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Understanding the Developments in the Business Perspective of Cloud Computing:
A Multidimensional Scaling Analysis

Harsh Parekh, Louisiana State University, USA*
https://orcid.org/0000-0002-3956-2401

Huai-Tzu Cheng, University of Massachusetts, Amherst, USA

Andrew Schwarz, Louisiana State University, USA

ABSTRACT

Research on cloud computing (CC) has gained a lot of momentum owing to its massive adoption. It has moved beyond the exploration of inherent capabilities to understand its disruptiveness and transformative value. In this vein, the authors conducted a comparative literature review of 101 articles to better understand the developments from previous reviews. This article serves as a replication study to evaluate the growth of the business perspective of CC. The authors identify 126 factors guiding the characteristics, adoption, governance, and business impact of the cloud. Further, they employ a rigorous analysis that situates our review at the intersection of these factors and applies a multidimensional scaling technique. The developed matrix (a) helps to clarify the current state of research, (b) identifies research gaps, and (c) identifies potential further research avenues. Unlike previous reviews, this developed multidimensional view of each article uncovers numerous perspectives that can guide future research.

KEYWORDS

Adoption, Business Perspective, Business Value, Characteristics, Cloud Computing, Governance

I learned very early the difference between knowing the name of something and knowing something. (Richard Feynman)

INTRODUCTION

According to the Gartner's Hype Cycle for cloud computing 2019 report, companies are moving from the "inflated expectation phase" towards the "enlightenment and productivity phase" for cloud-related technologies (Smith & Anderson, 2019). In the inflated expectation phase many companies experienced a pre-matured adoption, majorly because of lack of understanding of its business value and security threats. Research on Cloud Computing has matured beyond the technical development

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phase towards planning business-aligned cloud strategies. It emerges from the long-promised vision of utility computing and benefits from developments in computing power, data transmission speed, and mobile and internet communications (Armbrust et al., 2010; Venters & Whitley, 2012). Essential characteristics, service, and deployment models distinguish various definitions of cloud computing, the most popular of which is from the NIST (National Institute of Standards and Technology, USA), which defines it as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell & Grance, 2011). As a sourcing strategy, cloud computing is a form of outsourced shared-resource computing service leveraging a variety of service models—e.g., software as a service (SaaS), infrastructure as a service (IaaS), and platform as a service (PaaS) (Durkee, 2010; Zhang et al., 2020). Gartner's latest projection indicates a 21.7% growth in global end-user spending on public cloud services, surging to $597.3 billion in 2023 from $491 billion in 2022 (Stamford, 2023). The tremendous growth of cloud computing is based on its transformative value in helping to reduce upfront IT infrastructure costs, democratizing storage and computing services, and supporting business innovation (Joe-Wong & Sen, 2018). Like every technology, research moves from the discovery of characteristics to leveraging them for smooth adoption. However, the disruptive nature of innovation can impede effective IT governance and business impacts. On-demand network access and scalable IT resources are redefining traditional governance practices with transformative sourcing strategies (Venters & Whitley, 2012).

Research during the last decade has transitioned from seeking to understand cloud computing to exploring the effects of cloud computing on various business functions (Benlian et al., 2018; Breznitz et al., 2018; Fahmideh et al., 2019; Guo et al., 2019; Hosseini et al., 2020). Business researchers have offered a number of cloud research curations both from a descriptive general overview (Bayramusta & Nasir, 2016; Hoberg et al., 2012) and in terms of a specified business perspective (Salleh et al., 2018; Wulf et al., 2019). However, most of the existing review studies have not been able to provide a comprehensive classification of the studies because (a) the reviews predate some of the significant developments in the literature and (b) they use empirical analysis such as content analysis, which lacks a contextual in-depth understanding and sense-making. In this review, the authors position articles based on their exhaustive exploration of the major and minor contributions of the 101 articles included here. They develop and extend classifications established by previous reviews to situate articles at the intersection of various cloud parameters (i.e., subdimensions). Their review upgrades and strengthens previous research curations (Behrend et al., 2011; Iyer & Henderson, 2010; Janssen & Joha, 2011; Saya et al., 2010; Venters & Whitley, 2012) in that it goes beyond mere explanation of cloud parameters and clarifies the interplay between them.

This article follows guidelines proposed by Webster and Watson (2002) for effective processing and articulation of literature. It adopts the research design used by Hoberg et al. (2012) to articulate the current state of cloud computing research in information systems. The authors evaluate the state of theory in the domain of cloud computing by reviewing theoretical contributions, employed theories, and defining dimensions. They investigated cloud dimensions such as attributes, factors, and practices by scrutinizing literature on different levels of analysis. The article extends previous work by Hoberg et al. (2012) to evaluate the current state of cloud computing characteristics, including factors influencing cloud adoption, IT governance practices regarding cloud implementation, and the pragmatic impact of cloud computing on businesses. Examining the business value of cloud computing is essential because it reveals the potential of this transformative technology, facilitating informed decisions and yielding numerous other benefits. By scrutinizing the current state of cloud computing the article contributes to an understanding of the dynamic intersection between technology and business practices.

The remainder of the paper is structured as follows. First, the authors discuss past related literature reviews and then define the boundary criteria for this review. Subsequently, they analyze the literature utilizing the adopted framework. In the next section, they discuss their findings by deriving implications from some underexplored developing areas in the literature. Then, they address the development, analysis, and interpretation of the co-occurrence matrix. The final section presents research gaps and future research opportunities.

RELATED WORK

The cloud computing research domain has bewitched technical and managerial researchers with the revolutionary impact of its services. However, early literature review efforts using a holistic lens or framework to classify dimensions found an inadequate supply of articles from business or nontechnical perspectives (Hoberg et al., 2012; Yang & Tate, 2012). Yang and Tate (2012) positioned articles in their descriptive review based on technological issues, business issues, domains and applications, and the conceptualization of cloud computing (Yang & Tate, 2012). The authors took inspiration from a framework employed by Hoberg et al. (2012) categorizing extant literature into dimensions of characteristics, adoption determinants, governance, and business impacts. Thus, their study is a replication study that addresses some significant limitations related to an insufficiently mature paradigm study period. Early reviews were primarily focused on understanding cloud computing characteristics. For example, Venters and Whitley (2012) reviewed existing literature to understand key characteristics using technical and service desires for cloud users. Webster and Watson (2002) suggested that the selection of a high-quality pool of papers would provide focus on concepts and thus used articles from prominent information systems journals and conferences.

