activities before establishing their business model, primarily aiming to use their highly specialized technological knowledge assets. Process niche firms provide highly specialized industrial processes that can be incorporated into the value chains of one or multiple user industries. The internationalization process of these firms deviates from the gradual approach proposed by the incremental internationalization theory. However, it also differs from the complete adherence to the born-global internationalization theory, as it does not involve the development of networks to facilitate the process. Technology startups have the potential to "explore inbound leads and generate recurring revenue from foreign markets without investing in production, fulfillment, or even local sales and support" (Coviello *et al.*, 2017, p. 1153).

5.1.3 Marketing strategies. Digitalization and globally available digital platforms have opened up strategic opportunities for incumbents and new entrants by amplifying the market knowledge and the possibility to customize international marketing strategies in terms of:

- international market access and local adaptation (Bei and Gielens, 2020; Caputo *et al.*, 2021; Eid *et al.*, 2019; Guo *et al.*, 2023; Krings *et al.*, 2021; Troise *et al.*, 2023); and
- servitization (Bıçakcıoglu-Peynirci and Morgan, 2023; Jovanovic and Morschett, 2021).

The following papers (Bei and Gielens, 2020; Caputo *et al.*, 2021; Eid *et al.*, 2019; Guo *et al.*, 2023; Krings *et al.*, 2021; Troise *et al.*, 2023) describe the use of social media and digital platforms to manage relationships between incumbent firms and their international customers and to improve and customize further their marketing strategies and offerings,

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enhancing the access to international markets. For instance, Eid *et al.* (2019) explore how SMEs in B2B markets can take advantage of social media in their export activities. They find that social media lead to acquiring new international customer and market knowledge, which enhances firms' brand awareness and improves firm competitors' knowledge – thereby improving the export performance. The B2B market is also the focus of the study conducted by Krings *et al.* (2021), who investigate the business development process and the emergence of industrial marketing strategies in the software industry enabled by digital media. The authors propose a Digital Business Relevance Index to assess the importance of each type of digital media, i.e. professional networking sites (e.g. LinkedIn), corporate websites and blogs, CRM systems and others (e.g. YouTube), for each phase of the business development process, based on an extended survey of more than 530 practitioners including vendors, third parties and buyers. However, they find that face-to-face and word of mouth are still considered the main sources of information for B2B marketing decisions.

Market access is also discussed in the article of Bei and Gielens (2020), which describes how Chinese manufacturers successfully use third-party digital marketplaces, also called multisided multinational platforms (MMPs), to gain access to international customers. MMPs create value by connecting different groups of users on both sides of the market through digital platforms, thus helping to overcome cultural and infrastructural barriers and giving access to remote markets. Manufacturers often need help to reach Chinese consumers due to China's institutional and infrastructural weaknesses. The study also shows that, while adopting online marketplaces can compensate for traditional market knowledge, digital market knowledge can only be acquired through marketplace experience. Furthermore, the study shows that local companies, which rely heavily on advertising, benefit more from online marketplaces than those focusing on innovation.

In contrast, the opposite is true for foreign companies. Therefore, foreign companies with low advertising budgets can use online marketplaces to compensate for this weakness. Finally, when online marketplaces are used as an intermediary to acquire market knowledge, the study shows that foreign companies benefit the most because they have greater learning opportunities than their local counterparts.

Global digital platforms are also studied by Guo *et al.* (2023) as enablers of different KI processes that unlock strategic opportunities in times of crisis, such as the COVID-19 pandemic. In these contexts, as stated by affordance theory (Nambisan, 2017), multinational SMEs may leverage global digital platforms to enact vertical and/or horizontal KI processes and enhance local adaptation strategy. Similarly, Caputo *et al.* (2021) show that digital platforms can impact the economic performance of SMEs operating in foreign countries, leveraging knowledge-based factors, such as:

- SMEs' investment in ICT;
- the number of languages available on SMEs' websites; and
- the number of languages available on SMEs' social media pages.

Using the exploration-exploitation dichotomy from KM studies, the findings emphasize the significant role of exploitation factors in influencing the performance of SMEs in foreign countries.

Finally, digital technologies also unlock internationalization strategic opportunities by providing generally available platforms to access valuable resources and knowledge to enter international markets. This is the case of crowdfunding platforms studied by Troise *et al.* (2023) that help companies, especially SMEs, address internationalization challenges. Crowdfunding platforms can support SMEs with market intelligence and provide local knowledge appropriate to internationalizing services and products.

A second stream of research has emerged that discusses the strategic choice of servitization, that is, the service growth in product firms that pursue customization by integrating high

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value-added services with existing products, as discussed in two papers in the review (Jovanovic and Morschett, 2021; Bıçakcıoglu-Peynirci and Morgan, 2023). Digital tools offer the possibility to centralize organizational resources and deliver services remotely thereby separating the facilities for service delivery, machines, experts, know-how, data, from the place of transformation that takes place at the customer's location.

Jovanovic and Morschett (2021) focus on the international configuration impact of servitization, analyzing how digitization has impacted the localization decision of resources for the service provision. While they find that servitization leads companies to centralize their service resources in their home countries, they also identify several variables that influence resource centralization decisions. Although digital services at the core of the servitization strategy lower the interpersonal relationships with customers, these services leverage data to build relevant knowledge relying on product use and performance. Thus, firms with a strong focus on services prefer centralizing resources to reach economies of scale and learning. Conversely, firm size negatively impacts centralization; therefore, larger firms tend to decentralize more, while smaller firms, which have scarcer resources and are less able to absorb the risk associated with international expansion, tend to use more centralization of resources.

Bıçakcıoglu-Peynirci and Morgan (2023) discuss international servitization by analyzing cases of firms that have shifted their focus from products to services, leveraging digital technologies not only to develop the services that differentiate their offer but also to ensure the alignment of necessary resources and competencies. In particular, slack resources and digital marketing capabilities are most effective in the case of international servitization. While the former helps firms foster strategic and organizational agility, the latter help manufacturing firms provide basic and advanced services in global markets.

5.1.4 Strategies at the firm level enabled by interplays digital tools – knowledge processes at the macro level: future research avenues. When the interplay between digital technology and knowledge processes is observed at the macro level, technology is firstly recognized as a democratizing force for development and growth strategies. Indeed, digital platforms and internet technologies ease the global distribution of knowledge and information, thus becoming enablers of international development and growth strategies for firms, particularly in developing countries (Steinmueller, 2001). However, the literature indicates limitations to this democratic development process at the level of the individual firm and the external environment. While several authors in the review point out the need to develop absorptive capacity by individual enterprises and the ability to integrate different sources of knowledge (Paunov and Rollo, 2016), at the level of the external environment, the need to have forms of regulation, such as international copyright form to protect the ownership of knowledge and tools to ensure the reliability of data providers is emphasized (Dinwoodie, 2004; Rahman *et al.*, 2020). Further research is needed to investigate the internal and external conditions for realizing the potential offered by democratization in successful development strategies for enterprises concerning SMEs in emerging countries. What new skills are needed for SMEs in emerging countries to access the development opportunities promised by democratization? What new skills do firms need to develop to grasp the opportunities of markets opening up in those same countries due to democratization? And again, what regulatory tools should be developed, and by which international institutional actors, to foster the real expression of the potential offered by democratization in terms of social equity and sustainability?

The role of digitalization for internationalization has emerged in our review as widely acknowledged in the literature (for a recent review, see Bergamaschi *et al.*, 2020). However, there is a lack of studies highlighting the role of technology in enabling each step of the internationalization process and the specific knowledge processes that are enabled. Thus, additional research is also needed to understand how firms cope with the different technological readiness levels of the countries where they operate and how digital means

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and knowledge processes help increase firms' resilience during disruptive events that impose restrictions on the movements of people and goods (Autio *et al.*, 2021).

The affordances of digitalization enable the development of novel international marketing strategies, thus opening interesting research avenues. For instance, the organization of firms' resources for enriching products with value-added services and the design of the organizations themselves to manage the delivery of services across borders are scarcely discussed in the international business literature (see, e.g. Kowalkowski *et al.*, 2011 for a rare exception) and do not emphasize the role of technologies. Moreover, more studies are needed to identify the most effective degree of centralization of resources for service delivery depending on contextual factors, that is, which aids and functions should be centralized and which should remain decentralized in different organizational contexts. This decision should also be investigated about the centralization/decentralization of the enterprise's other activities to find possible effective synergies such as that, for example, between the service support channel and the product distribution channel.

The methodologies used in these articles show a bipartite approach; many use a conceptual approach, whereas others use a quantitative approach. While the first group relates mainly to sustainable development strategy and internationalization, the quantitative studies mostly relate to marketing strategies. This is also due to the aim of the articles, mostly theory building in the case of sustainability and more confirmative in the case of marketing strategies, which in many cases are linked to social media and digital platforms conveying a great amount of data. Thus, a quantification of the research may be at play, given the availability of quantitative evidence. Nevertheless, a qualitative and in-depth approach may be suggested to scrutinize the knowledge dynamics that occur at the intraorganizational level more in detail.

Table 5 summarizes strategies at the single-firm level, enabled by macrolevel interplay and suggestions for future research.

5.2 Interplay digital technology – knowledge processes observed at the macrolevel, strategies at the population of firms level

Papers in this category discuss the strategies experienced at the population of firm-level that are triggered by the interplay between digital technologies and knowledge processes observed at the macro level:

- international growth; and
- sustainability.

5.2.1 International growth. Technological change is transforming almost every industry, disrupting stable, oligopolistic traditional industries, such as automotive and creating new industries, such as 3D printing. In these cases, we see the emergence of new business ecosystems that ride on digital transformation and embrace collaboration-competition strategies to establish technology standards and interoperability rapidly. Ferràs-Hernández *et al.* (2017) provide a first contribution based on a literature review and the analysis of a set of venture-backed technology startups. They describe the disruption the automotive industry has been facing due to the growing importance of electronics, the urgency of finding sustainable solutions, and the pervasive availability of sharing digital platforms. This disruption, largely caused by the digitalization of product components and operative processes, let new players from consumer electronics, electric utilities and/or digital platforms enter the automotive industry. These new entrants are characterized by founding teams with advanced scientific and technological knowledge which, as digital experts, penetrate the automotive value chain traditionally locked up by incumbents. New ecosystems are formed around traditional original equipment manufacturers (OEMs), new OEMs, technology startups, old and new suppliers, venture capitalists and research labs

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Table 5 Interplay at the macro level – strategies at single firm level

Strategy	*Articles*	*Interplay digital tools-knowledge processes*	*Future research avenues*
Sustainable development strategy	Steinmueller (2001), Paunov and Rollo (2016), Rahman *et al.* (2020), Dinwoodie (2004)	The utilization of digital platforms enables the free exchange of knowledge and information, leading to a new social and economic phenomenon known as democratization. This process empowers companies operating globally by offering them the opportunity to achieve equitable and sustainable strategic growth across all their dispersed divisions. As a result, a more democratic distribution of power emerges among the various units of the company	Additional research is required to examine the internal and external factors that are necessary to transform the potential of democratization into practical development strategies for enterprises. This investigation should specifically focus on small- and medium-sized enterprises (SMEs) in emerging countries
Internationalization strategies	Autio *et al.* (2021), Barnard (2021), Benmamoun *et al.* (2021), Lehrer and Almor (2022)	Digital technologies have significantly reduced the limitations imposed by geographical boundaries, leading to a transformation in how companies shape their global strategies. These technologies also have the potential to initiate and facilitate internationalization strategies by enabling specific knowledge processes. However, it is important to note that when digital technologies are integrated into offerings that include physical products, they may become tied to specific locations. Additionally, if implemented as part of cross-border strategies, these technologies might encounter institutional and legal limitations imposed by the host country	Further understanding is required regarding the influence of technology in facilitating each stage of the internationalization process and the particular knowledge processes it enables. Consequently, additional research is necessary to comprehend how companies manage the varying levels of technological readiness in the countries where they operate. Moreover, it is important to investigate how digital tools and knowledge processes contribute to enhancing the resilience of firms during disruptive events that impose constraints on the mobility of people and goods
Marketing strategies	Eid *et al.* (2019), Krings *et al.* (2021), Bei and Gielens (2020), Guo *et al.* (2023), Caputo *et al.* (2021), Jovanovic and Morschett (2021), Bıçakcıoglu-Peynirci and Morgan (2023), Troise *et al.* (2023)	The advent of digitalization and the widespread availability of digital platforms have created strategic opportunities for both established companies and new players. These opportunities arise from the enhanced market knowledge and the ability to customize international marketing strategies. Specifically, these opportunities include: gaining access to international markets and tailoring offerings to local preferences; and the expansion of servitization	The advancements in digitalization offer opportunities for the development of new international marketing strategies, which present promising areas for research. However, there is limited discussion in the existing international business literature regarding the organization of firm resources to enhance products with value-added services and the design of organizations to manage cross-border service delivery, often overlooking the role of technology. Furthermore, there is a need for more studies to determine the optimal level of resource centralization for service delivery, considering contextual factors. This includes identifying which resources and functions should be centralized or decentralized in different organizational contexts. Additionally, it is important to investigate the potential synergies between the centralization/decentralization of service support channels and product distribution channels, as well as their relationship with the centralization/decentralization of other enterprise activities

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implementing international growth strategies based on new business models built around collaborative digital platforms, big data and next-generation sensors.

