SMEs Digitalisation Through Clustering, the Role of Open Innovation: A Research Agenda

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Abstract: Clustering has been a widely pragmatic practice of small and medium enterprises (SMEs) for innovation during the last two decades. Though its application is complicated due to the challenges and issues in low and middle-income countries, it is expected that all SMEs will benefit from the unique learning and innovative opportunities in a cluster. A systematic review and research agenda on how open innovation in a cluster could stimulate digitalisation in SMEs has not been addressed. Hence, this study seeks to review existing literature on the role of clusters in fostering SMEs' digitalisation through open innovation practices. The research objectives are to examine SMEs' practice of open innovation, analyse the benefits and assess the intermediate role of a cluster for digitalisation within the context of SMEs. The paper aims to provide a framework for future research by presenting propositions. The methodology and approach for the study with a discussion on data extraction and synthesis were articulated. A comprehensive review of the literature to justify the approach was applied. A detailed inclusion and exclusion criteria were presented. Also, the selection process for assessing the articles was provided. This review scrutinised published peer-reviewed papers between January 2014 and December 2021. Findings from the reviewed papers show that cluster development will increase specialisation and divide labour among participating firms. It reveals the process of open innovation in SMEs' practice and the management of open innovation practice in SMEs. Also, it will improve collaboration, shared infrastructure, and knowledge sharing for increased market competitiveness. In addition, collaboration in a cluster will reduce the cost of SMEs' digitalisation, promote new firms, and reduce operational costs. Some beneficiaries of this research were highlighted. Finally, directions for future research with suggestions were comprehensively provided.

Keywords: collaboration, cluster, digitalisation, open innovation, small and medium enterprises, technology

1. Introduction

The global economy is gradually moving from natural resources to technology. No economy solely relies on oil, gold or silver in today's evolving world. Technology is derived from knowledge and is the current most thriving commodity. Without technology, there will be no innovation or digitalisation. The use of digital technology and applications to improve existing firm processes, develop business models that will enhance employee effectiveness, boost customer experience, and provide new commodities to the public is described as digital innovation (Warner and Wäger 2019). Digital technologies would aid the digitalisation of small and medium enterprises (SMEs) by adjusting to modern business reality. (Ricci, Battaglia, and Neirotti 2021).

Extant literature is replete with the relationship between SMEs innovation and clusters (Gomezelj 2016; Hunt and Kiefer 2017; Kim and Shim 2018; Turkina and van Assche 2018; Chen, Zhang, and Fu 2019). However, most of these studies focused on how businesses within clusters encourage innovation among themselves. For instance, Kim and Shim (2018) assert that knowledge sharing is classified among businesses within clusters. Clustered businesses are more imaginative than geographically scattered ones (Belso-Martínez, Mas-Tur, and Roig-Tierno 2016). Clusters promote both innovation and growth in SMEs (Mudambi et al., 2017).

Therefore, our contribution to existing studies on the role of a cluster in SMEs' digitalisation is to uncover the external influence using open innovation (OI). Likewise, we will contribute to the body of knowledge by revealing the intermediate role of clusters in SMEs' digitalisation through the adoption of OI. Helpful guidance for future research in this promising and unique field will be provided to interested scholars. According to Sahut, Iandoli, and Teulon (2021), SMEs' digitalisation is enhanced by collaboration with a diverse range of technology partners located at greater distances from the businesses. Ben Arfi and Hikkerova (2021) reveal that OI activities such as cooperation and information sharing with partners substantially influence the ability of SMEs to innovate and grow. Nevertheless, their implementation frequently necessitates a significant restructuring of the business model. Many SMEs lack the resources to deal effectively due to a scarcity of human, financial, and managerial resources. In actuality, SMEs may be less able to adequately analyse the advantages and costs of these new technologies and plan and execute their successful adoption (Yunis, Tarhini, and Kassar 2018). SMEs might

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overcome this shortage by leveraging their external networks through OI, encouraging embracing digital innovation technology (Nambisan, Wright, and Feldman, 2019). The role of the external partners could range from raising awareness of the advantages of digital innovation technologies to offering appropriate information and implementation support that would help to lessen scepticism about investing in these technologies (Crupi et al. 2020). Clustering has garnered a great deal of attention as a strategy for increasing the innovation and competitiveness of SMEs seeking to take advantage of OI. Consequently, our paper aims to answer the following research questions: what are the OI practices of SMEs? And what is the input of clusters to SMEs' digitalisation through the adoption of OI?

