SMALL AND MEDIUM-SIZED ENTERPRISES' PERCEPTIONS OF THE USE OF CLOUD SERVICES

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ABSTRACT

Although cloud computing is a rapidly evolving technology and is considered one of the key technological drivers of business digitalisation, it is still a challenge for many businesses to adopt it. Implementing the right cloud services is challenging and requires the right level of knowledge. In addition, the size of the company, its digital maturity and its financial situation are also critical factors, which are particularly relevant for small and medium-sized enterprises. Therefore, in this study, we focus on the situation of small and medium-sized enterprises regarding cloud services. To this end, we conducted qualitative research to examine the studies on cloud services, their trends, research directions, and research areas and to explore the relationship between the publications and their scientific embeddedness.

KEY WORDS

SMEs, cloud computing, qualitative research

CLASSIFICATION

JEL: O1, O3

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INTRODUCTION

In today's connected world, the phenomenon of mobile working is becoming more and more natural [1]. Digital development also significantly impacts social and economic processes, transforming how we communicate, connect, do business, and work [2].

As a result of Industry 4.0, companies face several new challenges affecting their operations and collaborations [3]. Many believe that if a company wants to remain or become competitive, it needs to respond to consumer demands and digital trends [2]. However, these technological innovations have benefits and many risks that management should consider before adopting technology [3, 4]. One such technological innovation that has been received differently by businesses is cloud computing (CC) [5], as confirmed by a Eurostat [6] survey, which shows that, on average less than half (41 %) of businesses in the EU use CC.

The article is structured in the following elements: first, an overview of the state of the art of cloud services and their relationship with small and medium-sized enterprises (SMEs), followed by a second section presenting the research methodology used. In the third section, empirical results of the research are presented and finally the article concludes with conclusions, limitations and future research directions.

LITERATURE

Nowadays, information security has become an essential factor for everyone, whether a business or an individual. Nevertheless, information technologies are indispensable in everyday life. Another critical aspect for companies is that they are highly dependent on ICT tools for business management, partner relations, marketing and many other activities, which are carried out using digital devices [7]. Therefore, addressing information security is a crucial challenge for companies, as they aim to prevent exposure to security and privacy threats to information systems and protect their network infrastructure. Although a relatively large proportion of SMEs has a minimal IT infrastructure [8, 9], this infrastructure is not enough. It lacks skilled staff, IT specialists [10], adequate and modern digital devices [11], a supportive attitude of top management [12] and the necessary financial backing [13, 14]. However, one of the benefits of digitalisation is the emergence of cloud computing, which can be of particular benefit to SMEs, as it allows companies without (advanced) IT infrastructure to take advantage of technological developments [12]. Cloud computing is a relatively new topic with many potentials [15]. While larger, multinational companies can more easily implement it in their operations [16], SMEs do not even consider implementing it due to a lack of capital and knowledge [2].

CC, as a new area of outsourcing, has a promising future. Still, there are concerns about adopting the technology: the regulations and laws and the associated security and control aspects [17]. Moreover, the literature and adoption rates show that cloud adoption is still in its early stages, especially for SMEs in developing and less developed countries. According to Gutierrez et al. [2], the service is not yet a mature technology may be due to its low adoption rate. Another potential explanation could be that SME owners and managers lack confidence in the service and are more resistant to new technologies. As a result, they fail to see the potential opportunities, savings and ease of use [18].

Many studies have addressed CC from an SME perspective, both from a technological and economic point of view, as well as from the perspective of the drivers and barriers to technology adoption [19, 20]. However, the collection and synthesis of different perspectives and results, and the networking of these studies, are rare, and this article aims to bridge this gap. The aim of this research is to understand the perceptions, knowledge and opinions of

SMEs about cloud services and their use. Furthermore, to map the networking of the studies on which the research is based, i.e. the reciprocity between individual authors and the evolution of the research field across disciplines.

METHODOLOGY

For this study, systematic literature review was used as applied methodology, with the Web of Science (WoS) database providing the data for the bibliometric analysis. The research aimed to find out the opinions and knowledge of SMEs about cloud services. For this purpose, data were extracted from the WoS as mentioned above database. We tried to draw from as wide a range of publications as possible, but we also used some limiting conditions.

The research seeks to answer the following research questions:

1. Which publications or researchers are the most influential on the subject?
2. What are the areas of focus of existing publications on cloud computing?

In the following, we present the research results to this end. The data was analysed using VOSviewer and Excel software.

