Journal of Global Entrepreneurship Research (2021) 11:175–188
https://doi.org/10.1007/s40497-021-00273-2

REVIEW

An overview of cloud computing in SMEs

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Received: 7 December 2019 / Accepted: 28 February 2021 / Published online: 28 April 2021

Abstract

The emergence of the Web in 1990 gave rise to cloud computing; a disruptive innovation in the bird's-eye view of information technology. Cloud computing essentially sidesteps the need for capital investments in hardware and expensive information technology, yet has many hurdles to overcome. The purpose of this review is to identify the most discussed topics and relevant theories, while also focusing on the influential factors of cloud adoption in small and medium enterprises. This paper provides an investigation of 25 conference papers, articles, and review papers listed in Scopus and 67 articles from popular publications like Emerald Insight, Elsevier, and Sprouts. Articles are comprehended in three stages: (1) word frequency query, (2) cluster analysis, and (3) narrative review. Thus, the research design cumulatively covers 92 articles and uses two review methods; systematic and narrative. The synthesized outcome of the literature identifies four interrelations of topics; cost-services, adoption-factors, technology-business, and cloud-computing, while pinpointing at "policy" as an outlier. Findings highlight the applicability of influential factors such as "cost" and "flexibility" to multiple benefits of cloud computing, both tangible and intangible. The results encapsulate the synthesis of theoretical models (Technological-Organization-Environment framework and Technology Acceptance Model). Other summarizations are their embedded constructs, impediments, and cloud economics. The roles of other stakeholders enhance cluster-wise e-readiness for all-round benefits. Practitioners can leverage cloud benefits to augment successful adoption and diffusion. Researchers can look forward to addressing gaps in the area of policy, risks, and service models to facilitate the business aspect of cloud technology.

Keywords Cloud computing · Cluster analysis · Narrative review · Small and medium enterprise · Systematic review

Introduction

Enterprises are constantly focusing on their core competencies. Hiring managed services like cloud sourcing not only contain operational costs but also improve efficiencies. Small and medium enterprises (SMEs) represent a key market for such cloud-based offerings. Cloud computing (CC) essentially sidesteps the need for capital investments on hardware and expensive information technology (IT) infrastructure (Kramer 2014). The provider hosts products and services from a far-off location through his energy disbursing servers, and the consumers simply begin to use the network without fitting or installing anything. These services may be hosted in a public cloud, private cloud, or hybrid network (Mell and Grance 2010). Interestingly, shared cloud infrastructure or the public cloud has become ubiquitous and offers key value propositions like reduced costs and reduced return on investment (Doherty et al. 2015).

Business information and innovations such as cloud computing compel every small enterprise to chase technology (Soon et al. 2014). The reason is simple. SMEs are a vast resource of employment, revenues, and export earnings, representing a major portion of a nation's economy (Javalgi and Todd 2011). To paraphrase Subrahmanya (2007), globalization is in progress, ushering in the rapid flow of foreign direct investments into newly industrialized countries.

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Accounting for a $241 million market (a Forrester report), cloud computing is commercially important for SMEs to integrate into a global business.

CC emerges as a new promising paradigm in outsourced technology (Muhic and Johansson 2014). The assumption could be troubling for one reason. The dilemma is in the adoption of CC. Advocates of outsourced technology prioritize reduced energy consumption and reduced e-waste generation (Raut et al. 2019). Also, cloud computing qualifies as a disruptive innovation, possessing the required elements such as on-demand, low cost, and low infrastructure that threaten the existing premise-based IT market (Sultan 2013). However, scholars do not ignore the in-house development of an application that allows cost control and customization of business function processes (Tarhini et al. 2018).

Moreover, it is also argued that out-band reach and electronic wastages outweigh the cost and feature benefits of cloud technology (Soon et al. 2014). From this summary, it is unmistakable that a potential adopter requires the technology's merits and demerits before decision-making. In Haleem et al. (2018), an aspect called technology assessment serves as a benchmark to identify available technologies and evaluate the organization's outcomes.

On the downside, the literature reveals that cloud adoption is in an infant state, specifically in SMEs of developing and less developed nations. Gutierrez et al. (2015) point out that the related infancy of CC could be a cause for its low propensity for adoption. Furthermore, it could result in a lack of sufficient confidence and interest to learn among the SME owners. This issue is also explained by some unresolved issues such as large savings not materializing, vendor lock-ins, service level agreements, and migration interfaces (Kramer 2014). Undoubtedly, cloud migration draws attention to the role of cloud providers and their service strategies in small enterprises (Wang and He 2014).

The above outline has left us some questions, such as what stimulates an SME to embrace cloud technology. Will it be a strategic choice for an SME to adopt a cloud? How will a firm evaluate cloud suitability? It is required to understand if academia has addressed a practitioner's vision of cloud computing for SMEs. At the core, the study aims to address the fundamental research questions (1) What are the frequently discussed interrelations of topics and relevant theories in the area of CC in SME? (2) What are the most influential factors impacting the adoption of CC in SME?

Although CC has been largely researched from technical aspects, more needs are to be done from commercial and business relevance as stated by Yang and Tate (2012). Literature has reviewed articles relating to the drivers and barriers of cloud adoption (Alshamaila et al. 2013; Doherty et al. 2015; Li et al. 2015), business performance (Vasiljeva et al. 2017), financial metrics (Vidhyalakshmi and Kumar 2016), security and privacy concerns (Gupta et al. 2013; Priyadarshinee et al. 2017; Sinha and Sharma 2015; Sultan 2011; Vidhyalakshmi and Kumar 2016), governance structure (Prasad et al. 2014), and green benefits of cloud computing (Subramanian et al. 2014). Such contemporary issues have glossed over the business aspects of cloud computing. Beyond adoption and the appealing promises of CC, we make attempts to overview the contemporary landscape of this research stream, given its current importance.