2. Theoretical framework

Social Capital Theory

Pillai et al. (2017) reveal that social capital is a necessary prerequisite for the quest for supplementary knowledge. The social networks underpin learning processes in which organisations seek and employ new information. Many studies have also shown that firms are embedding inside their network of interactions to develop the business learning potential (Evans et al., 2017; Najafi-Tavani et al., 2018; Wang et al., 2018). Through resource sharing, collaboration, and adaptability, an inherent logic of exchange enhances a firm's economic and innovative success. As a result, the firm's success is greatly influenced by the networks of ties it maintains outside of the business (Leenders and Dolfsma 2016). Turkina and van Assche (2018) affirm that social capital theory promotes the formation of clusters that assist businesses in connecting with suppliers and other partners to obtain complementary or interdependent resources and enhance their learning capabilities that could generate innovation. Firms form clusters and alliances not just to get access to new resources but also to learn how to maximise the value of their existing resources (Delgado, Porter, and Stern 2014). A learning network fosters open innovation by encouraging the generation of new ideas, creativity, and efficacy in developing unique processes, products, and patents (Lauritzen and Karafyllia, 2019). Learning through social capital could promote innovation rather than a single firm working alone (Martínez-Pérez, García-Villaverde, and Elche 2016).

Clusters are the structural component of social capital, facilitating face-to-face interactions and promoting information transfer, tacit knowledge and creativity (García-Villaverde, Parra-Requena, and Molina-Morales 2018). SMEs located in clusters benefit from the social capital network and have a high innovation potential (Kim and Shim 2018). The social capital process is particularly critical for clustered firms (Ritala and Stefan, 2021).

3. Research methodology

This comprehensive literature review aims to critically examine research results from selected literature and summarise articles using systematic techniques (Snyder 2019). The study approach and procedures are thoroughly detailed in this section. It starts with a discussion of the study's research topic and concludes with data extraction and synthesis for its goal. Also, the justification for using a systematic literature approach and data gathering techniques are detailed.

Search strategy

For the study, the identification of keywords was based on the authors' prior experience, an initial assessment of the literature, and brainstorming sessions. Identified keywords include "SMEs," "small businesses," "open innovation," "cluster," "business cluster", "open innovation," etc. These keywords were then organised into search strings: [*open innovation* AND *small and medium-sized enterprises* OR *SMEs* OR *small businesses* *business cluster*]. Scopus and web of science were consulted as the search database for this study.

Table 1: Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
1. Studies that look at the strategic alliance, collaboration and partnership as a tool or source of innovation for innovative SMEs. 2. Studies focusing on OI that consider SMEs as their point of analysis or vice versa 3. Only journal articles, books, and book chapters were taken into account	1. Sources of evidence that do not match study objective. 2. Sources of evidence not written in Englis 3. Source of evidence requires payment access

To guide our assessment for inclusion, we considered collaboration and partnership as a tool or source of innovation; research that focused on OI and used SMEs as their point of analysis or vice versa and journal articles and books. While for the exclusion, we removed sources of evidence that did not match the research; we did not use papers not written in the English language and sources of data that did not match the topic.

Study selection process

The initial database search yielded over 32,000 results, of which we removed duplicated articles. The sources of evidence were limited to recent origin (January 2014 to December 2021) because these papers reflect the newest knowledge on the roles of a cluster for SMEs' Digital Innovation through Open Innovation. After customising the date range and removing irrelevant materials, the papers available for the title and abstract screening were 1,356. The titles and abstracts were then screened for the first selection of eligible articles. Nine hundred twenty-three articles were excluded based on duplicate, title and abstract screening. The full-text screening was done for the second selection of relevant articles based on inclusion and exclusion criteria. Thirty-seven articles were eligible for full-text review, and these thirty-seven papers were used for the systematic literature review.

