
Digital Innovations and SMEs: a systematic literature review and future research agenda

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Abstract: Digital technologies are altering competitive grounds in the different sectors of the economy worldwide. Therefore, the research on digital technologies in business and management literature has observed an increasing trend. However, despite growing research on digital innovations in SMEs, we lack an understanding of SMEs' external knowledge and resources exploration and exploitation to build digital innovations. Therefore, this research synthesizes the literature on SMEs' knowledge and resources exploration and exploitation for developing digital innovations. By conducting a systemic literature review, we identified actors and collaborative mechanisms that help SMEs overcome their resource and technological knowledge limitations. Furthermore, with the help of existing literature, we also explain the exploitation process of externally acquired knowledge and resources into organizational internal digital innovation systems.

Keywords: SMEs; digital innovations; knowledge exploration; knowledge exploitation; external collaborations; resource exploration; dynamic capabilities; technological capabilities.

Introduction

Small and medium enterprises (SMEs) are economic growth engines, mainly responsible for generating significant-scale employment and contributing significantly to most countries' GDP (Kumar et al., 2022). Their flexible organizational structure and agility characterize SMEs to respond to disruptions in their business environment (Chan et al., 2018). In recent developments, it has been evident that SMEs face additional challenges in configuring ways to implement and utilize digital technologies in their business processes and offerings (Kumar et al., 2022). Digital technologies are changing competing grounds at a breakneck pace (Mahmood et al., 2020), and effective utilization of digital technologies leads organizations to have superior organizational performance and outpace their competitors. Therefore, it is worth discussing mechanisms that support SMEs to overcome their resource limitations and help them to build digital innovations. Digital innovation has been defined as "the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology" (Nambisan et al., 2017). This broader term represents the implementation and utilization of digital technologies (including information communication technologies (ICT), information systems (I.S.), and information technologies (I.T.)) in organizational processes, models, and offerings.

Over the last decade, significant growth has been observed in research on digital innovations (Kumar et al., 2022; Chan et al., 2018; Mahmood et al., 2020; Petruzzelli et al., 2022; Estensoro et al., 2021). Extant research documents that due to their smallness, SMEs rely more on external collaborations to overcome their resource limitations and drive innovations than focusing on their internal developments. Research on digital innovations in SMEs shows authors have analyzed different mechanisms (Ricci et al., 2021; Haug et al., 2023; Lepore et al., 2023), organizational and individual level factors (Scuotto et al., 2021) that are antecedents to technology adoption and exploitation. In a recent literature review, Ramdani et al. (2022) identified organizational and environmental antecedents are imperative to build digital innovations in SMEs. Arguably environmental antecedents can be further divided into compelling and motivating factors. For instance, customer demand, competitors' pressure, and market scope can compel SMEs to adopt digital technologies and provide technology-based solutions (Soluk and Kammerlander, 2021). Government support, external collaborations, knowledge exploration, and resource complementarity can motivate SME management to explore opportunities offered by digital technologies (Ricci et al., 2021; Petruzzelli et al., 2022).

Despite growing research on digital innovations in SMEs, two key issues need the researcher's attention. First, while the existing literature review conducted by Ramdani et al. (2022) highlights environmental antecedents as critical enablers in digital innovations, the details on how SMEs acquire external knowledge and resources for building digital innovations are missing. In particular, a comprehensive framework that indicates the linkage between different types of collaborations (motivating factors) and SMEs' tendency to search for and acquire technological knowledge is missing. External knowledge sources and external actors that can help SMEs look at and complement their resource bases can prepare SMEs to acquire technological knowledge to initiate their digital journey. Therefore, it's worth identifying actors, activities, and collaborative mechanisms that support SMEs in developing technological knowledge that can help them complement their resource bases. To the researcher's best knowledge, no study has systematically identified types of actors, collaborative mechanisms, and SME strategies to explore and exploit external resources pertinent to building digital innovations. Second, the existing literature review (Ramdani et al., 2022) examined the organizational internal factors and mediators that facilitate the development of digital innovations in SMEs. Yet their research scope remains narrow, and they did not explicitly explore the bridge between acquiring external knowledge and resources and implementing it into an internal digital innovation system. Exploring this link of external knowledge and resources exploration and exploitation into internal digital innovation systems is highly interesting as the field is challenging to analyze as SMEs are less transparent; thus, a systematic literature review helps to find new insights.

