

# Cloud Computing: A Systematic Literature Review and Future Agenda

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## ABSTRACT

Global competition has extended the scope of trade and extended the supply chains causing information management to be an essential part of business. Many new technologies have recently been adapted by organizations in the era of digitalization. Cloud computing has an important place in these technologies and has been integrated widely. In recent days, unexpected and risky periods such as the global pandemic increased the interest towards cloud computing both academically and practically. The purpose of this study is to analyze and classify the contributions of the studies published in the cloud computing field. The cloud literature is analyzed systematically from the management and business points of view. The review is limited to journal articles and papers published between 2014 and 2019. This research summarizes the current research attempts, discovers the research gaps, and provides a research agenda for future research on cloud computing within the context of information management in business and management from a global perspective.

## KEYWORDS

Cloud Computing, Management, Research Agenda, Systematic Literature Review

## 1. INTRODUCTION

Many new technologies (e.g., Augmented Reality, Internet of Things, 3D Printers, Big Data, Cloud Computing, System Integration, etc.) have been widely used with the release of Industry 4.0. Industry 4.0 (Fourth Industrial Revolution) is defined as a production system based on cyber-physical systems (Kagermann et al., 2013). The integration of machines and objects, together with the Internet of Things technologies, has resulted in a huge amount of data. Collecting and analyzing this data will provide a competitive advantage for companies (Deloitte, 2015).

Cloud Computing is a new technology that could potentially revolutionize IT implementation and delivery (Alismaili et al., 2020). It is a model that can provide on-demand network access to configurable computing resources from a shared pool with minimal management effort or service provider interaction (Mell & Grance, 2009). Service providers are divided into three classes according to the service offered, such as PaaS, SaaS, and IaaS (Rimal et al., 2011).

SaaS is a software delivery model where software is hosted locally and delivered over the Internet, and the payment method follows a subscription model (MCSI, MIETE, 2009). Performance is an important feature depending on the quality of SaaS (Wang & Ying, 2018). Some SaaS applications

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have been developed for business technologies. This includes sales management, CRM, financial management, Human Resources Management. The second core service model PaaS provides developers with a platform that covers the developing, testing, distributing, and hosting lifecycle of advanced web applications as a service. Facebook F8, Salesforce App Exchange, Google AppEngine, Bunzee connect and Amazon C2 provides several ready-made services. This may indicate that PaaS can support multiple applications on a single platform (Xu, 2012). Finally, the most basic service of cloud computing is IaaS. The IaaS can be defined as the idea of purchasing IT hardware as a pay-as-you-go (post-pay).

Companies can create and maintain a tremendous competitive advantage through innovation. It is therefore not surprising that firms are highly concerned with the mechanisms that enable effective innovation (Chen et al., 2020). Cloud computing technologies can have businesses or individual users for different purposes (Chen et al., 2011). A cloud computing system holds critical data on the internet and provides users access wherever there is internet access (Duraó et al., 2014). Many companies or users can use cloud systems for data storage and backup to save capital and infrastructure costs. Dropbox, Google Drive and Amazon S3 are of cloud computing solutions (Borodako et al., 2021). ERP and CRM are cloud computing business management applications. Cloud computing enables data scientists to analyze data, find correlations, predict future crises, and assist data-driven decision-making in an enterprise.

In today's developing world, cloud computing continues to be more widely adopted by companies. The adoption of cloud-based services can help organizations ensure a seamless and timely flow of information (Lal & Bharadwaj, 2020). Despite some adverse effects of the global Covid-19 pandemic, the cloud computing market maintained its growth potential. This crisis has affected organizations globally. The vast majority of organizations had to adopt new ways of working styles with the pandemic. Deloitte has interviewed with CIOs from different sectors and it was seen that cloud computing adoption is one of the key trends in organizations' long-term priorities for CIOs. According to another research conducted by IBM and MC Kinsey, cloud investments will exceed traditional IT investments in 2020. In the study, it was seen that 94% of the participating companies used multiple cloud environments. This situation has raised some priority concerns (movement and connectivity among clouds, consistency of management) for organizations (Gagic et al., 2019).

Cloud computing has become one of the most demanded and studied topics. As mentioned above, some uncertain and crisis periods have increased the interest in cloud computing for organizations in recent years. Especially, the globalization of world trade widened the use of electronic trade and extended the supply chain networks drastically. Hence, the accumulation of data has been reached to significant amounts resulting from the need for an effective information management. Thus, the digitization of business increased the importance of information management for business. Moreover, the internet of things and Industry 4.0 has become essential for companies to achieve competitive advantages. As a result, cloud computing is arising as a cornerstone for these companies to build their information structure on. Therefore, cloud computing is becoming a crucial topic for businesses and management in a global context that can enable them to reach their targets.

Although there was a great deal of research in the period of 2014-2019 covering many different aspects of cloud computing, the maximum number of studies focused on cloud computing adoption and security. It is one of the most important steps for organizations to pay attention to their risks and make wise decisions to ensure the sustainability of adoption. This shows that why most of the researchers focus on the adoption and security issues of cloud computing in their studies.

According to Hanafizadeh & Zareravasan (2020)'s SLR study during the period between 2011 and 2018, cloud computing has been the most studied outsourcing strategy. Borodako et al. (2021) stated in their study that cloud services are gaining popularity in current business environments and emphasized the importance of using "cloud" (cloud data) in teamwork and brainstorming. However, studies and their contributions on this subject in the literature have not been widely examined. The purpose of this study is to examine and categorize the cloud computing studies from the business point

of view. Through this way, cloud computing and its application areas can be understood better. Also, we aim to reveal the literature gap, tendencies, interest and identify the research opportunities. Our study also offers a detailed overview of the cloud computing literature in terms of business context. We present some advantageous statistics, such as most studied sub-areas, top journals that publish cloud computing studies and top institutions. Similar researches have been studied for Industry 4.0 and its sub-component Internet of Things (see. Piccarozzi et al., 2018; Lu et al., 2018). This is the first study to present a detailed systematic literature analysis for the business aspect of the cloud computing literature between the years 2014 and 2019. The three research sub-questions for this detailed analysis that we aim to do are as follows:

- RQ1. What are the enabling features of Cloud Computing?
- RQ2. Who is working on the cloud computing and when?
- RQ3. What are the current research attempts, literature gap and future directions?

There exist review studies with various scopes (e.g., security, adoption, supply chain, education, and SMEs) in the field of cloud computing. As distinct from the previous review papers, our study focused more generally on business and managerial aspects of cloud computing and analyzed the results. Descriptive analysis was conducted to make inferences about the future of cloud computing.

Meanwhile, as a result of the analysis, it has been seen that adoption and technology acceptance are the most studied subjects. When cloud computing studies are examined according to research areas in general business terms, it has been determined that finance and accounting are very popular areas. Especially investment, budgeting, and pricing issues have been studied a lot. When we look at the field of production and operations management, it is seen that the most studied subject is the supply chain, which shows that cloud computing integration in supply chains can help managers to observe, plan and evaluate supply chain processes. Similarly, in the field of organization and management, human resource management is getting a lot of attention, and therefore, understanding digital skills and information communication technology embedded in human resources is crucial to cloud adoption.

The findings of this study can contribute to businesses striving to integrate cloud computing. Therefore, the outputs of this study can serve as a guide for managers and researchers, especially from a management perspective. So, this study can support the efforts of business people to strengthen the competitive advantages of their companies through cloud computing. Furthermore, this literature review is thought to inspire enterprises and managers that would like to use cloud computing in terms of the scope, solution methods, factors, dimensions, and the results achieved in a holistic view.