In addition to recognizing the necessity for this review by considering the limitations of preceding analyses, the authors aim to provide a rigorous synthesis of the conceptualization of business growth as indicated in prior reviews. In a pioneering endeavor to examine the business dimension of cloud computing, Marston et al. (2011) employed a SWOT analysis that yielded recommendations beneficial for business practitioners and IS researchers. They outlined five research categories for IS researchers in cloud computing: economics, IT strategy (including security), adoption challenges, green IT, and regulatory concerns. Durao et al. (2014) underscored the importance of effectively managing the diversity of dimensions and constituent elements in cloud computing to achieve a true on-demand environment. Aligned with this perspective, Yang and Tate (2012) emphasized the significant preoccupation within the practitioner community regarding cloud computing adoption. Many review articles have advocated an immediate necessity for articles that explain cloud computing technologies from a business perspective (Senyo et al., 2018). Explaining organizational desire to achieve efficiency, Venters and Whitley (2012) observed that many organizations grapple with poor cost understanding and struggle to assess cloud's relevance and face challenges in quantifying the associated risks. More recent reviews indicate a nuanced departure from the conventional approach of minimizing fixed IT costs and leveraging cloud-provided IT resource flexibility in terms of the existing perspective on cloud computing.

Disruptive and transformative aspects of cloud technology have been uncovered in Müller et al. (2015), drawing from the attained maturity in the literature. However, the authors point out a limitation in empirical investigations at the time to comprehensively examine these facets, highlighting the necessity for future research. In a similar viewpoint, Bayramusta and Nasir (2016) found a predominant focus of cloud computing research is on cloud computing adoption (19%), closely followed by investigations into the legal and ethical issues associated with cloud computing (15%). The study of these newer CC aspects encouraged companies utilizing cloud technology to not only focus on the immediate operational advantages but also employ it to drive innovative management practices. Major gaps in literature concern inadequate grasp of cloud computing research theories (Schneider & Sunyaev, 2016), incomplete awareness of lesser-explored cloud computing aspects (Müller et al., 2015; Wulf et al., 2021), and limited insight into the scope and geographic emphasis of cloud computing research (Senyo et al., 2018). Although there is no indigenous theory that has been developed for CC, the introduction of cloud-based IS has shifted the operational and management paradigm of the organization towards a service-dominant logic, fostering a landscape where firms engage in shared coordinated relations (Wang et al., 2016). In order to promote business growth of cloud computing, previous reviews have suggested open exchange of optimal operational practices (open source) (Oliveira et al., 2014). This fosters product improvement, price reduction, wider market acceptance, and industry growth. A recent review by Wulf et al. (2021) focused on critical business challenges associated with the initial choice to adopt cloud computing at an organizational level, as well as the subsequent utilization of cloud computing platforms. Consequently, post-adoption IT use entails not only continuity and habit but also how individuals creatively explore new applications for it. Moreover, the authors aim to comprehensively address all sub-dimensions of cloud computing research in order to shed light on previously underexplored areas.

The authors' search and selection processes were as follows. They conducted two rounds of selection and collection, first in November 2020 and then in July 2023. They started by locating the relevant literature in the IS field. They limited the search to peer-reviewed papers in the basket of eight academic journals as top journals in the Information System field; these included the *European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of the Association for Information Systems, Journal of Information Technology, Journal of Management Information Systems, Journal of Strategic Information Systems, and MIS Quarterly*. Moreover, they also searched the conference proceedings from the *International Conference on Information Systems (ICIS)* since conference proceedings cover more recent research (Hoberg et al., 2012). As suggested by Wulf et al. (2021) the general search phrase 'cloud computing' can be used to cover the terms IaaS, PaaS, and SaaS; therefore, they implemented the keyword, title, and abstract searches with the term 'cloud computing'. The search results contain 116 papers across the basket of eight journals and ICIS papers for all years (until 2023). They excluded 2023 from their review due to the pending release of journal issues and ICIS proceedings. Table 1 presents the investigated journals and the ICIS conference in their study.

Next, the authors followed Okoli and Schabram (2010) and Müller et al.'s (2015) approach to screen papers by using three steps as selection criteria to filter irrelevant papers in their literature review. First filter of articles was based on whether the abstract of the papers concern information technology (IT). Second filter was based on whether the abstract had its main topic as cloud computing. Third filtering criteria consisted of reading through all papers to see if the paper focused on cloud computing from a business perspective, such as cloud computing in a managerial or organizational context. The authors discarded 15 papers after the screening process based on their paper selection criteria. In total, they identified 101 papers relevant to the current state of cloud computing characteristics from a business perspective. The article coverage is from 2009 to 2022.

Table 1. Sources

Journal / Conference	Search Fields	Coverage	Analyzed
European Journal of Information Systems	Title | Abstract | Keywords	2009-2022	4
Information Systems Journal	Title | Abstract | Keywords	2009-2022	4
Information Systems Research	Title | Abstract | Keywords	2009-2022	12
Journal of the Association for Information Systems	Title | Abstract | Keywords	2009-2022	3
Journal of Information Technology	Title | Abstract | Keywords	2009-2022	9
Journal of Management Information Systems	Title | Abstract | Keywords	2009-2022	9
Journal of Strategic Information Systems	Title | Abstract | Keywords	2009-2022	4
MIS Quarterly	Title | Abstract | Keywords	2009-2022	5
International Conference on Information Systems (ICIS)	Title | Abstract | Keywords	2009-2022	51

REVIEW DESIGN

In this section, the authors present a comparative analysis of review vis-à-vis Hoberg et al. (2012). The review results are synthesized in four areas (characteristics, adoption determinants, governance, and business impact). These four areas are subcategorized into *dimensions* (design principles, service models, etc., as seen in Table 2) and *subdimensions* (on-demand self-service, broad network access, etc., as seen in Table 2) to clearly represent the research focus and positioning. Subdimensions are explained using their contextual meaning as observed in the reviewed literature. The popularity and importance of each subdimension are discussed in the analysis below.