Therefore, this systematic literature review is an effort to synthesize literature on SMEs' external knowledge and resources exploration and their exploitation to develop internal digital innovation systems. The research aims to identify the type of actors, collaborative mechanisms, and strategies that help SMEs to acquire technological knowledge and resources. The study also seeks to identify the underlying relationships between Knowledge and resource exploration and their exploitation into internal digital innovation systems. This research highlights factors, strategies, and capabilities required to exploit externally explored knowledge and resources into internal digital innovations. Hence, this research aims to develop a comprehensive framework highlighting underlying relationships between SMEs' collaborative mechanisms, knowledge exploration, and exploitation to build digital innovation systems. We achieve study objectives by answering the two overarching research questions.

R.Q-1: How do small and medium-sized enterprises (SMEs) acquire the resources and knowledge to implement and use digital technologies?

R.Q-2: How do small and medium-sized enterprises (SMEs) exploit externally explored knowledge and resources in internal digital innovation systems?

R.Q-3: What are the future research directions based on our findings?

Methodology

This section explains the research approach we followed in conducting the systematic literature review on the chosen scholarly field. This SLR has been conducted by following the recommendation made by Webster and Watson (2002).

Step 1 – Defining the conceptual boundaries

We began the systematic literature review by defining the conceptual boundaries of our paper based on the primary constructs of our paper. The main constructs in our research have been "Digital Innovations" and "SMEs."

To operationalize digital innovations, we adopted the definition of digital innovations suggested by Nambisan et al. (2017). Their definition suggests digital innovations are the creation/improvement of organizational business models, processes, and offerings due to utilizing digital technologies. This definition implies that digital innovation is an overarching term including various digital technologies, e.g., emerging technologies, smart technologies, industry 4.0 technologies (to name a few), and adoption and utilization of these technologies in business organizations.

Regarding SMEs, we find varied definitions based on the number of employees and turnover. For example, European Union (2015) definition explains that business organizations have 1-250 employees are classified as SMEs, while in USA Small Business Administration, organizations with less than 500 employees as SMEs. Similar goes for the East and Far East, where SMEs are firms having less than 500 employees. Therefore, it is hard to find a universal definition of SMEs; therefore, we used 500 employees as a cut-off point for SMEs to enhance the study scope.

Step 2 – Searching the relevant literature

We followed seven-step searches to identify relevant literature on digital innovation in SMEs. We began by searching a combination of two search terms, "Digital innovation*" AND "SME*" OR "small and medium enterprise*" in the top tier and leading journals in business management and information systems journals. Webster and Watson (2002) suggested this search technique, and it's beneficial to identify significant contributions in the research field. We followed the Journal ranking by the Chartered Association of Business Schools guidelines for 2021. The initial search was conducted on ABS's list of three and 3+ journals' homepages. A total of 15 articles were found in a basic search: *Information Systems Journal, Research Policy, Technological Forecasting and Social Change, R&D Management, and Journal of Production Economics*—the detailed reading of articles, we found various terms related to our research scope.

In step two, we adopted backtrack citations and explored the papers on SMEs' digital innovations. After consulting 20 papers, we concluded that we needed to modify and expand our search terms. We conducted a broader search using Web of Science and Scopus databases.

Step 3- Review the scope

We defined the review scope by defining the inclusion and exclusion criteria. We tried the search term combining various search terms listed in *Appendix 1*. Since digital innovation is a multidisciplinary area, we searched research papers across different fields of study, i.e., Computer Science, Operations Research, Decision Science, Business, and Management. A similar approach has been proven beneficial in earlier research by Robey et al. (2000). We included only papers published in English, and the year ranges from 2000 to 2023. The most critical aspect is technological innovations have also been embedded in digital transformation, digitalization, and digital innovations, so the search also included other relevant keywords beyond technological innovations. However, the final synthesis excluded irrelevant papers beyond technological innovations and organizational factors.

