Small and Medium Enterprises (SMEs) facing an evolving technological era: a systematic literature review on the adoption of technologies in SMEs

Received 23 July 2021
Revised 14 October 2021
16 December 2021
Accepted 11 January 2022

Seyedeh Zahra Zamani
Halmstad University, Halmstad, Sweden

Abstract

Purpose – This paper aims to map the influential concepts on technology adoption in Small and Medium Enterprises (SMEs) through conducting a systematic literature review and finding a better understanding of the current body of knowledge.

Design/methodology/approach – A systematic literature review approach is taken here, which includes the following steps: Determination of keywords and strings, selection of databases, setting inclusion and exclusion criteria, conducting the search in chosen databases over a specific period of time. This process has led to the final count of 349 peer-reviewed articles being studied, and the results are analyzed quantitatively and qualitatively.

Findings – As a result of the study, 11 categories of influential concepts on technology adoption are identified by reviewing literature from the past decade. This article indicates how fragmented the literature is and how it concentrates on studying the impact of only a limited number of categories of concepts. The scatted frameworks (theoretical and conceptual) and weak application of the used theories found in this research also highlight the need for the development of a framework that looks into technology adoption as a dynamic process due to the dynamic nature of new technologies today.

Research limitations/implications – Based on the above findings, future research avenues are to look into technology adoption from a process perspective, to dig into less researched influencing concepts such as infrastructure, regulations, strategy and resources and their role in adoption of technology in SMEs as well as development of a framework for technology adoption that is aligned with these elements.

Practical implications – Practitioners and policymakers will benefit from finding a helicopter view of the barriers and supporting factors throughout their technology adoption journey. The knowledge they gain from this study will better prepare them in building tools they need for adopting technology in their organizations and provide an in-depth insight to what elements can affect their journey.

Originality/value – This review provides an insight into the current body of knowledge on the topic, which researchers can benefit from constructing an in-depth understanding of the state of research as well as influencing concepts of technology adoption in SMEs. Moreover, it adds value in building up the knowledge of technology adoption in today's dynamic world of digitalization.

Keywords Systematic literature review, Technology adoption, Small and medium enterprises, Integrated framework, Digitalization, Technology adoption enablers

Paper type Research paper

1.Introduction

The purpose of this paper is to present a systematic literature review (SLR) to map the current body of knowledge and to identify the research shortcomings in technology adoption in Small

and Medium Enterprises (SMEs). The COVID-19 crisis has double proved the need for smaller and medium sized enterprises to digitalize and adopt emerging technologies to be able to compete and stay alive in ever changing business environment of today (Chen *et al.*, 2016). SMEs are defined as companies with fewer than 250 employees according to the EU recommendation (European Commission, 2003) which contribute to the development of society in various ways. It is important to study technology adoption in SMEs for several reasons. Although they are considered small, they represent, for example, 99% of the companies in Europe (Yang *et al.*, 2019). They also play an essential role in the economic developments of many countries across the world through generating more employment opportunities (Oduro, 2019), enhancing competition, entrepreneurship and aggregating productivity increase (Jin and Choi, 2019). They contribute to trade by providing sustainability and inserting innovation in economies (Hernandez, 2018a).

SMEs are, on the other hand facing new challenges every day as the global market competition rises (Chen *et al.*, 2016). Business operations in SMEs are affected daily, which has forced them to consider the vital role of Information Communication Technology (ICT) in business development (Chen *et al.*, 2016; Trigueros-Preciado *et al.*, 2013). The more SMEs can use digital technologies, the more sustainable competitiveness and growth they are expected to have (Gareeb and Naicker, 2015). Therefore, many SMEs go through digital transformation, bringing more attention to research on technology adoption in SMEs (Bayo-Moriones *et al.*, 2013).

The literature on this topic indicates that SMEs that use ICT can gain new opportunities and expand in the market and gain new knowledge about their customers, and have a better product development process (Fu *et al.*, 2014). Therefore, they are more competitive in business (Cerchione *et al.*, 2015). Existing literature also indicates that SMEs face multiple challenges in the adoption and use of new technologies (Abou-Shouk, 2013; Cerchione *et al.*, 2015).

Although the context of the adoption of new technologies has received more attention from researchers over the past recent years, there are still shortcomings in research. For example, the technology adoption process and sub-processes are less studied (Eze *et al.*, 2019b; Nguyen and Waring, 2013). The role of digital platforms and architectures, e.g. Blockchain, Distributed Ledger Technologies (DLT), etc., during the adoption process of new technologies has also been less studied (Rowe *et al.*, 2012). The mentioned shortcomings in research appear to be even more critical and impactful when it comes to SMEs (Li *et al.*, 2018). To help address these shortcomings, this paper presents the results of an SLR covering an entire decade (June 2010–June 2020) of contributions related to the adoption of technology in SMEs.

These shortcomings and their weight of influence become bolder and more critical with the rise of new technologies and evolvement of emerging technologies on a daily basis and creating an environment with uncertainties that SMEs need to struggle with every day. On the other hand, the changes in the business environment, like what we observed with COVID-19, have forced SMEs to adopt technologies that they did not feel the need for before. These adoptions also need to be performed in a way that does not leave SMEs behind in business which means, it needs to be done with a pace rational to the speed of the changes happening. The influencing factors, barriers and supporters of technology adoption change as new technologies emerge and the business environments change. This highlights the importance of a study that maps the influencing factors of adoption of technologies in SMEs today.

To this end, I adhered to two main research objectives: The first is to identify studies related to technology adoption in SMEs. The second was to synthesize insights from the literature to glean possible future research directions. As a result, this research makes four contributions to the literature. First, it advances our understanding of technology adoption in SMEs by presenting an overview of the status of research in this field. Second, this research

proposes 11 categories of influencing concepts to be considered in the adoption of technology in SMEs through integrated frameworks. Third, for SME managers, entrepreneurs and policymakers, this study draws on extant research to support them in decision making, planning and strategizing for the adoption of technologies in their business. Lastly, I shed light on the current challenges and issues surrounding the adoption of new technology in SMEs and suggest future research avenues. The rest of the paper is organized as follows: Section 2 presents an insight into the methodology and procedure for identification of extant research in technology adoption in SMEs; Section 3 provides the results, Section 4 is then followed presenting the conclusion, and finally, Section 5 ends the paper by opening future research avenues.