Bouncken and Barwinski (2021) describe the international growth strategy of a population of pioneering firms in the nascent 3D printing industry. Performing an in-depth multiple case studies analysis, the authors show that these companies share the need for rapid growth and international establishment of the new industry, which includes setting technology standards, sharing protocols and interoperability. Starting from the assumption that digital and nondigital knowledge ties are important for boosting their global business, these companies leverage digitalization to enable explicit and implicit knowledge exchanges through the emergence of the shared digital identity as a collective self-concept of an in-group of firms, separated from out-groups. The greater knowledge exchange enabled by digital technologies and motivated by the shared digital identity drives firms' boundary spanning and, as such, technology diffusion and international expansion. Through digital identity, firms share explicit and tacit knowledge and feel part of a community. This allows them to leverage or stretch their limited resources to grow and enter new markets. While explicit knowledge is easily shared by digital technology, tacit knowledge requires strong ties with a long-term collaboration perspective and trustful and frequent relationships (Bouncken and Fredrich, 2016; Hughes *et al.*, 2018).

5.2.2 Sustainability. Wang and Wang (2019) propose a novel digital twin-based system for waste electrical and electronic equipment that gathers and maintains comprehensive product, component and material knowledge in the cloud throughout the product's life cycle, from design to recovery. This virtual global repository of electrical and electronic product data and knowledge supports the sharing and integration of circular product life-cycle knowledge along the recycler-remanufacturer chain to optimize resources and pursue a common sustainability strategy. In the same vein, King *et al.* (2023) adopt a mixed-method approach based on soft systems methodology and systems engineering to propose a universal definition of a digital product passport ecosystem that should provide interoperability across multiple product life cycles and stakeholders to achieve benefits in terms of the global circular economy and sustainability. Under certain circumstances and coordinative efforts at the macro level, the digital product passport ecosystem could lead to a more effective industrial symbiosis.

5.2.3 Interplay digital technology – knowledge processes observed at the macro level, strategies at the population of firms level: future research avenues. The papers in this category suggest that the general global availability of digital technologies unleashing knowledge dynamics opens up new opportunities for the emergence of coordinated strategies at the level of populations of firms geographically dispersed. In fact, on one side, we observe that firms that are not colocated but, for example, act in the same nascent industry can find virtual spaces to collaborate and push the international growth and establishment of the industry, a goal they have in common. This would favor the argument that geography does not matter, as the opportunity to build trusting relationships can be based on a shared digital identity that informally guards even tacit and proprietary knowledge exchange via digital technologies. On the other side, regulatory issues and limitations in the market access that emerged due to the latest events, such as the energetic crisis, could act against this possibility. Whether digital identity can overcome geographic and institutional barriers deserves better scrutiny. Digital technologies may allow the emergence of bundled knowledge opening up new international growth strategies through industry disruption. However, the coordination mechanisms that enable firms to pursue coordinated strategies of international expansions still need to be investigated. Future research should better clarify how the new knowledge is made available at the interorganizational level to formulate new shared international strategies. The collaboration around technological innovation induces firms to define interoperability protocols, standards and data exchange procedures that may have strategic impacts. Cocreation strategies may emerge due to implicit coordination that defines new technological standards

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and digitally enabled bundled knowledge. Nevertheless, how these cocreation strategies complement the firms' international strategy is also unclear.

Regarding the development of sustainability strategies, the presence of only two conceptual contributions to this very important issue on the agenda of European institutions and most developed countries governments denounces how much the development of technological and regulatory tools to address this topic in manufacturing is still in its infancy. Several obstacles stand in the way of real collaboration between the different stakeholders of the manufacturing ecosystem, setting up a common strategy to foster a circular economy. Foremost among them is the reluctance of manufacturers to share design data and detailed technical product information due to concerns about intellectual property protection. In addition, the design of these systems presents critical challenges from the perspective of security and safety of data access, which must be granted only to the right people at the right time. From the policymaker's standpoint, the challenges include developing effective systems for assessing the impact of these systems on achieving sustainability goals and evolving regulations that can incentivize producers and different actors in the value chain to invest in sustainability while minimizing the bureaucratic burden. Future research should develop incentives for producers to share data and technical information and to adopt open architecture integrating their existing solutions within the ecosystem. In addition, future research should model common architectures able to accommodate the specifics of various products and guarantee interoperability between systems to avoid adding further complexity to the ecosystem. Further research is required to explore the incentives that encourage producers to share data and integrate their current production systems into broader ecosystem architectures, ensuring optimal interoperability while minimizing redundancy.

Table 6 summarizes strategies at the population of firm-level, enabled by macrolevel interplay and suggestions for future research.

5.3 Interplay digital technology – knowledge processes observed at the meso level, strategies at the single firm level

The papers in this category discuss the strategies enacted at the level of single firms as triggered by emergent social and economic processes, which derive from the interplay between digital technologies and knowledge processes observed at the meso level. Digital technologies enable knowledge generation, exchange and integration processes occurring between firms in alliances, networks, and ecosystems built around a specific technology or technological product, giving rise to different possible business strategies. The formation of technology-based ecosystems and dyadic alliances or business networks is made possible by sharing a common technological knowledge base. In addition, specific characteristics of the new digital technologies, essentially interoperability and positive network effects, favor the creation of business ecosystems, where relationships are generally described as coopetitive in that they involve cooperation between competitors to generate innovative solutions and their commercialization. It is worth noting that a platform-based ecosystem can also refer to a GVC. Alongside the common ecosystem strategy or the strategic goals of an alliance or a network of firms, different single firm strategies emerge, including internationalization, marketing, open innovation and new strategies in the GVC (Nambisan *et al.*, 2019). The emerging strategies considered in the reviewed papers are as follows:

- internationalization;
- marketing;
- open innovation; and
- new strategies in the GVC: governance, resource optimization and social sustainability.

5.3.1 Internationalization. Articles dealing with internationalization distinguish three strategies based on knowledge processes enabled by digital technologies pursued by

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Table 6 Interplay at the macro level – strategies at the population of firm level

Strategy	*Articles*	*Interplay digital tools-knowledge processes*	*Future research avenues*
International growth strategies	Ferràs-Hernández *et al.* (2017), Bouncken and Barwinski (2021)	Digitalization disrupt traditional industries or create around them brand new industrial sectors that rely on new technological knowledge bases and bring to the establishment of new business ecosystems, including old and new actors, that embrace collaboration-competition strategies to quickly achieve a stable global dimension	New studies may investigate whether digital identity actually has the strength to overcome geographic and institutional barriers The coordination mechanisms that allow firms to pursue coordinated strategies of international expansions are still under-investigated. Future research should better clarify how the new knowledge is made available at the interorganizational level to formulate new shared international strategies. Cocreation strategies may emerge as a result of implicit coordination that lays upon the definition of new technological standards and digitally-enabled bundled knowledge, but research on this topic is scarce
Sustainability strategies	Wang and Wang (2019), King et al (2023)	Product life-cycle knowledge in manufacturing ecosystems is collected, stored and shared among various actors, through digital technologies and supported by regulatory solutions to make possible sustainability strategies	Future research should develop incentives for producers to share data and technical information and to adopt open architecture integrating their existing solutions within the ecosystem Future research should model common architectures able to accommodate the specifics of various products and guarantee interoperability between systems in order not to add further complexity to the ecosystem

Source: Authors' own creation

different types of firms in different relational business contexts. The so-called born-global firms (Bhatti *et al.*, 2022; Freeman *et al.*, 2006, 2010, 2012; Gabrielsson *et al.*, 2022) pursue early and rapid internationalization paths through alliances. Industrial SMEs in ecosystems (Del Giudice *et al.*, 2019; Kolagar *et al.*, 2021) and in university-industry relations (Corsi *et al.*, 2022) pursue gradual internationalization paths based on knowledge acquisition generation and integration in local networks and its subsequent exploitation in international business. Large digital firms (Aversa *et al.*, 2021; Cha *et al.*, 2023; Rong *et al.*, 2022) follow internationalization strategies based on integrating into local ecosystems, overcoming obstacles related to the lack of a user base, of existing relationships with local complementors and different regulation of online services.

Born-global firms generally operate in hi-tech sectors where, unlike incumbents, they need to establish revenue streams quickly due to their structural lack of economic resources and large R&D expenditures. This situation drives smaller firms with high levels of technological knowledge to market their products before competitors in global markets are ready to adopt their technology (Freeman *et al.*, 2006). To this purpose, they develop a range of alliances and collaborative partnerships with geographically distant firms based on common technological knowledge that allows rapid transfer and development of new knowledge and facilitates product commercialization before competitors (Freeman *et al.*, 2010). The use of technology and the development of networking competencies emerge as elements that allow firms to overcome their constraints and develop a range of alliances and collaborative partnerships for successful internationalization. Freeman *et al.* (2010) aim to make a theoretical contribution to the Uppsala internationalization model (Johanson and Vahlne, 1977, 2003) emphasizing the role of "technological experience" and shared "technological knowledge" rather than "market-specific experience and operation experience" to explain rapid internationalization. Freeman *et al.* (2012) focus on the differences between the internationalization process of born-globals and older firms. Born-global companies rely more on their technological knowledge. They are more proactive than older companies in moving from culturally proximate to nonculturally proximate markets simply because older firms can also draw on their preexisting international experience. Therefore, while the internationalization process of older firms is explained by the experiential model based on the accumulation of international knowledge that leads to an initial preference for culturally proximate markets (Johanson and Vahlne, 1977, 2003), the born-global approach emphasizes the importance of technological knowledge for internationalization.

Two recent contributions deal with the early and rapid internationalization process of digital start-ups focusing on the central role of the founding entrepreneur, who lacks resources and prior international experience. Still, they can leverage new technologies to develop new digital business models based on continuous knowledge development and sharing with the main business stakeholders in newly created international digital communities. Gabrielsson *et al.* (2022) extend the entrepreneurial effectuation theory, revealing three main theoretical mechanisms largely based on digital technologies and knowledge processes, which allow inexperienced digital entrepreneurs to make decisions relative to networking behavior to internationalize their digital start-ups rapidly. Based on the analysis of their background, including identity, knowledge and active networks, entrepreneurs can search for new partners through pull-based digital communication channels, such as forums and blogs, or they can target known network contacts through push-based digital communication tools, such as e-mails, video negotiations and interactive social channels. Following these alternative paths, entrepreneurs realize the commitment to the digital community (e.g. platforms). Networking with digital communities generates learning and accumulating international knowledge, bringing continuance of commitment to international markets. During the realization of continuance commitment, entrepreneurs start adopting causal-based decision-making based on accumulated knowledge. Still, they can also return to effectuation–based decision-making for new iterations of the model. Therefore, knowledge creation and sharing in digital communities explain an effectuation-based rapid

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internationalization strategy that complements the current entrepreneurial effectuation theory. Bhatti *et al.* (2022) similarly focus on the entrepreneur's role in understanding the firm's internationalization behavior. Through a longitudinal case study, they aim to develop a theoretical contribution to the 2017 version of the Uppsala model (Vahlne and Johanson, 2017). Specifically, they aim at extending its validity to the entire business evolution in light of Industry 4.0 technologies, not only the internationalization process. In fact, digitalization within Industry 4.0 offers firms opportunities to compete globally, using platforms and breakthrough digital technologies that revolutionize knowledge processes, generation, and sharing through continuous interactions with relevant stakeholders. They analyze how such emerging technologies affect how firms organize their value-added activities with business stakeholders, resulting in radical business transformation, increased business competitive advantage and successful internationalization, among other positive consequences.