We explore and analyze the most widely used theories, discuss interrelations between relevant topics, and identify significant factors impacting CC adoption. A systematic review of 25 articles is first conducted by employing the method of word frequency statistics. It is followed by the clustering of main topics to fulfill our research questions. The output is a model framework called the dendrogram and is used in our study to scrutinize the research substance. Furthermore, 67 articles were reviewed to discuss the top four co-occurrences that carry high interrelations across topics. Policy, though less extensively researched, is also discussed in this study.

The paper is arranged as follows: the "Introduction" section provides introduction and motivation. The "Review methodology" section describes the review methodology, wherein we conduct a systematic analysis of papers through the tool-supported procedure. Literature analysis and interpretation, which constitutes of review of topics and sources, are presented in the "Literature analysis and interpretation" section, followed by a narrative review. The last section concludes with inference, implications, the scope of further research, and limitations.

Review methodology

To identify the main topics and widely used theories, we first use systematic review, synthesize, and produce a transparent and clearly stated output. Scopus database provides the relevant articles for a systematic review. In the subsequent method, we conduct a narrative review, to cover the relevant theories and adoption factors comprehensively. The review is structured around two important technology adoption theories; the Technology Organization Environment (TOE) framework and the Technology Acceptance Model (TAM). The narrative review also deepens our understanding of the co-related topics and common content of sources. The sources are extracted from popular publications like Emerald Insight, Elsevier, Sage, and Sprouts, a few conference papers and, book chapters. The research framework is represented in seven steps, as guided by Karunakaran et al. (2015).

Step 1: Research questions identify the research area and formulate research questions.

Herein, this review, motivated by the business perspective of cloud, focuses on two research questions; (1) What are the frequently discussed interrelations of topics and relevant theories in the area of CC in SME? (2) What are the most influential factors impacting the adoption of CC in SME?

Step2: Article Search 1 conducts an article search to identify relevant papers in the Scopus database.

Our initial search in Scopus used the keyword "cloud computing" keeping subject areas such as computer science, business management, decision science, social science, and engineering as constant. The search produced 503 articles for the period 2000–2015. A further search of combined keywords such as "cloud computing and SME" produced 30 documents in one subject area (social science). These included articles, reviews, and conference papers. We eliminated anonymous reviews and articles that had a loose relation to cloud computing. All articles are in English language only.

Exclusion criterion: loosely related articles—three, anonymous reviews—two

Thus, the total number of articles finalized is 25.

Step3: Word density identifies routinely used words in the content through word frequency search.

The word frequency is an indication of its intensity of usage in a given text or source. We do the search plan in 25 papers with two sub-steps (a) word query of sources and (b) word query of the term. The process is directed to condition the papers for generalization of words, a procedure in which the process of stemming (nouns, verbs adjectives, and adverbs) is taken into a single word. Table 1 contains a list of the top nine words based on their density measured through the weighted average. The query produced one hundred types of words in all in the entire source data and a total of 197,084 words, which means an average of 12,317 words per paper. An additional requirement of our study is to find relevant factors. Therefore, we repeat the word search process for the term "factor" to locate dense determinants of cloud adoption. We shortlisted three words for discussion, based on their weights and relevance. They are cost (Wt.avg.: 1.05), flexibility (Wt.avg. 0.91) and services (Wt.avg.: 0.91). Cost and flexibility are found to be motivating factors and strategic elements of competitive advantages (Muhic and Johansson 2014).

Step 4: Developing a model framework.

Clustering is a characteristic feature of this work for bringing out interrelations between two topics or sources. It is adapted from Karunakaran et al. (2015), whose work analyzed decision themes by clustering related decisions concerning a business aspect. In this review paper, Jede and Teuteberg (2016) combined the word frequency statistic with co-occurrences to enable a better understanding of their complex text.

The NVivo software uses nodes specifically, in a cluster to represent a theme, occurrence, person, or organization. The word frequency statistics augmented by representative literature are taken to finalize the set of nodes. Thus, we identify nine nodes (Table 1) based on two criteria, a weighted average of words and a survey of the literature. They are adoption (0.88), factor (0.34), cloud (2.07), computing (0.77), technology (0.79), business (0.77), services (0.90), cost (0.40), and policy (0.25). We then code relevant contents of the papers to the nodes by an extensive review of the literature and subsequently subject the nodes to cluster analysis. NVivo processes the outcome, which is called the dendrogram. Sokal and Rohlf (2017) define dendrograms as diagrams of relationships that carry statistical significance. Dendrograms represent clustered nodes with coding similarity. Similarity co-efficient termed as Jaccard's index (JI) measures interrelations between occurrences. JI is denoted by

$$J = a/a + b + c$$

"*a*" represents the report's paragraph where both the nodes occur, "*b*" and "*c*" represent the report's paragraph where either of them occurs (Tan et al. 2005). The dendrogram (Fig. 1) depicts relationships between any two nodes by Jaccard's index. Nodes representing the highest four values (Table 2) are adoption and factor (0.59), cloud and computing (0.55), technology and business (0.60), and services and cost

Table 1 Word frequency—stemmed

	Weighted percentage (%)
Cloud	2.07
Computing	1.32
Services	0.91
Adoption	0.88
Business	0.77
Technology	0.79
Cost	0.40
Factor	0.34
Policy	0.25

Table 2 Nodes clustered by coding similarities

Node A	Node B	JI
Cost	Services	0.73
Business	Technology	0.60
Factors	Adoption	0.59
Computing	Cloud	0.56

(0.72). As observed, policy is an outlier on account of its low interrelations with each node (JI = 0.1).

We run another loop of cluster analysis in the same manner, on sources to determine common content discussed by two types of research.

Step 5: Article search2, a manual search plan

In this manual plan, we search for relevant articles that discuss the identified dense words to sync with our focus. This search extends up to the year 2017.

The highest interrelated topic, one of the highest weighted average words and a crucial factor for adoption, is found as "cost." Therefore, we are directed to also evaluate cloud economic models for highlighting the potential cost benefits. The manual search plan extracts 67 articles within top-ranking journals. We interpret all 67 articles by narrative literature review, which has 2-fold goals; (a) to deepen our understanding of the identified interrelated topics and interrelated sources (b) to analyze cloud adoption framework and models; TOE and TAM.