With regard to the methodology used in the research, a few sentences on network analysis should be mentioned to provide some background to the analysis. Network analysis makes it possible to combine a number of disciplines and to understand and map the relationships and interactions between the points under investigation [21]. In the present case, we have examined the network of studies to identify the most relevant studies, authors and countries in terms of SMEs' use of cloud computing services.

DATA COLLECTION AND DATABASE

To collect the data, we used the Boolean terms small and medium size* (Topic) and cloud* (Topic) and 2010-2020 (Year Published) Article (Document Type) and English (Languages). This search resulted in 553 results. We then searched the publications for repeated instances but found none. Finally, we screened the papers by title, abstract and keywords to see if they were all related to the topic we were looking for, and as a result, 433 articles were filtered out, leaving 120 studies to be dealt with further.

RESULTS

We examined the year-on-year evolution of publications that satisfy our search criteria between 2010 and 2020. Out of the 120 studies reviewed, one was published in 2010, followed by four in 2011 and 28 in 2020, the last year examined. The number of publications shows an upward trend, despite two or three years of decline. The majority of studies were published in 2017 and after.

We then looked at which research area the publications under review fell into and selected the ten most researched research areas, as shown in Figure 1. Figure 1 shows the 120 publications by research topic. The Computer Science area received the most significant number of studies, with almost 41 % of the studies falling into this area. Engineering follows this with 27,5 % and Business & Economics with 25,8 %. Looking at the research areas, the question arises that while the high number of studies from computes science is understandable, the low number from the economic area is surprising. As already mentioned in the literature section, the lack of appropriate knowledge and capital is the reason for the low number of CC implementations. However, it is precisely this discipline that has not researched its effectiveness, necessity and potential.
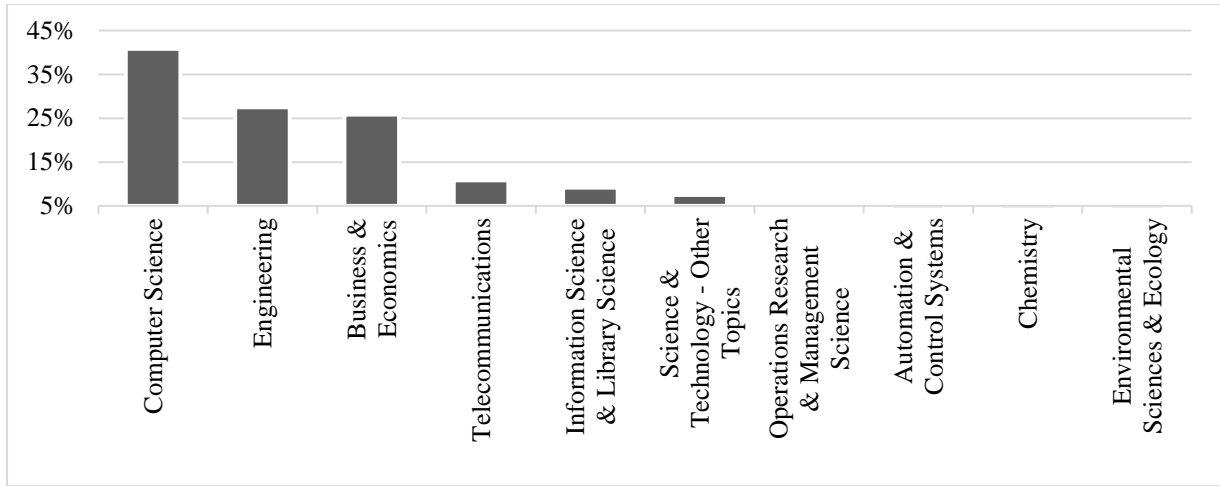
Figure 1. Research areas of the analysed papers.

KEYWORDS CO-OCCURRENCE

We analysed the co-occurrence of keywords, and the results of it can be seen in Figure 2. Out of the 661 keywords, 28 meet the threshold, which is a minimum of five occurrences of a keyword. Twenty-eight keywords were selected by the software. There are four clusters with 230 links and 507 total link strength. The most frequently used keyword was cloud computing, which appeared 47 times and was mentioned together with 25 other words. This is followed by SME with 21 occurrences and with 88 link strengths and adoption with 19 occurrences and 83 link strengths.