2. Methodology

2.1 Systematic literature review (SLR) approach

Following the SLR taken by researchers in Durst *et al.* (2015) and Tell *et al.* (2016), in this research, an SLR approach is taken based on the following six steps:

(1) Identification and selection of keywords: Since the purpose was to conduct a comprehensive search in order to establish the current body of literature and knowledge in technology adoption in SMEs, therefore, several keywords were searched, which were tech*, technology, adopt*, adoption, "technology adoption", SME*, SMEs/small and medium enterprises/small and medium-size companies/family businesses.

(2) Specification of keyword combinations: Next, the search strings as a combination of keywords that could help researchers focus on the targeted literature were built up, which were tech* + adopt* + SME, "technology adoption" + SMEs, technology + adoption + SMEs.

(3) Selection of databases: The initial search on different databases showed that the majority of relevant literature is found in Emerald although reached through other databases. Therefore, I decided to pick Emerald as one of the databases for this review. EBSCO and Scopus were the other two databases searched in this study.

(4) Setting inclusion and exclusion criteria: Before conducting the search, a set of inclusion and exclusion criteria was decided. The inclusion criteria were publication in peer-reviewed journals, English language, document type of article, literature from 2010 to July 2020, full-text articles with no limitation of research approach or industry and papers discussing technology adoption in SMEs. The exclusion criteria were chosen to be studies in languages other than English, papers discussing different aspects of technology adoption, and grey literature.

(5) Conducting the search: The search was next conducted in three databases of Emerald and Academic Search Elite (EBSCO) and Scopus in a period of two months from April 2020 to June 2020. Based on the different sets of search strings searched in each database, different numbers of hits were reached.

(6) Quality assessment: the next step was quality assessment, including scanning the abstracts and selection of papers, extraction of data based on a pre-designed SLR matrix, analyzing the patterns to identify the research gaps and the research done and finally writing up the literature review.

The procedure of the conducted search and quality assessment of the resulted hits is shown in Figure 1.

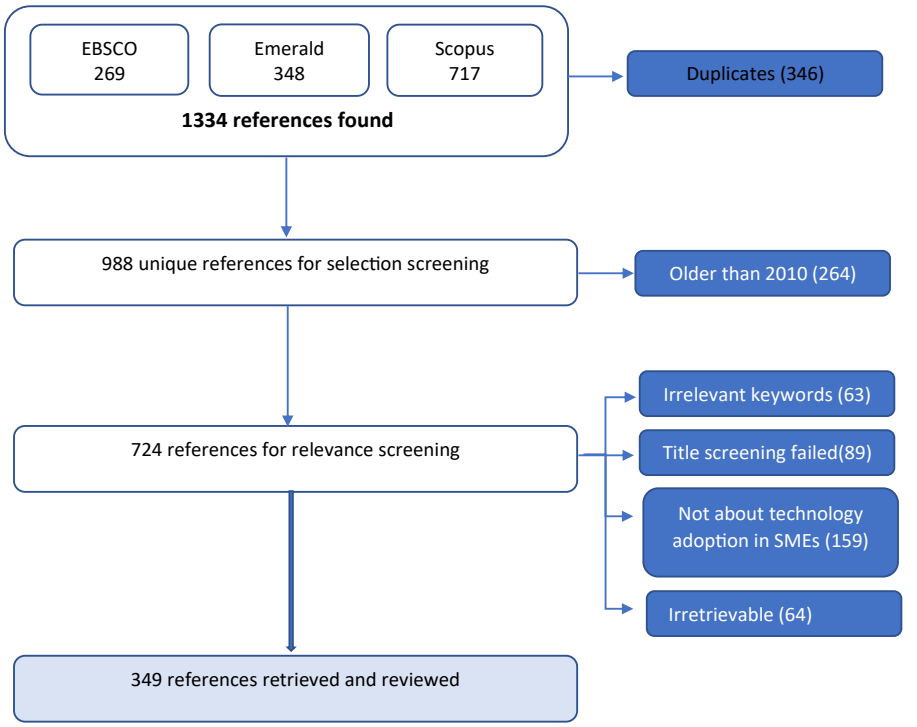

Figure 1.
Conducted search procedure

Next, data were extracted from the final 349 papers based on a pre-designed SLR matrix designed by the author and explained in the following section.

2.2 SLR matrix design

I designed a matrix to be able to extract the relevant information from each paper to increase the comprehensiveness of the literature review. Here the intention and meaning of each criterion as well as the coding used are presented:

2.2.1 Theoretical aim. Here the nature of the theoretical purpose of the article is extracted. This information is useful for a better understanding of the theoretical contribution of the paper as well as the initiatives to researchers for doing the research. It also helps in configuring the stage of the research in the context and maturity of literature. The paper's theoretical aim is coded as exploratory, development or elaboration, testing and others.

2.2.2 Main concept/theories. In order to be able to look into the frameworks in which the researchers took advantage of in subjects of innovation activities and so build a body of knowledge on the relative theories and concepts, the main theories or theoretical framework or conceptual framework of the paper has been extracted too.

2.2.3 Methodological approach. The research approaches taken by research in available literature have been coded as empirical and conceptual papers as well as mixed-method approach, and for empirical papers, it is identified to be quantitative or qualitative. This information is beneficial to know in order to build a better understanding of whether the body of knowledge is based on conceptual thinking or experiments and so analyze the experiments done.

2.2.4 Research methods. The different methods of research and data collection had been extracted and coded as an interview, observation, survey, experiment, secondary data, focus group or others. It is beneficial to know this information as different research methods have different purposes and different levels of validity as a measure to help to determine the accuracy of the results.

2.2.5 Number of research methods. It is an advantage to know how many of the papers have used multi-methods in research since having more than one source of data collection and research method will benefit the research from a deeper understanding and offsetting the probable weakness of one method only and probable triangulation, allowing the researcher to obtain a more accurate understanding of a phenomenon as they are approaching the problem from different angles.

2.2.6 Geography setting. Stating the country or countries or region which has been studied in order to build knowledge on the state of current knowledge and where it has been conducted as the results might differ from region to region and also reach the finding that which countries have so far been more interesting for researchers.

2.2.7 Level (unit) of analysis. Different levels of analysis might have different impacts on the results. Therefore, it is important to know which levels of analysis have been taken so far by researchers. The level of analysis in this paper is coded as individual, group, firm, regional, national, international and others.