Step 6: Data collection

We tabulate a total of 92 articles, 25 out of article search process1 and 67 out of article search process2 in a structured manner with recorded author names, titles, context, relevance, methods, data analysis, variables used, conclusion, and gap. We also classify them under main topics such as TOE and TAM models and cloud economic models.

Step 7: Data analysis

We examine the research density of most occurring topics based on the dendrogram framework, classify theories, and identify factors based on word frequency statistics. The model framework fulfills our research questions.

Literature analysis and interpretation

Cluster analysis of main topics

Cost-service (JI: 0.72)

Cost and services are the most widely observed topic, both in terms of interrelation and weighted average. Referring to cost leadership by Porter (1980), a firm benefits enormously in low investment and the lowest maintenance information technology costs in the industry, and at indistinguishable service quality (Jede and Teuteberg 2015). The cloud has always been an ideal outsourcing paradigm for small enterprises, due to its lowered cost of entry. The cost efficiencies have thus opened

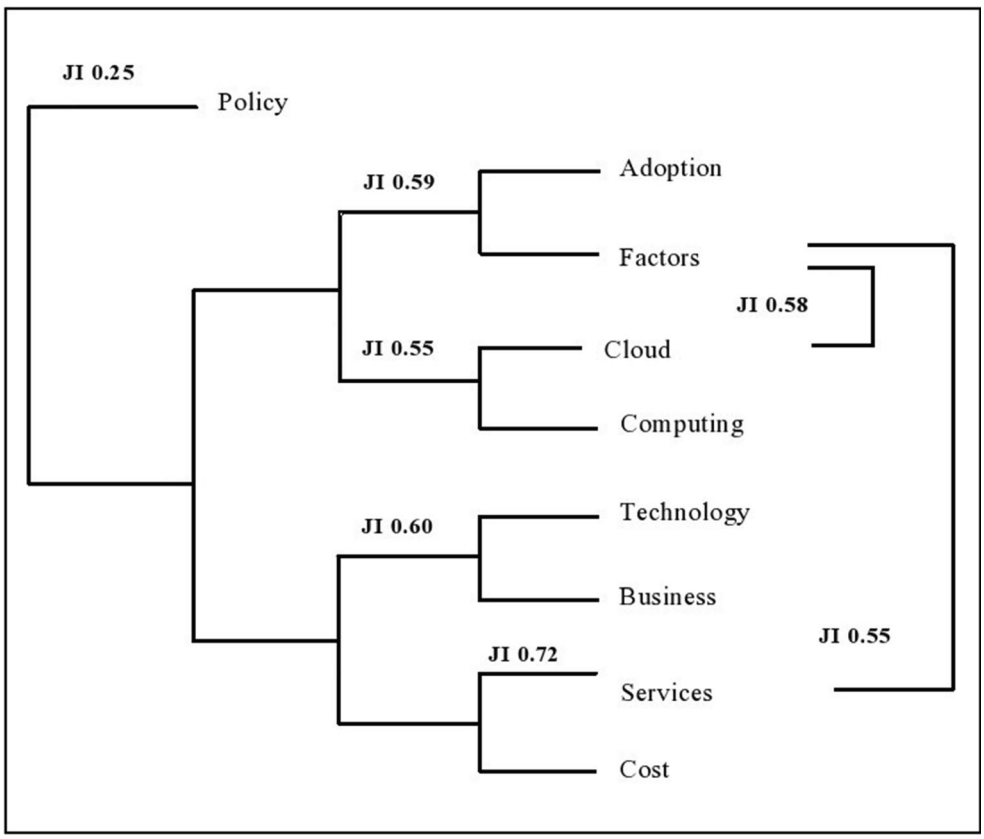

Fig. 1 Dendrogram 1-nodes clustered by coding similarity

up vast opportunities, especially in the third-world countries (Chong et al. 2014).

Researchers have produced a multitude of cost benefits (Doherty et al. 2015; Marian and Hamburg 2013; Ross and Blumenstein 2013; Scott and Watson 2012; Sultan 2011) that can be widely divided into tangibles (low operational cost, low maintenance cost, space utility) and intangibles (resource optimization, less downtime, scalability, flexibility). Cloud services concerning costs are not fastened to direct capital investments. CC and its architecture simply offer data accessibility without having to worry about hardware and platforms (Agostino et al. 2013). That also makes base cost matter for small enterprises and enables a cloud utility model to restrain small baseline specifications (Soon et al. 2014).

SMEs are also less sensitive to the unexpected. Soon et al. (2014) pointed out that economic turbulence had no impact on IT investment decisions; bare bone utilization is a way forward during economic uncertainty. SMEs can choose to buy services that deliver only solutions relevant to their specific market sector. By doing so, they achieve optimization, especially from a fit-all product that offers minimal value (Agostino et al. 2013). Many researchers (Li et al. 2011; Sultan 2011) are upbeat about the public cloud compared to a private one for its features (e.g., metered software use, less infrastructure, and less skilled labor). While it is easier for SMEs to remain attracted to the available features, a lack of skills in risk management can lead to mistrust in the public cloud (Brender and Markov 2013).

Taken independently, end users can access the deliveries on Software as a service (SaaS), Platform as a service (PaaS), and infrastructure as a service (IaaS). Software as a service is more cost-effective and can deliver applications like email, backup services (Mozypro), and video conferencing (Dialcom) that are found most suitable for SMEs (Ariwa and Ibe 2013). A look into the market brings forth communication tools like LiveMeeting and unified communications that enable quicker transmission and less travel (Scot & Watson, 2012). Allied with information interaction is the need for proactive resource sharing among different roles (Xu 2018). Such needs put real-time access to information on the radar of SMEs with the help of cloud-based customer relationship management (CRM).