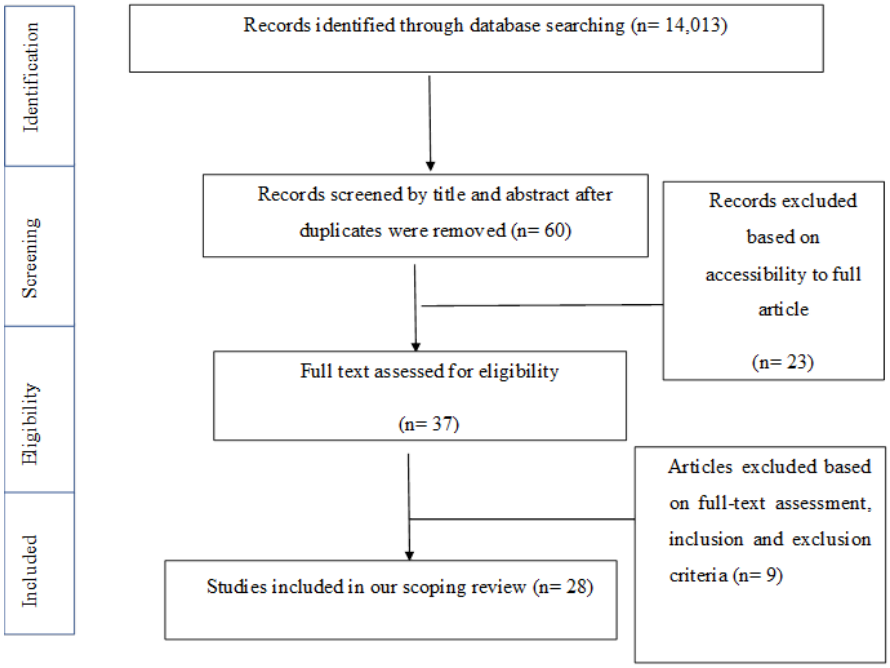

Figure 1: Prisma flow chart of the studies identification and selection process

We assessed the number of articles that overtly discussed OI, cluster and digitalisation within the context of SMEs. As presented in table 2, the papers evaluated either separately or two of the variables together. Though there has been increased research around this area, none of the articles attempted to research the combination of OI, cluster and SMEs digitalisation. The publication inclination proposes that this would be an exciting area of research for scholars.

Also, we evaluated journals on this research area and found the following: Journal of Small Business Management (n = 4), Journal of Business Research (n = 4), Research Policy (n = 3), Small Business Economics (n = 2), Entrepreneurship & Regional Development (n = 2), International Journal of Contemporary Hospitality Management (n = 2), Strategic Entrepreneurship Journal (n = 1), Journal of Product Innovation Management (n = 1), Industry and Innovation (n =1), R & D Management (n = 1), World Development (n= 1), Entrepreneurship Theory and Practice (n = 1), Journal of Travel Research (n = 1), Journal of Business Venturing (n = 1), Journal of International Business Studies (n= 1), Long Range Planning (n = 1) and IEEE Transactions on Engineering Management (n = 1)

Table 2: Journals used for the study

Journal Name	#	Author's name
Journal of Small Business Management	4	Brunswicker and Vanhaverbeke (2015), Chang and Webster (2018); Taura and Radicic (2019); Aliasghar et al., (2020)
Journal of Business Research	4	Eller et al., (2020); Fossen and Sorgner (2021); Matarazzo et al., (2021); Shao and Sun (2021)
Research Policy	3	Delgado, Porter, and Stern (2014); Hervas-Olivera, Lleoa, Cervello (2017), Chen, Zhang, and Fu (2019)
Small Business Economics	2	Ben Arfi and Hikkerova (2021); Sahut, Iandoli. and Teulon, (2021)
Entrepreneurship & Regional Development	2	García-Villaverde, Parra-Requena, and Molina-Morales (2017); Bliemel et al., (2019)
International Journal of Contemporary Hospitality Management	2	Martínez-Pérez., García-Villaverde, and Elche, (2016); Kim and Shim (2017)
Strategic Entrepreneurship Journal	1	Autio et al., (2018)
Journal Product Innovation Management	1	Baker, Grinstein, and Harmancioglu (2016)
Industry and innovation	1	Cassetta et al., (2020)
R & D Management	1	Denicolai, Ramirez, and Tidd (2014)
World Development	1	Gebreeyesus and Pierre (2013)
Entrepreneurship Theory and Practice	1	George, Merrill and Schillebeeckx (2021)
Journal of Travel Research	1	Martínez-Pérez et al., (2019)
Journal of Business Venturing	1	Luo et al., (2020)
Journal of International Business Studies	1	Turkina and Van Assche, (2018)
Long Range Planning	1	Warner and Wäger, (2019).
IEEE transactions on engineering management	1	Woods, Galbraith, and Hewitt-Dundas, (2019)