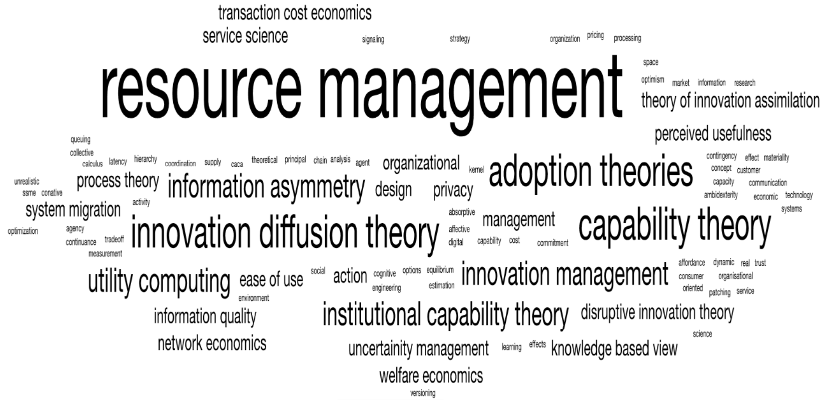
Based on their inclusion criteria, the authors selected 101 articles for the final pool. The distribution of articles is not uniform across the years included in the study period, perhaps due to factors such as journal focus (special issues), conceptual maturity, etc. They observed a minor dip in publication between 2014-2017. They collected their sample during the summer of 2023; hence, articles published after 2022 are not included in the sample. Among the articles reviewed, 53% of the studies used quantitative methods, 31% utilized qualitative methods, and the remainder used a mix of both techniques.

Next, the authors extracted theories, concepts, techniques, and paradigms used in the reviewed studies. Using JMP 16 pro software, they performed textual visualization to represent concepts, theories, techniques, and paradigms in word cloud form, as seen in Figure 1. Information Systems

Table 2. Terminologies used in review

Terminology used	Description	Factors
Areas (4)	The highest level of classification, which is achieved using an innate theory or research questions for any technology.	Characteristics, Adoption determinants, Governance factors, and Business impact
Dimensions (17)	This sub-classification of major areas represents different research streams, which may or may not be valid with other technology.	Design principles, Service model, Deployment model, Pricing model, Market structure, IT benefits, Business benefits, Structures, Processes, Organization, etc.
Subdimensions (126)	These are cloud specific or native features, which define the relevance of the cloud technology.	On-demand self-service, Broad network access, Decision authorities, Scalability, Elasticity, Security, Cost of capital, etc.

Figure 1. Word cloud of concepts and theories used to study CC



scholars have found resource management techniques such as scheduling, allocation, and forecasting to be most useful. These techniques help to optimize cloud rental cost (Hosseini et al., 2020), clarify resource allocation in terms of fairness and social welfare (Joe-Wong & Sen, 2018), develop models for backup resource provisioning (Guo et al., 2019), and achieve similar optimizations on trade-offs (Bodenstein et al., 2011). Adoption theories (Aggarwal et al., 2015; Messerschmidt & Hinz, 2013), innovation diffusion theory (Benlian et al., 2018; Breznitz et al., 2014; Wright et al., 2017), and institutional capability theory (Kathuria et al., 2018; Messerschmidt & Hinz, 2013; Zhang et al., 2020) have been very useful for studying the organizational implementation of cloud computing. This multidimensional perspective allows for a holistic understanding of cloud computing's internal dynamics and its implications for Information Systems. Apart from operational and organizational concepts, some peculiar or cloud-native notions, such as grid computing (Messerschmidt & Hinz, 2013; VanderMeer et al., 2012) and utility computing (Chen & Wu, 2012) have also been studied. Cloud computing literature provides opportunities for IS researchers to broaden boundaries by delving into native characteristics such as coordination strategies (ASPs and AIPs) (Demirkan et al., 2010), latency pricing effects (Cheng et al., 2016), patching strategies (Choudhary & Zhang, 2015), and more. As cloud computing evolves, optimizing resources through theory-driven approaches becomes vital for maximizing its transformative potential. A review by Wang et al. (2016) concluded that no indigenous theory has been formulated exclusively for cloud computing. Such theories can be developed through well-structured reviews. They highlighted that multiple perspectives support these initiatives, exemplified by the shifting dynamics among participants within a cloud-enabled value chain. The authors posit the necessity for a novel theory that elucidates the transformative impact of cloud computing on a company's digital strategies and innovation endeavors.

In the next core section of the review, the authors follow the categories predesigned by Hoberg et al. (2012) to classify articles into four major areas (1-4).

What Characteristics Are Observed in the Cloud Computing Literature?

Cloud computing characteristics have remained a popular research topic over the years because this area provides much supporting literature for further research. Out of 101 reviewed articles, 71 analyzed, utilized, and discussed cloud characteristics. Table 3 represents the literature review analysis of articles that explain cloud characteristics. The findings are grouped into five similar dimensions—design principles, service models, deployment models, market structure, pricing strategy—as well as one different dimension versioning strategy from Hoberg et al. (2012). On-premise and SaaS variants of application software are evaluated in the literature based on security risks (August et al., 2014). This area of research has diversified into 29 unique subdimensions, nine of which appear in the present review.

The new dimensions are not prominent in the literature because of their late realization; however, they influence crucial dimensions such as pricing (Cheng et al., 2016), sourcing (Schneider & Sunyaev, 2016), migration (Fahmideh et al., 2019; Pang & Tanriverdi, 2022), provisioning strategy (August et al., 2014), and cost reduction (Krancher et al., 2018). Cloud latency tolerance leading to differential pricing across different geographical markets has become a major issue for cloud computing efficiency (Cheng et al., 2016). Fahmideh et al. (2019) developed a generic cloud migration process model using a metamodeling approach to explain the interrelation between the tailorability, modularity, and reusability of legacy systems. Exploring the interplay of characteristics and their mutual influences has been a focus of research. For instance, Pang and Tanriverdi (2022) shed light on the strategic contribution of IT modernization and cloud migration in reducing cybersecurity risks within organizations. Similarly, elasticity and abstraction capabilities of PaaS services help software development teams to enhance their collective learning processes (Krancher et al., 2018).