2.2.8 Journals of publications. The journals of publications were extracted to provide the readers with an insight into which research fields the existing body of knowledge emerged from. After extracting the journals ad based on the data, I classified the journals according to four broad categories: science and technology journals, business, economics and management journals, information systems journals and sustainability and environment journals.

3. Results

In this paper, I have performed both the quantitative and qualitative analysis of the literature. And the results of each are presented in the following subsections.

3.1 Quantitative analysis

The analysis of disciplines of studies, as shown in Figure 2, presents that majority of studies in this field are done in a single discipline, with most of the focus being on IT and technical

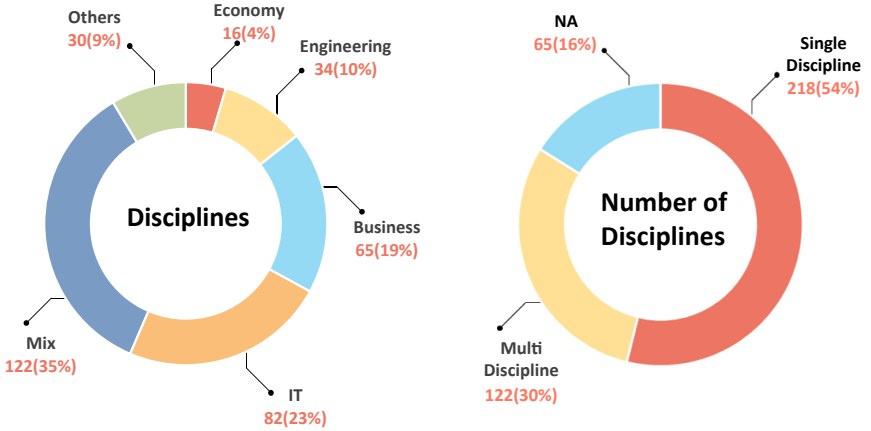

Figure 2.
Analysis of disciplines

aspects, which introduces a limitation to the research. Adoption of technology in SMEs is influenced by multiple concepts, which in this paper specifically 11 of them are identified and explained in the coming sections that each can be studied in a different discipline. Therefore, to have a better understanding of this phenomenon, a multi-disciplinary study approach is lacking and is recommended in order to aid both researchers and practitioners to be able to have an understanding from different perspectives.

Analysis of the theoretical aim of the papers shown in Figure 3 indicates that the majority of the research is exploratory, and a limited number of studies are in development and testing. This shows, although the extent of literature on technology adoption in SMEs is not small, yet the depth of the study is still shallow and needs more advanced research that goes beyond exploration to study development and testing.

The analysis of the theoretical frame of references presented in Figure 3 also revealed that the majority of the studies implemented a theoretical framework, and a limited number of studies implemented conceptual, analytical, testing, development or even integrated frameworks. This can be a result of most studies being in an exploratory phase and clearly shows the lack of more in-depth conceptual and integrated research. Among the studies that implemented a theoretical framework, the most used theories are technology, organization and environment (TOE), diffusion of innovation (DOI), technology acceptance model (TAM), actor-network theory (ANT), unified theory of acceptance and use of technology (UTAUT) and theory of planned behavior (TPB).

Quantitative analysis of the research approach in this SLR shown in Figure 4 indicates that the current body of knowledge lacks a conceptual foundation while the empirical approach with the majority of focus on the quantitative study is the dominant approach which shows the empirical foundation of studies is missing adequate qualitative or mixed method of approach.

The analysis also shows that surveys followed by secondary data were the most popular research method, as shown in Figure 5. Considering the variety of concepts influencing the adoption of technology in SMEs, which were mentioned previously in this study, having a limited number of studies taking the mixed method of data collection shows the risk that the studies can be built on limited knowledge and did not take a more extensive picture approach.

Analysis of regions of studies presented in Figure 6 shows that the majority of studies have been conducted in Asia, followed by Europe, Africa and America, and very limited studies have included multiple regions. Considering today's trends of globalization

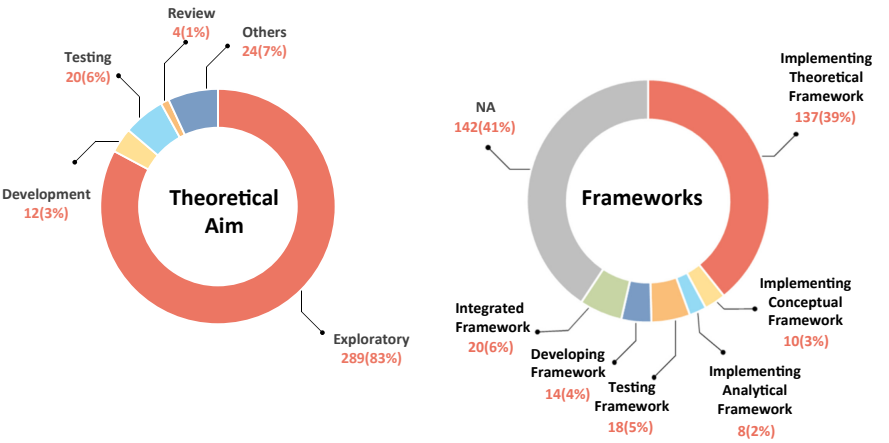

Figure 3.
Analysis of theoretical aim

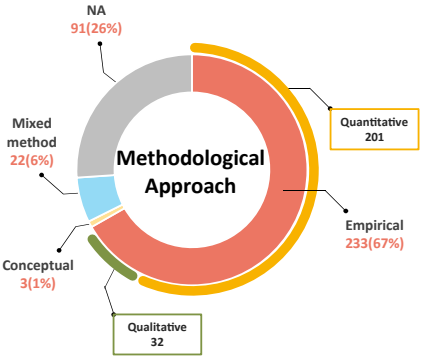

Figure 4.
Analysis of methodological approach

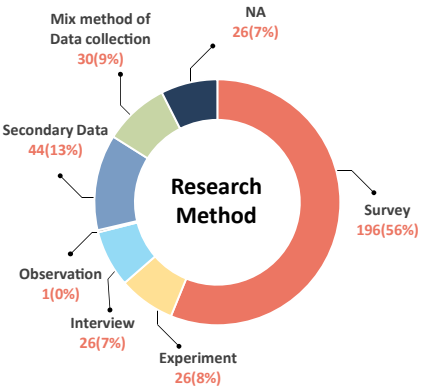

Figure 5.
Analysis of research method

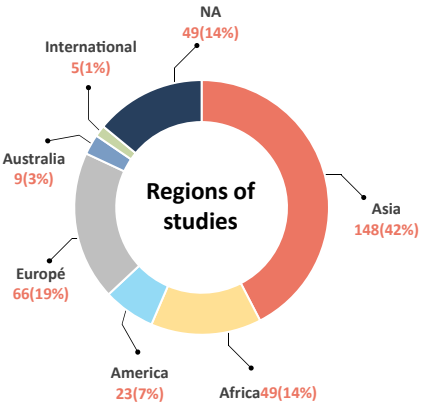

Figure 6.
Analysis of regions of studies

introduced to SMEs by digital transformation (Faridi and Malik, 2020; Garzoni *et al.*, 2020) more multi-regional approach in this study is recommended.