We focused only on research papers published in peer-reviewed journals, excluding conference proceedings and book chapters. This is important since most conference proceedings and book chapters are published without critical evaluations (Sivarajah et al., 2017). Furthermore, we also excluded conceptual, editorial, and literature review papers. We focused only on paper with practical research design since we wanted to focus on backing our findings with empirical evidence. Finally, we chose papers published in the Association of Business Schools (ABS) and their journals ranking ABS 2 and 2+. We limit the research journals to ABS list rankings two and 2+ for two reasons; first, we aimed to build findings of this research based on the leading work in the field. Second, such a criterion helped keep the sample size manageable without omitting the relevant work (Calabro et al., 2019).

that external knowledge is key strategic resource that help SMEs to sense technological opportunities and develop their capabilities to seize them.

The initial results of the literature review suggest that SMEs reach out to different actors in their external business environment through various mechanisms. Such interaction helps them to orient themselves on the implementation and utilization process of digital technologies in their business processes, offerings, and models. SMEs' external knowledge and resource exploration can be further divided into two categories:

- Actors in their external environment
- Collaborative mechanisms

- Actors

Initial results of the literature review suggest actors can be further divided into four distinct categories based on their roles and the nature of collaborations:

1. Value chain partners (customers, suppliers, competitors, and other industrial network partners)
2. Technology solution providers (Solution developers, technology consultants)
3. Universities, research institutes, and Knowledge brokering organizations
4. Govt organizations

1- Collaboration with value chain partners

Reviewing the literature on SMEs' collaborations with core value chain actors suggests that such interactions help SMEs scan and seize opportunities (Haug et al., 2022; Soluk and Kammerlander, 2021; Kumar et al., 2020). Opportunity scanning has been established as a point of departure for SMEs' digital innovations, and integrating and building technological solutions is another critical subsequent process of digital innovations. Scholars have profoundly discussed collaboration among core value chain actors and their role in supporting SMEs to acquire technological knowledge on digital technologies, their utilization in manufacturing processes, new product development, digital servitization, and configuring business model level changes (Haug et al., 2022; Ricci et al., 2022; Lepore et al., 2023). Compared to other external actors, core value chain actors provide industry-specific technological knowledge, which helps SMEs to translate opportunity scanned into opportunity seized. Depth in external knowledge search leads SMEs to a more profound process of sensing and seizing the opportunities of using digital technologies in product design and manufacturing operations (Ricci et al., 2022; Horvath and Szabo, 2019). Such an extended knowledge search leads SMEs to develop digital maturity and build technological solutions (Haug et al., 2022). Research also suggests co-creation with core value chain actors enables SMEs to acquaint themselves with the latest digital trends, general-purpose technologies, and their implementation.

2- Technology solution providers

Technology solution providers and consultants have also been highlighted as essential in SMEs' external business environment. Literature shows that technology solution providers facilitate SMEs in technology implementation (Haug et al., 2022). However, unlike core value chain partners, SMEs' collaborations with technology solution providers remain transactional-based and have a limited role in enhancing the SMEs' technological knowledge capacity (Haug et al., 2022). SMEs utilize technology consultants to compensate for their lack of technological maturity and expertise to implement digital technologies (Benitez et al., 2020; Helper et al., 2019). Therefore, most technology solution providers play a supplementary role in helping SMEs develop digital innovations.

3- Universities, research institutes, and knowledge-brokering organizations

Existing literature indicates universities and research institutes are recognized as knowledge beacons, particularly for innovation in SMEs. In their primary role, universities act as knowledge beacons in technological knowledge generation and dissemination. They leverage their role through technology and knowledge transfer offices and activate SMEs in sensing the technological opportunities. By collaborating with universities and their TTOs and KTOs, SMEs have access to knowledge on the objective realm of product/service platforms to invest in different information technology layers to support the digitalization of a product. However, universities and other intermediary organizations help SMEs in the digital servitization of the products, and literature shows their less role in new product development through technology utilization. It has also been proposed that collaborating with universities and intermediary organizations introduce SMEs to general-purpose technologies such as IoTs, manufacturing, and communication technologies (van de Vrande et al., 2009; Spithoven et al., 2013). Few researchers show inconclusive evidence on the link between SMEs' collaborations

with universities and research institutes and their new product development based on digital technologies (Haug et al., 2022). They found a more significant role in the innovation process of scientific knowledge sources such as universities and research institutes. Albeit universities and intermediary organizations act similarly in terms of opportunity spotting for SMEs, we found universities and research institutes act as knowledge creators and brokers. In contrast, intermediary organizations' role was limited to knowledge brokering since they facilitate collaborations through shaping and connecting the different actors in co-creation processes.