Should we critically view the unconscious assumption of cost reduction? Others who share this belief that cost is not a very important factor are Jede and Teuteberg (2015) and Kannabiran and Dharmalingam (2012). It is well known that the ease of use and convenience replaces cost. The exponential growth of handheld gadgets, such as tablets and smartphones (Gupta et al. 2013), serves as an excellent example. Another instance is from the health care industry; smartphones, personal computers (PC), and personal digital assistants (PDA) promise relief to medical staff and patients. Such devices are persuasive to cloud-based applications (Sultan 2014) for the fact that CC is device-independent.

Our second loop of manual search on cloud economics produced work done on cost-benefit analysis (Walterbusch et al. 2013); a mathematical model to evaluate the return on investment (Schniederjans and Hales 2016), furthermore, to optimize economic performance and environmental performance (Alkhalil 2013). Researchers use cost-based models such as total cost of ownership (TCO) and transaction cost economics (TCE). Quantitative researches focus on return on investment (ROI) calculations, while qualitative researches focus on business strategies and model classification. Both cost and services are best described in a cloud computing business model developed by Chang et al. (2013). The bottom-up approach of this framework focuses on the delivery of services, and the top-down approach provides strategic directions.

Although research on the implications of the cloud has not broadened (Walterbusch et al. 2013), benefits management in

Table 3 Examples of cost-based papers

Author(s)	Context	Theoretical model	Significant factors
Schniederjans and Hales (2016)	CC in supply chain collaboration	TCE	Waste management, optimized material purchase, reduced operation cost, profitability, reputation, assets, sales growth, ROI
Walterbusch et al. (2013).	CC services in start-up companies	TCO	Cost-type (T) is a function of application cost factors (f). Cost types—strategic evaluation, service (IaaS, Paas, SaaS) costs, implementation, training, maintenance, system failure, backsourcing. application cost—expended time, computing power.
Misra and Mondal (2011).	Modeling cloud's return on investment	ROI	Investment in IT, usage pattern of resources, data susceptivity, work criticality, factors for ROI model are CC intangible benefits like cost-saving, flexibility, scalability, time value, customer satisfaction, faster time to market, focus on core competencies, disaster recovery, risk.

cloud services has been investigated through cost-benefit analysis (see Table 3). Several such related surveys provide insights to CC users in determining direct and indirect costs and minimizing risks. Firms may keep the total cost of ownership (TCO) unchanged, meaning that the firms may account for only fixed costs and ignore the "other costs" (Walterbusch et al. 2013). On the contrary, Misra and Mondal (2011) suggest that costs such as operational costs and costs saved out of elimination/reduction of the data center are equally critical for calculating the return of investment (ROI). By including intangible benefits and quantifying them in the calculation, ROI sums up CC economics. Economic performance is also viewed together with environmental performance in the transaction cost economics (TCE) model (Schniederjans and Hales 2016). The idea behind TCE is that when CC enables the reduction of solid wastes and energy consumptions, firms are improvising environmental reputation. If environmental performance improves, economic performance would be achieved. Table 3 summarizes the significant factors corresponding to the three aforementioned research studies.

The developing and less developed countries have inadequate basic infrastructure, which at the firm levels relate to financial, managerial, and technical resources (Zhu et al. 2004). Opportunity costs of resources in such countries are never low (Heeks 2002). What can be lucrative to the SMEs in developing nations is the cost component and service delivery of affordable technology. Here, the basic infrastructure, such as broadband speeds and increased usage of mobile devices, is intensifying and sufficient enough to enable cloud technology (Sultan 2013). Also, broadband in developing economies costs higher than in developed economies. Nevertheless, studies reveal that perceived costs of IT are significantly important over adoption (Ghobakloo & Tang, 2013). The cloud's perceived cost reduction in the form of high quality and green services can mean one unique opportunity to acquire inexpensive word-class IT capabilities (Subramanian et al. 2014).

Technology-business (JI: 0.60)

Technology must be seen as an inherent part of a business system (Morgan-Thomas 2015). Bringing technology into business means converting cloud computing benefits into a competitive advantage. Such actions enable SMEs to improvise their competencies (Alshamaila et al. 2013). To do so, SMEs must become first movers than laggards (Lian et al. 2014). It is then that a developed IT infrastructure can become more relevant to move the SMEs into the global competition (Alkhalil 2013). The aspects that make cloud occurrence grow more and more each day are dynamic, flexible, and cost-based efficient. Cloud migration will allow the firms to leverage their investments to design unique IT assets and skills with a promise of gaining a competitive advantage. When technology gets obsolete, the competitive advantage becomes meaningless. For those who see cloud computing as an emerging computing resource model, the fear is concerning the maturity of technology (Sultan 2011). As an effect, vendors attempt to overcome mature markets with negotiable price packages (Soon et al. 2014). On the whole, cloud computing can be viewed as a strategic technology by the tangible business benefits that it promises to deliver.

Recent research points of interest are in technological concepts like disruptive innovation, business intelligence, and green IT influencing cloud adoption. There are many aspects of cloud computing to qualify as a disruptive innovator if one has to engage the theory of disruptive innovation developed by Christensen et al. (2004). CC can enter a new market by spending IT resources with its innovation or a low-end market by destabilizing the existing premise-based IT market with low costs and infrastructure (Sultan 2013). Subramanian et al. (2014) provide an excellent example of the innovative Chinese small logistic providers eager to adopt CC for survival and sustenance, through "green tags." They propose that rising environmental consciousness and demand for green product services are precedents for others to follow. An evolutionary model developed by Scott and Watson (2012) identifies value dimensions relevant to green IT, basically to address society's needs in terms of reducing energy costs and combating global warming. It is a valuable guide for whom green IT is a value challenge.

Adoption-factors (JI: 0.58)

Factors for adoption are central to our paper's second research question. A multidimensional concept, cloud adoption, has been evaluated from technological, socio-technical, organizational, and cultural aspects. Previous studies into the relationships of adoption factors largely remain conclusive that technological factors such as relative advantage, compatibility, and complexity exist significantly along with the environmental factors such as trading partner pressure and competition.