This article is organized as follows. In Section 2, the literature review studies on cloud computing have been analyzed. In Section 3, basic review principles, review methodology and data collection are presented. In Section 4, the results of the study about each research question are discussed and illustrated. Section 5 concludes the paper and highlights the direction for the future research.

## 2. LITERATURE REVIEW

There are some review studies on cloud computing technologies, which can be divided into narrative and SLR. The narrative literature review studies focus on the semantic features of papers, while SLR studies focus on quantitative and reproducible elements of papers.

One of the benefits to conduct a SLR is that this method provides a straightforward structure of literature (Pickering & Jason, 2014). Literature reviews are important to identify hypotheses, research topics and research questions and propose methodologies that may be useful for further researches (Rowley & Slack, 2004).

Table 1 summarizes the basic literature review papers on cloud computing technologies and their purposes. There are 28 studies that review the Cloud Computing Systems literature. 20 of these studies conducted SLR method. The vast majority of these studies have focused on a specific subject of cloud

computing and searched the literature, such as, structural equation modeling in cloud computing (Pisirir et al., 2019), supply chain integration (Novais et al., 2019), cloud computing adoption in developing countries (Mrhaouarh et al., 2018), cloud computing service composition (Jula et al., 2014), open source cloud simulation platforms and types (Lynn et al., 2016), applying semantic technologies in cloud computing (Brabra et al., 2016), resource scheduling and security in cloud computing (Sheikh et al., 2019), penetration testing in Mobile Cloud Computing apps (Al-Ahmad et al., 2019).

Some literature review studies focus on some specific managerial topics in cloud computing. For instance, cloud computing implication on service requirements (Benslimane et al., 2014), decisions related to cloud computing from the business point of view (Karunakaran et al., 2015), cloud computing and supply chain management (Jede & Teuteberg, 2015; Novais et al., 2019), computing adoption (Alsaed & Saleh, 2015; Ibrahim & Hemayed, 2015; Salleh et al., 2018; Mrhaouarh et al., 2018; Mohammed Banu et al., 2018), cloud computing and SMEs (Salleh et al., 2018; Pisirir et al., 2019).

The discussion of cloud technologies in business and management context is limited in the literature. Karunakaran et al. (2015) examined cloud computing technologies in terms of business and managerial perspective, but this study only deal with the papers till 2014. However, a great majority of the studies about cloud computing in the literature were published after 2014 and there has been no systematic literature analysis that deals with cloud computing in terms of business context since 2014. This study aims to review the state-of-art literature of cloud computing field from business perspective and to illustrate future research opportunities.

### **3. METHODOLOGY**

There are some studies to provide a guideline to conduct a systematic literature review (Pickering & Jason, 2014; Okoli & Schabram, 2010). Those are discussed in the following sections.

#### **3.1 Included and Excluded Criteria**

The explanations about which studies will be included or excluded based on the criteria to be reviewed are summarized in Table 2. As can be seen in Table 2, inclusion and exclusion criteria divide into four main subsets can be seen in Table 2.

#### **3.2 Methodology**

In this study, a systematic literature review was conducted using quantitative and qualitative research methods. The flow chart that we used in this study in Figure 1 was adopted from Garza-Reyes (2015) to identify the different stages of the SLR (Moher et al., 2009). The stages of the Systematic Literature research are shown in Figure 1 in a flow chart.

##### **3.2.1 Collection of Papers**

The collection of the paper process was explained in four phases (Table 3.). In general, Step one shows the first keyword search in different databases, Step 2 and Step 3 show the results with our research restrictions and Step 4 shows the results after duplications and were refined by included and excluded criteria.

The research of the articles was done by using the keyword “Cloud Computing” in Web of Science, Scopus and Science Direct databases (Step 1.). Business, Operations Research and Management Science, Management and Economics categories were used in the Web of Science database. In Scopus and Science Direct databases, it was limited to Business, Management and Accounting categories (Step 2.). All searches were restricted in title, in English and the years after 2014 were taken into consideration. Book chapters, books and conference articles were not included in the search (Step 3.).

After the duplicated articles were excluded, the remaining articles were analyzed by reading only the titles and abstracts. The articles that were repeated in the first short review process were

Table 1. Cloud Computing Literature Review Studies Summary

Author and Year	Research Focus	Research Type	No. of Papers
Jula et al., 2014	This study focused on all reliable and effective studies that have examined Cloud Computing Service Composition.	SLR	NA
Benslimane et al., 2014	The aim of this study was cloud computing challenges and opportunities and applications on service requirements were discussed.	SLR	132
Pfarr et al., 2014	This study was about the profile of the academic cloud computing literature in terms of data protection and data privacy.	LR	33
Karunakaran et al., 2015	The decisions related to cloud computing in business aspect were examined.	SLR	155
Müller et al., 2015	By synthesizing the existing literature, it was aimed to determine the levels of cloud computing advantages and suggested applications on how to realize these benefits.	SLR	47
Lehrig et al., 2015	Existing definitions and metrics were analyzed from the point of cloud consumers and cloud providers.	SLR	20
Alsaeed & Saleh, 2015	This study reviewed the literature on cloud computing adoption by higher education.	SLR	133
Jede & Teuteberg, 2015	Existing researches on Cloud Computing and Supply Chain Management were analyzed and research gaps in the literature have been reviewed.	SLR	99
Ibrahim & Hemayed, 2015	It was aimed to present evidence of the cloud computing adoption to the education system at universities and higher education institutions.	SLR	27
Brabra et al., 2016	It was aimed to present a wholistic glance of new ways to apply semantic technologies in cloud computing technologies.	LR	36
Bayramusta & Nasir, 2016	The main purpose was to analyze the evolution of cloud computing in progress of time.	SLR	236
Lynn et al., 2016	By using descriptive and synthetic analysis, it was aimed to understand the open source cloud simulation platforms.	SLR	256
Solms & Willet, 2016	A literature review has been carried out on resources that can help prepare assurance evidence within the scope of IT senior management authority while applying IT.	LR	33

continued on next page

**Table 1. Continued**

<b>Author and Year</b>	<b>Research Focus</b>	<b>Research Type</b>	<b>No. of Papers</b>
Yu et al., 2017	It was aimed to make contribution to the understanding of cloud computing security by presenting an explanatory literature review in terms of information security discipline.	Descriptive Literature Research	74
Mrhaouarh et al., 2018	The studies about cloud computing adoption for developing countries that depending on TOE studies were reviewed.	SLR	40
Senyo et al., 2018	The main purpose was to examine the cloud computing evolution over time.	LR	285
Salleh et al., 2018	Literature review on cloud computing and SMEs, has been made including adoption and post adoption stages.	SLR	39
Mohammed Banu et al., 2018	This study aimed to define and evaluate empirical findings on the advantages and drawbacks of Cloud Computing adoption in the context of education.	SLR	20
Pisirir et al., 2019	The existing state of the SEM literature in the cloud computing field was examined.	SLR	96
Ibrahim & Hemayed, 2019	The studies about the integration between Trusted Computing and IaaS have been surveyed.	SLR	86
Novais et al., 2019	The aim of this study is to analyze previous researches that examined the Cloud Computing and Supply Chain Integration.	SLR	100
Al-Ahmad et al., 2019	This study provided a systematic literature review about the penetration testing in Cloud Computing mobile applications.	SLR	30
Sheikh et al., 2019	This study focused on reviewing studies related with cloud computing security and resource scheduling and identifying the research gap.	SLR	NA
Klaib et al., 2021	This study discussed the eye tracking techniques and applications with a focus on modern approaches such as machine learning, Internet of Things and cloud computing.	LR	180
This Study	Our study provides a SLR for cloud computing literature from the business point of view between the years of 2014 and 2019.	SLR	141

Table 2. Included and Excluded Criteria

Explanation of the Criterion		
<i>Excluded</i>	Non- Full Text	Articles with only have title, abstract or keywords and full text is not available.
	Not related	Non-academic texts
		Studies not examining cloud technologies from an administrative and organizational perspective
		Studies not examining cloud computing technologies.
<i>Included</i>	Less Related Closely Related	Studies that the concept of cloud is used only as an example.
		Cloud computing in terms of management has not been examined but some of cloud computing results or examples in terms of management has been given.
		The cloud, whose main concept is not cloud computing. Studies dedicated to all research efforts explicitly and specifically for cloud computing.

distinguished and then, considering the inclusion and exclusion criteria detailed in Table 2, non-English, non-academic publications were eliminated. Then, the first screening process was completed by reading the titles, abstracts and by briefly reviewing the full texts of articles (Step 4.).