Del Giudice *et al.* (2019) suggest a positive relationship between horizontal technology spillover and SMEs' international growth mediated by horizontal knowledge spillovers that occur among SMEs in an industrial cluster in China. Here, the presence of multinationals and technological development generate the mobility of skilled human resources and knowledge spillovers, resulting in the development of new technological knowledge in SMEs. This translates into a boost for the growth of SMEs at the international level. Therefore, peer-to-peer collaboration among SMEs in emerging markets, in a context heavily influenced by digitalization, connectivity and high-speed data networks, reduces resource gaps and enables tacit knowledge generation that drives global growth. Kolagar *et al.* (2021) explore industrial SMEs' internationalization strategies enabled by digital servitization through the gradual achievement of digital service maturity and ecosystem involvement. The authors identify three main strategies: the first leverages innovation and proceeds through the incremental attainment of digital service maturity; the second leverages ecosystem and proceeds through the gradual achievement of ecosystem involvement; and the third, which is the fastest and most resource-intensive, leverages the simultaneous development of service maturity and ecosystem involvement. These enabling processes, digital service maturity and ecosystem involvement imply knowledge processes in digital networks, such as knowledge acquisition, creation and integration with customers and business stakeholders that culminate in the successful internationalization of SMEs. Corsi *et al.* (2022) extend network-based SMEs' internationalization theories by unveiling two new roles of universities, in the triple helix perspective, as internationalization catalysts and platforms. Universities have traditionally been regarded as knowledge suppliers to the industries commercializing them. The authors reverse this relation using the triple helix perspective and the revised network-based Uppsala internationalization model to understand how university-industry links work when extended internationally. Through the longitudinal case study of a four-year project run by a UK university and aimed at creating R&D partnerships between UK SMEs and Chinese organizations, the authors unveil a double role of the university. The university represents both a catalyst, as it creates market opportunities for UK SMEs in China by lending its international network and reputation and a platform to do business in China. Indeed the project progressively shifted its focus from supporting collaborative R&D to providing SMEs with Chinese market knowledge.

Digital firms – i.e. firms relying on the internet for their production, operating and delivery processes (Monaghan *et al.*, 2020) – and digital firms in sharing economy – a type of economy that implies users granting temporary access to underutilized assets, possibly for money (Möhlmann, 2015) – owe their very existence and success to digitalization and, specifically, to the extraordinary global spread of digital platforms. These platforms enable the emergence of business models largely based on digital networks of business actors, such as suppliers, customers, complementors and groups of users, which contribute to the value propositions of these new types of multinational firms. These companies face new obstacles in pursuing their internationalization strategies; therefore, the current theories on the internationalization process need to be integrated and extended. Rong *et al.* (2022)

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consider digital companies and identify a new liability they face in the internationalization process: the *liability of ecosystem integration*. The authors observe that integration in local ecosystems is particularly necessary for digital enterprises whose competitive success depends on their ability to interact with local user networks to continuously cocreate value and, with local complementors to coinnovate, and with local institutions and the broader society to gain their support and develop their strategies. To overcome this kind of liability, internationalizing digital companies need to coinvest and coinnovate with these external actors to build the ecosystems to support and fuel a competitive offering. Among digital companies, sharing economy ones mainly face barriers to their internationalization efforts related to the local regulations of host countries. Cha *et al.* (2023) address the problem of divergence of global e-commerce policies among different countries and its impact on traditional internationalization theory and the Uppsala model. The authors rely on Hayek's knowledge economy approach to explain how sharing economy firms successfully expand their business internationally without investing in ownership but promoting collective actions of complementary agents in the host country. Therefore, they shift from Coase's assumptions (the theory of the firm) to Hayek's assumptions (the dispersed knowledge economy) adopting the view of ecosystems-as-construct that, with the autonomous but interdependent actions of self-organizing actors, contribute to the firm's value proposition and value creation and collectively represent its competitive advantage. To analyze how divergent e-commerce policies between different countries affect the internationalization process of sharing economy firms, the authors develop a set of theoretical propositions addressing the four main aspects of decision-making for internationalization, i.e. geography, control, efficiency and effectiveness. Internet regime divergence across countries is supposed to affect negatively the remote localization of services (geography) and positively the self-organization of local actors (control). In addition, differences in Internet regimes negatively affect the efficiency of asset-light business models, as direct investments in the host country by sharing economy firms are needed to overcome institutional and infrastructural gaps. A negative impact can also be observed on the effectiveness of innovation in countries with more restrictive internet regimes, as the full access to potentialities and benefits of emerging technologies could be limited.

Aversa *et al.* (2021) also address the issue of different rules in different countries that can lead to banning sharing economy firms offering services that threaten incumbents through the action of nonmarket stakeholders (i.e. media and regulators). Longitudinally comparing the Spanish market entry strategies of two companies offering similar transportation services, such as Uber and BlaBlaCar, the authors identify the theoretical reasons for the former's failure and the latter's success. Both accused by trade associations of unfair competition, they were taken to court, where they received dissenting opinions; and while the former was banned, the latter was fully discharged. According to the authors, the reason for such different treatment by the same regulator lies in the different self-categorization strategies of the two firms. While Uber opted for an incumbent-focused and economic categorization strategy – which strongly stimulates demand and offer but also backfires incumbents – BlaBlaCar chose an emergent-focused and noneconomic categorization –which supports a slower market growth but fits into a nascent and deregulated market category, so it does not trigger sanctions.

5.3.2 Marketing. Korbi and Chouki (2017) discuss marketing strategies of EU-based MNEs made possible by knowledge transfer processes to medium or small business partners in developing countries. These international asymmetric alliances are seen as platforms to overcome the barriers to knowledge transfer due to geographical distance, which undermines the interaction between partners and the development of a common language required for transferring knowledge, thus hindering effective interfirm KI. The authors apply the knowledge translation perspective and analyze selected case studies of EU-based MNEs that engage in transferring knowledge to Tunisian SMEs to gain access to local nonknowledge-intensive resources to feed their international marketing strategies. Typically,

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in these cases, a high level of organizational incompatibility and asymmetric objectives and knowledge capabilities undermine the effectiveness of the asymmetric alliances. The authors underline the importance of manual and digital artifacts used by both partners for translation and proximity, with their geographical, organizational and technological dimensions, to overcome obstacles in knowledge transfer. Asymmetric relationships are also studied in the context of innovation ecosystems, where they prove beneficial for SMEs to overcome the liability of smallness. In this perspective, Ceccagnoli *et al.* (2012) show how small companies may use digital platforms to seek access to bigger companies' technological standards and knowledge base to pursue their innovation commercialization strategy. The authors discuss the value cocreation mechanisms that are unlocked by a platform ecosystem and the advantages for small companies of joining such platforms in terms of increased sales and the likelihood of eventually attaining an initial public offering, i.e. a well-recognized measure of success for start-ups. Interorganizational collaboration is favored by participation in a joint platform ecosystem. In particular, in the enterprise software industry, the partnership between small independent software vendors and a software platform owner is likely to facilitate knowledge spillovers and appropriability mechanisms that maximize the benefits of the partnership. This results in positive financial effects and increased market penetration for small independent software vendors, especially those benefitting from greater intellectual property rights protection and downstream capabilities. Smaller companies in ecosystems can also benefit from access to high-quality sources of knowledge.

5.3.3 Open innovation. Digitalization makes possible the construction of international networks of firms, which may also include institutional actors, research centers and universities and may take different configurations, e.g. incubators, transnational networks, R&D alliances and platforms, within which other knowledge processes are enabled, ranging from simple access to and acquisition of external knowledge, to knowledge sharing, integration and cocreation. The papers in this section analyze, mainly through quantitative empirical methodologies (except for Rocha *et al.*, 2019), the conditions, both related to internal factors and the environment, that enable companies of various sizes and in different contexts to develop successful innovation strategies based on these knowledge processes, their implementation and the relative results. Bouncken *et al.* (2023) explore the possible configurations of absorptive capacity in cross-border R&D alliances, where various forms of distance are at play, not only technological. They reveal that high absorptive capacity is associated with older and smaller firms allying with younger and bigger partners under technological similarities and when both partners are aware of digitalization cognitive biases and cope with them. Specifically, the authors point out the risk of overestimating the benefits of digital technologies and underestimating their challenges when employed in complex contexts and creative processes such as those related to R&D. Rocha *et al.* (2019) discuss the strategy of access to the innovative knowledge of hi-tech start-ups by large manufacturing companies engaged in I4.0 transformation. Specifically, the authors consider the context of a start-up incubator, where start-ups make intense use of knowledge innovation practices by capturing ideas, knowledge and technologies externally, e.g. from universities, companies and other incubated start-ups, to develop digital solutions and then sell their innovations to manufacturing companies involved in I4.0 transformation. Therefore, this paper shows two types of open innovation strategies. The first is enacted by start-ups in the incubator and is enabled by knowledge-sharing and integration processes with international incubator members favored by digital technologies. The second is enacted by big manufacturers that acquire innovative digital solutions from start-ups to be implemented in I4.0 industrial settings.

A different angle to this stream of research is provided by Scuotto *et al.* (2017). This paper focuses on SMEs and discusses whether ICTs, which support innovation processes at intraorganizational and interorganizational levels, sustain SMEs' innovation strategies. By assuming that SMEs use both internal R&D and open innovation to overcome the liability of

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smallness, the authors demonstrate that digital technologies mediate the relation between in-house R&D and innovation performance. Moreover, the results support the idea that SMEs can and should exploit digital technology to expand their innovative capacity, e.g. by acquiring big data, information and knowledge from sources dispersed in the outer environment. The increased collaboration with external actors also results in better management of internal resources. These results reinforce the view of open innovation as a way to integrate internal knowledge with external sources of knowledge and innovative ideas. Always concerning SMEs, Zahoor *et al.* (2022) investigate the affordances of digital technologies to access international and dispersed sources of knowledge to enable international open innovation in emerging country SMEs (ESMEs). The authors start from the widely-demonstrated assumption that open innovation fosters the international strategies of large companies and aims to investigate whether this is also the case for ESMEs. About SMEs, most studies focus on the impact of domestic open innovation on international competitiveness.

In contrast, Zahoor *et al.* (2022) consider international open innovation more significant, particularly in resource-constrained ESMEs. Specifically, they question the relationship between international open innovation and the market success of ESMEs and the impact of cross-cultural competencies and digital alliance skills. Based on a survey of ESMEs, the authors find that international open innovation positively influences their international market success and that both cross-cultural competencies and digital alliance capabilities moderate the relationship between international open innovation and ESMEs' international market success.

In this line, Wukich *et al.* (2017) discuss how social media platforms unlock the potentiality of information sharing in transnational knowledge networks when the central firms of the networks are organizations with higher levels of capacity located in wealthier countries. By focusing on the domain of emergency management, the authors show that transnational knowledge networks mediated by social media mitigate the "homophily" effect, i.e. the tendency to bond with similar organizations, lower the traditional barriers to information sharing, such as geographic distance and language, while enabling boundary spanning behaviors. This facilitates the emergence of global transnational knowledge networks enabling knowledge seeking strategies and innovation from peripheral organizations to organizations in wealthier countries.

5.3.4 New strategies in the global value chain: governance, sustainability and resource optimization. The literature shows three emerging strategies related to the GVC due to the interplay between digital tools and knowledge processes:

- governance,
- resource optimization; and
- sustainability.