4- Govt organizations

Literature on regional clusters and smart specialization provides essential insights into govt organizations' role in improving digitalization in SMEs. The literature review indicates that Govt organizations influence the implementation of digital technologies in SMEs through policy-level interventions (details in Table 1).

Table 1. Different actors' roles and activities to support SMEs in digital innovations

Actors	Role	Activities
Core value chain actors (Haug et al., 2022; Soluk and Kammerlander, 2021; Kumar et al., 2020)	Sensing and seizing digital knowledge and opportunities	<ul style="list-style-type: none"> Jointly searching technological knowledge and opportunities Co-creation of industry-specific technological solutions Integrating technological solutions into supply chains Contribute to capacity building of all actors
Technology solution providers (Benitez et al., 2020; Helper et al., 2019)	Provides customized technological solutions to SMEs	<ul style="list-style-type: none"> Transaction-based relations to provide technological solutions Does not contribute to capacity building of SMEs
Universities, research institutes, and knowledge-brokering organizations (van de Vrande et al., 2009; Spithoven et al., 2013).	Technological knowledge creation and brokering to spot technological opportunities for SMEs	<ul style="list-style-type: none"> Knowledge creation through research projects Testing and prototyping of technological solutions Connecting and facilitating different actors in joint projects for technology diffusion and implementation.
Govt Organizations (Doh et al., 2014)	Policy level interventions	<ul style="list-style-type: none"> Strategy development Financial resource mobilization, Lobbying for favorable policies and laws

II- Collaborative mechanisms

The collaborative mechanism has been identified based on the type of actors collaborating, relationships among the actors, governance, and coordination structure among the collaborating entities. We found SMEs acquire technological knowledge and complement resources through interactions in different kinds of collaborative mechanisms:

- Inter-organizational collaborations
- Industrial networks
- Triple helix
- Ecosystem and platform collaborations
- Open innovation

Inter-organizational collaborations include SMEs' interactions with other micro firms and large organizations. Inter-organizational collaborations also include interactions with traditional value chain actors, as well as include cooperation. Literature suggests collaborations predominantly focus on developing technological solutions related to issues faced by supply chain actors. Therefore, primarily focus on implementing and utilizing digital technologies to increase supply chain integration and process efficiency and improve manufacturing processes (Kumar et al., 2020). However, in cooperation, trust, and communication, effective communication strategies are critical elements in knowledge sharing. While industrial networks literature explains, they are extending forms of inter-organizational collaborations, which include industrial clusters and symbiosis. Industrial networks contain actors and organizations from different industries,

and their collaborations are more focused on developing industry-wide consensus and awareness of the implementation of digital technologies.

We found another important collaborative model, triple helix: SMEs collaborate to access knowledge and co-create technological solutions. The triple helix model is based on the shared consensus among industry, academia, and civil government for regional development. As an integral part of regional economies, SMEs' economic growth and development have been essential in the triple helix model. Recently, scholars have started analyzing triple helix relevance and its role in supporting SMEs in their digitalization.

Ecosystem collaborations are more dynamic and contain specific characteristics, i.e., an anchor tenet actor or orchestrator is compulsory, actors show untraded interdependencies, share the same value and fate, and co-evolve their roles in the different phases of an ecosystem (Scaringella and Radziwon, 2018). Emerging research has heavily emphasized forming ecosystem-based collaborations for value creation and appropriation. However, research emphasizing ecosystem-based collaborations for SMEs' digital innovation and value creation has been comparatively scarce. Few researchers have analyzed ecosystem-based collaborations and SMEs' digital innovation and technologies implementation.

We also found empirical research that shows open innovation has been another emerging stream of research that contributes to our understanding of SMEs' technological innovations. A notable study conducted by Petruzzelli et al. (2021) claims SMEs engaging in open innovation help them to implement industry 4.0 technologies. In the context of digital technologies implementation and utilization, both open innovation breadth and depth are positively related to technology adoption. At the same time, the industry's technology intensity acts as a moderating factor in their relationships. Another research explains that inbound open innovation support SMEs in developing their technological capabilities to implement emerging digital technologies (Lepore et al., 2023).