The results present that analysis at the firm level is the dominant level of analysis, and there is a lack of analysis at multiple levels, as shown in Figure 7. However, since this topic is a

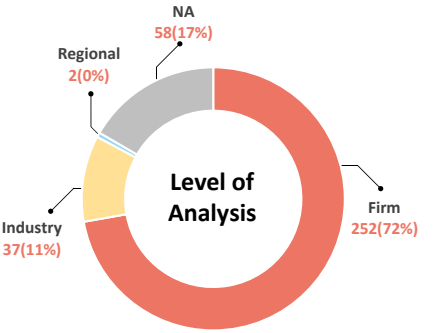

Figure 7.
Analysis of level of analysis

complex topic and concepts that affect technology adoption in SMEs go beyond the firm and include concepts like industry (Bowen and Morris, 2019; Liagkou and Stylios, 2019; Pradhan *et al.*, 2020; Prause, 2019), globalization (Dey and Deb Nath, 2020; Ferri *et al.*, 2020), market environment (Alismaili *et al.*, 2020; Octavia *et al.*, 2020; Thontla and Madahvi, 2017) and networks (Gono *et al.*, 2016; Martínez-Román, 2020; Narwane *et al.*, 2019) for instance, therefore a multiple level analysis is strongly recommended.

As regards the journals that have published research on technology adoption in SMEs, one can see a broad mix, i.e. journals can be assigned to the areas of business, economics and management, and/or information systems, as well as science and technology and environment and sustainability.

The majority of publications were found in the business, economics and management area (196 articles), which stresses the critical importance of managing technology adoption in SMEs, followed by the science and technology area (113 articles), which also stresses the importance of this study from a technical point of view and finally information systems as well as sustainability and environment areas with 20 articles each. In the next step, I also organized the data regarding the topic's journal distribution. The highest publishing journals are *Journal of Enterprise Information Management* (10 publications), *Journal of Small Business and Enterprise Development* (9 publications), *Journal of Science and Technology Policy Management* (8 publications), *Journal of Manufacturing Technology Management* (7 publications), *Journal of Sustainability* (6 publications), *Journal of Systems and Information Technology* (5 publications) and *Journal of Systems and Information Technology* (4 publications). This indicates that the study of technology adoption in SMEs enriches a number of different research disciplines.

3.2 Qualitative analysis

In Figure 8, it is shown that 142 papers implemented a theoretical framework which out of these, 55 of them implemented the theory of TOE. The TOE framework identifies three contexts of an enterprise influencing the process through which it adopts and implements technology: technological context, organizational context and environmental context (Subawa *et al.*, 2020). TOE framework is consistent with Rogers DOI theory since it is focused on internal and external organizational concepts, called organizational and environmental concepts, as well as technical characteristics of new technology (Ghobakhloo *et al.*, 2011), and it is also believed to have the most explanatory capacity compared to other adoption models in literature such as TAM, TPB, UTAUT, theory of reasoned action (TRA) and DOI besides being the most popular foundational model (Khayer *et al.*, 2020).

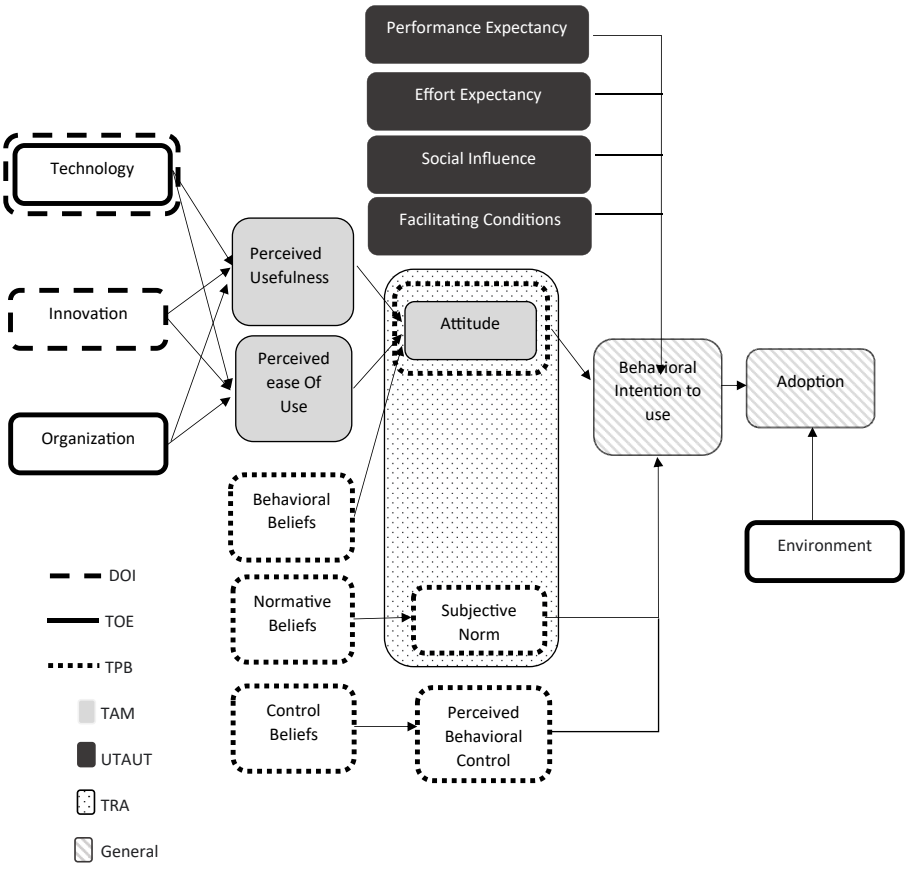

Figure 8.
An integrated framework for technology adoption

Another popular framework in literature is the DOI theory. This framework was developed by E.M. Rogers (Rogers and Cartano, 1962) and is one of the oldest social science theories which is originated to explain how, over time, an idea or product diffuses (or spreads) through a specific population or social system (Pathan *et al.*, 2017).