First, two papers (Hartmann *et al.*, 2020; Mola *et al.*, 2017) focus on the new governance strategies in the GVC made possible by the spread of new digital technologies and their potential to improve the processes of accessing and sharing knowledge.

Mola *et al.* (2017) explore how digital technologies enable the choice between different types of value chain governance in e-commerce projects involving fashion companies and their e-commerce service providers. The study shows that the choice is determined by the ability and willingness of the fashion companies to share knowledge with their technology service providers. Therefore, how much knowledge is shared and how between the companies and their technology service providers (e-commerce) determines the governance strategy applied to the relationship. Governance strategies in the GVC are also discussed by Hartmann *et al.* (2020). They describe three types of governance structures between Kenyan horticultural smallholders and their international buyers: the captive design

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that results in a strong power asymmetry with European multinational buyers and two market-based structures. The research shows that adopting internet technology accessible via smartphones enables Kenyan smallholders to access new knowledge and identify and use new production and marketing techniques. This allows them to reconfigure GVC arrangements with local partners, especially moving to market-based ones. At the same time, the study does not find evidence of increased control by large international buyers based on digital technologies in GVC captive arrangements, as feared by some studies (Unwin and Unwin, 2017).

Second, six papers focus on resource optimization strategies in the GVC. Yao and Deng (2016) recognize the dynamic nature of resource distribution within a GVC due to knowledge-sharing processes at the level of local networks composed of the focal MNEs' foreign subsidiaries and their local partners (intranetwork knowledge transfer) and to knowledge spillovers or externalities (knowledge transfer to organizations outside the network). The authors aim to integrate these embeddedness-interaction mechanisms within a global resource optimization strategy in internationally distributed manufacturing. As part of this strategy, the focal MNE in a GVC coordinates the knowledge-sharing processes among all the resources (or enterprises) through knowledge transfer within the network. Resources outside the network interact with the inner resources through inter network knowledge spillovers.

Therefore, over time, all the resources experience some change in their technological, production and marketing knowledge. For this reason, the focal MNE periodically conducts a new round of resource integration to reassign global production tasks to the best resources. Two more papers (Raisinghani and Meade, 2005; Zhu and Tang, 2023) focus on strategies to improve the efficiency and effectiveness of a GVC. Adopting a socio-technical perspective, Raisinghani and Meade (2005) propose a strategic decision-making tool that is useful for managers to select which KM construct is most beneficial in developing an agile SC driven by the strategic performance criteria of time, cost, flexibility and quality of the organization. The outcome will differ depending on the decision maker's perceptual weightings, but the process and the model are not valuable, just as mechanisms to support a final decision.

Conversely, they are valuable tools for learning as they stimulate management to become familiar with the issue and to frame the problem in a systemic and interrelated way by understanding the linkage between organizational performance and the dimensions of agility, supply-chain drivers and KM. Zhu and Tang (2023) also focus on the construct of SC agility, which is closely tied to the ability of the SC to react to unexpected demand changes effectively and customer needs while reducing costs and optimizing resources. Adopting a quantitative research methodology, the authors show that platform and KI drive SC agility in emerging markets. Moreover, they analyze the moderation effects of institutional contexts, specifically ownership structure and level of regional openness, i.e. to what extent a region is open to the outside world for economic, cultural and social exchanges. The authors reveal that state-owned enterprises have a greater return than nonstate-owned enterprises from their investments in KI with channel distributors in terms of SC agility. Regarding regional openness, KI with channel distributors works better for firms in regions with a high level of openness than for regions with a low level of openness. For the latter, investing in platform integration with distributors is more beneficial.

Still in the area of distributed manufacturing, Xie *et al.* (2005) propose a reconfigurable platform to support the development of one-of-a-kind products (OKPs), i.e. highly customized products in a certain production area. The reconfigurable platform, proposed and prototyped by the authors, is an architecture-centric approach to support the design, planning and production of OKPs, based on open standards and interfaces. Through this platform, employees within a company benefit from an integrated and concurrent environment. They can share software tools and product development data and work

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simultaneously to develop OKP products cost-effectively. The topic of efficient and effective resource management in a GVC is also a focus of Cai *et al.* (2010), who present a prototype intelligent system semantic Web-based manufacturing resource discovery for distributed manufacturing between dispersed enterprises. The system converts resources into machine-understandable knowledge, which is the first step for the efficient and effective discovery and management of resources in business collaboration in the context of a GVC. Finally, Hohn and Durach (2021) wonder who appropriates the efficiency gains from adopting sophisticated digital manufacturing technologies, specifically additive manufacturing, in a GVC in the apparel industry. Additive manufacturing can complement existing production systems enabling the acceleration of the production process and the mass customization of apparel by embedding market-sourced knowledge and small-volume production.

Moreover, additive manufacturing can be implemented as a standalone production technology, thus enabling a reshored production scenario. In both cases, any efficiency gains from new digital technology implementation will be handed down the SC to the apparel retailers who leverage their powerful position in the SC, thus amplifying rather than improving current social sustainability issues. Social sustainability as a strategy in the GVC is the topic covered in Sendlhofer and Lernborg (2018), which explore the possibilities of transferring knowledge about labor rights to workers afforded by new technologies, specifically a custom-designed digital training tool usable from an application. Through such a digital tool, MNEs can pursue a strategy of social sustainability in the context of a GVC, by being able to disseminate, down to the most remote factories, knowledge about workplace policies, health and safety, fire and building safety and workplace dialogue. The authors focus on the content conveyed to workers during digital training to verify that it is knowledge and not just information. They also underline the importance of adapting it to local needs, tastes and culture. The advantages of pursuing a social sustainability strategy based on digital technologies concern both the effectiveness of the method, linked to the possibility of customizing the content and the usability of the tool, and the efficiency, related to the opportunity of updating content remotely and interacting asynchronously with participants.

5.3.5 Interplay digital technology – knowledge processes observed at the meso level, strategies at the single firm level: future research avenues. The single-firm strategies described in this section are triggered by digitally-enabled knowledge processes observed at the meso level, e.g. interfirm alliances, international networks or ecosystems, such as business ecosystems, DPEs or GVCs. Knowledge processes enabled by new technologies in different contexts open up a variety of international strategies that raise interesting research questions and deserve further research.

Regarding internationalization strategies, articles in this set confront the traditional Uppsala model and its more recent network-based version and revise it, integrating it in light of new digital technologies. The most radical revision of Uppsala's gradual internationalization model is based on the observation of born-global firms implementing a form of rapid internationalization based on alliances with firms that share the same technological knowledge base (Freeman *et al.*, 2006, 2010, 2012). However, we observe a difference between international alliances that arise based on a prior relational trust versus newly formed networks that start as interfirm alliances through necessity but subsequently develop relational trust-like outcomes over the long term. New studies may investigate the knowledge processes involved in both cases, the technologies supporting each stage of the relevant processes as well as other organizational and governance aspects, internal and external, including the role of cross-border knowledge facilitators, whether public, e.g. federal and provincial government or government-related organizations, business associations or private, e.g. banks and accounting, consulting or law firms. In addition, new studies could investigate the durability of the relationships born on a common technological basis and their ability to overcome difficulties and situations of uncertainty without a

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previous relationship of trust. Emerging governance mechanisms, issues of formalization vs non formalization in the alliances, and the emergence of new organizational structures could be mediators or moderators of the international strategic outcomes at the single firm level. Regarding the internationalization strategies of digital sharing economy companies, further studies are needed to define the most useful categorization to adopt to enter the new market while mitigating the risk of being hindered by nonmarket stakeholders.

Regarding the research methodologies adopted to study internationalization strategies, we observe that the vast majority (8 out of 11) are based on case studies, some longitudinal, single or comparative on 2 or 3 firms, and others multiple. This demonstrates the need to explore a phenomenon that, while not new, is profoundly changing due to the emergence of new technologies and new industries paving the way for new business models and, necessarily, new internationalization processes. This is reflected in a couple of attempts at systematic structuring through conceptual contributions, such as Freeman *et al.* (2010), who integrate the traditional Uppsala model to explain the born-global phenomenon, and Cha *et al.* (2023), who develop a model of internationalization for sharing economy enterprises. In contrast, quantitative studies that could validate and generalize the findings of qualitative surveys and provide the basis for new theoretical developments still need to be included.

However, the results of qualitative surveys have important managerial implications related to internationalization processes. For example, studies on born global firms suggest the importance for start-ups or small technologically advanced firms to recognize their limitations and leverage their strengths, not only by taking advantage of their knowledge – and technology-intensive capabilities but also by networking with other internationalizing firms or by building partnerships with older firms with experience and established networks, with whom they can share their technological skills.

B2B alliances are also investigated in the context of possible marketing strategies arising from digitally-enabled knowledge exchanges in asymmetrical relationships (Korbi and Chouki, 2017), i.e. between large and small firms, such as big manufacturers in European countries and small foreign commercial partners localized near customers. The case study approach is appropriate to grasp the communication difficulties between partners due to the lack of proximity, studied in its three main dimensions, organizational, cultural and geographical. If managers within asymmetric alliances can draw interesting insights from the study on the importance of translation and the use of artifacts, researchers could delve more deeply into existing barriers, using an ethnographic approach. Future research is needed to identify new tools to facilitate knowledge sharing in asymmetric relationships in terms of size, institutionally, socially and culturally. Where there are significant differences between enterprises, the difficulties associated with knowledge transfer can be enormous and relate to social, cultural and language aspects. More inductive qualitative research is needed to explore the role of digital technologies in easing boundary-spanning behaviors. Asymmetric relationships are also very common in DPEs (Ceccagnoli *et al.*, 2012), where the platform owner plays the role of the hub, surrounded by smaller, peripheral firms that draw from and simultaneously give value to the platform. Analysis of the strategies of smaller firms in these contexts reveals the risk of the emergence of dependencies and lock-in effects that could undermine the organizational ability of firms participating in the ecosystems. These possible drawbacks of DPEs deserve further research, specifically identifying what capabilities or assets smaller firms should develop to protect their competitive position. To this purpose, case study analysis, which is particularly appropriate when there is a need for a deep understanding of how firms develop know-how and capabilities, could provide interesting insights. In the same vein, further research adopting the eco-systemic approach is also needed in the context of software platforms. This could further clarify how firms of different sizes participate in the ecosystem and the appropriate value from IT investments.

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Analyzing the risks for small innovative firms to participate in DPEs has important managerial implications for the small firms and the platform hub. In particular, small innovative firms need to carefully consider whether they should participate in the ecosystem based on the real opportunities they have to protect the intellectual property of their products through tools such as copyright or to strengthen their competitive position by developing downstream capabilities. At the same time, the platform owner should be aware of the risks faced by its valuable small innovative partners and strategically manage their appropriability concerns to sustain the entire ecosystem.

Regarding open innovation strategies, new studies should further investigate the multifaceted concept of distance in international business. Specifically, cultural differences and perceived cultural distance should be explored, expanding on the idea of psychic distance (Bouncken *et al.*, 2023) and how it affects the implementation of digital technologies. Past studies largely explain perceived psychic distance by resorting to geographical distance (Håkanson and Ambos, 2010), almost neglecting the role of culture. Methodologically, qualitative methodologies seem best suited to explore in depth the multifaceted concept of perceived psychic distance and its implications on the implementation of digital technologies within international R&D alliances.

These articles highlight the limitations of digital technologies (Bouncken *et al.*, 2023; Scuotto *et al.*, 2017; Zahoor *et al.*, 2022) in transferring knowledge within innovation-oriented international relationships have important implications for managerial activity. Specifically, managers should be aware of "virtuality traps," i.e. over-reliance on digital technologies to transfer knowledge without sufficient contextual knowledge. Recent studies (Bouncken *et al.*, 2023) show that the role of digital technologies in fostering international relations is undeniable. Still, firms should pay close attention to investments and costs for understanding, adapting, improving or developing digital technologies to absorb knowledge from their ongoing international partnerships.