4. Results

The outcomes of the systematic revealed the following

Open innovation practices of SMEs

Studies such as Autio et al. (2018) suggest that entrepreneurial ecosystems could vary from traditional clusters. They highlighted the advantage of digital exploitation for organisations' entrepreneurial opportunities (EO) in searching and redesigning their business model. EO can be spur through voluntary horizontal knowledge spillovers by cluster-external locus. Baker, Grinstein, and Harmancioglu (2016) affirm that external networks benefit SMEs with weak EO and boost their innovative performance more than those with solid EO. In recent years, research on OI practices in SMEs has extended and stirred increasing attention. Although the importance of knowledge conversion through OI within businesses was identified (Leckel, Veilleux, and Dana 2020), the growing literature on OI emphasises the role of inbound knowledge sources for SMEs' digitalisation (Lauritzen and Karafyllia 2019; Nambisan, Siegel, and Kenney 2018; Flor, Oltra-Mestre, and Sanjurjo 2019). Also, studies by Nambisan, Wright, and Feldman (2019); Taura and Radicic (2019); North, Aramburu, and Lorenzo (2020) have also shown that e-business digital technologies help in internationalisation. In comparison, scholars such as Turkina and van Assche (2018), Urzelai and Puig (2019), and Luo et al. (2020) explored the opportunities provided by clusters for SMEs to develop digital technology and sustain development. In particular, some of these researches have suggestions that can contribute to and accelerate SMEs' start-up and infrastructural growth.

Management of Open innovation practices of SMEs

Some authors noted that OI might be used as a new paradigm for managing innovation in SMEs (Brunswicker and Vanhaverbeke 2015; Torchia and Calabrò 2019; Woods, Galbraith, and Hewitt-Dundas 2022). However, (Luo et al. 2020) assert that the factor affecting the adoption of OI in SMEs varies. Still, they are mostly related to SMEs' restricted access to external resources and the limited amount of technical assets they may offer for sale to potential customers. A lack of financial resources prevents SMEs from gathering critical information and knowledge and selecting partners with whom to collaborate (Taura and Radicic, 2019). As a result of their lack of access to extensive knowledge repositories, their ability to absorb new information is severely limited (Bliemel et al., 2019). This ability to recognise, grip, and use external information is described as the OI practice of the firm (Torchia and Calabrò, 2019). It contrasts with larger enterprises, which can easily monitor their surroundings and identify potential partners quickly due to their strategic position, colossal capital or asset base (Papa et al., 2021).

Proposition 1: OI is significantly beneficial to SMEs

According to our sample of articles, the advantages of OI adoption for SMEs have been well investigated (Luo et al., 2020; Taura and Radicic, 2019). When it comes to enjoying the benefits of openness, SMEs have shown to be more effective than big corporations (Martínez-Pérez et al., 2019). Businesses in the SME sector that successful OI attempts have more experience experimenting with and deploying OI approaches at both the firm and project levels than their less successful competitors (Urzelai and Puig 2019). Moreover, such successful SMEs make better use of the available resources (Luo et al., 2020). In addition, organisational characteristics have contributed to forming an OI culture and the expansion of SMEs' capacity for innovation (Sahut, Iandoli, and Teulon 2021. For the most part, SMEs who participate in OI are trailblazers rather than laggards in their field (Naqshbandi 2018).

Proposition 2: Cluster as a catalyst for SMEs digitalisation through OI

SMEs often accept just a few technologies, such as cloud computing, while others, such as autonomous robotics, horizontal and vertical system integration, and the Industrial Internet of things, are still in the early phases of adoption (Gebreeyesus and Mohnen 2013). These technologies involve a more radical restructuring of SMEs, demanding the acquisition of particular skills and the development of competencies that many enterprises lack (Zangiacomi et al., 2020). To develop these resources, SMEs would increase their network of external partners and form clusters of cooperation with these actors, as this would be pursuing in-depth collaboration (Ahn et al. 2019). Collaborating with competitors helps firms access technical skills that would be costly to develop and time-consuming if they should do it alone (Cozzolino and Rothaermel 2018).

Proposition 3: The intermediate role of clusters in SME digitalisation

Studies showed that innovation intermediates might assist SMEs in more easily developing OI procedures in clusters (Bayona-Saez et al. 2017; Figueiredo and Piana 2018; Flor, Oltra-Mestre, and Sanjurjo 2019; Guertler and Sick 2021; Shao and Sun 2021). As an innovation intermediary, a cluster facilitates technology transfer between businesses and universities by providing access to scientific and technical resources for innovation and a vast face-to-face network of collaborators (Squicciarini 2017). These intermediaries perform three basic tasks: connecting persons, cooperating or supporting one another, and offering technical services. Connect actions include the production of network databases, the building of networks, and the administration of networks (Squicciarini 2017). Cooperate or support activities comprise knowledge sharing, healthy competition, and direct or indirect collaboration (Shao and Sun 2021). In contrast, technical services enable innovation to thrive (van Oorschot, Hofman, and Halman 2018).