Most of the subdimensions observed in the Hoberg et al. (2012) reviews are retained; however, the research focus moves between those dimensions. For example, the service model research focus extends from SaaS to PaaS and IaaS. Researchers have studied critical design decisions on PaaS

Table 3. Cloud computing characteristics

Characteristics		
Factor	**Description**	**Source**
Design Principles		
On-demand self service	"[…]the ability to provide on-demand self-service helps organizations automatically use IT resources as and when needed without requiring human interaction with service providers" (Battleson et al., 2016).	(Battleson et al., 2016; Benlian et al., 2018; Bodenstein et al., 2011; Chen & Wu, 2012; M. Chen et al., 2021; Giessmann & Legner, 2016; Kaltenecker et al., 2013; Kaltenecker et al., 2015; Karunagaran et al., 2016; Kranz et al., 2016; Schneider & Sunyaev, 2016; Schneider et al., 2018; Venters & Whitley, 2012; Zainuddin & Gonzalez, 2011)
Broad network access	"[…] cloud computing provides broad network access through standard mechanisms thereby enabling organizations to access resources across multiple platforms. Broad access also facilitates rapid scaling up and down of IT resources in response to market dynamism" (Battleson et al., 2016).	(Battleson et al., 2016; Bhattacherjee & Park, 2014; Cheng et al., 2016; Giessmann & Legner, 2016; Guerin et al., 2019; Schreieck et al., 2021; Zainuddin, 2012)
Resource pooling/ distribution	"[…] the resource pooling feature of cloud computing enables organizations to pool computing resources and dynamically assign and reassign them according to their needs" (Battleson et al., 2016).	(Battleson et al., 2016; Bodenstein et al., 2011; M. Chen et al., 2021; S. Chen et al., 2021; Guerin et al., 2019; Guo et al., 2019; Hosseini et al., 2020; Joe-Wong & Sen, 2018; Kumar et al., 2022; VanderMeer et al., 2012; Yuan et al., 2018; Zainuddin & Gonzalez, 2011)
Scalability/ Elasticity	"[…] scalability is a significant enabler of dynamic capability. In fact, a major advantage of cloud computing is the ability to scale resources up and down" (Battleson et al., 2016).	(Battleson et al., 2016; Benlian et al., 2018; S. Chen et al., 2021; Krancher et al., 2018; Retana et al., 2012; Schneider & Sunyaev, 2016; VanderMeer et al., 2012; Venters & Whitley, 2012; Xiao et al., 2020; Zainuddin & Gonzalez, 2011)
Measured service	"[…] cloud computing provides measured service, organizations can carefully monitor, control and optimize the amount of resources that are used to support organizational processes" (Battleson et al., 2016).	(Battleson et al., 2016; Choudhary & Zhang, 2015; Guerin et al., 2019; VanderMeer et al., 2012)
Virtualization	"Enabled by virtualization techniques, application systems have become independent from their underlying physical resources[…]Virtualization allows elastically scaling these resources up and down——a key characteristic of cloud computing" (Benlian et al., 2018).	(Benlian et al., 2018; Guerin et al., 2019; Kaltenecker et al., 2015; Luftman & Zadeh, 2011; Schneider & Sunyaev, 2016)
Service and interface description	"Paradoxically, despite the enormous concerns of potential cloud customers for lock-in, hold-up, and opportunistic repricing, almost no significant standardization efforts under way today are aimed at ensuring interoperability or portability among […] cloud vendors" (Clemons & Chen, 2011).	(Clemons & Chen, 2011; Fahmideh et al., 2019)
Limited customizability	"Customer-specific configuration can be made at the meta-data layer on top of the common code using interfaces provided by the SaaS vendor" (Xin & Levina, 2008).	(Schneider et al., 2018; Winkler & Brown, 2013; Zainuddin & Gonzalez, 2011; Zhang et al., 2020)
Security and privacy	"[…] the use of cloud computing (CC) is still subject to uncertainties. Users express concerns about data privacy and security (Ryan 2011). These concerns pose a great problem for CC providers as they face the challenge of gaining users' trust" (Walter et al., 2014).	(Aggarwal et al., 2015; Agudelo-Serna et al., 2017; August et al., 2014; Choudhary & Zhang, 2015; Kaletsch & Sunyaev, 2011; Pang & Tanriverdi, 2022; Walter et al., 2014; Zhang et al., 2020)
Latency tolerance	"Network latency, defined as the total elapsed time from the time a request is sent via the Internet to the time a response is received" (Cheng et al., 2016).	(Cheng et al., 2016; Saha et al., 2021)
Design robustness	"[...] enduring in the face of changes in the marketplace and technology, and being continuously useful even with the passage of time. [...] the efficacy of different theoretical perspectives, the appropriateness of alternate firm strategies, and thus the usefulness of various theories when some of the conditions of a setting are changing" (Bardhan et al., 2010).	(Bardhan et al., 2010; Schneider & Sunyaev, 2016)

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Table 3. Continued

Characteristics		
Factor	**Description**	**Source**
Reusability	"Tailorability is required as the integrating legacy systems with cloud services may be undergone by several factors such as the choice of a target cloud platform, reusability of legacy system codes, security requirements, and system workload" (Fahmideh et al., 2019).	(Bardhan et al., 2010; Fahmideh et al., 2019; Krancher et al., 2018)
Modularity	"Modularity refers to the degree a system's components can be separated and recombined [...] permits parts of the software or the system to be easily changed with minimal interactions elsewhere and integrated into the whole system when there is a need" (Bardhan et al., 2010).	(Bardhan et al., 2010; Benlian et al., 2018; Fahmideh et al., 2019)
Abstraction	"Virtual abstraction to enable the rapid deployment of applications and data to reduce the cost and complexity of providing the underlying infrastructure, which also simplifies operations" (Krancher et al., 2018).	(Krancher et al., 2018)
Service Model		
SaaS	"[…] applications delivered as services over the Internet and is commonly seen as the highest layer of the Cloud Computing stack" (Winkler & Brown, 2013).	(Aggarwal et al., 2015; August et al., 2014; Chen & Wu, 2012; Chen & Huang, 2014; Choudhary & Vithayathil, 2013; Choudhary & Zhang, 2015; Demirkan et al., 2010; Fahmideh et al., 2019; Gustavsson & Ljungberg, 2019; Kaltenecker et al., 2015; Liu et al., 2015; Schneider & Sunyaev, 2016; Winkler & Brown, 2013; Wright et al., 2017; Xiao et al., 2020; Zainuddin & Gonzalez, 2011)
PaaS	"PaaS involves transformation of previously highly protected software into platforms and related components or applications (apps) that are developed in emerging ecosystems of third-party developers." (Giessmann & Stanoevska, 2012).	(Benlian et al., 2018; Choudhary & Vithayathil, 2013; Fahmideh et al., 2019; Giessmann & Legner, 2016; Giessmann & Stanoevska, 2012; Gustavsson & Ljungberg, 2019; Krancher et al., 2018; Schneider & Sunyaev, 2016)
IaaS	"Infrastructure as a Service (IaaS), which offers units of computation and storage to customers accessing these services via Wide Area Networks" (Stieglitz et al., 2014).	(Bodenstein et al., 2011; Choudhary & Vithayathil, 2013; Fahmideh et al., 2019; Gustavsson & Ljungberg, 2019; Schneider & Sunyaev, 2016; Stieglitz et al., 2014)
Deployment Model		
Public	"Public cloud is available to the general public or an industry group, and is owned and managed by a vendor" (Su, 2011).	(Choudhary & Vithayathil, 2013; Guerin et al., 2019; Kumar et al., 2022; Retana et al., 2012; Schneider & Sunyaev, 2016; Su, 2011)
Private	"Private cloud is operated within a single organization by the organization itself or a third-party vendor" (Su, 2011).	(Choudhary & Vithayathil, 2013; Guerin et al., 2019; Kumar et al., 2022; Schneider & Sunyaev, 2016; Su, 2011)
Hybrid	"Hybrid cloud is a composition of a set of internal and external clouds" (Su, 2011).	(Schneider & Sunyaev, 2016; Su, 2011)
Community	"Community clouds are 'controlled and used by a group of organizations that have shared interests, such as specific security requirements' (Marston et al., 2011: 180), where its strengths and weaknesses fall between those of a private cloud and those of a public one" (Schneider & Sunyaev, 2016).	(M. Chen et al., 2021; Schneider & Sunyaev, 2016)
Market Structure		
Decentralized market	"Coordination structures represent patterns of decision making and communication among a set of actors who perform tasks to achieve goals. There are four coordination structures—product and functional hierarchies, and centralized and decentralized markets" (Bardhan et al., 2010).	(Bardhan et al., 2010; Demirkan et al., 2010)
Provider	"[…] the platform owner or cloud provider – who runs a business dedicated to rent out cloud computing resources" (Gustavsson & Ljungberg, 2019).	(S. Chen et al., 2021; Demirkan et al., 2010; Gustavsson & Ljungberg, 2019; Karunakaran, 2017; Liu et al., 2015; Loske et al., 2013; Su, 2011; Walter et al., 2014)