Our review has highlighted several themes where the perspective of knowledge processes enabled by digitalization stands out as a key to interpreting the strategic choices of the focal firm in terms of governance, optimization of resource allocation processes, performance improvement or sustainability. The partial overlap of the two streams of international business and GVC is giving rise to interesting future research avenues that have already been the object of reviews highlighting their mutual contributions (De Marchi *et al.*, 2020; Sinkovics and Sinkovics, 2019). For example, the possible application of the industry focus typical of the GVC approach to international business studies, which generally adopt a firm-centered approach, deserves more scholarly attention, as De Marchi *et al.* (2020) suggested. Indeed, the GVC approach includes commercial resources and capabilities, besides technological and manufacturing competencies, which have typically been emphasized by the international business approach as critical resources to the construction and exercise of power. Moreover, one aspect that needs to be addressed is the multiplicity of actors participating in these global knowledge flows and helping open the frontiers of innovation and cross-sector contamination. In these terms, the GVC approach offers a privileged viewpoint on actors that, external to the focal firm, are devoted only to secondary and marginal attention, (see, e.g. Delios, 2017 for a severe critique of the "fetishistic" focus of International Business research). Furthermore, new studies exploring the dark side of GVC digitalization are needed. Digitalization undeniably allows for significant efficiency gains, but these gains risk being distributed asymmetrically among the various actors. The issue of social sustainability related to the implementation of new digital technologies, such as additive manufacturing, within GVC, is still in its infancy but already offers interesting managerial implications. Specifically, corporate decision-makers should be aware that implementing emerging technologies, such as additive manufacturing, in SC carries possible consequences beyond operation concerns or technological safety, including social issues. Therefore, a wider SC perspective should be adopted, considering

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changing governance structures and social sustainability consequences. Moreover, firms should be aware that new technologies in manufacturing, even though they do not consider adopting them, provide interesting business opportunities and open the way to possible new, fully technology-based competitors on the market.

Table 7 summarizes strategies at the single-firm level, enabled by meso level interplay and suggestions for future research.

5.4 Interplay digital technology – knowledge processes observed at the meso level, strategies at the population of firms level

The papers in this category discuss strategies enacted at the population of firms' level and deriving from the interplay between digital technologies and knowledge processes observed at the meso level. The experienced strategies are as follows:

- collaborative innovation; and
- resource optimization.

5.4.1 Collaborative innovation. Articles in this set discuss collaborative innovation strategies that emerge as a collective strategy of a population of firms in several contexts, e.g. DPEs (Bereznoy *et al.*, 2021), collaborative networks (Ibáñez *et al.*, 2021; Papa *et al.*, 2020) and virtual environments (Aslesen *et al.*, 2019). DPEs have been extensively discussed in international business as organizational arrangements of interfirm collaboration fostering innovation (Nambisan *et al.*, 2019). Participating in a DPE eases access to different sources of knowledge related to the local markets and digital technologies. Thus, digital platforms may foster new technologies' commercialization strategies via value cocreation and value appropriation between big and small companies. In its turn, the development of complementary innovation raises the value of the digital platform. Therefore, DPEs can be considered enablers of open innovation strategies as they provide a "systemic and effectively organized process for the collective developing of complex innovative products or services" (Bereznoy *et al.*, 2021: p. 2029). Bereznoy *et al.* (2021) argue that the advancement of new digital technologies has empowered the intertwining of knowledge creation and sharing processes that has generated the DPEs as a digitally-enabled Japanese "ba-sho," i.e. a place where knowledge sharing is in motion and dynamically interacts with knowledge creation. The paper discusses several conceptual issues connected to DPEs, such as effective motivation systems, architectural aspects and governance instruments. It offers a new theoretical model for successfully creating and effectively using innovation platforms, highlighting the main associated challenges.

The paper by Papa *et al.* (2020) aims to explore the impact of collaboration with outside sources and business data analytics (BDA) adoption on the innovation strategies of complex international collaborative networks, using the number of patent applications as a predictor. The authors develop and test two research hypotheses: the association between the number of patent applications and the amount of innovation obtained through collaboration with external sources – i.e. open innovation – and the association between the number of patent applications and the use of BDA. The results show that open innovation strategies significantly affect the innovation performance of the interfirm collaborative network by stimulating the search for reflective knowledge exchange. Specifically, adopting open innovation strategies by encouraging collaborative knowledge access keeps the risk of negative spill-over to its minimum and intensifies efficiency and efficacy in knowledge access. At the same time, open innovation strategies may augment the knowledge base shared among the firms' partners.

On the other hand, the relationship between the use of BDA and patent applications needs to be supported, meaning that BDA and digital capabilities only, to a limited extent, affect knowledge creation and appropriation processes in interfirm collaborative networks for

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Table 7 Interplay at the meso level – strategies at the single firm level

Strategy	*Articles*	*Interplay digital tools-knowledge processes*	*Future research avenues*
Internationalization strategies	Freeman *et al.* (2006, 2010, 2012), Bhatti *et al.* (2022), Gabrielsson (2022), Del Giudice *et al.* (2019), Kolagar *et al.* (2021), Corsi *et al.* (2022), Rong *et al.* (2022), Cha *et al.* (2023), Aversa *et al.* (2021)	Digital technologies provide the common knowledge ground on which companies can set up rapid internationalization strategies based on knowledge sharing and cocreation with geographically distant companies, or gradual through integration into local ecosystems in the host country	New studies may investigate the knowledge processes involved in alliances based on common technological knowledge vs alliances based on prior relational trust, the technologies supporting each stage of the relevant processes, as well as other organizational and governance aspects, internal and external, including the role of cross-border knowledge facilitators. New studies on the internationalization strategies of digital sharing economy companies with reference to the type of categorization that is most useful to adopt to enter the new market while mitigating the risk of being hindered by nonmarket stakeholders
Marketing strategies	Korbi and Chouki (2017), Ceccagnoli *et al.* (2012)	Digitalization enables knowledge exchange between firms in asymmetric alliances (dyadic or in DPEs), making possible new marketing strategies	Future research is needed to identify new tools to facilitate knowledge sharing in relationships that are asymmetric not only in terms of size but also institutionally, socially and culturally More inductive qualitative research is needed to explore the role of digital technologies in easing boundary spanning behaviors The possible drawbacks of DPEs (dependencies and lock-in effects for smaller firms) deserve further research specifically to identify what capabilities or assets smaller firms should develop to protect their competitive position Future research could further clarify how firms of different sizes participate in software platform ecosystems and appropriate value from IT investments
Open innovation strategies	Bouncken *et al.* (2023), Rocha *et al.* (2019), Scuotto *et al.* (2017), Zahoor *et al.* (2022), Wukich *et al.* (2017)	Digitalization enables knowledge sharing and acquisition – in cross-border R&D alliance, by large companies from hi-tech start-ups, by SMEs and ESMEs from international dispersed sources, by peripheral from central organizations that make possible open innovation strategies	New studies should further investigate the multifaceted concept of distance in international business. Specifically, cultural differences and perceived cultural distance should be explored, expanding on the concept of psychic distance and how it affects the implementation of digital technologies

(*continued*)

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Table 7

Strategy	*Articles*	*Interplay digital tools-knowledge processes*	*Future research avenues*
New strategies in GVC: governance, sustainability and resource optimization	Hartmann *et al.* (2020), Mola *et al.* (2017), Yao and Deng (2016), Raisinghani and Meade (2005), Zhu and Tang (2023), Xie *et al.* (2005), Cai et al (2010), Hohn and Durach (2021), Sendlhofer and Lernborg (2018)	Digitalization enables knowledge transfer, sharing and integrating processes that make possible different strategies in the GVC. In fact, at the upstream end of the chain, new governance models are made possible while, along a manufacturing chain, resource optimization strategies are enabled to pursue efficiency, effectiveness and agility. Moreover, MNEs can pursue new social sustainability strategies leveraging on digitalization to disseminate knowledge about workplace policies, health and safety, fire and building safety and workplace dialogue to the most geographically remote factories	More studies are needed that take an industry-centered approach, as opposed to the traditional focal firm-centered approach New studies that consider the perspectives of multiple actors in the GVC ecosystem, including from the perspective of innovation and cross-contamination. More studies exploring the dark side of GVC digitalization, which undeniably allows for significant efficiency gains but risks being distributed asymmetrically among the various actors

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innovation. Collaboration for innovation can also take place among different stakeholders of a global value chain, internal to the focal organization and external, which, in turn, can be value-chains internal, such as suppliers, processors or downstream users, retailers and end-customers, or external such as potential customers, citizens, etc. Grunwald (2022) proposes a conceptual input-process-output model of sustainability cocreation in a digitalized GVC context. The authors investigate the process of sustainability cocreation involving stakeholders' specific knowledge and competencies combination and fit alignment between stakeholder and organizational goals and values on the macro, meso and micro levels. Overarching ecosystem-level strategic goals related to the ecological, social, and economic dimensions of sustainability and enabled by I4.0 technology adoption should be aligned with relationship-oriented goals of cooperation, involving, e.g. building trust and commitment, and with individual goals of the participating stakeholders, involving, e.g. enhancing effectiveness of sustainability-related measures.

Still on the subject of collective innovation strategies related to sustainability, Ibanez *et al.* (2022) explore social innovation strategies enacted by N-Helix collaborations (e.g. industry, government, university, nonprofit organizations and civil society) in response to global exogenous events, such as COVID-19 pandemic, that create societal emergency and needs that governments are not able to satisfy. N-helix actors transfer knowledge, technology, and innovation to promote digital social entrepreneurship, aiming to generate value and solve social problems created by the emergency event. Specifically, digital social entrepreneurship drives sustainable, innovative solutions driven by digital technologies to address N-Helix stakeholders' needs.

Collaborative innovation strategies by populations of firms, which involve not only businesses but also actors such as universities, institutions and research centers, are also studied in the context of virtual environments. These studies generally focus on the affordances of virtual collaboration tools, their effectiveness, and their limitations compared to physical spaces. Aslesen *et al.* (2019) investigates the role of physical and virtual spaces in knowledge creation and exchange, providing interesting insights into the innovation strategies of collaborative business networks. The authors observe that physical spaces have dominated the literature on collaborative networks for innovation and that, in a digitalizing world, a deep reflection on the role and potentialities of virtual spaces as spaces for interaction and collaboration is needed. Virtual spaces do not substitute physical spaces; they are a different and complementary dimension that interacts with physical spaces in a dynamic of mutual influence. From this point of view, digital technologies provide businesses with new dimensions of global and virtual collaboration and allow access to local and global knowledge sources to be combined to innovate. The virtual space should be seen as an arena that can reinforce existing knowledge linkages and allow for the establishment of new ones. In this regard, Dossick *et al.* (2015) study the conditions for fruitful collaboration in virtual spaces between globally dispersed teams oriented toward problem-solving and innovation. Specifically, they examine the collaboration affordances of a specific virtual world, a cyber-enabled global research infrastructure for design, through a multi year experiment and identify the needed conditions for messy talks. Messy talks are defined and operationalized as processes in which teams mutually discover issues, critically engage in clarifying and finding solutions to the discovered issues, exchange and synthesize knowledge and resolve the issue. Powerful generative messy talks at the basis of the generation of innovative solutions are supported by specific functionalities of the virtual technology presented, such as shared visualizations and mutable information models.

Regarding the affordances of new digital technologies in virtual collaboration efforts, Dougherty and Dunne (2012) claim that simulation tools are sources of a new type of knowledge embedded in virtual models of reality, i.e. technological knowledge, which can play out an important role in collaborative innovation efforts in the field of scientific research. Integrating technological knowledge from digital models and traditional knowledge from

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experience in interfirm collaborations for innovation is crucial to address complex international innovation projects. Specifically, they investigate collaboration between digital scientists, who use digital representations of reality and manipulate signs, and traditional scientists, who use conventional laboratories and manipulate physical material, in drug discovery. The authors warn about the difficulties in integrating these two types of knowledge and reveal the emergence of new boundaries within core innovation activities.