Technically, the role of flexibility is seen as a key component under adoption factors. Research cites this factor together with elasticity as a significant determinant of cloud sourcing (Alkhalil 2013; Doherty et al. 2015; Muhic and Johansson 2014). The ENISA survey found that 68% of the SME responses indicated that it is not viable to avoid capital expenditure in IT infrastructure, while almost 64% responded to flexibility and scalability of IT(Sultan 2011). Some of the areas that benefitted from this determinant were supply chain management (Jede and Teuteberg 2016), remote workforce (Scot & Watson, 2012), healthcare (Sultan 2014), and intelligent manufacturing (Yan et al. 2017). What should not be ignored is the desired grade of flexibility that still demands

manual and technical skills. Assante et al. (2016) advocate "didactic units" to tackle this barrier. The units include technical skills related to data integration, analysis, and other business skills such as contract and vendor negotiation and security compliance.

Other than cost factor, an SME also looks at security very seriously both in terms of payment security and information security (Kannabiran and Dharmalingam 2012). However, the concerns of privacy, security, and lock-ins still loom large (Muhic and Johansson 2014). Scholars have accentuated the element of trust as an essential attribute for transparent service level agreements (Alshamaila et al. 2013; Gupta et al. 2013; Li et al. 2015; Low et al. 2011). Other measures, such as data residency, and offline function, draw the attention of service providers and reduce the uncertainties and risks of the potential adopters and prospectors (Shetty and Panda 2020).

Other basic non-adoption causes indicated are financial constraints (Deniz and Kuyucu 2011), lack of human infrastructure, and the absence of IT infrastructure (Sinha and Sharma 2015). For example, a developing country like Morocco reported challenges such as expensive hardware and software, and a lack of trained and skilled IT workers (El Garah et al. 2010). Likewise, developing countries of South Africa hesitated due to doubts on technology performance. They were inhibited by its risks, security, lack of vendor trust, function suitability, customization limitations, and above all, satisfied with their existing systems (Faasen et al. 2013). In developing countries, we must take cognizance of the lowest basics, like energy and power that hinder technology adoption.

Notwithstanding the diversity of perceptions, every country has a developmental pattern in technology adoption, which affects the cloud landscape. For example, Indian SMEs are likely to be motivated by cost-saving. For their Latvian counterparts, data security concerns pose a major issue. Innovation in small firms flourishes under pressure, especially when the firms have a distinguished position in the supply chain of transnational companies (Shetty and Panda 2020). Nevertheless, Kshetri (2015), in his study of Chinese industries, contested the expectations of trade and professional association. Few other scholars have found significance in organizational factors, namely, organization readiness (Low et al. 2011) and top management support (Alshamaila et al. 2013; Gangwar et al. 2015). Research identifies other significant factors such as uncertainty, geo-restriction, compatibility, trialability, size, prior experience, innovativeness, industry, market scope, supplier efforts, and external computing support. The above issue explains that researchers can try a different set of adoption factors and offer their model as starting blocks to reshape dimensions appropriate to contexts.

Cloud-computing (JI: 0.55)

Interrelation is an obvious result of the basic concept of our search. Cloud computing is a conception against the backdrop of grid computing and virtualization and also an innovation that provides customers with computing services (Alkhalil 2013). With migration, organizations can defeat the under-utilization issues of services. That is to say, organizations can keep their human resources exclusively on core focus and relieve the maintenance resource from avoidable wastage of time (Doherty et al. 2015). According to Deniz and Kuyucu (2011), the three primary motivating reasons for a firm to engage in CC are

- eliminating investment in hardware, software and support system, by engaging the usage-based model
- flexibility and scalability of IT resources
- business progression and resiliency planning.

It is also well known that SMEs face a common threat associated with cloud migration. What could explain such disparity? SMEs, while graduating from non-core business to cloud environment, face a lack of standard in cloud computing. In the cloud, standards give rise to interoperability and integration of applications and data between different vendor clouds (Alkhalil 2013). Such migration issues could disrupt the CC environment. The need for organizational resilience was highlighted by Herrera and Janczewski (2014), who guided the academicians and practitioners to understand the impact of risk and assess ICT's operational resilience. Other explanations may also account for cloud deployment being less desirable. Grubisic's (2014) findings revealed that service persistence and data resistance pose concerns for both vendors and clients. Evidence suggests that inter environmental synchronization can get complex while implementing.

SMEs account for two well-regarded approaches for their growth. One is the efficacy and competence of the decision process, and the other is the change in its organizational structure (Wach 2020). Choosing the right cloud service is a strategic step while migrating to the cloud (Lonea et al. 2012). The decision will be based on what information should move into the cloud and who will access it. In such situations, a clear understanding of a firm's business needs and its suitability test for cloud inclusion can bolster migration decisions (Marian and Hamburg 2013). Suggested deployment solutions for small enterprises are public cloud offerings (Sultan 2011) and Software-as-a-Service (Vu 2017).

Policy (JI: 0.25)

"Policy" is the least researched topic yet commands a high degree of priority. Researchers have found that countries like the United States of America and India have concerns about

cloud adoption on their top agenda (Kshetri 2015). Likewise, scholars have also discussed government-led SMART models for ICT, such as Smart Thailand Vision (Wonglimpiyarat 2014), Digital India, and Digital Bangladesh (Azam and Quaddus 2013). Such models provide thrust to diffusion indicators like mobile penetration, internet usage, and secured servers. From a nation's perspective, policies related to information and communication technologies (ICT) must be driven to impact the economy, society, and governance (Vu 2017). The European Commission Review, 1999, is a forward-looking policy. However, the quick pace at which ICT convergence in the ASEAN[1] countries is being initiated is also encouraging. In this view, India's National Telecom Policy 2012 (NTP 2012), Taiwan's mandate under Ministry of Economic Affairs, Turkey's 5-year document called Development Plan (Deniz and Kuyucu 2011), Information Technology and Broadcasting Bureau (ITBB) of Hong Kong, and Infocomm and Development Authority (IDA) of Singapore have been examples of directing policies towards technology advancement and establishing an information society. Considering the government's role in the nation's ICT ranking, a question regarding the absence of such initiatives arises. Although China strongly advocates cloud services of international standards, a weak civil society may be the cause for its latency in policy initiatives. That is to say, China's state is strong enough to discourage trade association pressures (e.g., cloud service providers) for sensible regulations (e.g., national data protection laws). Other measures that define government quality are transactional clarity, liaison dependency, and problem resolution techniques (Singh and Singh 2018). Policies required for cloud implementation-related issues, as cited by researchers, are concerns of interoperability, sourcing, IT auditing, security and privacy, risks, service level agreements, and contracts. The cloud sector is also the recipient of subsidies and fiscal benefits.