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Table 3. Continued

Characteristics		
Factor	**Description**	**Source**
Consumer/ Customer	"[…] consumers prefer PaaS solutions to offer the migration itself as a service, not just provide tools to support the migration process" (Giessmann & Stanoevska, 2012).	(Bardhan et al., 2010; Demirkan et al., 2010; Giessmann & Stanoevska, 2012; Hurni et al., 2022; Koehler et al., 2010; Nikkhah & Sabherwal, 2017; Park et al., 2017)
Integrator/ Aggregator	"This group is composed of business partners, systems integrators, value-added resellers, and systems solutions brokers. In such cases, the customer may interact with these intermediaries in their service encounters due to expertise that the intermediaries bring" (Demirkan et al. 2010).	(Bardhan et al., 2010; Demirkan et al., 2010)
Pricing Model		
Pay per use	"On an infrastructure layer pay per use is the common pricing tariffs […] Providers as Amazon base their prices on usage of requested server performance in hours" (Koehler et al., 2010).	(S. Chen et al., 2021; Kaltenecker et al., 2015; Koehler et al., 2010; Liu et al., 2015; Schlereth, 2013; Schneider & Sunyaev, 2016; Zhang et al., 2020)
Fixed fee	"Fixed fee tariffs are dominant on a SaaS layer ... fixed fees are easy to implement and convenient to handle" (Koehler et al., 2010).	(Ackermann et al., 2012; S. Chen et al., 2021; Koehler et al., 2010; Liu et al., 2015; Schlereth, 2013; Zhang et al., 2020)
Versioning Strategy		
On-premises	"When software vendors such as Microsoft and SAP offer SaaS versions of traditionally locally hosted software [...] is installed on premises at the customer's location)" (August et al., 2014).	(August et al., 2014; Kaltencker et al., 2013; Kranz et al., 2016; Schneider & Sunyaev, 2016; Schreieck et al., 2022; Winkler & Brown, 2013; Zhang et al., 2020)
SaaS	"Over the last two decades, consumers have harnessed SaaS applications for personal email, online gaming, photo sharing, and social networking" (August et al, 2014).	(August et al., 2014; Choudhary & Zhang, 2015; Kaltenecker et al., 2015; Kranz et al., 2016; Schneider & Sunyaev, 2016; Winkler & Brown, 2013)

business models (Giessmann & Legner, 2016), delineated their market expectation (Giessmann & Stanoevska, 2012), and measured the impact of PaaS on the software development team (Krancher et al., 2018). Similarly, IaaS resource management design has attracted much attention in terms of performance metrics (such as delay, bandwidth overhead, reliability, and security) (Guo et al., 2019) and formulating strategies for a cost-efficient IaaS portfolio (Bodenstein et al., 2011). The cloud plays a role as an ecosystem orchestrator that addresses institutionalization challenges while facilitating the transition from a product platform ecosystem to an innovation platform ecosystem. The cloud platform acts as a decoupling layer between on-premises systems and cloud applications (Schreieck et al., 2022). Interesting deployment models have been studied where, instead of implementing separate IT services, governments collaborate to pool their IT resources into a single unified service. While these community deployment models encourage the adoption of shared IT services, the absence of effective coordination can lead to notable under-utilization of these services (M. Chen et al., 2021).

How and to What Extent Are Cloud Computing Concepts Adopted in Practice?

The call for research on cloud adoption is reflected in a multitude of theories and levels of analysis employed to study adoption phenomena (Battleson et al., 2016; Elie-Dit-Cosaque & Pallud, 2010; Hoberg et al., 2012; Saya et al., 2010). In addition to the three dimensions and 17 subdimensions from the Hoberg et al. (2012) review, the authors' review presents two new dimensions and 41 new subdimensions. Table 4 represents the dimensions and subdimensions that relate to the adoption of the cloud computing concept as studied in the literature. Out of the 101 articles reviewed, 50 studied the interrelation between the adoption of cloud computing concepts and adjoint attributes. Cloud adoption behavior is affected by the firm's capability at an organizational level (Messerschmidt & Hinz, 2013) and IT knowledge at an individual level (Aggarwal et al., 2015; Malladi & Krishnan, 2012). The impact of cloud adoption on a firm's IT department structure (Choudhary & Vithayathil, 2013),