5.4.2 Resource optimization strategies. Papers in this category present collective resource optimization strategies in global virtual enterprises (Yoo and Kim, 2002), and hyper-connected SC ecosystems (Pessot *et al.*, 2022), made possible by the digital transformation that enables the systematic sharing and integration of knowledge among different organizational actors. Yoo and Kim (2002) present a Web-based KM system designed to facilitate the seamless sharing of product data among application systems in global virtual enterprises, broadly defined as networks of independent companies connected by temporary relationships managed through the information technology (Byrne *et al.*, 1993). They show that technology, such as the internet or an intranet, seldom stands alone. It also needs to rely upon other complementary technologies to enable the global sharing of product data among various application programs. The presented KM system also provides users with a map of product data, which supports the identification of local information and enables the content-based search, which increases the effectiveness of search and provides an automatic translation and reuse of product data among diverse application systems. Yang *et al.* (2008) also note the potential offered by the internet to share ideas and knowledge on a large scale and the need to develop interorganizational information systems to manage knowledge globally by overcoming cultural and language barriers. The authors propose different approaches and compare the efficiency and effectiveness of different algorithms to solve the problem of cross-lingual semantic interoperability and thus make possible the emergence of interorganizational strategies of global resource optimization.

Pessot *et al.* (2022) explore resource optimization strategies enacted by the actors of an SC ecosystem based on transforming a traditional SC into a hyper-connected network led by digital technologies through adapting and changing its processes and routines based on knowledge sharing and integration. Specifically, new technologies increase data generation at each node of the network, and SC actors should be able to create value from data to improve the performance of the whole network. Interconnections across SC processes, enabled by digital technologies, occur at various levels of the SC, i.e. within the factory, in the upstream network with suppliers, during the overall product life-cycle with customers, with markets to extract aggregated data to study trends, forecast demand, etc., in innovation with partners and selected customers, in logistics and, finally, with workers from production to sales. The authors also point out several challenges of hyper-connected SC ecosystems, including real-time data collection and subsequent data modeling to extract value from them, traceability of the order status any-time and any-were, standardization of information structure, sustainability of IoT and connectivity of long-life products, and, above all, change of culture and new skill development to face hyper-connectivity.

5.4.3 Interplay digital technology – knowledge processes observed at the meso level, strategies at the population of firms level: future research avenues. Virtual interactions, virtual collaboration spaces or virtual teams emerge as loci where populations of geographically dispersed firms leverage digitally-enabled knowledge processes mainly to pursue joint innovation strategies. Many contributions in our review refer to these loci as globally distributed DPEs (Nambisan *et al.*, 2019; Bereznoy *et al.*, 2021), open innovation networks (Papa *et al.*, 2020; Grunwald, 2022; Ibanez *et al.*, 2022) or virtual teams (Aslesen *et al.*, 2019; Dossick *et al.*, 2015; Dougherty and Dunne, 2012).

Regarding DPEs, two theoretical contributes (Nambisan *et al.*, 2019; Bereznoy *et al.*, 2021) identify the main models in the literature and provide a conceptualization of them as

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environments that foster inter-firm knowledge processes enabling various collaborative strategies in international business, including innovation. Nevertheless, more insights are needed on the role of technology platforms as a common knowledge base around which the interests of different actors forming a business ecosystem are focused. Coopetition dynamics seem to characterize these innovation environments, but interesting issues remain unanswered regarding ecosystem architecture and governance mechanisms (in line with Bereznoy *et al.*, 2021). Regarding knowledge cocreation and sharing in multistakeholder collaborations, as in a GVC or an N-Helix context, two quantitative contributes (Papa *et al.*, 2020; Ibanez *et al.*, 2022) give evidence of the roles played by different types of stakeholders in innovation networks, the emergence of new phenomena of digital entrepreneurship at disruptive global events and their impact on innovation, while a theoretical paper (Grunwald, 2022) conceptualizes through an input-process-output model the process of cocreation of innovation in a GVC in the field of sustainability.

The results of studies on knowledge cocreation and collaborative innovation in DPEs, innovation networks or interfirm alliances of various kinds have important practical implications. Indeed, one theme that consistently emerges is the motivation for the active participation of multiple stakeholders in the collective innovation effort. According to equity theory, in these contexts, it is critical to identify, understand, and intervene on benefit/cost ratios for each stakeholder and their perceptions to ensure stakeholder satisfaction and contribution to the overall innovation project. Communicating clearly and understandably to all stakeholders involved in the process of long-term goals; striving to align goals and values at the micro, meso and macro levels through the development and communication of a shared value proposition; and measuring, communicating timely and discussing results with all participants are key elements in stimulating motivation.

Future studies could delve into the aspect of motivating different stakeholders to collaborate for a common strategy and develop more precise directions on how to design and implement collaborative innovation models, applying theoretical frameworks such as the commitment-trust theory of relationship marketing (Morgan and Hunt, 1994) and service-dominant logic (Vargo and Lusch, 2004). To this purpose, preliminary explorative research should be conducted to identify the main drivers of motivation for the different types of stakeholders to define proper variables for subsequent quantitative studies.

Similarly, the papers that describe strategies of global resource optimization (Yoo and Kim, 2002; Yang *et al.*, 2008), conceptual in nature, discuss the operational mechanisms of the ecosystems, whose efficiency impact on the strategy execution. Nevertheless, the extant literature needs to clarify if and how the coordination mechanisms are embedded in the digitally enabled knowledge processes or stem from other coordinated actions between the ecosystem actors. As a final remark, the papers in the review seem to focus on ecosystems as a strategic entity *per se'*, whose strength also lies in the ability to attract newcomers. However, the longitudinal perspective is often neglected, and it remains unclear if any motivational levers can be designed to attract targeted complementors to participate in collaborative innovation activities in the ecosystem and how the digitally enabled knowledge dynamics also lead to the emergence of the ecosystem. To this purpose, a qualitative analysis could help identify motivational drivers of possible innovative newcomers to increase the value of the ecosystem. Regarding hyper-connectivity, Pessot *et al.* (2022), with their qualitative contribution, show how the globally distributed actors of a SC in manufacturing combine advanced digital technologies to improve and expedite processes and routines, thus increasing SC performance. Results provide practitioners with guidelines, practices, and routines to integrate advanced technologies at different levels to transform the SC into a hyper-connected global network, dramatically impacting process efficiency and effectiveness.

Future studies on hyper-connectivity, given its pervasiveness in businesses and society, may come out of the context of production to study interaction models with smart cities and

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with governmental institutions and other entities, such as nongovernmental organizations, aimed to solve societal challenges and emergencies.

Table 8 summarizes strategies at the population of firm-level, enabled by meso level interplay and suggestions for future research.

5.5 Interplay digital technology – knowledge processes observed at the micro level, strategies at the single firm level

The papers in this category discuss strategies enacted at the firm level deriving from the interplay between digital technologies and knowledge processes experienced at the micro level, i.e. within the firm. The strategies reported in the reviewed papers are as follows:

- marketing;
- innovation;
- internationalization; and
- international expansion.

5.5.1 Marketing. Digital platforms enable marketing strategies by fostering processes of generation, sharing, integration and transfer of knowledge, both commercial (Ballerini *et al.*, 2023; Liu *et al.*, 2023; Schleimer and Riege, 2009; Zeng *et al.*, 2019) and product (van Bommel *et al.*, 2021). Schleimer and Riege (2009) describe a large multinational automotive company's attempt to implement shared marketing strategies across its internationally dispersed sales subsidiaries through a marketing portal on the intranet. The portal should provide an essential corporate link between existing internal knowledge and newly generated knowledge from customers to develop and share new and more effective marketing strategies internationally. Results show that subsidiaries' managers perceive the marketing portal as the least effective communication channel compared to face-to-face communication, telecommunication and e-mail systems. Its low usage level for transferring specific knowledge also confirms this perception. Indeed, the intranet that should connect different organizational units is interpreted as a one-way knowledge dispenser solely by central management to inform units dispersed in remote countries. The article claims that the effectiveness of technology in transferring knowledge between units and enabling the implementation of shared marketing strategies depends on managers maintaining social network ties, absorptive capacity, learning adaptiveness and communication channels.

Zeng *et al.* (2019) focus on a new breed of MNEs, such as the multisided platform corporations, which provide digital infrastructure, communication and technology to create value by linking different user groups and complementors. The success of these types of firms is based on developing proprietary digital platforms to integrate internal and external sources of knowledge and cocreate value with customers and drawing on the capabilities of ecosystem partners to understand the market and deal with uncertainty. The authors thus suggest that the internalization theory is challenged by these new corporations that lay their market growth on access to and mobilization of external resources.

Focusing on manufacturing SMEs, Ballerini *et al.* (2023) observe that the rise of digital platforms enabling e-commerce is a good opportunity for them to embrace digital transformation, improving their economic results and better coping with uncertainty and disruptive events like the pandemic. Ballerini *et al.* (2023) explore possible SMEs' e-commerce strategies based on technology affordance theory. A quantitative analysis based on a survey combined with interviews shows that direct selling through owned websites actualizes consumer knowledge generation and internationalization, as it allows firms to develop their websites without big investments, easily collect and analyze a multitude of data and reach foreign markets. On the other hand, indirect selling actualizes customer diversification and internationalization, as manufacturers can approach several

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Table 8 Interplay at the meso level – strategies at the population of firm level

Strategy	*Articles*	*Interplay digital tools-knowledge processes*	*Future research avenues*
Collaborative innovation strategies	Papa *et al.* (2020), Grunwald (2022), Ibanez *et al.* (2022), Bereznoy *et al.* (2021), Aslesen *et al.* (2019), Dossick *et al.* (2015), Dougherty and Dunne (2012)	Digital technologies provide businesses with new dimensions of global and virtual collaboration, and allow access to both local and global knowledge sources that are to be combined to innovate. Moreover, virtual models can be used in scientific research to generate a new type of knowledge that, integrated with traditional knowledge	Future research may delve into the role of technology platforms as a common knowledge base around which the interests of different actors forming a business ecosystem are focused. In fact, coopetition dynamics seem to characterize these innovation environments, but interesting issues remain unanswered in terms of ecosystem architecture, governance mechanisms and individual actors' motivation in collaboration. Moreover, theoretical frameworks such as commitment-trust theory of relationship marketing (Morgan and Hunt, 1994) and service dominant logic (Vargo and Lusch, 2004) could be applied to develop more precise directions on how to design and implement collaborative innovation models
Resource optimization strategies	Yoo and Kim (2002), Yang *et al.* (2008), Pessot *et al.* (2022)	Web-based knowledge management systems allow data and knowledge sharing among companies in virtual enterprises, enabling collective resource optimization strategies. In a hyper-connected global value chain resource optimization strategies are based on enhanced data and knowledge generation at each node, value creation by each actors, seamless sharing and integration of knowledge and adaptation and change of processes and routines at value chain level	New studies adopting a longitudinal perspective may investigate how motivational levers can be designed to attract targeted complementors to take part in collaborative innovation activities in the ecosystem and how the digitally enabled knowledge dynamics also lead to the emergence of the ecosystem Future research on hyper-connectivity may come out the context of production to design collaboration models among different stakeholders, not only businesses but also institutions and nongovernmental organizations, to face societal challenges and emergencies

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e-tailers in the same market, which can also bring new sources of revenues and easily reach foreign markets, but not customer knowledge generation. Generally, indirect sellers are reluctant to share customer data with manufacturers. Instead, the agency selling through third-party platforms actualizes all three affordances, as normally, these platforms provide their vendors with easy-to-use tools to analyze consumer behaviors and with accurate selling forecasts obtained through their sophisticated AI algorithms applied to customers' purchase history. Liu *et al.* (2023) focus on several possible marketing strategies of companies enabled by the application of BDA to objects within the enterprise (inside-out BDA), including products, services, processes, channels and transactions, or outside the enterprise (outside-in BDA), including customers, competitors, partners and the market. Stimulated by the mixed views in the literature on the economic returns to BDA investments (Davis, 2018; Zhang *et al.*, 2017), the authors set out to understand if and how firms generate business value. As the analysis focuses on individual firms' use of BDA and the benefits they derive from it, Liu *et al.* (2023) consider standardized BDA services offered by major e-platforms so that differences cannot depend on variations in BDA. Relying on the knowledge-based view, the authors suggest value-creation mechanisms derived from using BDA, specifically the inside-out approach that enables responding to external needs and challenges by leveraging internal resources and developing internal knowledge bases.