Cluster analysis of sources

From the sources whose interrelations are found high in the clustering of sources, the highest JI rating found is at value 1. Therefore, we analyze the co-occurring contexts of the top four source clusters (Table 4). Business and technology aspects are found co-occurring by surveying the research work of Ren et al. (2013) and Ross and Blumenstein (2015). Both the research works highlight the global competition and international opportunities for a small enterprise. This requires a trade setting that can be transformed by innovation. Innovation and collaboration are influenced by knowledge-intensive and efficient manufacturing (Ren et al. 2013). The new paradigm of cloud manufacturing (Ren et al. 2013) from the technical aspect is considered a viable instrument to get the theory to practice. Keeping the basic concepts in the discussion, we also notice the high degree of priority given to security procedures and protocols. A possible explanation for this might be that improved security and privacy means undisputed reliability for small enterprises (Gupta et al. 2013).

Again, while citing the critical role of CC in accessing global markets (Ross and Blumenstein 2015), we are not ignoring the destructive scenario owing to the failure of adaptation of the cloud environment by some firms. Adoption decisions are the common ground of a survey made by Sinha and Sharma (2015) and El Garah et al. (2010). Most researches indicate adoption metrics, cost-based metrics such as cost of hardware, software infrastructure, training, and skilled labor (Garah et al. 2010). There are non-adopting decisions abound by socio-technical metrics such as interoperability, scalability, and security (Sinha and Sharma 2015). Using factors, El Garah et al. (2010) discriminated adopters from non-adopters to develop a profile of potential users of the cloud, which in turn can influence market design decisions for providers. Decision-making steps for migration can get better when a firm can determine what information moves into the cloud, who will access the information, who the cloud service provider (CSP) is, and how the firm will manage cloud services (Cervone 2010). The point is closely linked to the strategic choice of adoption, as discussed by Li et al. (2012) which emphasized cloud service as an innovation of type III with a core business process. Other types such as type II (innovation assisting the administration of the business) and type I (innovation limited to information system task) in Swanson's (1994) topology provide valuable insights of information systems in larger firms. Such innovation can impact business activity in times of economic turbulence as found by Soon et al. (2014) who interpreted IaaS as barebone cloud technology most suited for resource-constrained SMEs. It is also important to understand other platforms and the types of services involved that enables application build-up (Sinha and Sharma 2015).

A narrative review of theories

We use a narrative review of 67 articles to examine the research essence of the most widely used theories. Early research work identified Innovation Diffusion Theory (IDT) by Rogers (1995) as a widely applied theory for technology adoption studies. Other relevant key theories in previous research are Diffusion of Innovation (DOI) by Rogers (1983); Theory of Planned Behavior (TPB) by Ajzen (1991); Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975); and Technology Acceptance Model (TAM) by Davis (1989). IDT renders decision mechanisms that are explained from

[1] Association of South-East Asian Nations (ASEAN) comprises of 10 nations; Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. ASEAN is a global ICT primarily engaged in producing ICT hardware and ICT service exports.

Table 4 Nodes clustered by sourcing similarity

Source A	Source B	JI co-occurrence
Ross, Peter K.; Blumenstein, Michael (2015)	Ren, Lei; Zhang, Lin; Tao, Fei; Zhao, Chun; Chai, Xudong; Zhao, Xinpei (2013)	1 Business—technology
Sinha, Indrajit; Sharma, Milind Kumar (2015)	El Garah, Wafa; Berrado, Abdelaziz; El Ouarti, Nizar (2010)	1 Adoption
Vidalis and Angelopoulou (2013)	Ren, Lei; Zhang, Lin; Tao, Fei; Zhao, Chun; Chai, Xudong; Zhao, Xinpei (2013)	1 Security
Vidalis and Angelopoulou (2013)	Ross, Peter K.; Blumenstein, Michael (2015)	1 Business—technology

acceptance or rejection of an innovation. DOI by Rogers (1983) defines a pattern of adoption, as explained by psychological and sociological theories. TRA and TPB determine technology adoption on individual levels. TAM is useful in explaining users' acceptance of technology within a different organizational context. TAM uses TPB's behavioral intention to explain the relationship between technology acceptance and adoption (Gangwar et al. 2015). The two core constructs of TAM that influence attitude creation towards the adoption of technology are perceived usefulness (PU) and perceived ease of use (PEOU) (Davis 1989). PU, as defined by Gounaris and Koritos (2008), is the entity that apprehends the advantages of technology while PEOU captures difficulties in learning and using technology. TAM explains the link between the user's perception and the actual use of technology (Oliveira and Martins 2010). Bagozzi et al. (1991) had apprehensions of theoretical strength in linking intention with actual use. By considering just the two direct casual descendants of TAM, we may be missing the other mediators of the external environment, such as individual difference factors, regulations and laws, and geo-restrictions that influence system usage.

Over time, with complexities in innovation, technology for multiple businesses, and inter-organizational systems (Oliveira and Martins 2010), TOE found suitability in explaining adoption at organizational levels. Research shows TOE as a widely preferred theoretical model, comprehensively built on technological, organizational, and environmental factors. First advanced by Tornatzky and Fleischer (1990), the TOE model is based on the three aforesaid elementary characteristics to study firm-level adoption of various technologies. TOE has the advantage of "environment" to explain intra-firm innovation adoption when compared to IDT (DePietro et al. 1990). More insightful is the argument that TOE has an impediment in its constructs when applied to SME since it is assumed to find its use in larger organizations that exhibit certainty in plans (Awa et al. 2015). On the contrary, Alshamaila et al. (2013) found motivational capabilities in TOE constructs and a broader area of environmental context for SMEs.