#### 4. DATA ANALYSES AND RESULTS

As far as the electronic databases were considered, 68% (96 papers) of the articles were obtained from the Web of Science database. 18% (25 papers) were obtained from Science Direct and 14% (20 papers) from Scopus databases.

##### 4.1. Journal Analysis

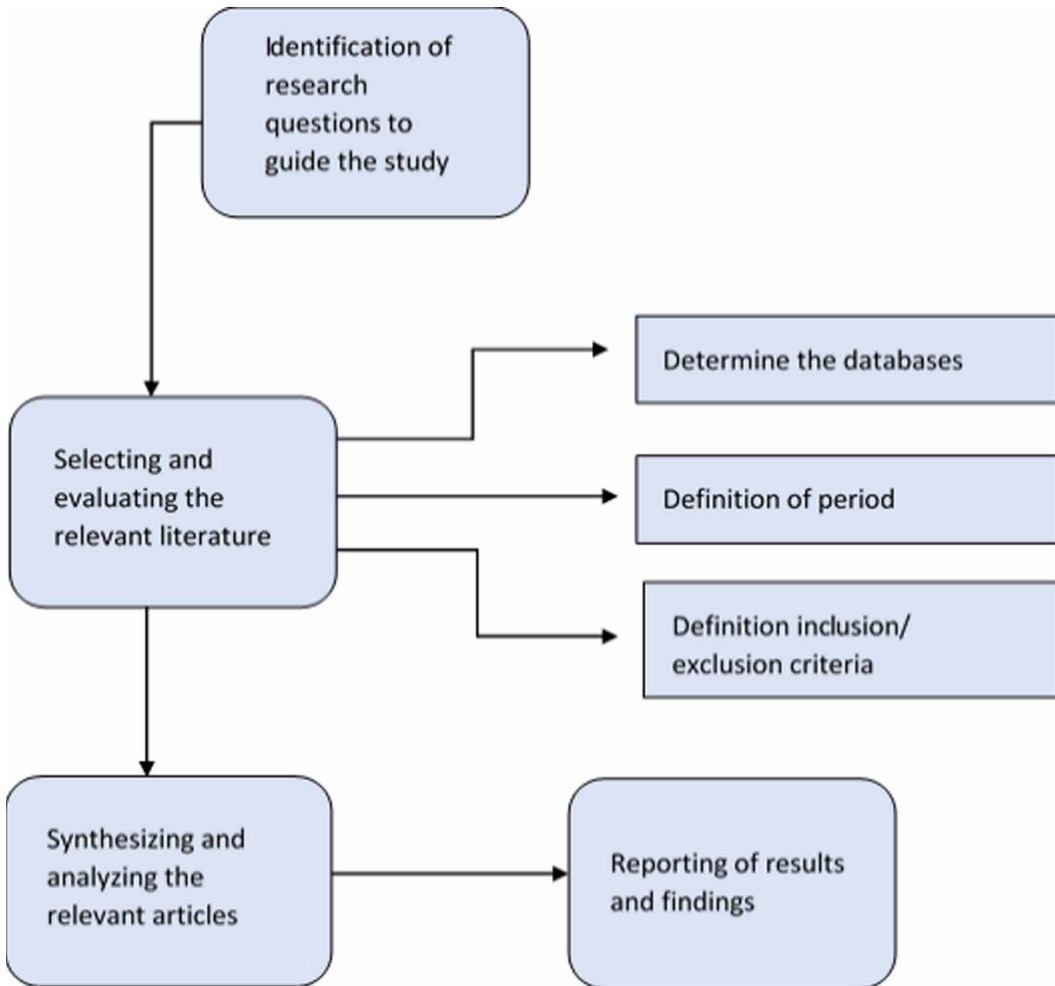
When the journals in which the articles published were analyzed, it has been found out that studies examining the cloud computing technologies from the perspective of business and management have found to published in 90 different journals. 77.77% of them (70 journals) have 2018 Thomson Reuter Impact Factor (IF). Figure 2 shows Future Generation Computer Systems (a Netherlands journal), International Journal of Accounting Information Systems (an England journal), and Journal of Enterprise Information Management (an England journal) as the three journals with the highest impact factor among 25 journals. 31.1% of the journals published more than one studies dealing with cloud computing technologies from business point of view.

As shown in Figure 3, 49% of the journals were published in the subject area of Business, Management and Accounting. In addition, the subject areas of Management Science and Operations Research (%14) and Computer Science (%14) were the second most studied fields.

Table 3. Collection of the papers process

	Web of Science	Scopus	Science Direct
Step 1	12, 332	91, 916	108, 555
Step 2	754	3, 384	1, 702
Step 3	308	797	423
Step 4	91	24	20

Figure 1. Flow chart showing stages of the SLR (adopted from Garza-Reyes (2015))



## 4.2. Analysis By Year

As can be seen from the Figure 4 studies on cloud computing technologies have increased sharply since 2015. The number of studies reached its peak in 2017. This may be related to the emergence of concept of the Industry 4.0 in 2011. The cloud computing concept is one of the most essential components of the 4th Industrial Revolution.

## 4.3. Author Analysis

Table 4 demonstrates the number of authors in each paper and their proportions. Considering the selected studies, the total number of authors is 422. It has been observed that articles related to cloud computing technologies have more than 1 author. Approximately 30% of the articles (43 papers) written have 3 authors and 28% of them have 2 authors (39 papers). The proportion of the papers that have more than 3 authors (4, 5, 6 and 7 authors) is 30%.