In contrast, the outside-in approach focuses on building knowledge of the external environment and acquiring external resources. Results show that using inside-out and outside-in BDA functions has a positive independent and combined impact on sales performance. Furthermore, the authors demonstrate that the degree of impact depends on the firm performance level. Specifically, firms with high sales performance levels should focus on outside-in BDA functions because their impact increases with sales performance. In contrast, the impact of inside-out BDA functions decreases with sales performance, and the opposite is true for low sales performance level firms. Instead, concerning the combined effects, it shows an upward trend in sales performance. Therefore, firms with higher performance can obtain better results from the synergy between the two integrated approaches than firms with lower performance.

Regarding the development of product platforms, van Bommel *et al.* (2021) argue for the importance of integrating market knowledge in the architecture of product platforms to favor coordination mechanisms at personal and structural levels. Personal coordination mechanisms are supported by individuals' bilateral knowledge, i.e. marketers' knowledge of the product platform and the platform's architect's knowledge of market opportunities. In contrast, structural mechanisms refer to the marketing's department bilateral knowledge. While individuals' knowledge is generally intangible, the knowledge at the department level is tangible and shareable. The authors show that when the marketing department has a great deal of platform knowledge, this works as a structural coordination mechanism that favors marketing unit involvement in product platform creation, positively impacting the product platform's financial performance. The marketing unit's participation in this process increases its influence on the product platform creation team and decisions resulting in better transfer of market knowledge and improved fit between the product platform and its market, affecting not just a single product but an entire family of products. Therefore, personal coordination mechanisms are irrelevant in such a case because the marketer's technical knowledge is not questioned. Instead, when the marketing department lacks technical knowledge, personal coordination mechanisms based on the bilateral knowledge of individuals assume relevance, performing the same function. Through a survey of multinational electronics companies, the authors show that the internal integration of marketing and technical knowledge domains enables the development of marketing strategies on the platform based on choices such as the optimal number of modular architectures that should be created to serve the various target customers, and the relative set of component-based functionalities that each modular architecture should be designed to contain.

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5.5.2 Innovation. Articles in this set focus on digitally-enabled innovation strategies, covering a variety of technologies and industries, including digital simulation in virtual teams of physical product design and testing (Bailey *et al.*, 2012), digital innovation of complex technical products in B2B manufacturing (Abrell *et al.*, 2016), process innovation in manufacturing through an integrated data mining system (Jacobsen and Tan, 2022) and in shared service companies through Robotic Process Automation (Klimkeit and Reihlen, 2022), global talent management strategies based on AI, as part of MNEs' global innovation strategies (Malik *et al.*, 2021).

With an intraorganizational focus, complex digital platforms can be used to simulate international working environments in which tasks are interdependent and require the interaction between people and digital objects (Bailey *et al.*, 2012). Under this perspective, digital simulation is not only a conduit for accelerating knowledge transfer across countries but could also lead to experimentation and innovation (Bailey *et al.*, 2012). The authors warn about the use of simulation in innovation strategies and especially about the risks of separating people from the physical referents of virtual objects in the simulation activity. Indeed, companies may be tempted to use simulation for design and testing activities, relocating these activities to countries where labor costs are lower while underestimating the risks of working within virtual representations, over-trusting them and losing the reference to physical entities. The study demonstrates how simulation requires changes in work organization and the definition of tasks and roles to be effectively used in innovation strategies. In fact, unlike virtual teams and remote control, the advantage of simulation does not lie in the ability to separate people from objects or other people spatially but rather in making people temporarily independent of objects or other people. Models need to be tested and validated, which requires constant interaction with the represented objects or people. This is consistent with Abrell *et al.* (2016), who focus on digital innovation in the B2B heavy manufacturing industry (power plants, ships) and on the use of digital technologies for experimentation and innovation. Digital innovation is defined as the process of "carrying out new combinations of digital and physical components" to produce novel products and services (Yoo *et al.*, 2010, p. 725). In this field, the customer is not necessarily the final user of the products. While customer knowledge is generally explicit, focused on the short term, and capable of stimulating the development of incremental innovations, user knowledge is mainly tacit in nature, more focused on the long term, and potentially able to stimulate radical innovations that set long-term direction for digital innovation. As radical innovations are costly to develop and test and the reference market tends to be conservative, normally, companies adopt a reactive approach to innovation, based more on planning than experimenting, given the uncertainties about future market needs. Abrell *et al.* (2016) grasp the challenge of adopting a proactive approach to this type of innovation by suggesting new methods of acquiring, distributing and using tacit user knowledge. To acquire and manage the tacit knowledge of the user, the study hypothesizes the use of arrangements such as digital innovation technology labs where the producer can explore new digital technologies with the user in a controlled environment, separated from daily operations, and develop innovations that, once consolidated, can enter the day-to-day business. In this case, digital technology is not used to eliminate the physical distance from the user but rather to separate experimentation from operations, in which knowledge is shared and generated.

Regarding operations in manufacturing, new digital technologies, specifically a sensor-based monitoring approach integrated with data mining systems, can be used to innovate food production processes in terms of food quality and safety. Jacobsen and Tan (2022) present a tool that, thanks to its high degree of automation, covers the whole process from data extraction to visualization, allowing for high scalability and applicability to similar cases, beyond the food sector. Therefore, the paper overcomes the limits of existing studies on data mining in food safety applications, which typically focus on standalone models characterized by heavy work for users in data loading and postimplementation customer-

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specific efforts. Digitalization can also be applied to automate transactional tasks in shared services, where work has traditionally been characterized by standardization, controlling the labor process and deskilling. Klimkeit and Reihlen (2022) explore the impact of digitalization on organizational identity innovation in shared service companies, which, instead of resigning themselves to the reduced need for operators and the resulting staff cuts, have responded to the change by reprofessionalizing the workforce and moving up the value chain to more professional and value-added services. Through a qualitative abductive methodology, the authors investigate the process of identity change in a set of case studies triggered by digitalization. Robotic process automation threatens shared service centers' identity as deskilled providers of mechanic transaction-based services. They observe in their cases that the new technology act as an enabler of organizational change. Through organizational innovations, such as workforce reprofessionalization, adopting new practices, and creating a new professional image, the companies examined succeeded in moving up the value chain, improving the quality and accuracy of the services offered.

New digital technologies, particularly artificial intelligence, can also support centralized talent management in MNEs as part of their global innovation strategy. Through a qualitative study of a highly innovative MNE in an emerging market, Malik *et al.* (2021) demonstrate that the use of sophisticated AI-based technology for talent-specific KM supports the firm's innovation strategy and, at the same time, is enabled by the firm's innovation orientation and culture. Moreover, talent-focused knowledge sharing results in increased job satisfaction and reduced turnover intentions among talents, therefore, supporting the company's innovation strategy in the long term.

5.5.3 Internationalization. Two recent studies focus on SMEs internationalization and how their modes of entry in foreign markets are affected by digital technologies by focusing on servitization (Agnihotri *et al.*, 2022) and business model innovation (Anwar *et al.*, 2022).

Agnihotri *et al.* (2022) propose a taxonomy and put forward several propositions based on macroenvironmental conditions that influence the choice of entry mode, shifting from product-centric to service-centric business models (servitization). Through a conceptual approach, the authors introduce a taxonomy that categorizes foreign market entry modes for servitization, likely based on factors like market characteristics, industry type and firm-specific variables.

Business model innovation (BMI) is studied by Anwar *et al.* (2022), focusing on the significance of digital capabilities in driving BMI within SMEs. It highlights that SMEs with strong digital capabilities are more likely to engage in innovative business model practices, enabling them to adapt to market changes and customer needs more effectively. Additionally, the study suggests that these digitally-driven business model innovations play a crucial role in the internationalization efforts of SMEs, helping them overcome entry barriers and succeed in foreign markets.

5.5.4 International expansion strategies. Two articles in this set (Mathews *et al.*, 2016; Pergelova *et al.*, 2019) explore the market growth strategies of SMEs, while a third one analyses the emergence of a global industry based on digital innovation, i.e. mobile money (Wormald *et al.*, 2021).

Mathews *et al.* (2016) explore how internet marketing capabilities enable SMEs to overcome a lack of knowledge about foreign markets. The authors find that firms that develop greater internet marketing capabilities benefit from reduced uncertainty and increased international network capabilities and that this fosters their international market growth strategies. They also show that internet marketing capabilities have a beneficial effect on the development of the strategic orientation of SMEs, which, in turn, has a beneficial impact on the development of international network capabilities through better knowledge of new sales channels and partnership opportunities and on international expansion. Conversely, Pergelova *et al.* (2019)

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underline how digital technologies may support entrepreneurs in accessing market knowledge and enabling interactions with customers and partners. They show that, by favoring the collection of relevant knowledge and developing international market intelligence, digital technologies facilitate the international expansion of SMEs, especially those led by female entrepreneurs. Indeed, they tend to leverage their information management systems better for market knowledge generation that feeds their international market growth strategies.

On a different level of analysis, Wormald *et al.* (2021) study the emergence of a global industry based on digital innovation, i.e. mobile money, by investigating the process of international expansion of different kinds of pioneering firms, namely, multinationals diversifying entrants, developed countries start-ups or developing countries startups. These categories of companies differ in their internationalization strategies, which are largely based on the downstream capabilities they possess or can access through alliances, and, according to the authors, these differences can explain the different impacts they have on the nascent mobile money industry. Specifically, the authors find that developing country startups have the highest impact on the industry through subsequent platform launches pursuing a strategy based on developing a "bundled knowledge" capital, consisting of technology, problem-solving and alliance management capabilities. Being untethered from a preexisting customer base, these startups relied on multiple alliances with mobile network operators and banks with their downstream client bases, thus overshadowing the internationalization efforts of other pioneering firms types. Developing country startups' internationalization strategies are based on the internal development and deployment of bundled knowledge capital made of technological and demand-side capabilities, thus from an interplay between technology and knowledge processes observed at the micro level and enables firm-level strategies.

5.5.5 Interplay digital technology – knowledge processes observed at the micro level, strategies at the single firm level: future research avenues. The articles in our review display a vivid debate on the digitally-enabled knowledge dynamics within a single firm and its implications at the firm-level strategic opportunities. The competence to leverage such digitally-enabled knowledge dynamics constitutes a strong foundation for the firm's success in the international arena. More than others, two recent articles (Zeng *et al.*, 2019; van Bommel *et al.*, 2021) raise interesting questions worthy of future research. Zeng *et al.* (2019) challenge the traditional theory of internalization, suggesting that this strand of research involves a thorough revision of traditional theories of internationalization in light of the unprecedented potentials of knowledge sharing, creation and distribution offered by digital technologies. Firms confront the strategic option of developing digital solutions that activate virtuous knowledge dynamics through digitally enabled access to external sources of information. For example, proprietary platforms allow firms to integrate internal and external sources of knowledge, sustaining the pursuit of international strategies.

Nevertheless, these knowledge flows may permeate firms' boundaries, challenging the traditional notion of internalization vs externalization and suggesting the emerging need for more adequate coordination and control mechanisms. From a researcher's perspective, our results also suggest that spillover effects may occur, and future research could investigate the synergies in knowledge dynamics generated by such a "bundled" strategic approach. At the same time, from a practitioner's perspective, our results suggest that a digitalization strategy and an internationalization strategy may be pursued simultaneously. Moreover, practitioners may find it useful to understand better the exploration vs exploitation debate and how digitalization can allow them both. From a practical point of view, as companies seek to expand their global reach and adopt service-oriented business models, Agnihotri *et al.* (2022) provide valuable insights into effective foreign market entry strategies. Managers and decision-makers can use the taxonomy and propositions to make informed choices when entering new markets and undergoing servitization.

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Additionally, van Bommel *et al.* (2021) bring the traditional organizational debate on the need to integrate the domains of technical and marketing knowledge to the topic of product platform design, which thus becomes a vehicle for implementing the firm's strategy. Future studies should consider the integration of different knowledge domains and logic, not only marketing and technical but also, for example, SC management in platform design, but also its implementation and exploitation. Moreover, it is worth noting that this topic, which traditionally deals with organizational design and related coordination mechanisms, in light of the industry shift toward smart products and digital services, deserves future research.