Theoretical Implications

The link between OI and digitalisation is currently understudied, even though environmental factors may influence both (Kurnia et al., 2015). Scholars like Dunne et al. (2016), Prajogo (2016); Prasad and Junni (2016); Barasa et al. (2017), and Wang et al. (2020) have studied how innovation is greatly influenced by the environment in which the business operates. Some specific variables, such as the amount of research and development, the type of goods, and technical expertise, have been shown to influence SMEs' decisions in adopting digitalisation (Cassetta et al., 2019; Fossen and Sorgner, 2021; Pappas et al., 2021). SMEs in low-tech sectors, in particular, should adjust their business models more dramatically than SMEs in high-tech industries

to incorporate digital innovation technology (George, Merrill, and Schillebeeckx 2021). Since their workers' technical skills are limited, low-tech SMEs face more implementation challenges. They usually operate in a less dynamic setting, and their managers are more resistant to change (Eller et al., 2020). As a result, collaboration with other organisations may be crucial for SMEs in low-tech sectors. Still, its impact on the adoption of digital innovation technologies is less clear, as their poor absorptive capacity may restrict their ability to grip new information (Thomä and Zimmermann 2020). The diagram below depicts how clusters could stimulate digitalisation in SMEs through OI.

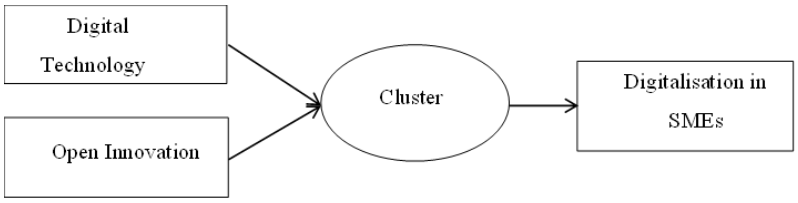

Figure 2: How cluster could stimulate SMEs' digitalisation

Clusters have an impact on the successful application of OI for SME digitalisation. According to Denicolai, Ramirez, and Tidd (2014), high-tech and low-tech businesses provide various settings for knowledge generation and exchange, resulting in differing degrees of OI. The degree of complexity in industrial knowledge bases influences the link between OI and firm success. The knowledge-sharing process and creation can be affected by the level of R&D, healthy competition sources, and failure risk (Woods, Galbraith, and Hewitt-Dundas 2022). These elements could impact SMEs' willingness and ability to embrace external partners through OI based on extensive or intensive connections (Aliasghar, Sadeghi, and Rose, 2020). We intend to fill a vacuum in the literature by studying the moderating role of clusters on SMEs' digital innovation by adopting OI. In the illustration in figure 1 above, we propose that cluster has a beneficial influence on SMEs' adoption of digital innovation through OI. In the subsequent sections, we further addressed this. Finally, we propose that SME clustering has a distinct intermediary between OI and digitalisation.

Our findings would be relevant to members of business boards of directors, chief executive officers (CEOs) and captains of industries. It may inspire the various tiers of government to formulate policies that will directly or indirectly support clusters development and promote SMEs' digitalisation through OI, as shown by our findings. Furthermore, cluster administrators should focus more on collaborative activities, which are critical to the advancement of digitalisation. They may also utilise their office to persuade those in leadership authority to allocate more funds to OI initiatives in budgetary allocations. Also, additional resources to boost OI in clusters by leveraging collaboration with universities and research institutions should be encouraged. Stakeholders and intending entrepreneurs interested in gaining a better grasp of how cluster governance could support OI may treasure our findings. Similarly, our results would help entrepreneurs be more aware of the advantages of involving themselves in OI and the need to increase their creative skills.

5. Further research

Future research should concentrate on an empirical examination of the propositions presented in this study to generalise the findings. Hence, there is a need to empirically authenticate the recommendations that OI is significantly beneficial to SMEs. Cluster as a catalyst for SMEs' digitalisation through OI. And the intermediate role of clusters in SME digitalisation. There is also a need for a wider variety of clusters and a quantitative approach. The interplay between entrepreneur innovation strategies, governance processes, and inventive performance should focus on more research in the future. Subsequently, from our findings, more entrepreneurs may decide to participate in collaborative initiatives to spur innovation and raise their value creation. As a result of their efforts, members of cluster governance may be persuaded to alter their practices and put a greater emphasis on facilitating cooperation.

6. Limitation of the study

Even though this study would be a source of inspiration to researchers in SMEs digitalisation, cluster and open innovation, it does have some limitations. Firstly we provided a comprehensive review of thirty-seven articles published between 2014 and 2021. However, we imply that researchers test any of our propositions using tools like causality test or structural equation modelling. Secondly, this study could not outline observations and reports because it only used empirical studies and literature reviews.

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