Table 4. Cloud computing adoption determinants

Adoption		
Factor	**Description**	**Source**
Technology		
Abandonment options	"Abandonment options include scoping down or switching an investment and refers to the possibility of discontinuing it and redeploying remaining resources effectively" (Saya et al., 2010).	(Aggarwal et al., 2015; Saya et al., 2010; Xiao et al., 2020)
Asset specificity	"[…] cloud computing provides unprecedented flexibility in the way organizations can use IT and non-IT assets, capabilities, and knowledge that they can bring together to respond to the environment" (Battleson et al., 2016).	(Bardhan et al., 2010; Battleson et al., 2016; Karunagaran et al., 2016; Schneider & Sunyaev, 2016; Winkler & Brown, 2013)
Cost of capital	"Building a new data-center or renovating current facilities for the purpose was going to cost the university up to Aus $35 million and taken a minimum of two years" (Sarkar & Young, 2011).	(Breznitz et al., 2018; Wright et al., 2017; Xiao et al., 2020)
Cost reduction	"Reduction of transaction costs and initial technology investment" (Karunagaran et al., 2016).	(Battleson et al., 2016; Bodenstein et al., 2011; S. Chen et al., 2021; Cheng et al., 2016; Choudhary & Zhang, 2015; Guo et al., 2019; Kaltenecker et al., 2015; Karunagaran et al., 2016; Luftman et al., 2012, 2013; Saha et al., 2021; VanderMeer et al., 2012; Wright et al., 2017; Yuan et al., 2018)
Deferral options	"Deferral options include learning and refers to the possibility of delaying an investment in order to learn more about it before committing to the investment" (Saya et al., 2010).	(Saya et al., 2010; Yuan et al., 2018)
Growth options	"Growth options include scoping up an investment and refers to the opportunity to pursue potential follow-on investments beyond what was initially anticipated" (Saya et al., 2010).	(Breznitz et al., 2018; Gannon, 2013; Saya et al., 2010)
Inimitability	Inimitability is the extent to which "[…] applications represent indispensable and non substitutable factors in the core processes of companies enabling them to gain competitive advantages" (Benlian et al., 2009).	(Aggarwal et al., 2015; Venters & Whitley, 2012)
IT flexibility	"[…] the 'speed of delivery,' not the cost differential, was the prime driver behind the university's consideration of cloud services" (Sarkar & Young, 2011).	(Guerin et al., 2019; Venters & Whitley, 2012)
Security and privacy	"[…] security and privacy are significant concerns because cloud computing increases the number of people with potential access to sensitive information. Many focal organizations expressed concern with storing sensitive data on the clouds" (Battleson et al., 2016).	(Ackermann et al., 2012; Agudelo-Serna et al., 2017; Bhattacherjee & Park, 2014; Ghoshal et al., 2014; Haag & Eckhardt, 2014; Karunagaran et al., 2016; Kranz et al., 2016; Luftman et al., 2015; Messerschmidt & Hinz, 2013; Nikkhah & Sabherwal, 2017; Pang & Tanriverdi, 2022; Stieglitz et al., 2014; Zhang et al., 2020)
Strategic value	"Based on the strategic goals of a firm, the firm develops its own business analytics strategy….the relationship between business analytics strategy and adoption of social, mobile and cloud computing (SMC) technologies is influenced through various firm level antecedents of adoption of SMC technologies" (Ghoshal et al., 2014).	(Agudelo-Serna et al., 2017; August et al., 2014; Bodenstein et al., 2011; Breznitz et al., 2018; M. Chen et al., 2021; Choudhary & Zhang, 2015; Ghoshal et al., 2014; Guo et al., 2019; Hurni et al., 2022; Kaltencker et al., 2013; Kaltenecker et al., 2015; Kathuria et al., 2018; Pang & Tanriverdi, 2022; Schneider & Sunyaev, 2016; Schreieck et al., 2021; Yuan et al., 2018; Zhai et al., 2018)
Network dependency	"Network dependency may impede access to cloud services that may be outside of organizational control" (Battleson et al., 2016).	(Battleson et al., 2016; S. Chen et al., 2021; Saha et al., 2021)
Perceived usefulness	"[…] the degree to which users believe that adopting a new IT will improve their task performance, and has been validated to positively influence user intention to use IT across a wide range of IT adoption contexts" (Bhattacherjee & Park, 2014).	(Bhattacherjee & Park, 2014; Nikkhah & Sabherwal, 2017)
IT unavailability	"[…] such as hardware outage, network disruption, or data unavailability demonstrate themselves through application unavailability which business really cares about" (Amiri et al., 2014).	(Amiri et al., 2014; S. Chen et al., 2021; Saha et al., 2021)