The minimum number of citations of a paper is five. Of the 121 documents, 74 meet the threshold. In Figure 3 can be seen 64 papers in four clusters because ten items in the network
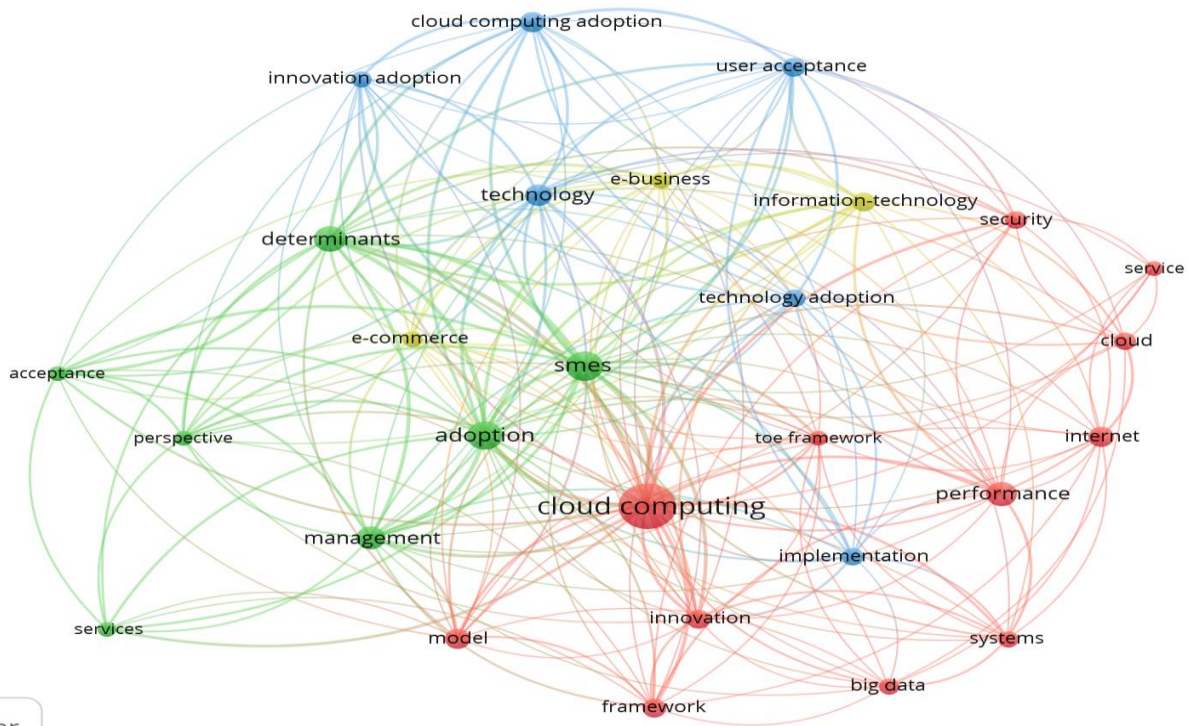

Figure 2. Keywords co-occurrence of the papers.

are not connected ,and there are 381 183 links. If two or more texts quote the same work, they are clustered closer together. Each node's size reflects the number of citations it has received. The most strength total link belongs to Seidel-Sterzik [22], which is 3 218. It is followed by Seethamraju [23] 2 177 and Vorisek [24] with 1824 link strength. However, in terms of citations, Ren et al. [25] stand out with 144 citations, but also Wu et al. [26] 137, and Huang et al. [27] have 131 citations.
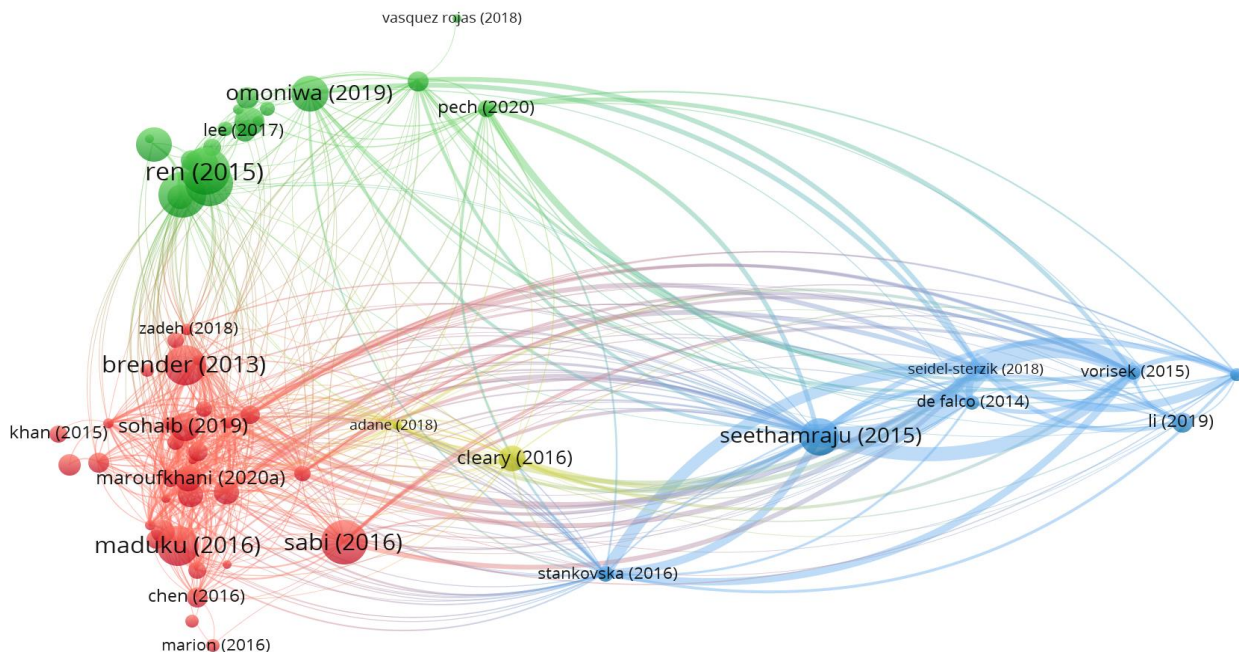