Figure 2. Analysis of Journal Articles

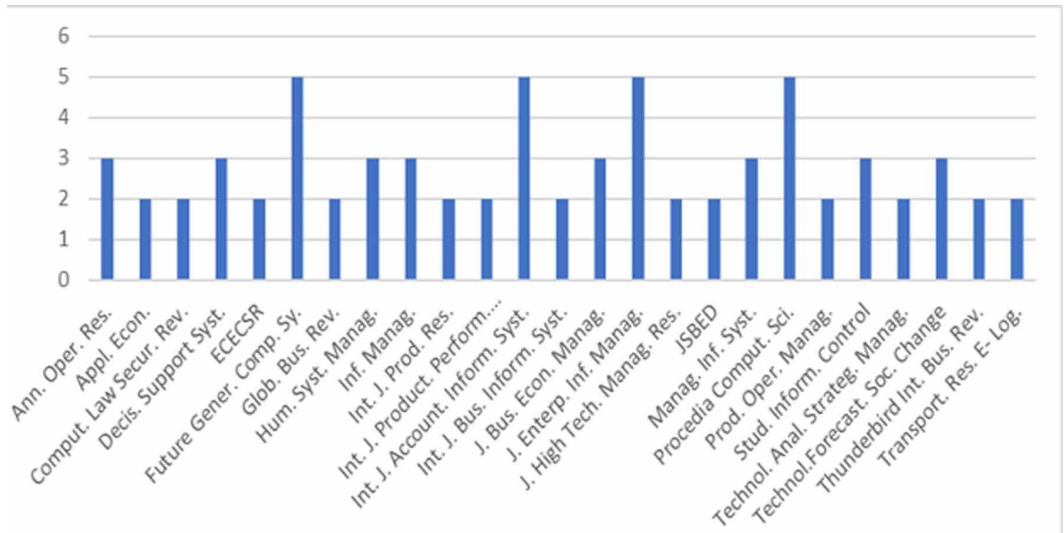


Figure 3. Journal Categorization based on each different journal with IF

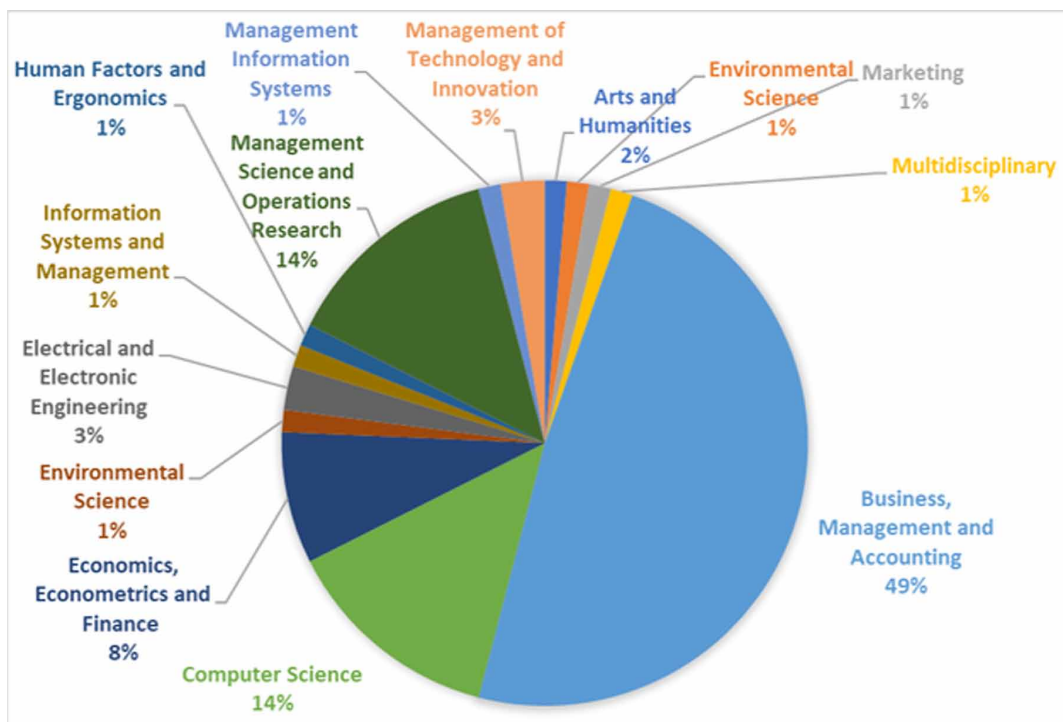
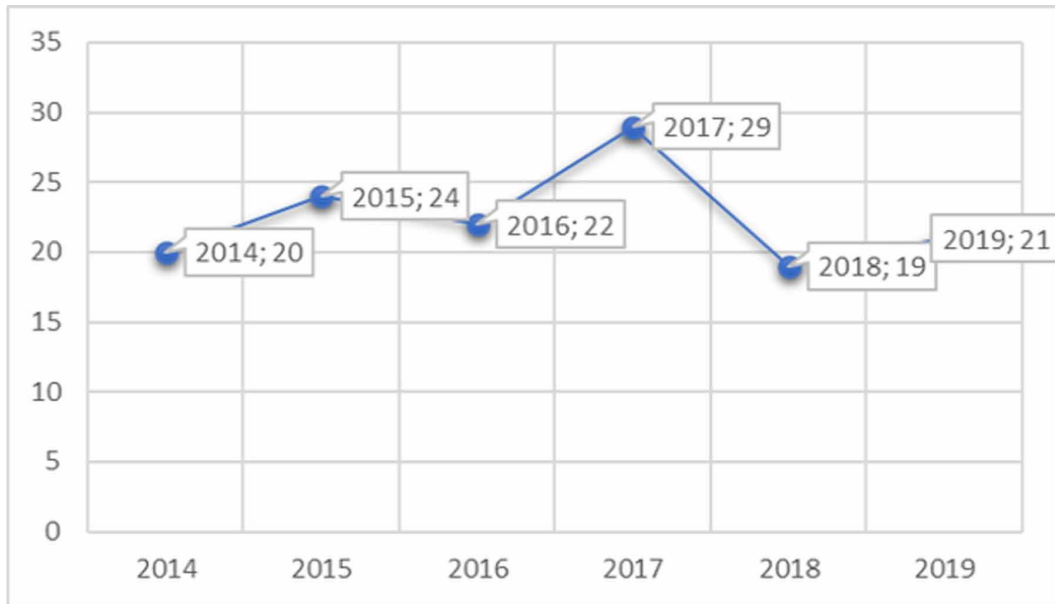


Figure 4. Distribution of articles by years



#### 4.4. Methodological Analysis of The Papers

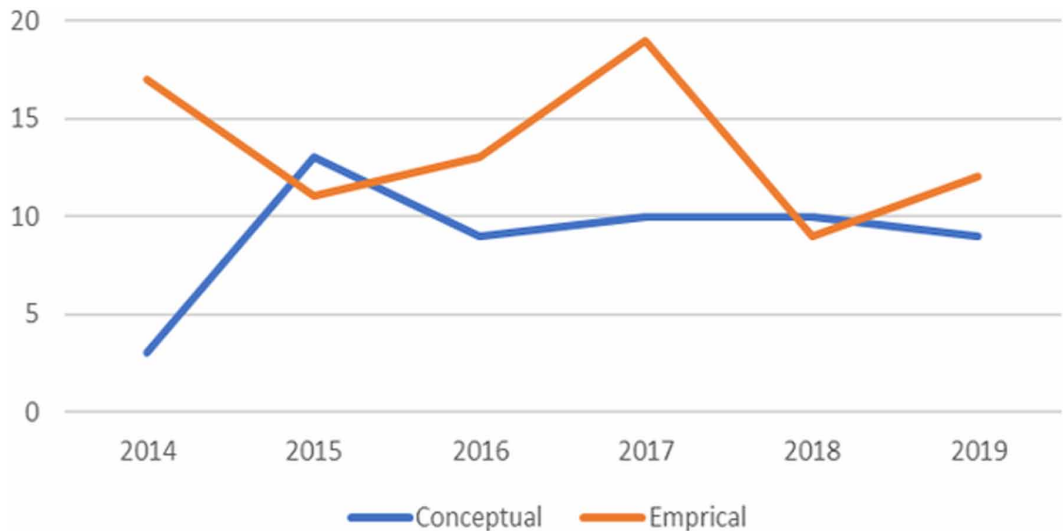
The first distinction is the basic methodological approaches that are used in the relative papers, which are classified as experimental and conceptual contributions. It was found that 40% (54 papers) of the studies were conceptual and 60% (82 papers) were experimental studies and it can be seen from Figure 5, that more empirical studies have been carried out in recent years. When the empirical studies were examined in detail, 16.1% of them were found to have qualitative and 83.9% have quantitative research design.