Other interesting avenues of research concern the impact of new technologies on organizational identity, the perception of impact as a threat/opportunity, and the strategic response implemented by individual companies. New digital technologies can also affect the identity of entire industries, stimulating a process of identity change at the industry level and, possibly, a coordinated strategic response by a population of firms. Only a few studies define an interorganizational dimension of identity against which individual firms can define themselves by identifying the knowledge structures shared among key stakeholders (Clegg *et al.*, 2007; Rosa *et al.*, 1999). An industry is characterized by determining the knowledge structures shared among key stakeholders (Rosa *et al.*, 1999) that provide the interorganizational dimension of identity against which individual firms can define themselves. Even in this review, several contributions analyze the disruption of entire industries, or the emergence of completely new industries brought about by the introduction of new technologies, and the strategic response of companies (Ferràs-Hernández *et al.*, 2017; Bouncken and Barwinski, 2021), but none of them study the phenomenon through the lenses of organizational identity. Organizational identity is based on belief systems that "characterize how organizational members understand their competitors, their internal capacities, market development, and future demand, the boundaries of their environment and their role within the larger value chain," which is potentially strongly influenced by new technology. Organizational identity and, in a broader sense, an industry's identity provide an interesting and novel lens for further study of organizational strategies enabled by digitalization. Moreover, as some scholars observe, these belief systems are shared assumptions that are socially constructed, so the adoption of a socio-material view would be appropriate.

Another possible future research avenue regards global talent management as part of MNEs' broader innovation strategies. New AI-based applications enable all the global talent management functions, including talent acquisition, developing and retaining, proving their effectiveness both at the organizational level, being an important element of broader innovation strategies, and at the individual level, improving employees' satisfaction and retention (Malik *et al.*, 2021). As talent attraction, development and retention are recently emerging as one of the most critical challenges companies face worldwide, new research is needed to elaborate on some salient aspects. For example, further studies would consider the role of macro environmental factors such as the external labor market in global talent management issues or, at the micro level, possible internal barriers to knowledge and talent sharing in highly competitive environments, e.g. divisional or project-based organizations (Huemann *et al.*, 2007; Pemsel *et al.*, 2016).

The methodologies used are mainly qualitative through either single or multiple case studies. This approach is effective in the exploration of innovative strategies in the attempt to shed light on the impact of digital technology on the identification of new categories of knowledge (such as bundled or integrated knowledge – Wormald *et al.*, 2021; van Bommel *et al.*, 2021) and new process innovation strategies based on the exploitation of digital affordances – Bailey *et al.* (2012), Abrell *et al.* (2016), Jacobsen and Tan (2022). Nevertheless, additional studies could investigate the organizational impact of such process innovation, building on the insight that the interaction among artificial and human actors could lead to countereffects and undermine the innovation strategic outcomes, as

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suggested by Klimkeit and Reihlen (2022). Moreover, longitudinal and quantitative studies could add a longer-term perspective to assess the sustainability of innovations based on digitalization.

Table 9 summarizes strategies at the single-firm level, enabled by micro level interplay and suggestions for future research.

6. Concluding remarks

We have discussed how digitalization and the enabled knowledge processes can trigger firms' international strategies. Our study revolves around a key unanswered question about the characteristics of the interplay between digitalization and knowledge processes that trigger new firms' or firm populations' international strategies. Building on an SLR, we have focused on the key characteristics of the interplay between digitalization and knowledge processes to shed light on the emergence of a wide range of new international strategies by firms and populations of firms. We organized the reviewed articles into a framework as presented in Table 1. The visualized framework identifies the relationship between the firms' strategies and the context in which such interplay occurs. Six major related building blocks (macro, meso and micro level of observation of the interplay vs the level where strategies are experienced, single firm level and population level) describe how the interplay between digital tools and knowledge processes drives strategies in international contexts. In so doing, our findings shed light on the significant impacts of digital tools on knowledge utilization and strategy formulation. In the case of individual firms, our results highlight distinct patterns in how single firms leverage digital tools to access and use different types of knowledge, leading to diverse strategic implications depending on the source of newly generated knowledge. When digital tools make knowledge publicly available at the industry level, it often relates to new possible customers, customers' new preferences or local markets. Firms then tend to use this knowledge to refine their marketing strategies, explore new markets by internationalizing, or undertake sustainable development strategies, overcoming constraints due to scarce local resources.

Conversely, when knowledge is internally produced within firms or is specific to their unique context, digital tools are often used for coordination and orchestration purposes within the boundaries of the firms. This is the case of a firm's knowledge of its existing customers. In this case, digital tools allow firms to redistribute and coordinate internal knowledge effectively, leading to the development of more refined internal marketing strategies. However, it is crucial to note that the successful implementation of this approach heavily depends on the firm's capabilities of achieving higher levels of coordination. Another notable finding is the role of digital tools in generating new product knowledge. Firms can enact product innovation strategies through simulations, data analysis and extracting high-level knowledge from product users. This suggests that digital tools contribute significantly to fostering innovation and adaptability within firms, facilitating their ability to respond to changing market dynamics.

Moreover, in specific cases, digital tools have induced process innovation, contributing to the professionalization of workforces within firms. This implies that digital tools not only impact firms' strategies externally but also drive internal process improvements, potentially leading to enhanced productivity and efficiency.

At the population of firm level, the reviewed papers report on the role of digital tools in connecting diverse actors and allowing the formation of ecosystems with different types of knowledge shared. Different strategies are embraced depending on the kind of knowledge shared: product or process innovation strategies when they enable the optimization of resources or sustainability strategies in the case of a product life-cycle knowledge shared.

Finally, different strategies can emerge on the appropriability of knowledge flowing at the meso level. When knowledge is widely shared among geographically dispersed companies

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Table 9 Interplay at the micro level – strategies at the single firm level

Strategy	*Articles*	*Interplay digital tools-knowledge processes*	*Future research avenues*
Marketing strategies	Schleimer and Riege (2009), Ballerini *et al.* (2023), van Bommel *et al.* (2021)	Regarding MNEs, digital commercial platforms linking the focal company and its commercial subsidiaries, geographically dispersed, can enable the integration of existing internal knowledge and newly generated knowledge coming from customers at local level and its sharing within the MNE to favor coordinated marketing strategies. Regarding SMEs digital platforms enable several e-commerce strategies that actualize different technology affordances, i.e. customer knowledge generation, market internationalization and customer differentiation As regards product platforms, they can be the locus of integration between technical knowledge and market knowledge, provided that marketing units are involved in their creation. This favors a better fit between the platform and its market, and the enactment of successful marketing strategies	Need to revisit traditional theories of internalization in future studies to represent the case of multi national multi sided platforms that thrive by mobilizing resources of others Integration of different knowledge domains and logics, not only marketing and technical but also, for example, relative to supply chain management, not only in platform design but also in its implementation and exploitation Future research on the integration of different knowledge domains in platforms in light of the industry shift toward smart products and digital services
Innovation strategies	Bailey *et al.* (2012)	Digital simulation technologies enable work in virtual teams, focused on product design and testing, through iconic representations of the digital objects, processes or people they represent. Scholars advise the firms to mitigate the risks connected to permanently eliminating the distance between simulators and objects	A promising stream of research relates to the integration of different knowledge domains and logics, such as marketing and technical, as well as supply chain management in platform design. The whole framework of exploration and exploitation could be challenged Future research on the impact of digitalization on single firms and entire industries adopting the organizational identity lens and the relative strategic response in terms of innovation Regarding AI-based global talent sharing, new studies could consider the role of macro environmental factors such as the external labor market in global talent management issues or, at the micro level, possible internal barriers to knowledge and talent sharing, in highly competitive environments
	Abrell *et al.* (2016)	Digital innovation of complex technical products in B2B heavy manufacturing adopting a proactive approach based on new methods of acquiring, distributing, and using tacit user knowledge enabled by digital technologies. Digital technologies allow the separation of experimentation from operations	
	Jacobsen and Tan (2022)	A sensor-based monitoring approach integrated with data mining systems, can be used to innovate food production processes in terms of food quality and safety	
	Klimkeit and Reihlen (2022)	Process innovation in shared service companies enabled by Robotic Process Automation of transactional tasks. Digitalization can act as an enabler of organizational identity change, that, through reprofessionalizing of the workforce, adopting new practices and building a new image, leads companies to move up the value chain	
	Malik *et al.* (2021)	AI-based technology support centralized talent management in MNEs as part of their global innovation strategy	

(*continued*)

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Table 9

Strategy	*Articles*	*Interplay digital tools-knowledge processes*	*Future research avenues*
Internationalization	Agnihotri *et al.* (2022), Anwar *et al.* (2022)	Servitization drives entry mode decisions of firms in international markets. In general, digital capabilities indirectly boost the internationalization of SMEs through business model innovation (BMI)	The stream of studies on servitization could benefit from additional studies on servitization-based relationship management with the customers from different perspective. Future research should deepen the understanding of how digitalization affects business model innovation across firms' size and industry, also taking into account the organizational capabilities of firms
International expansion strategies	Mathews *et al.* (2016), Pergelova *et al.* (2019) Wormald *et al.* (2021)	Digital technologies impact positively SME internationalization through the mediation of international market intelligence Through internet capabilities, small-scale specialized firms can overshadow large-scale generalist firms	Future studies could investigate variations in international expansion strategies within industries that use platforms to facilitate alliances for both upstream and downstream capabilities to sectors where platforms create two-sided markets connecting providers and consumers

Source: Authors' own creation

through digital tools, thus forming a common basis for setting up alliances, internationalization becomes a strategic choice. When a company appropriates knowledge exclusively, an open innovation strategy can be adopted. A marketing strategy may be used when knowledge is shared between two parties, creating a power asymmetry because one side requires knowledge, and the other grants it.

Overall, the study underscores the multifaceted role of digital tools in facilitating knowledge utilization and strategy formation in individual firms. It highlights the importance of understanding the different mechanisms through which digital tools enable knowledge processes and how firms can leverage this knowledge to drive strategic decisions – comprehending the evolving dynamics between digital devices, knowledge utilization and firm strategies in an increasingly digitized world.

Although we performed a comprehensive search to capture the relevant literature dealing with international business, digital technologies and knowledge processes, we acknowledge that our study has some limitations. The first limitation regards the chosen domain of the journals analyzed, and the databases searched. We cannot exclude that interesting contributions to the topic could be found in different contexts and venues. For example, given the focus on digital technologies, further studies could focus on articles in the research field of information systems to complement our study with a specific information system/information technology view of the topic. Another limitation regards the time span of the research, which refers to the past 23 years. Normally SLRs would cover a higher period, but our choice is motivated by the fast innovation that has interested digital technologies over the past two decades. This period results in collecting studies focusing on very heterogeneous digital technologies using different labels for intrinsically similar phenomena.

Nevertheless, as shown in the description of the time evolution of the reviewed papers, the latest years have been mostly prolific, thus suggesting that this field is of utmost interest. New studies adopting a historical perspective in analyzing technological evolution and relative impacts on international strategies could complement our study. A limitation is that the review only briefly mentions the negative aspects of digitization and only superficially treats the cultural and social aspects. We believe that this is most likely due to the design of our review, which excludes articles that focus on the impact of digitization on individuals, limiting it to effects on enterprises and business populations. Due to this design choice, we lose the whole aspect of organizational microstructure, where a critical view of digitization is often found. Finally, regarding the analysis of the articles, we limited the content analysis to a qualitative approach. Following other studies on different topics, a quantitative approach to constructing the categories could have been followed. Nevertheless, our decision has been grounded on the need to fully grasp the content of the reviewed studies at the intersection of three research fields (digitalization, KM and international business).

We hope that our proposed understanding of the interplay between digital technologies and knowledge processes and the emerging international strategies provides the basis for further research on the nascent stream of digital business strategy, which incorporates international scope, knowledge challenges and technological affordances.

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