Research Question -2: How do small and medium-sized enterprises (SMEs) exploit externally explored knowledge and resources in internal digital innovation systems?

In the last section, we explored mechanisms and actors that help SMEs explore technological knowledge and find resource complementarity. Moving forward, we carefully analyzed papers that acerbate on mechanisms, capabilities, strategies, and organizational structures that enable SMEs to exploit externally acquired technological knowledge into internal digital innovation systems. The literature review suggests external knowledge exploration does not directly leads SMEs to implement digital technologies and develop digital innovations. Instead, it contributes to organizational learning to build individual-level and organizational-level competencies. Organizational competencies include dynamic capabilities (Madrid-Guijarro et al., 2021), digital-related capabilities (Nasiri et al., 2020), technological capabilities (Lepore et al., 2023), technological innovation capabilities (Yao et al., 2020), digital maturity (Haug et al., 2023), and absorptive capacity (Singh et al., 2022). Furthermore, it was also evident that business strategy alignment is an eminent factor for SMEs to develop innovative solutions and improve financial performance through digital technologies (Wang et al., 2022).

Similarly, research also shows such collaborations increase operational-level employees' and managers' capabilities to integrate digital solutions into their internal technological systems (Nelles et al., 2016; Lepore et al., 2023; Scuotto et al., 2021). Moreover, external collaborations increase top management's social capital and ability to envision technological opportunities offered by digital technologies (David et al. 2021). Hence such collaborations facilitate SME management to develop technology-friendly strategies to maximize the benefits of digital technologies.

R.Q-3: What are the future research directions based on our findings?

Since the current version is a work in process, this question will be answered in the full version of the paper upon reviewing the complete list of sample papers.

Contributions

This research synthesizes the literature on external SME collaborations for knowledge and resource exploration. It identifies organizational-level capabilities and mechanisms required to exploit externally acquired knowledge and resources into internal digital innovations systems. We enhance scholars' understanding of SMEs' digital innovations and stimulate scholarly discussion on digital innovation management in manufacturing SMEs. This research also bridges the research gap by providing a comprehensive framework on mechanisms to acquire external knowledge and resources and exploit them to build internal digital innovations.

Feedback:

We would appreciate feedback on the research methodology and keywords combination we used in the current research. Moreover, suggestions are also welcomed on research questions and the scope of research.

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Appendix 1

Scopus:

TITLE-ABS-KEY("Digital innovat*" OR "technological innovat*" OR "digitalization" OR "digital technologies" OR "smart technologies" OR "industry 4.0" OR "industry 5.0" OR "technological knowledge" OR "digital transformation" AND SME* OR "small and medium enterprise*" AND manufactu*) AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (SUBJAREA,"BUSI") OR LIMIT-TO (SUBJAREA,"ENGI") OR LIMIT-TO (SUBJAREA,"COMP") OR LIMIT-TO (SUBJAREA,"DECI"))

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Scopus search with yearly criteria 1999-2024:

TITLE-ABS-KEY ("Digital innovat*" OR "technological innovat*" OR "digitalization" OR "digital technologies" OR "smart technologies" OR "industry 4.0" OR "industry 5.0" OR "digital transformation" OR "digital integration" OR "business intelligence" OR "data capabilities" AND sme* OR "small and medium enterprise*" AND "manufactur*") AND PUBYEAR > 1999 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "ENGI") OR LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "DECI")) AND (LIMIT-TO (LANGUAGE , "English"))

300 papers

WOS:

("Digital innovat*" OR "technological innovat*" OR "digitalization" OR "digital technologies" OR "smart technologies" OR "industry 4.0" OR "industry 5.0" OR "digital transformation" OR "digital integration" OR "business intelligence" OR "data capabilities") AND (SME* OR "small and medium enterprise*") AND ("manufactur*") (All Fields) and Proceeding Paper or Review Article or Editorial Material (Exclude – Document Types) and Management or Engineering Manufacturing or Engineering Industrial or Business (Web of Science Categories)

243 papers

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