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Table 4. Continued

Adoption		
Factor	**Description**	**Source**
Information quality	"[…] the degree to which information has attributes of content, accuracy and format, and timeliness" (Elie-Dit-Cosaque & Pallud, 2010).	(Elie-Dit-Cosaque & Pallud, 2010)
System quality	"[…] refers to the characteristics of the system. System quality is related to the user friendliness and ease of use of a system." (Elie-Dit-Cosaque & Pallud, 2010).	(Elie-Dit-Cosaque & Pallud, 2010)
IT risks	"[…] the potential for an unplanned event involving Information Technology (IT) to threaten an enterprise objective" (Amiri et al., 2014).	(Ackermann et al., 2012; Amiri et al., 2014; Keller & König, 2014; Loske et al., 2013)
Complexity	"[…] the degree to which innovation is perceived as being difficult to use" (Karunagaran et al., 2016).	(Karunagaran et al., 2016)
Equivalence	"to guarantee security, availability and response time which are at least equivalent in quality to that experienced by a locally running client-server service on a local area network" (Venters & Whitley, 2012).	(Venters & Whitley, 2012)
Variety	"Put simply a cloud service must provide sufficient variety (in terms of its functionality or its ability to be programmed and altered for users) in order to meet the needs that users intend to use it for. Thus the variety of a service is related to the 'number of distinguishable states that it could take on' in use" (Venters & Whitley, 2012).	(Venters & Whitley, 2012; Zhang et al., 2020)
Continuance	"where continuance describes the user's continued use of the technology after adoption" (Aggarwal et al., 2015).	(Aggarwal et al., 2015)
Pricing	"The SaaS pricing structure is typically subscription based. However, since we do not focus on the temporal variation in software price and quality, users who subscribe to SaaS software at the time of software release will continue to subscribe to it for its lifetime" (Choudhary & Zhang, 2020).	(Bodenstein et al., 2011; Chen & Wu, 2012; S. Chen et al., 2021; Cheng et al., 2016; Choudhary & Vithayathil, 2013; Demirkan et al., 2010; Guerin et al., 2019; Guo et al., 2019; Joe-Wong & Sen, 2018; Kaltencker et al., 2013; Kumar et al., 2022; Saha et al., 2021; Yuan et al., 2018; Zhai et al., 2018; Zhang et al., 2020)
Organization		
Access to external IT capabilities	"For organizations to survive in challenging environment, they may exploit appropriate external technology capabilities offered by cloud computing instead of relying solely upon internal technical capabilities" (Battleson et al., 2016).	(Battleson et al., 2016; Breznitz et al., 2018; Choudhary & Vithayathil, 2013; Krancher et al., 2018; Kranz et al., 2016; Messerschmidt & Hinz, 2013; Schreieck et al., 2021, 2022)
Change of roles/ responsibilities	"sourcing cloud-based ES bears certain peculiarities, such as self-service acquisition and shifting task responsibilities for requirements determination, which require organizations to adjust their sourcing processes" (Schneider & Sunyaev, 2016).	(Schneider & Sunyaev, 2016; Schneider et al., 2018)
Lock-in	"vendor lock-in problem, increases switching costs for subscribers, and may lead to incompatibility with the services of other vendors" (Kathuria et al., 2018).	(Kathuria et al., 2018; Kranz et al., 2016; Schneider et al., 2018; Schreieck et al., 2021; Wright et al., 2017)
Organization size	"Large firms exhibit differences in terms of resources and expertise compared to small and medium enterprises. These differences, in turn, may have an impact on the way in which firms perceive technology attributes." (Karunagaran et al., 2016).	(Karunagaran et al., 2016; Messerschmidt & Hinz, 2013; Winkler & Brown, 2013)
Usage frequency	"[…] because consumers experience misfit each time they use a product, the higher a consumer's usage frequency, the higher is the misfit cost that the consumer incurs" (Zhang et al., 2020).	(Joe-Wong & Sen, 2018; Zhang et al., 2020)
Trust	"Trust (i.e., trust in a third party without a prior relationship) is built through cognitive processes that influence trusting beliefs by processing available information and cues (McKnight et al. 1998), such as certifications and reputation" (Lansing & Sunyaev, 2013).	(Karunakaran, 2017; Lansing & Sunyaev, 2013; Stieglitz et al., 2014; Walter et al., 2014)
Organizational innovativeness	"[…] defined as the willingness of key organizational decision-makers to experiment with new technologies that are external to the organization" (Wright et al., 2017).	(Battleson et al., 2016; Böttcher et al., 2022; Wright et al., 2017)

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Table 4. Continued

Adoption		
Factor	**Description**	**Source**
Readiness to adopt IT innovation	"Innovations that are incompatible with an organization's capabilities to support these innovations and existing technological infrastructure will likely not have a high rate of adoption or assimilation" (Wright et al., 2017).	(Wright et al., 2017)
Switching cost	"[…] defined as 'one-time costs that customers associate with the process of switching from one provider to another" (Bhattacherjee & Park, 2014).	(Bhattacherjee & Park, 2014; Conboy & Morgan, 2012; Ghoshal et al., 2014; Saha et al., 2021)
Self-efficacy	"[…] people's judgment of their personal ability to perform a particular behavior, which is a well-established predictor of IT usage intention" (Bhattacherjee & Park, 2014).	(Bhattacherjee & Park, 2014; Conboy & Morgan, 2012; Ghoshal et al., 2014)
Integration and coordination	"[…] organizations may need significant resources for the integration and coordination of cloud computing services with existing IT infrastructure" (Battleson et al., 2016).	(Battleson et al., 2016; M. Chen et al., 2021; Hurni et al., 2022; Karunagaran et al., 2016; Malladi & Krishnan, 2012; Schreieck et al., 2021)
Empowerment of employees	"We have empowered many of our employees to redesign processes if they can better meet the needs of the marketplace. They are the ones who are dealing directly with the customers and have a better understanding of what works best" (Battleson et al., 2016).	(Battleson et al., 2016)
The Significant role of top management	"Top management beliefs refers to top management's subjective cognitive beliefs regarding the technology's potential to provide significant benefits to the organization. Top management participation refers to the actions taken by top management to promote and facilitate assimilation of the technology" (Wright et al., 2017).	(Wright et al., 2017)
User dissatisfaction	"[…] is an affect representing users' overall evaluative response to their prior first-hand experience with IT usage" (Bhattacherjee & Park, 2014).	(Battleson et al., 2016; Bhattacherjee & Park, 2014; Elie-Dit-Cosaque & Pallud, 2010; Hsieh & Huang, 2012; Saha et al., 2021)
User experience	"[…] the expectation disconfirmation theory (EDT) is one of the dominant lenses for examining and understanding user experiences." (Huntgeburth et al., 2013).	(Huntgeburth et al., 2013)
Internal demands	"[…] the felt need to improve internal efficiency, is an important catalyst for companies adopting SMC technologies" (Ghoshal et al., 2014).	(Ghoshal et al., 2014)
Market demands	"[…] are even considered part of an organizational culture that drives customer value through monitoring needs and responding accordingly" (Ghoshal et al., 2014).	(Ghoshal et al., 2014)
Cloud computing adoption strategy	"[…] two approaches with different characteristics to implement CC. First, one could use a big bang approach," by which a large amount of applications is migrated to the cloud at one point, or within a small period. Second, one could follow a "gradual implementation approach," by which applications are evaluated at strategic decision points to decide whether they should be migrated to the cloud" (Wulf et al., 2019).	(Wulf et al., 2019)
IT budget	"IT budget size has a significant negative effect on the intention to adopt" (Messerschmidt & Hinz, 2013).	(Breznitz et al., 2018; Choudhary & Vithayathil, 2013; Gannon, 2013; Messerschmidt & Hinz, 2013; Pang & Tanriverdi, 2022)
Change in requirements	"Once implemented, users and organizations learn from experiences with the ES and adjust their requirements resulting in customizations and ongoing maintenance of the ES. Furthermore, requirements are shaped by contextual factors, such as organizational and societal structures" (Schneider et al., 2018).	(Choudhary & Vithayathil, 2013; Schneider et al., 2018)
Compatibility	"The IS literature has examined innovation compatibility of organizations (Ramamurthy et al, 2008). Innovations that are incompatible with an organization's capabilities to support these innovations and existing technological infrastructure (Schultz & Slevin, 1975) will likely not have a high rate of adoption or assimilation" (Wright et al., 2017).	(Benlian et al., 2018; Schreieck et al., 2021; Wright et al., 2017)