Figure 3. Analysing of bibliographic coupling of the papers.

Following that, a study of the writers who were most frequently cited by the same document (co-citation) was conducted. Co-citation coupling is a technique for determining the subject similarity of two publications. At the same time, co-citation analysis reflects significant authors on the subject [28]. In this case, the threshold was a minimum of 10 citations of cited sources. Of the 3 041 cited references, 92 meet the threshold. Figure 4 shows 91 items because one the not connected to the others. The size of the nodes corresponds to the citation number. Figure 5 illustrates the 60 items in 4 clusters with 2 510 links and a total link strength of 28 881. As shown in Figure 4, most of the studies included in our analysis refer to studies published in the International Journal of Information Management and the Journal of Enterprise Information Management.

It should be noted here that the bibliographic coupling is a connection that connects two publications that both reference the same source. In contrast, co-citation is a link that connects two objects referenced in the same document.

For further analysis, we selected the top 10 cited studies and subjected them to further analysis, the results of which are presented in Table 1.

The total amount of citations was 1163, which provides an average of 116 citations per article. Three of the most cited publications were published in 2013. These studies have been published in 8 different journals, as well as in Enterprise Information systems and the International Journal of Information Management stand out from the list with 2-2 publications.

CONCLUSION

Although cloud technology is not a new invention [34] and has been rapidly adopted by users, it is still a technology in its infancy and is only just being explored. The big problem is that SMEs can hardly keep up with technological progress [35], even though they are the engine of the economy and should be able to react or even control it faster.

The study examined the importance of CC over the past decade, exploring the directions, research areas, journals and research focus on the topic. For this purpose, we reviewed relevant and significant-high-quality publications in WoS. In addition, the study analysed the existing literature and found that cloud computing is a much researched and growing research area.

The study revealed that the use of cloud computing in SMEs is emerging and the potential is abundant. More importantly, cloud services are an inevitable way for SMEs in the sector to digitise their processes, but there are also several limiting factors. The present study has highlighted the relevance of cloud computing today and has given an overview of state of the art in studies on SMEs, which is growing in terms of the number of studies and the range of issues covered. However, in terms of research areas, the technical side still strongly dominates, despite the subject area increasingly requiring a multi-, if not trans-disciplinary approach.
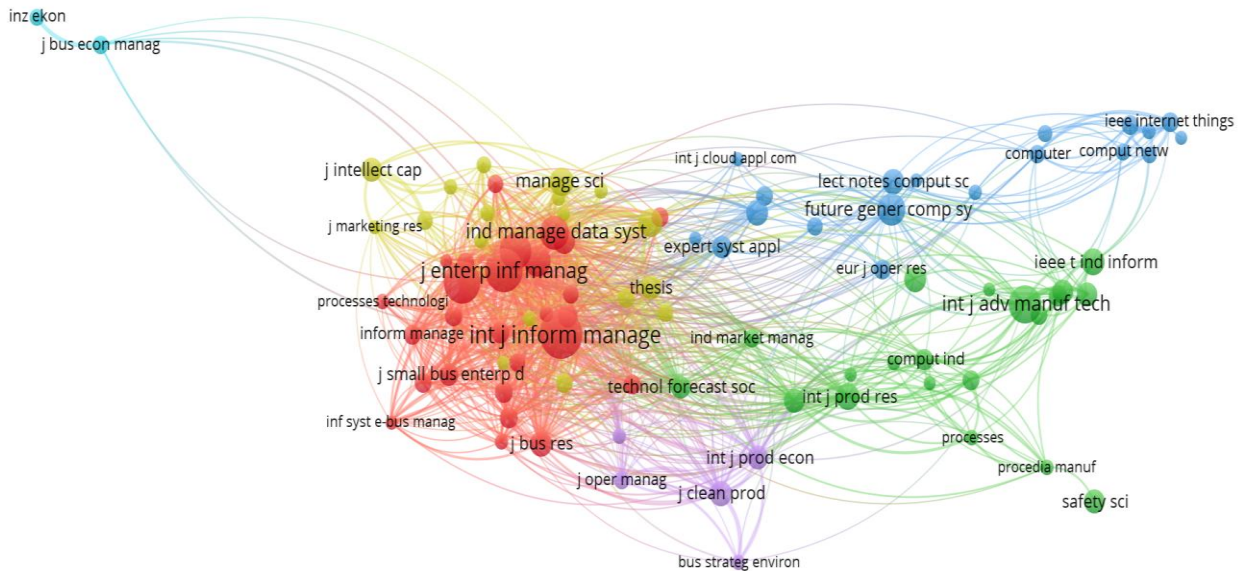