In the studies that qualitative approaches were used, in depth interviews were conducted in 18 papers (51.4%) and remaining papers were based on case studies and qualitative methods (48.6%). In quantitative papers, questionnaire tools were commonly used and, in some papers, (8.7%) databases were used to collect data. The questionnaires have often been conducted online and sent by e-mail or shared in social media (Such as Linked in or Twitter). The response rate was found to be high in most

Table 4. Analysis of Articles by Number of Authors

# of Authors	# of Articles	Relative Frequency(%)
1	17	12.06
2	39	27.66
3	43	30.50
4	21	14.89
5	15	10.64
6	3	2.13
7	3	2.13
<b>Total</b>	<b>141</b>	<b>100</b>

Figure 5. Contribution of the papers



of the papers. The surveys were conducted usually in a single country (i.e., USA, Australia, India, China, Turkey, Brazil and Slovenia) and only three of them were conducted in several countries (i.e., USA and Turkey; USA and Australia; Germany, France, Italy, Poland, Spain and UK).

When the conceptual studies were deeply examined, it was found that the studies were based on two different research designs as review studies and studies that construct a model or a framework. In 46 papers (85.2%), a model has been constructed. Some of them used case studies with their models or exemplified the models and/ or frameworks. Different review techniques (i.e., systematic literature review, portfolio review or literature review) have been used in the remaining of the conceptual studies.

#### 4.5. Analysis of Keywords

The keyword analysis of the included articles provided an overview about the focus of the papers, areas of research, and which areas of cloud computing focus more on business or managerial aspects. In total 532 keywords were collected and then these keywords were grouped different related clusters. For instance, “Technology Adoption”, “Cloud Computing Adoption”, “Adoption Readiness”, and “Cloud Computing Adoption Framework” keywords were grouped into a cluster of Adoption.

The collected keywords were analyzed quantitatively. The total cluster number was 64. The most used cluster was “Cloud Computing” (113 times) that cover 21.25% of the total keywords. As shown in Figure 6, out of the “Cloud Computing” cluster, the top 5 clusters (Figure 6.) are “Adoption” (32 keywords), “Innovation and Technology” (26 keywords), “Information Technology” (24 keywords), “Small and Medium Enterprises” (18 keywords), and “Technology Acceptance” (14 keywords).

#### 4.6. Analyses of References

The analyses of references comprise both frequencies of references in general and frequency of references that include “Cloud Computing” in their titles. Figure 7 indicates the papers that were most cited (424 times) is Gangwar et al. (2015)’s study. This study aims to integrate the TAM and TOE models in the frame of cloud computing adoption in organizations. After that, the second most cited article (271 times) were found to be “Cloud computing adoption framework: A security framework for business clouds”. This article also highlighted the “Cloud Computing Adoption Framework” in businesses (Chang et al., 2016).

Figure 6. Top 5 most frequently used keywords

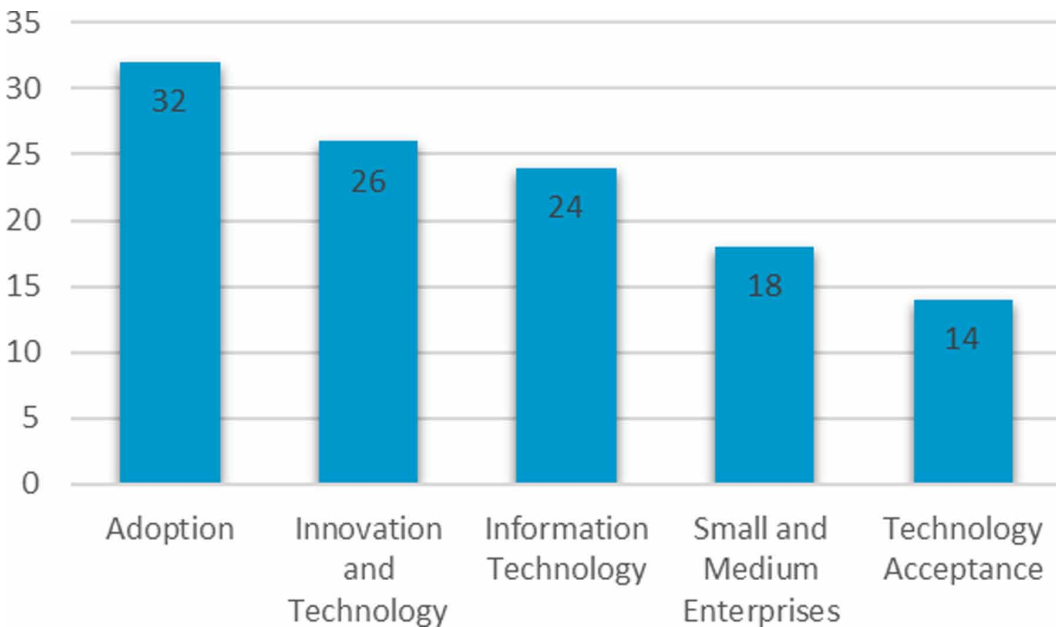


Figure 7 demonstrates that the references that include the “cloud computing” term in the titles. This can provide a comprehensive explanation about the common agreed Cloud Computing citations. 2 papers included “adoption” in their titles in the first reference analysis (Figure 7.) and in the second one, there were 4 papers, which include “adoption” in their titles (Figure 8.). This frequency analysis showed that the most cited papers were about “adoption”. The remaining references were cited 3.9 times on average (including “cloud computing” in the titles).

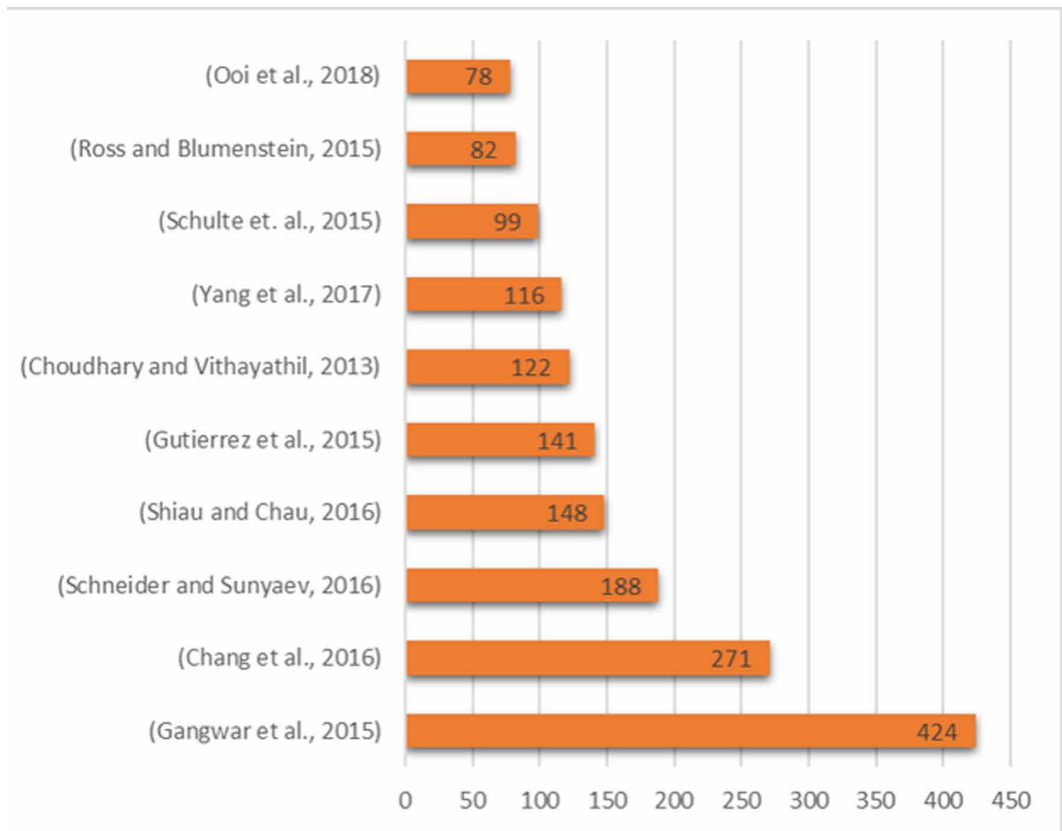
#### 4.7. The Word Frequency Analysis

As can be seen in the Table 5, first column indicated the top 25 most frequent words that were used in the included papers. The second and third columns represent the frequency and document proportion of the words (For instance, the word “service(s)” was used in %99 of the related documents). The last three columns represent the top 3 words that were combined with the in the first column.