TAM is a theory that models how users come to accept and use technology. This theory discusses that behavioral intention is a concept that leads to the adoption of technology and is influenced by attitude, which is the general impression of the technology. TAM suggests that a number of concepts influence users decisions about how and when they will use it, such as perceived usefulness (PU) being defined by Fred Davis as the degree to which a person believes that using a particular system would enhance his or her job performance and perceived ease-of-use (PEOU), defined as the degree to which a person believes that using a particular system would be free from effort (Awa, 2019).

Two closely associated theories – the TRA and the TPB – suggest that a person's behavior is determined by their intention to perform a behavior (Awa *et al.*, 2017).

UTAUT is a technology acceptance model that aims to explain user intentions to use an information system and subsequent usage behavior through influencing four key constructs of performance expectancy, effort expectancy, social influence and facilitating conditions.

As mentioned earlier in this section, TOE is the most popular theory in literature, which categorized concepts influencing technology adoption into three categories of TOE. The thematic analysis of this study took the categories resulting from the analysis of the TOE framework as the starting point. All 349 papers were classified independently. The categories were extended to 11 categories extracted from the papers. If more than one aim was proposed, the paper was classified into all relevant categories. Within each category, several concepts were identified, as shown in Table 1.

Technological aspects were paid a decent amount of attention by multiple researchers. Among the technological concept; top three most discussed ones were compatibility, complexity and relative advantage. Compatibility was seen as an important determinant of the adoption of technology in SMEs and defined as the degree of consistency of technology with existing values, past experiences and needs of potential adopters by some researchers (Chau *et al.*, 2020; Mekhum, 2020; Singh *et al.*, 2020). It was also looked at from two different dimensions of technical and organizational, meaning the degree the technology is compatible with meeting technical needs but also the degree it is compatible to support the organization in meeting the organizational missions (Chatterjee and Kar, 2020; Hamad *et al.*, 2018; Shahzad *et al.*, 2020).

Alongside compatibility, complexity was at the center of attention too. Lower technical complexity was discussed to reduce the total cost of technology ownership and so reduce the capital investment and result in elastic scalability (Soong *et al.*, 2020). Similar to compatibility, complexity was also looked from two dimensions of internal and external complexity which internal referred to the number and diversity of relationships and number and diversity of elements within a given technology, and external complexity referred to external organizational context to suppliers, customers or governmental authorities in terms of efficiency gains from the adopted innovation (Prause and Günther, 2019) while some other researchers believed complexity of technology is different based on the size of the company by looking at different enterprise resource planning solutions in different size companies (Anwer, 2019). Meeting customers' requirements and customer pressure was also identified as one of the top factors influencing SMEs in adopting new technology (Nguyen *et al.*, 2015).

The relative advantage was discussed a number of times as an important concept influencing technology adoption in SMEs and was looked at as the degree to which an innovation is perceived as being better than the idea it supersedes (Khayer *et al.*, 2020; Narwane *et al.*, 2019). It is linked to how well a new technology supports SMEs regarding ensuring the customers are receiving the best product and service (Eze *et al.*, 2019a).

Environmental concepts were richly researched too. The top three most discussed environmental concepts were competitors' pressure, customers' pressure and external support. Saka and Chan (2020) studied Chinese and Taiwanese SMEs and found the fact that competitors' have adopted a new technology has pressurized the enterprises more than the complexity and relative advantage of the technology in technological concepts. Competitors' pressure was studied to be among the top determinant in the adoption of new technology in SMEs due to the competitive advantage it creates by supporting firms in providing more efficient, modern and quick services and products to customers (Abed, 2020; AlSharji *et al.*, 2018; Chau *et al.*, 2020; Prause, 2019).

On the other hand, Susanty *et al.* (2019) discussed customers' pressure and its positive and direct effect on the full implementation through early adoption of new technology in SMEs. Some researchers also discussed the role of customers' pressure in influencing SMEs to adopt technology and enabling them to take new approaches but also pushing firms to consider their needs (Eze *et al.*, 2019a; Hungund, 2019), while also acting as a predictor in technology adoption for SMEs in a way that higher demand from customers relates to the higher rate of technology adoption in SMEs (Salah *et al.*, 2019).

Table 1.
11 identified categories and influencing factors

No	Category	No. of studies	Identified concept within the category
1	*Technological category* Any concept that relates to the technical nature and characteristics of the particular technology	315	Availability (5), capability (2), compatibility (43), complexity (32), creditability (3), effectiveness (3), efficiency (8), flexibility (8), integration (9), interoperability (2), observability (9), operational agility (1), perceived ease of use (21), perceived usefulness (22), perceived benefit (26), perception of technology (1), privacy (5), quality (6), relative advantage (28), reliability (8), scalability (6), security (34), technological readiness (9), technology type (11), technology risk (1), technological support (1), technology maturity (1) and triability (10)
2	*Environmental category* Any concept that refers to the surrounding and the context in which the organization that is adopting technology is working in such as market, geographical location, industry, etc.	204	Brand image (3), client demand (2), Competitor's pressure (54), Customer's pressure (23), customer readiness (4), environmental uncertainty (1), external support (26), geographical location (8), globalization (6), industry (15), market orientation (7), market transparency (1), market trends (3), market uncertainty (5), network (7), social influences (13), subjective norms (6), supplier (6) and trading partners pressure (14)
3	*Management category* Any concept that comes in as a characteristic of the top managers on the organization from their demographic features to skills, knowledge and experience	157	Foreign management (2), management age (4), management attitude (8), management average education (6), management competency (2), managers innovativeness (9), management gender (2), management structure complexity (6), managerial productivity (2), managerial time (1), management involvement (3), management motivation (5), management perception (5), top management support (62), top management commitment (12), top management use of technology (3), top management lack of skills (3), top management willingness (5), top management knowledge (16) and visionary leadership (1)
4	*Organizational category* Any concept that can be considered as a characteristic of the organization	156	Absorptive capacity (4), age of the firm (8), centralization/Decentralization (3), facilitating conditions (6), organization attitude (6), organization capability (5), organizational culture (10), organization ethics (1), organization formality (1), organization interest (1), organization innovativeness (13), organization learning pace (1), organization mission (2), organizational practices (3), organizational readiness (21), organization scope (7), organization structure (5), organization support (2), research collaborations (2), satisfaction with existing systems (1) and size (54)

(*continued*)

Table 1.