In response to the assumptions, the premium may be placed on specific settings and external variables (Awa et al. 2015). Various studies have incorporated additional external variables that differ across contexts and their significance (Gangwar et al. 2014). For example, the inclusion of cloud service trust (Li et al. 2015) and process (Agostino et al. 2013) in the TOE framework justified the usage of extraneous variables in the transformation of the process in SMEs. The inclusion of the process model has a central position in terms of operations, functions, and events, directly and indirectly, affected by stakeholders who in turn, affect strategies. Likewise, Hsu et al. (2014) included pricing mechanisms and deployment strategy in the TOE construct for the firms of Taiwan. Lian et al. (2014) study offered a relational perspective of cloud adoption in the healthcare information system in a hospital context by theorizing the Human-Organization-Technology fit (HOT-fit) model with TOE.

Top contributing authors, namely, Doherty et al. (2015), Alshamaila et al. (2013), Gerhardter and Ortner (2013) and Li et al. (2015) examined drivers such as relative advantage, compatibility, complexity, technical readiness, customer demographics, trading partner pressures, social influence, top management support, and firm size.

The two primary attributes, namely, cost and flexibility, whose scoring is high in our word density search, are interestingly significant. Another significant factor, the relative advantage is increasingly finding its way in cloud applications, offering qualities that promise business a variety of gains. Paradoxically, Lian et al. (2014) state in their study that relative advantages in the healthcare industry are relatively unimportant when cloud computing is considered a necessary investment. In Hsu et al. (2014) study, technical readiness in terms of IT capabilities is less prominent in smaller firms.

TOE emphasizes less on individual characteristics such as employee and manager traits. The concept of individual difference factors arises typically in a small enterprise, mainly because the decision-related activities rest with the owners (Rogers 1995). Here individual beliefs stay sententious.

The need for a robust theoretical base has led various studies to use aforesaid additional parameters and integrate theories. Ghobakhloo and Tang (2013) built their model on DOI integrating with TOE using extension factors such as perceived behavioral control and innovativeness. Individual

difference factors (IDF) such as level of education, system expertise, age, and gender form the characteristics of customer demographics. Although some examples of innovation adoption assumed to consider customer demographics (Awa et al. 2015) and as a moderating variable (Giovannis et al. 2012), past researchers (Dickerson and Gentry 1983; Gatignon and Robertson 1985; Ostlund 1974) have not placed importance on this dimension. The impact of gender on the prediction of internet banking adoption revealed marginal variability in behavioral intention among males and females (Giovannis et al. 2012). Also, it is not surprising that attributes vary based on the type of products.

In general, there is expected to be some correlation between the TOE theory and the TAM model. Their relation is highlighted for discussion. On the one hand, the mixing of differences in TOE and TAM will be confronting for some analysts. However, it is suggested that factors like relative advantage and complexity correlate conceptually (Moore and Benbasat 1991) with perceived usefulness and perceived ease of use. On the other hand, it also needs to be explored if the behavior is treated as a means to a more fundamental goal and if usage and ease of use can mediate all influences from the external environment. One way to overcome this difference is to integrate one strong theoretical model. The integrated TOE is enabled with an alternate measure to evaluate the high involvement behavior of a firm and its owner. Integrated theoretical models (Table 5) possess more predictive power and also good predictive performance as substantiated in TOE-TAM (Gangwar et al. 2014), TOE-DOI (Ghobakhloo and Hong Tang 2013), TAM-DOI (Gounaris and Koritos 2008) and TAM-IDT (Giovannis et al. 2012). There is a preference of TOE and TAM over other theories in technology adoption (Gangwar et al. 2014), the relationship resulting in a huge fertility upgrading to a more general level for improved explanatory (Awa et al. 2015).

Conclusion

The concentration throughout the study is to conduct a clear structural analysis that can provide authentic results in the area of cloud adoption in SMEs. Accordingly, a systematic review and a narrative review undertaken in this paper contribute to the knowledge bank, a better understanding of interrelated topics, and key factors of cloud adoption. Also, it provides a comprehensive scope of the theories and the embedded constructs. The synthesized outcome of the literature identified four interrelations of factors; cost-services, adoption-factors, technology-business, and cloud-computing, while pinpointing to the policy as an outlier.

The review findings highlight the applicability of influential factors such as "cost" and "flexibility" to multiple benefits of cloud computing, widely divided into tangibles and

Table 5 Examples of the TOE, TAM, and integrated models in cloud adoption

Author(s)	Context	Theoretical model	Significant factors
Alshamaila and Papagiannidis (2013)	Cloud adoption, SME in NE England	TOE	Relative advantage, uncertainty, geo restriction, compatibility, trialability, size, top management support, innovativeness, prior experience, market scope, industry, suppliers computing effort
Li & Zhao (2015)	Cloud adoption in China	TOE	Reliability, information security, entrepreneurship, institutional pressure, structure assurance, cloud trust.
Shroff et al. (2011)	E-portfolio system in students	TAM	Perceived usefulness, perceived ease of use, attitude towards usage
Ghobakhloo and Tang (2013)	E-commerce in Iran SB	TOE-DOI	Perceived benefits, perceived compatibility, perceived costs, perceived competitiveness, perceived innovation
Giovannis et al. (2012).	Internet banking in Greece	TAM-IDT	Compatibility, risk, customer demographics, perceived usefulness, perceived ease of use
Gangwar et al. (2015)	CC in the Indian industry	TAM-TOE	Relative advantage, compatibility, complexity, readiness, top management support, training and education, perceived usefulness, perceived ease of use
Low et al. (2011)	Cloud in the high tech industry	TOE	Top management support, size, competitive pressure, trading partner pressure.
Gutierrez et al. (2015)	CC in the UK industry	TOE	Technology readiness, competitive pressure, trading partner pressure.
Snowden et al. (2006)	Mobile technology in SME	TAM	Complexity, facilitating conditions, social influence, LT usefulness, ease of use, attitude to use
Gounaris and Koritos (2008)	Internet banking in Greece	TAM-DOI	Relative advantage, image, voluntariness, perceived ease of use.

intangibles. Other significant highlights that fortify key value propositions are the affordable SaaS delivery model and the ubiquitous public cloud. To respond to the current economic situation, SMEs must conceive the convergence of technology between the stakeholders (cloud service provider, government) and their performance. The review provides an alternative to the myopic view on the migration aspects of the cloud by highlighting business resilience and progression. Also, it provides an insight into suitable applications such as outsourcing collaboration software, backup solutions, web-based emails, and data storage that suit an enterprise's business needs and its suitability test for cloud inclusion. The results encapsulate impediments of the theoretical models, their synthesis (e.g., TOE-TAM), the embedded constructs, and also span cloud economics and applications.