Based on the combinations with top 3 co-occurrence words, meaningful phrases were composed. Firstly, commonly known terms that are related with cloud computing were cloud service, cloud computes service, technology adoption, innovation adoption, information technology, technology acceptance, service provider, cloud security, information security, and information technology. This measurement can represent the commonly used research areas.

Table 6 represents the top 10 words combinations (limited three words), their frequency and document proportion of the word. The most frequent word combination was used in 63.62% of the documents (984 times), second most frequent combination was “cloud computing adoption” and the fourth one, “adopt cloud compute” (244 times) was also related with adoption. That means the subject of the adoption is one of the top topics in cloud computing studies in organization level. The fifth most used combination is “supply chain management” is used 27.69% of the included documents (166 times) and the last most used combination is also “supply chain integration” (144 times). This shows that the cloud computing systems are important in supply chains. It also demonstrates that the integration of these systems into supply chains is the topic most studied topic.

Figure 7. Frequency of references in general (top 10)



#### 4.8. Analysis of Research Area

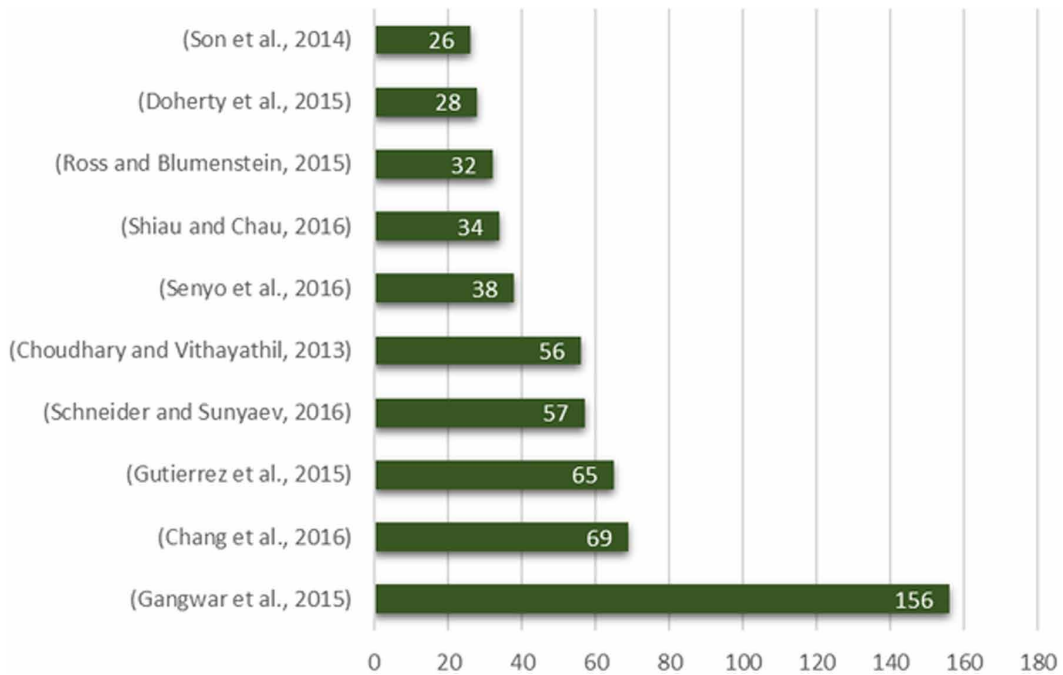
In this section we analyzed the papers in terms of their research area in general terms. As a result of the analysis, the business activities that used cloud computing and the most used research areas have been emphasized. Moreover, this analysis would be useful to determine the business subjects that have not get enough attention.

As can be seen in the Figure 9, finance and accounting is the most studied area (26%) in the management literature of cloud computing. After that, the second most studied area is management (23%). In the following part of this section, these research areas are to be analyzed in detail.

##### 4.8.1. Finance and Accounting

In Finance and Accounting, according to Figure 10, most of the papers studied financial planning, budgeting, pricing, treasury, and investment. When the studies on pricing were examined in detail, it was seen that Chen et al. (2019) studied choosing optimal price schemes for cloud providers. Basu et al. (2015) provided a guideline for cloud providers for pricing their offerings, while Javed et al. (2016) presented a new dynamic pricing method to cloud providers. The general purpose of the papers about pricing is to provide a guideline for pricing to cloud providers. Pricing has an important effect on organizations' profit, revenue, and market share and therefore, these studies can help the cloud providers to make a good decision about their pricing strategy. When the studies on investment have been deeply analyzed, most of the studies were found to investigate whether the transformation from

Figure 8. Frequency of references that include “Cloud Computing” in their titles



classic IT infrastructure to cloud was beneficial or not (see. Maresova et al., 2017) and evaluate the suitability of cloud computing adoption (Kumar et al., 2017).

#### 4.8.2. Management

As can be seen in Figure 11, the human resources management is the most studied subject. Embedded digital skill in human resources and better understanding the information communication technology are acquired for cloud adoption. Some papers consider the effects of information communication technology on cloud computing adoption (Hadhri et al., 2017; Kyriakou & Loukis, 2019). The second most studied subject is reliability and security. Organizations want to transfer their data to cloud to reduce cost and increase efficiency, but security issues remain challenge to adopt cloud computing (Chang et al., 2016). Surprisingly, although it is known that the adoption of cloud computing provides a more environmentally friendly and efficient business structure in the long term (Marston et al., 2011), the sustainability subject has not got enough attention in recent years.

#### 4.8.3. Production and Operations Management

As presented in Figure 12, supply chain is the most studied topic in the production and operation area. The studies dealing with the supply chain integration is mostly in the context of small and medium sized enterprises (Raut et al., 2018; Manuel et al., 2019). Cloud computing integration on supply chains can help managers to observe, plan and evaluate supply chain processes. The second most studied topic is Production, Operations and Quality. In these studies, the new way of production (i.e., smart factories) is a vital subject (Nodehi et al., 2017; Ooi et al., 2018). Cloud computing contributes to the transformation of traditional manufacturing into a more digital one. Therefore, the integration of cloud computing and investing in cloud are critical decisions for manufacturers. Raut et al. (2019) and Haug et al. (2016) worked on cloud adoption decisions in manufacturing.