No	Category	No. of studies	Identified concept within the category
5	*Knowledge category* Any concept related to knowledge, experience, education, and skills of any stakeholder involved in the adoption of technology except the top managers	106	Awareness (9), biased perceptions (1), employees average education (2), employees technical knowledge (28), Employee's training (12), knowledge constraints (20), knowledge management (9), knowledge sharing (1), perceived information (2), policymakers knowledge (1), prior IT experiment (15), Stakeholder's awareness (2) and technical self-efficiency (4)
6	*People category* Any attribute of adopters except their knowledge-related features	69	Age (4), effort expectancy (5), egoistic mindset (1), Employee's commitment (3), engagement (4), ethnicity (1), fear (3), gender (4), generation (1), homogeneity/heterogeneity (1), individual attitude (6), individual differences (1), intention of adoption (6), organizational position (1), perceived trust (10), performance expectancy (5) and resistance/openness to change (13)
7	*Financial category* Any concept that can be considered as a measurement of profitability or is related to making adoption of technology financially sound	68	Cost (42), financial supports (4), perceived affordability (4) and return of investment (ROI) (18)
8	*Resources category* Any concept that can be a source of supply, or aid, especially one that can be readily drawn upon when needed	59	Access to technology (6), financial resources (21), human resources with skills (8), implication resources (2), IT resources (2), knowledge resources (1), limited resources (3), organizational resource availability (5), resources strength (5), slack resources (1), time (4) and training resources (1)
9	*Strategy category* Any concept that involves setting goals and priorities, determining actions to achieve the goals to execute adoption of technology	51	Communication (5), duration of adoption (1), HR strategy orientation (1), information policies (1), lack of strategies/guidelines (8), maturity strategy (1), perceived risk (10), R&D strategy (1), strategic alignment (3), strategic orientation (18), short term/long term vision (1) and tax compliance (1)
10	*Regulations category* Any concept related to rules made by the government or other authority to control the way technology is adopted	50	Government awareness (1), government e-readiness (2), government regulations (23), government support (18), institutional push (2), legal environment (2), legislation (1), public policies (1)
11	*Infrastructure* Any basic systems and services that an organization needs to adopt the technology	19	Infrastructure limitations (3), IT infrastructure (14) and organizational infrastructure (2)

Maroufkhani *et al.* (2020) discussed the importance of external support from the government and partners such as service providers and its highlighted role in the adoption of technology in manufacturing SMEs. But external support was not only studied in manufacturing SMEs and from the supplier's perspective but also from the angle of the knowledge and learning interaction the external environment provides to SMEs during the adoption of a technology (Muñoz-Pascual *et al.*, 2021; Walker *et al.*, 2016; Zaidan, 2017).

Even though environmental concepts were the second most studied concepts, yet most of the focus in this category is on competitors, and customers pressure and limited research looks at the business environment as a whole. Organizational and management concepts were among the most studied category of concepts. However, when it comes to management concepts, minimal studies studied the technology management aspects and mainly focused on only support and competency of the management team as well as demographic features rather than management of technology adoption as a process. The number of studies on other categories such as people, financial, regulations drastically decreased with a minimum number of studies on strategy and infrastructure category of concepts.

The third most studied category of concepts was the management category which was cored with the concept of top management support. Top management support was looked at from various different perspectives of the initiative to integrate a new technology (Dey and Deb Nath, 2020; Nguyen, 2009; Singh *et al.*, 2020), the existence of lacking the support (Saka and Chan, 2020), its influence on younger employees to innovate (Saka and Chan, 2020), supporting employees in improving their performance (Awa, 2019), examining a new technology (Asiaei and Rahim, 2019) and its role specifically in technology adoption in SMEs in developing countries (Anwer, 2019).

The top management commitment during the early adoption and implementation of new technology in SMEs and consistency they include throughout this process has also been identified as a critical element in literature (Gandhi *et al.*, 2018; Hernandez, 2018b; Hungund, 2019; Shemi and Procter, 2018; Susanty *et al.*, 2019).

Another identified category of influencing concepts is organizational concepts, in which the size of the organization was pointed to be the most effective concept. While some researchers found a direct relationship between the size of the firm and technology adoption (Giotopoulos *et al.*, 2017; Msomi *et al.*, 2019; Nguyen, 2009), some discussed the size of the firm plays a role according to the type of the technology (Martínez-Román, 2020) and others did not find a correlation between the size of a firm and technology adoption (Ayinla and Adamu, 2018; Vrchota *et al.*, 2019). The age of an organization was also studied to be influential in a way that the younger the companies they were believed to be faster and easier adopters of a new technology (Msomi *et al.*, 2019; Pradhan *et al.*, 2020).

In the category of knowledge, employees' technical knowledge has received the most attention from researchers. It was discussed that employee's knowledge and prior experience of technology influences their own motivation (Okundaye *et al.*, 2019), innovative leadership (Ngibe and Lekhanya, 2019) as well as the new technology adoption cost (Al-Tit, 2020), speed, and efficiency (Kossaï *et al.*, 2020; Mbatha and Ngwenya, 2018).

Accordingly, research also shows the higher the knowledge, the lower the resistance to change, which was identified as one of the most influential concepts in the people category (Kannabiran, 2012; Saka and Chan, 2020; Sridevi, 2019).

Many other researchers paid attention to studying the financial category of concepts in which the cost of technology adoption was at the center of their discussion. Lower cost of adoption was found to have a strong influence on the adoption of a technology (Masood and Sonntag, 2020; Pradhan *et al.*, 2020), and it was also discussed to be associated with the risk of technology adoption (Ghobakhloo and Ching, 2019).