Figure 4. Analysing of co-citation of the published papers.

LIMITATIONS AND FUTURE DIRECTIONS

The limitations of the present study include two factors: first, the database used, which should be expanded in future research to include other databases, and second, the nature of the studies should be extended to include studies published in conference proceedings. The second limitation is the lack of a survey of SMEs by target country or area, which is worth looking at in a more limited way in future studies by looking at a region or country.

Table 1. Top ten cited papers.

Ref.	Title	Journal	Results

[29]	Authorised Public Auditing of Dynamic Big Data Storage on Cloud with Efficient Verifiable Fine-Grained Updates	IEEE Transactions on Parallel and Distributed System	Data security is one of the main problems with CC. Data auditing is a solution, but it is not a hassle-free solution. The paper proposes an enhancement that could reduce the additional communication costs of checking for minor updates and provide greater security and flexibility.
[25]	Cloud manufacturing: from concept to practice	Enterprise Information Systems	A cloud manufacturing system has been developed to serve as an application example.
[26]	A fog computing-based framework for process monitoring and prognosis in cyber-manufacturing	Journal of Manufacturing Systems	A new computational framework was developed and proven for remote, real-time detection, monitoring, and scalable, high-performance analysis for diagnosis and prognosis. Wireless sensor networks, CC, and machine learning are all used in this framework.
[27]	Cloud manufacturing service platform for small- and medium-sized enterprises	The International Journal of Advanced Manufacturing Technology	A framework and platform were created, and its feasibility explored to consider the possibilities of facilitating the adoption of cloud services by SMEs in the manufacturing sector.
[30]	Conceptualising a model for adoption of cloud computing in education	International Journal of Information Management	A model for the adoption of cloud-based services in education has been developed. Based on preliminary surveys conducted in sub-Saharan Africa, socio-cultural factors were found to be significant in the adoption process.
[3]	Risk perception and risk management in cloud computing: Results from a case study of Swiss companies	International Journal of Information Management	Some of the benefits of cloud services are more important for SMEs than for larger companies, but there is still a high level of mistrust in CC due to a lack of expertise and poor risk management.
[31]	Linking building data in the cloud: Integrating cross-domain building data using linked data	Advanced Engineering Informatics	The authors advocated for linked data to be used as a technology for cloud-based data services. When cross-domain data sources are migrated to a cloud-based data service, connected data technology is an effective tool for boosting interoperability.
[32]	Applications integration in a hybrid cloud computing environment: modelling and platform	Enterprise Information Systems	Companies are using several cloud services at the same time, and they also have an internal intranet network. The authors have created a run-time platform and a cross-computing environment process modelling technique to simplify this.
[23]	Adoption of Software as a Service (SaaS) Enterprise Resource Planning Systems in Small and Medium Sized Enterprises (SMEs)	Information Systems Frontiers	According to the study, the factors that determine whether a company implements a SaaS ERP include the reputation of the software vendor in the market, the fit of the software to the business, the vendor's potential willingness to support the customer throughout the product lifecycle, the vendor's involvement in creating value for the customer.
[33]	Fog/Edge Computing-Based IoT (FECIoT): Architecture, Applications, and Research Issues	IEEE Internet of Things Journal	The fog/edge computing-based IoT (FECIoT) distributed architecture enhances service provisioning and is suitable for mission-critical applications. However, it also provides better resource allocation, service delivery and higher levels of privacy.

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