Table 5. Top 25 most frequent words related to Cloud Computing related word combinations

Word	Frequency	% (relative frequency)	Word Combinations		
			1st	2nd	3rd
service(s)	9276	99.231	cloud	compute	provider(s)
adoption	3646	83.077	intention	innovation	service(s)
technology(s)	3424	95.385	information	compute	acceptance
resource(s)	3289	97.692	compute	cloud	allocation
provider(s)	3042	92.308	service(s)	cloud	SaaS
system(s)	2684	99.231	information	support	computer
security	1723	80.769	information	datum	cloud
support	1713	93.077	management	decision	system(s)
application	1695	96.923	cloud	base	service(s)
user(s)	1692	95.385	cloud	end	acceptance
performance	1681	86.923	business	firm	operational
level	1671	93.077	service	agreement	restriction(s)
innovation(s)	1408	69.231	technological	technology	service(s)
software	1291	95.385	engineer	enterprise	application(s)
access	1218	93.846	network	date	gain
network(s)	1217	90.769	social	access	value
framework	918	84.615	TOE	theoretical	conceptual
platform	830	83.846	cloud	compute	deployment
development	729	91.538	service(s)	software	technological
IaaS	662	65.385	cloud	PaaS	service(s)
Computer	531	74.615	system(s)	science	generation
Internet	524	83.077	base	service(s)	connection
computer	418	75.385	system(s)	science	generation
PaaS	391	60.000	IaaS	provider	SaaS
algorithm	377	30.769	genetic	schedule	propose
Software	340	70.000	engineer(s)	enterprise	application(s)

As a result of the analysis made so far, it has been seen that CC adoption is one of the most studied topics. It has been observed that 55 studies are dealing with cloud computing adoption and technology acceptance. There are also studies found on these issues with different subjects and viewpoints. 34% of the studies focused on cloud computing adoption in small and medium-sized enterprises, which have an important place in most of the developing economies, even though they face with many challenges, such as inability to access appropriate technologies, lack of qualified personnel etc.

Table 6. Top 10-word combinations in the papers

The Combinations of Three Words		
Words	Count	Relative Frequency (%)
cloud compute service	984	64.62
cloud compute adoption	740	45.38
cloud service provider	268	52.31
adopt cloud compute	244	40.00
supply chain management	166	27.69
top management support	162	21.54
security and privacy	153	33.85
cloud compute technology	149	33.85
decision support system	145	40.00
supply chain integration	144	9.23

#### 4. DISCUSSIONS AND MANAGERIAL IMPLICATIONS

With the emergence of Industry 4.0, technologies such as artificial intelligence, cloud computing and big data have been used effectively by organizations. Recently, cloud computing has become a mature structure that is widely used by companies. Organizations move their workloads and sensitive data to the cloud to integrate cloud computing into their systems, which brings some risks and concerns (cloud security, secure access, identity management). Using multiple cloud service providers in organizations and managing the situation safely and effectively are one of the most important issues. The vast majorities of companies are concerned about cloud security and cloud data loss (Crow Research Partner, 2018; Bommadevara et al., 2018).

Cloud computing is nowadays converting into an issue that has become the main element of many companies' business models. Cloud computing provides a cost advantage to businesses, as many systems can be set up in different environments outside of their systems due to the cloud computing infrastructure. It increases the scalability of systems and this affects a company's success, reputation, and profitability. The use of cloud computing technologies helps businesses to react and adapt quickly to the market needs.

One of the most important effects of the cloud is leverage. There are many disruptive technologies (technologies that will cause major transformations such as artificial intelligence, internet of things, big data, autonomous robots etc.) that come along with Industry 4.0, which are expected to improve many industries. If these technologies can be combined with the cloud, the benefit they offer can be seen easily. For instance, when the Internet of Things is combined with the cloud, the data received from the devices can be instantly distributed to many places, allowing real-time decision making. On the other hand, the cloud computing can show a leverage effect by adding value to all destructive and innovative technologies related with Industry 4.0.

In this paper, we obtained some results from general and detailed data analysis corresponding to research questions of the included papers. The results summarize the current research attempts; most demanded and examined research topics and the research gap in cloud computing literature from managerial perspective. The current literature review reveals the fact that cloud computing is an intersecting theme of many interdisciplinary fields (Information communication technologies, supply chain, management, logistics, engineering, marketing, etc.). In addition to the research gaps and future research paths arising from answering previous research questions, some areas of business are particularly interesting in the cloud computing.