Implications

The article has answered our fundamental questions of what stimulates an SME to embrace cloud technology. Will it be a strategic choice for an SME to adopt cloud and how will a firm evaluate cloud suitability?

If one recognized the importance of the concept of willingness to pay (WTP) as a vital metric, SME perceives WTP to be lower than the market price. This can be a serious weakness for service providers whose sustenance would be rather difficult. Financial constraints of SMEs are confronted with an awkward proposition offered by the CSP. Compared to hi-technology firms, the problems are more serious in lower technology firms whose owners are at a technology disadvantage. The promised levels of service level agreements are expected to be clear on pricing, accessibility, back up, and lock-in during a cloud migration activity (Colicchio et al. 2015). A related problem is the SMEs' lack of knowledge in mapping their requirement to the potential leverage of cloud solutions. Frequently, this is reinforced with the neglect of CSP in identifying appropriate service models and applications with balanced proprietary versus standardized infrastructure (Srinuan 2017). It is a viable proposition to seduce the SMEs with value additions such as bundling product packages and test offers, not forsaking price differentiation (Srinuan 2017). As vital stakeholders, SMEs can come together to promote a Software-as-a-Service-based infrastructure to complement their financial resources in terms of minimizing TCO and maximizing ROI. More than before, their business requirements could now be fulfilled through services such as co-creation and customization of services.

The study conducted on cloud applications (Bieber et al. 2016) is very valuable to handhold SMEs into guiding and choosing the appropriate cloud services needed for their business process. The latest scope of the cloud has expanded into business intelligence and analysis. In such situations, mapping the business need with a suitable cloud service poses a challenge to business owners and an extent for the service providers (Bieber et al. 2016). The usage of a suitability test for cloud inclusion explained how this issue could be handled (Vidhyalakshmi and Kumar 2016) by classifying intangible benefits and tangible risks.

For a massive uptake of the cloud, there needs to be a concentrated effort on the part of the stakeholders (government, CSP, and SMEs). As a part to play in the participatory stakeholdership (Singh Kalsi and Kiran 2013), the government fosters participatory citizenry, through digital empowerment. Proactive support through powerful training and awareness programs translates into a CSP's role as a whole. Cluster-based programs for SMEs can include an agent who can facilitate the applicability and procedures of cloud adoption. The net effect can be cluster-wise e-readiness for collateral benefits.

Scope for further research

The result of our efforts offers a few research directions as followings:

1. The study highlights the usage of the TOE as a theoretical base in developing countries. Integrated theories with TOE can possess more predictive power. Economic fulfillment as an outcome of cloud adoption can be a hypothesized relationship in such integrations.
2. The policy is the least occurring topic, with not enough literature hitherto. Therefore, it needs to be analyzed extensively. Owing to the dynamism of cloud characteristics such as inter-operability, tailor-made applications, pricing, and technical skills, developing a cloud-specific policy has become a challenge. Research can contribute in this area. The anticipation is that it can relatively make the complex cloud-specific policies simpler.
3. Classification and framework of cloud applications could become further research candidates. Grouping them based on industry type and even cluster type in the SME segment would benefit both the SMEs and the CSP.
4. Cloud economics is another critical area for SME which needs attention. Hitherto, examples of cost-benefit analysis (TCO) and ROI models have been extended by Walterbusch et al. (2013) and Sultan (2011), respectively, to tap the power of the cloud, but there is a need for a functional level of economics that measures sales growth, profitability, return on assets, and ROI (Schniederjans and Hales 2016) as an impact of cloud adoption.

Practitioners can benefit from the analysis in leveraging the cost and flexibility of cloud applications to augment cloud adoption in SMEs. Researchers can look forward to

addressing gaps in the area of policy, risks, and service models to facilitate the business aspect of cloud technology.

Limitations

The study focused on a limited usage of keywords, which makes it challenging to generalize the results. Also, the locus of discussion was on the adoption of CC. The examination of post-adoption phases can throw new light in the area of the business aspects of CC.

Abbreviations ASEAN, Association of Southeast Asian Nations; CSP, cloud service provider; DOI, diffusion of innovation; IaaS, infrastructure as a service; ICT, information and communication technology; IDA, infocomm and development authority; IDT, innovation diffusion theory; IT, information technology; ITBB, Information Technology and Broadcasting Bureau; JI, Jaccard's index; NTP, National Telecom Policy; PaaS, platform as a service; ROI, return on investment; SaaS, software as a service; TAM, Technology Acceptance Model; TCE, transaction cost economics; TCO, total cost of ownership; TOE, technological organization environment; TPB, theory of planned behavior; TRA, theory of reasoned action; SME, small and medium enterprises; WTP, willingness to pay

Author contribution In this review, the authors have taken stock of the most discussed topics and identified relevant theories for cloud adoption. The study has a 2-fold goal; one is to guide the cash-strapped SME towards advancement, through information technology and the other to contribute to the research knowledge bank. JPS carried out the research as her ongoing doctoral thesis under the close supervision of her supervisor and co-author, RP. Both authors read and approved the manuscript.

Data availability Data sharing does not apply to this article as no datasets were generated or analyzed during the current study. This being a literature review article; all publications that are reviewed are provided in the reference.

Declarations

Competing interests The authors declare no competing interests.

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