The discussion around cost has also led research into focusing on resources and in specific financial resources has received the most amount of attention. Lack of financial resources was studied to be one of the concepts negatively affecting the adoption of new technology in SMEs, especially with lower tolerance to longer product development periods in SMEs (Lim and Baharudin, 2013; Masood and Sonntag, 2020; Ngo *et al.*, 2020; Sutton, 2015). Less attention was paid to the strategy, regulations and infrastructure category of concepts. The studies on strategy were scattered around the perceived risk of a specific technology (Shahzad *et al.*, 2020), inefficiency in strategic orientation in SMEs (Astuti *et al.*, 2020), not having a clear strategy or communication (Al-Tit, 2020; Faridi and Malik, 2020), and identifying them as barriers to adoption of new technology in SMEs. In regulations studies, lack of government support in terms of regulations, institutional push and providing an efficient legal environment, especially in the adoption of emerging technologies, was discussed (Chau *et al.*, 2020; Li *et al.*, 2019; Saka and Chan, 2020).

The final identified category was infrastructure which most of the research was around the role of IT infrastructure in SMEs in the adoption of new technology. Studies show that SMEs with a better, more efficient and more diverse IT infrastructure in terms of technical stacks, have a higher rate of success in the adoption of new technology (Giotopoulos *et al.*, 2017; Hernandez, 2018a; Mokhtar, 2016; Salah *et al.*, 2019).

On the other hand, researchers such as Venkatesh *et al.* (2011) claimed that there is a need for modification, revision and extension of an individual model for the adoption of technology.

Therefore, researchers came up with extensions and modifications of TOE with a number of other popular theories like DOI, TAM, TRA, TPB and UTAUT, etc. The majority of the studies adopted one framework, and only 6% of the studies counting for 20, implemented integrated frameworks, which also discussed that it is not enough to consider one theory only and that one theory alone cannot cover influential categories. Besides the number of studies that used integrated frameworks being small, these small number of studied maximum integrated two of frameworks. Each of these frameworks is also limited to a group of influencing concepts which are not covering the identified 11 categories. These gaps are shown better in coming illustrations. Figure 8 shows an integrated framework of all most used theories in this SLR.

The observation in this figure, showing the overlap in the technological category of concepts which indicates the emphasis on this category by DOI and TOE, is also indicated in Table 1 as the most studied category of influencing concepts. Figure 9 shows a mapped version of this integrated model to 11 identified influencing categories. The solid line boxes are the categories taken into consideration, and the dashed boxes indicate the missing categories. Keep in mind the dashed categories are also being studied in the literature, but not from a framework perspective and rather as a stand-alone category of influence.

Figure 9 shows that even in an integrated framework of all the top six theories of adoption of technology and innovation, you can see that only a limited number of categories are studied and taken into consideration.

4. Conclusions

This paper was initiated to investigate and determine the current body of knowledge regarding the adoption of technology in SMEs. In this paper, 349 articles were reviewed using the SLR method.

I drew two main conclusions from this study, including a few sub conclusions.

4.1 The scatteredness (theoretical and conceptual) and weak application of theory

This indicates that although the studies on technology adoption in SMEs are rich in numbers, it still does not own a comprehensive theoretical framework developed for it.

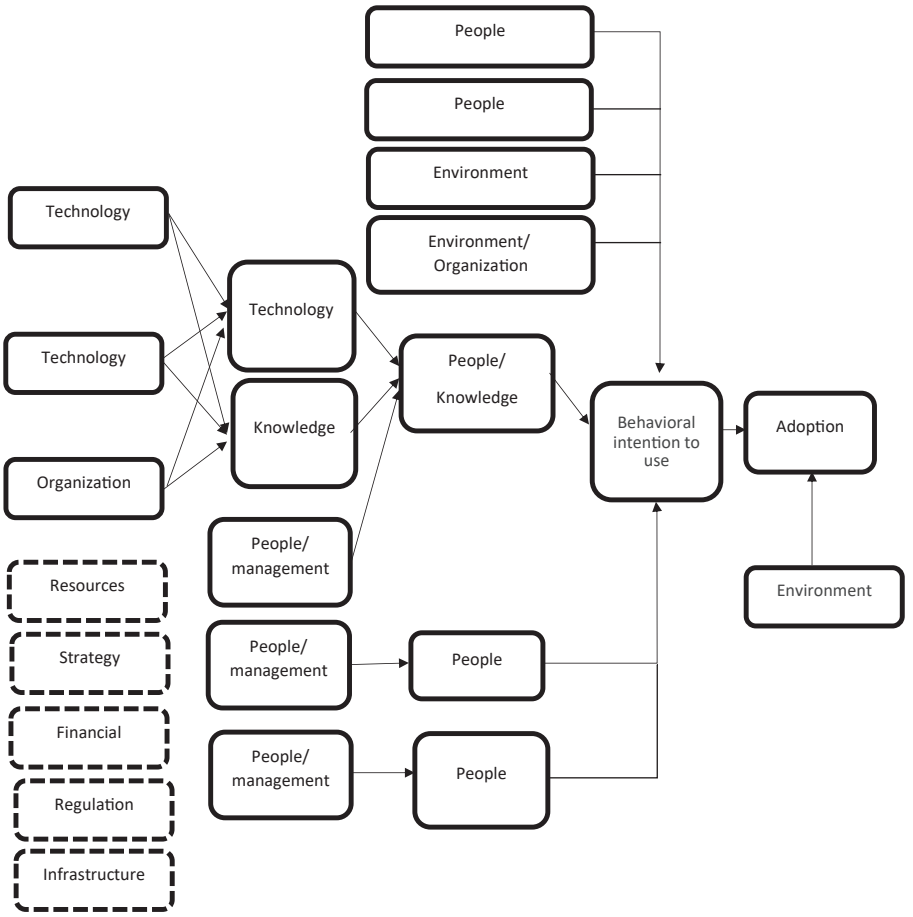

Figure 9.
Categories mapped on integrated framework

4.1.1 Limited and random influential concepts being studied. The lack of such a comprehensive framework has led to literature focusing on a limited number of influential concepts on technology adoption in SMEs. Moreover, the findings presented how the literature has randomly mapped the influential factors on technology adoption. These random factors are chosen based on what theory, framework, or model was being adopted or picked from previously empirically tested and validated concepts in this field of research (Ramdani *et al.*, 2013). The finding also indicates that none of the available theories, frameworks, or models takes into consideration all influential factors identified in this paper.