Figure 9. Research Area of the Papers

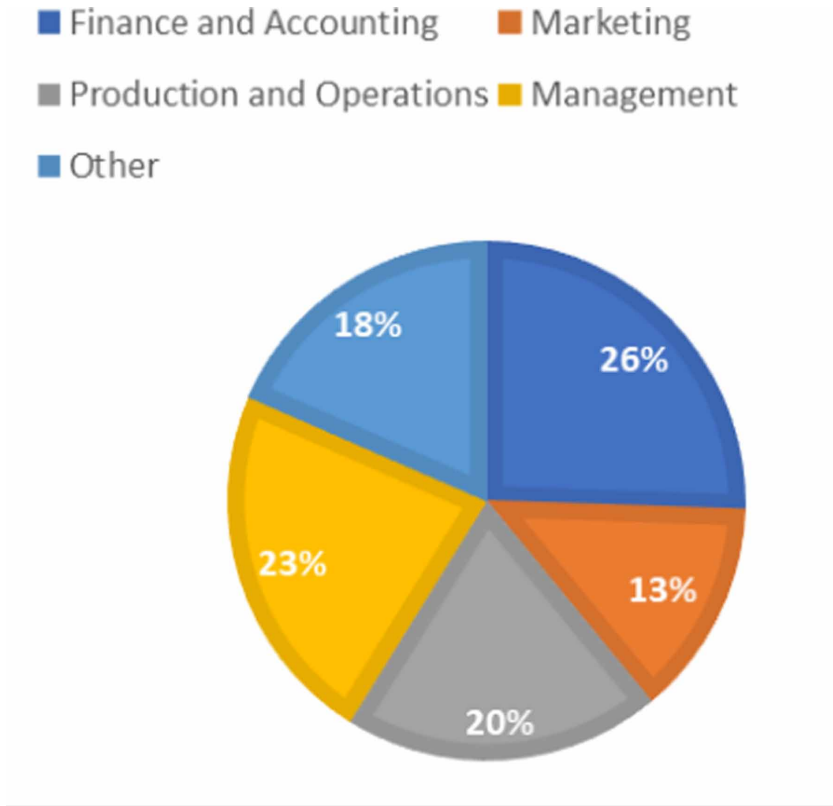


Figure 10. Finance and Accounting Papers

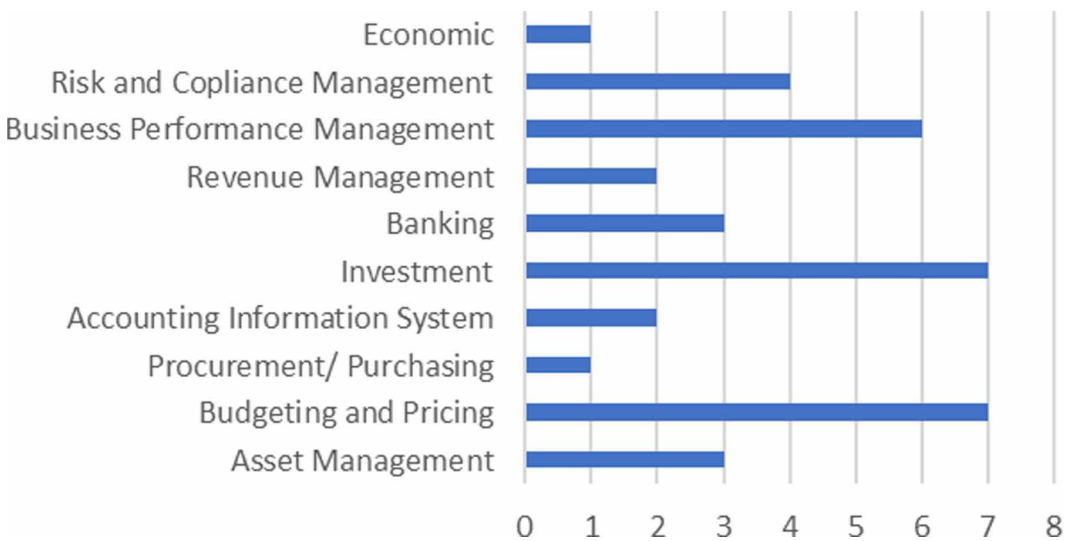


Figure 11. Management Papers



Figure 12. Production and Operation Management Papers



Table 7. Some application areas of cloud computing

Reference	Year	Company	Proposed Solution
(1) <i>Hauff et al., (2014)</i>	2014	Market Maker	Market Maker is an intermediary between cloud users and cloud providers. It provides a cloud platform that is called Cloud Market.
(2) <i>Mladenow et al., (2015)</i>	2015	Cloud Pilots	Cloud Pilot is a German cloud solution provider for construction companies, and it offers mobile cloud base applications.
(3) <i>Suherman &amp; Simatupang, (2017)</i>	2017	Bina Simar Amity	The adoption of a cloud-based solution is to automate the business processes.
(4) <i>Dumitrache et al., (2017)</i>	2017	ICIPRO project	ICIPRO is a cloud computing platform for Romanian companies. It provides data storage, Infrastructure as a Service (IaaS) and virtualizes cloud resources.
(5) <i>Nieuwenhuis et al., (2018)</i>	2018	Microsoft Dynamics AX	It was generated to operate Microsoft's cloud computing platform (Azure). Azur provides building deploying, managing applications and it offers to access online tools, frameworks and services.

As can be seen in the Table 7, there are only 5 papers (3.7%) that offer the cases of application. Four of them used case studies and one of them was a project for a specific country (ICIPRO). It was discovered that (1) focused on the applicability of a cloud market in an inter-organizations context and how organizations were achieved standardized IT resources in future (Hauff et al., 2014). (2) The advantage for cloud-based real estate companies is the ability to regulate IT-based resources supply to unstable IT-based resources demand in the short term (Mladenow et al., 2015). (3) The cloud solution performs well when it complements other existing systems in companies such as ERP (Suherman & Simatupang, 2017). (4) The overall objective of the ICIPRO project is the modernization, development and optimization of public services offered to citizens through a Cloud Computing infrastructure (Dumitrache et al., 2017). (5) Microsoft is responsible to operate the software smoothly in the Cloud, and standardized software optimizes sustainability and lowers cost in return (Nieuwenhuis et al., 2018).

Despite the increasing importance of cloud applications, there are few practical studies on this subject in the literature. It can be concluded from this analysis that companies and academicians rarely interact with each other, although there is a growing interest in this issue from both sides.

## 5. CONCLUSION

Industry 4.0 has been one of the most important subjects of academic research since 2011. It has basically 11 components (Internet of things, big data, cyber security, augmented reality, cloud computing, simulation, horizontal and vertical integration, additive manufacturing, autonomous robots, cyber physical systems and smart factories). As a result of the research, it has been seen that there is no systematic literature review about some components of Industry 4.0 from business perspective. In the future, researchers can conduct systematic literature review using smart factories, augmented reality, system integration and autonomous robots keywords in terms of business, supply chain management, manufacturing and sustainability perspective.

Our study contributes to the current cloud computing literature between the years of 2014 and 2019. Methodologically, our study reveals an organized collection of knowledge accumulated in this field. From a research perspective, we propose a classification across the spectrum of business aspects in cloud computing. The main purpose of this research is to systematically review and analyze the studies undertaken between the years 2014 and 2019 that dealing with cloud computing from business viewpoint. This study indicates literature gaps, reveals current research efforts and presents a research

agenda for future studies. It has revealed the importance of cloud computing from both theoretical and practical perspectives. Firstly, the articles related to the cloud computing in managerial field and the prominent journals were listed. Then, the categories of the journals were examined. A general list of keywords has been made and then keywords have been clustered specifically. The analysis of the keywords provided important information on the topics that are currently been studied related to cloud computing. The most frequently used words in the articles and the statistics of using words used together were also very useful in determining the current study areas, research focus and some neglected subjects in the literature. Moreover, our analysis showed that “adoption” is the area that is most studied in the cloud computing research and the researchers can review the cloud computing literature systematically in terms of “adoption”.

In addition to the research gaps as a result of the analysis made, some other areas of management are found to be particularly interesting in the cloud computing field. Systematic literature analysis has shown that technology acceptance, supply chain management and technology (innovation) from managerial aspect are frequently studied. As a result of the analysis, it was seen that the subject of adoption of cloud computing has been studied from different perspectives in the literature. The issue of cloud adoption in SMEs has attracted a lot of attention. The supply chain is the topic that is most studied by researchers related to production. Surprisingly, cloud computing technologies have not gained enough attention in terms of sustainability.

Similar to Karunakaran et al. (2015)’s study, which showed that the most studied themes are pricing, market, sourcing, and adoption on cloud computing till 2014, our study has shown that adoption is still one of the most studied topics in cloud computing literature between the years 2014 and 2019. Additionally, our study analyzes the relevant literature deeper in terms of the business research areas and reveals that human resources management; supply chain management, production and operations management, quality management, investment, and budgeting are also among the rising topics in cloud computing literature.

The purpose of this study is not only to reveal the gap in the cloud computing literature, but also the tendencies, and interest towards this topic from managerial perspective. Our study also offers a research agenda for the cloud computing literature in terms of business viewpoint. The findings of this study may contribute to management endeavoring to implement cloud computing within companies to foster decision making processes. Hence, the outcomes of this study may further act as a guideline for managers in global context especially from information management perspective. Therefore, this study can support the efforts of the business people towards strengthening the competitive advantages of their companies via cloud computing.

There are some limitations of the study. The conference proceedings, Ph.D. theses, and articles published after the year of 2019 were excluded. This review covers the accessible papers on cloud computing from the business perspective that were published in the years between 2014 and 2019 in three databases (Web of Science, Science Direct and Scopus). Because of the search criteria limits in English language, existing cloud computing papers published in other languages are excluded. However, expanding this systematic review of the literature may be interesting for future research.

This systematic literature review indicated the current state of cloud computing literature from business perspectives. Many multi-criteria decision-making methods were used in the existing literature. Future studies can focus on new models, methods, numerical studies and approaches. Thus, more robust strategies can be developed for integrating cloud computing technologies into companies with different organization levels, supply chains and logistics networks. With the increase in cloud computing investment in recent years, the adoption of cloud computing has become an important topic. Companies have started to be concerned with cloud security and sensitive data protection. As a result, cloud security is an important issue to be studied in the future both practically and academically. In future studies, quality management and its sub-topics can be studied more in terms of cloud computing. Moreover, the future research may focus on cloud adoption on larger enterprises.

Some factors affecting the adoption such as trust, security, and top management support can be further studied in the future. Moreover, sustainability is a trendy topic in the relevant literature, which has not been enough studied. Therefore, environmental and social sustainability concerns can be addressed further in the cloud literature. Furthermore, as mentioned before, there are few practical studies in the relevant literature, so more empirical and practical research needs to be carried out by utilizing various theories and models. For instance, the adoption of cloud computing in various industries and sectors (e.g., tourism and manufacturing) and different economies can be analyzed by employing various quantitative and qualitative approaches. In addition, investigating the relationships among service quality, trust, loyalty, and respect for customer privacy for success in CRM systems can be considered in the future.

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