4.1.2 Interrelatedness of influential factors. Additionally, it is indicated that all these 11 identified concepts are intertwined and interconnected with each other and drawing a line to separate them or separately studying them can mislead researchers or leave out essential pieces to be studied and this again highlight the need for a comprehensive theory.

4.1.3 Deeper studies of influential categories. This scatteredness and weak application of theirs is even observed in the literature on the most studied concepts like technological concepts. This paper identified 11 categories of concepts influencing technology adoption in

SMEs, which are technological, environmental, organizational, financial, regulations, people, management, infrastructural, resources, strategy and knowledge. Digging deeper into the most studied categories which each come with their own influential concepts, there is a concentration on a few of those influential concepts. For example, in this study the technological category is the most studied category of concepts which indicated the focus of research on technical aspects of technology adoption. Although technological category have been the center of attention in research in technology adoption, yet among the influencing concepts in this category, the concept of *technology type* is certainly under-researched among all concepts, though it comes with its influence on the adoption of a technology (Clohessy and Acton, 2019; de Corbière *et al.*, 2019; Okundaye *et al.*, 2019). With the rise of disruptive technologies like Blockchain, Machine Learning, the Internet of Things, etc., and considering the fundamental changes they make in an organization, studies around the effect of type of technology in the adoption of technology in an organization can be studied to a larger extent.

4.1.4 Standalone studies. The findings also show among all influential concepts, some are not studied through a robust framework and some other are rather studied as a stand-alone concept such as resources (Saka and Chan, 2020), financial (Pradhan *et al.*, 2020), strategy (Shahzad *et al.*, 2020), infrastructure (Skafi *et al.*, 2020) and regulations concept (Chau *et al.*, 2020). However, on the other hand, the industry often speaks about the role of regulations and government policies in the mass adoption of emerging technologies by SMEs, which opens a gap in research (Bakar *et al.*, 2020).

4.2 Technology adoption in SMEs from process perspective in a dynamic environment

It is vital to keep in mind how all of these new technologies evolve and mature up during the time, which highlights the need to study technology adoption in SMEs from a process perspective. Current studies on technology adoption rather look at technology adoption as a static and one-time event than a dynamic process which is not aligned with the dynamic and fast-changing digital era the organizations are living in today (Venkatesh *et al.*, 2011). Furthermore, when this paper refers to dynamic, it is not limited to dynamic aspects of an adoption process over time but also takes into consideration how dynamic and ever evolving the nature of new technologies are, such as Blockchain that is evolving on a daily basis.

To sum up, it is concluded in this study that the research in adoption of technology in SMEs rather needs to look at technology adoption from a dynamic process perspective. This dynamic process study needs to include all influencing concepts through a more comprehensive or integrated framework that can address the characteristics of today's dynamic emerging technologies while taking into consideration the SMEs characteristics. This would advance the study of technology adoption in SMEs by supporting them through development of a framework that rather helps SMEs by making it easier and faster to adopt technologies and so to be able to compete in this digital transformation more efficiently.

5. Future implications

In this paper, I have future implication suggestions both for researchers and practitioners. This study provides researchers with an in-depth knowledge of influencing concepts and factors on the adoption of technology in SMEs. As the identified gaps suggest, future research could benefit from looking into technology adoption from a process perspective. In today's dynamic world and the rise of disruptive technologies, research on the identified gaps of type of technology, regulations and dynamicity becomes even more critical. For that reason and based on the findings and conclusions in this paper, the following hypotheses are

suggested to be addressed in future research to be studied quantitatively to assist in designing an integrated/comprehensive framework:

The first hypothesis is referring to the lack of studies in the regulations category and is seeking an answer to the relationship between regulation and policies of institutional context the SMEs operate in and the technology adoption in SMEs.

H1. The institutional context in which the SMEs operate, in terms of government regulations and policies, is positively related to the adoption of technology in SMEs.

H1a. The more regulated the institutional context, the easier the technology adoption in SMEs.

H1b. The more aware the government is about the technology, the easier the adoption of the technology in SMEs.

The second hypothesis is referring to lack of deeper studies in influential factor in technological category and focuses specifically on technology type.

H2. The technology type in terms of maturity and scalability is positively related to the adoption of technology in SMEs.

H2a. The more mature the technology, the easier the technology adoption in SMEs.

H2b. The more scalable the technology, the easier the adoption of the technology in SMEs.

The third hypothesis refers to dynamicity of both the technology and the context. Technology dynamicity in this paper refers to the evolvements of the technology over time. The context dynamicity refers to the changes in the context of technology adoption such as the environment over time.

H3. The dynamicity in terms of technology dynamicity (evolvement of the technology over time) and context dynamicity is positively related to the adoption of technology in SMEs.

H3a. The more dynamic the technology, the easier the technology adoption in SMEs.

H3b. The more dynamic the context of technology adoption, the easier the adoption of the technology in SMEs.

Additionally, qualitative study to fill the gap of research in the dynamic process of technology adoption is suggested to be performed to be able to answer two proposed research questions:

RQ1. How is the process of technology adoption evolving in SMEs in terms of phases?

RQ2. What are the influential concepts in different phases throughout the process of technology adoption in SMEs?

The answer to these hypotheses and research questions can give more insight and prepare the research society to develop the needed framework to study dynamic technology adoption in a dynamic era for SMEs.

As for practitioners and policymakers in SMEs, this study provides them with categories of concepts they need to take into consideration while planning or considering the adoption of technology. The suggestion for them is to ensure they consider the maximum number of possible influencing factors, and that they strategize their adoption roadmap accordingly. This study provides them with a helicopter view of the barriers and supporting factors throughout their technology adoption journey, and therefore, they can be more prepared for it.

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About the author

Seyedeh Zahra Zamani is an industrial PhD candidate. Her PhD research is in adoption of blockchain technology in small and medium enterprises (SMEs) and she conducts her research at the University of Halmstad, Sweden. She works as Chief Solutions Architect at Swedish blocklchain company, ChromaWay and is a blockchain architect in technical expertise. She started her research path in travel technologies in SMEs and eventually evolved to study adoption of blockchain as a disruptive technology in SMEs. She is among the expert panel members of EU Blockchain Advisory and Forum. Her international and diverse tech experience has resulted to be featured as one of the 21 women in blockchain in 2021 by Fintech Review and 10 most influential women in technology in 2021 by Analytics Insights. Seyedeh Zahra Zamani can be contacted at: zara.zamani@hh.se