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Table 4. Continued

Adoption		
Factor	**Description**	**Source**
Innovativeness	"Organization's level of organizational innovativeness, defined as the willingness of key organizational decision-makers to experiment with new technologies that are external to the organization" (Wright et al., 2017).	(Benlian et al., 2018; Böttcher et al., 2022; Kaltencker et al., 2013; Pang & Tanriverdi, 2022; Wright et al., 2017)
Transformative value	"We understand the transformative value of a technology as the realized or unrealized potential that widespread diffusion of this technology leads to fundamental and large-scale innovations that benefit individuals, organizations, markets, and societies" (Benlian et al., 2018).	(Benlian et. al., 2018)
Environment		
Subjective norm	"People who influence my behavior (friends, colleagues etc.) think that I use Google Apps" (Bhattacherjee & Park, 2014).	(Agudelo-Serna et al., 2017; Bhattacherjee & Park, 2014; Giessmann & Legner, 2016; Schneider & Sunyaev, 2016; Wright et al., 2017; Xiao et al., 2020)
Uncertainty	"[…] the lack of information or knowledge, which translates into difficulties in accurately assessing current and future decision situations" (Karunakaran, 2017).	(Bodenstein et al., 2011; Karunakaran, 2017)
Fairness/social gains/ social welfare	"Specifically, the concept of social gains, which comes from institutional theorists, was introduced to capture the impact of IT adoption on external partners" (Wright et al., 2017).	(M. Chen et al., 2021; S. Chen et al., 2021; Chen & Huang, 2014; Choudhary & Vithayathil, 2013; Joe-Wong & Sen, 2018; Wright et al., 2017)
Regulatory support	"[…] large firms have been keen on securing customized solutions which are often lacking in cloud solutions. Also, the large firms with a global footprint and existing regulations and standards are impacted more by the legal issues (taxation issues, data protection issues and security issues) involved in cloud compared to SME's" (Karunagaran et al., 2016).	(Karunagaran et al., 2016)
Service		
Efficiency	"For much of the literature efficiency is seen as an attribute of a product, rather than a value-proposition which customers define the value of" (Venters & Whitley, 2012).	(Benlian et al., 2018; Cheng et al., 2016; Guerin et al., 2019; Joe-Wong & Sen, 2018; Luftman et al., 2015; Luftman & Zadeh, 2011; Luftman et al., 2012; Venters & Whitley, 2012)
Creativity	"A key service desire is the extent to which cloud can enable creativity and innovation by lowering the transaction costs associated with innovation and enabling the development of value-networks" (Venters & Whitley, 2012).	(Benlian et al., 2018; Venters & Whitley, 2012)
Simplicity	"The complexity of the underlying hardware, for example by abstracting and by limiting the variety of a cloud service. The resulting simplicity can be reflected in simpler and more standardized contractual arrangement for the purchase of services by a larger number of customers" (Venters & Whitley, 2012).	(Venters & Whitley, 2012; Wright et al., 2017)
Customer commitment	"Theoretical concept of commitment, which is defined as "a frame of mind or psychological state that compels an individual toward a course of action Commitment has been widely used in the marketing discipline to study customer retention and customer switching behavior, both at the individual level and the "organizational level" (Xiao et. al., 2020).	(Benlian et al., 2018; Gannon, 2013; Guo et al., 2019; Schneider et al., 2018; Xiao et al., 2020)
Individual		
IT knowledge	"IT knowledge of end users is conceptualized as how well individuals understand fundamental IT concepts [and] how well informed they are about IT in their organization" (Aggarwal et. al., 2015).	(Aggarwal et al., 2015; Agudelo-Serna et al., 2017; Schneider et al., 2018; Winkler & Brown, 2013)
Expectancy	"Effort expectancy is essentially another way of describing the user's self-efficacy toward the specific technology in question" (Aggarwal et al., 2015).	(Aggarwal et al., 2015; Benlian et al., 2018)
Trust	"Define trust as the expectation that an actor can be relied on, will be predictable, and will act fairly. Therefore, in a grid computing context, trust has two dimensions: First, the participant can trust the technology" (Messerschmidt & Hinz, 2013).	(Agudelo-Serna et al., 2017; Benlian et al., 2018; Messerschmidt & Hinz, 2013)
Transformative value	"Individual users can access and leverage virtual resources whenever needed, providing individuals the capability to access everything-as- service, but also leading to an increased blurring of work-life domains" (Benlian et. al., 2018).	(Benlian et al., 2018; Schreieck et al., 2022)

IT governance issues (Vithayathil, 2018), and knowledge transfer (Zainuddin, 2012) demonstrates the popularity of organizational impact studies (Khalil et al., 2017). For individuals, higher tolerance to congestion can prevail when switching is more expensive, as observed with Dropbox (Saha et al., 2021). In contrast to early cloud adoption research, more recent investigations into cloud adoption have revealed a shift wherein a technology buyer's profit might decrease despite cost reduction. This highlights the idea that transitioning to cost-efficient cloud services might not consistently result in favorable business outcomes (Saha et al., 2021).

Firm size (SME or large) leads to differential effects on adoption factors that can be leveraged to design a specific cloud strategy (Karunagaran et al., 2016; Li et al., 2012; Wulf et al., 2019). For example, large firms perceive technological integration and compatibility as incumbent issues; however, in the case of SMEs, these factors have a positive impact on adoption (Karunagaran et al., 2016). Differences in perceived stakeholder value related to cloud computing technology influence cloud adoption by creating an internal (organizational) and external (market) demand (Ghoshal et al., 2014). The trajectory of cloud computing adoption has significantly evolved, witnessing a substantial migration of both small and large enterprises from on-premises infrastructure to embrace a multi-cloud or hybrid approach (Miranda et al., 2022). Khalil et al. (2017) identified business managers that perceive value based on the performance, agility, and ubiquity benefits of cloud computing, as opposed to managers that focus on threats related to security, compliance, and reliability. Research endeavors have also concentrated on developing optimal cloud load balancing mechanisms that address central concerns like resource allocation, thereby promoting green IT through optimized cloud computing networks (Kumar et al., 2022). Moreover, harnessing green IT innovation in data centers emerges as a viable strategy to elevate firm value while adhering to environmental regulations (Park et al., 2017).

The level of maturity of the literature allows for the assimilation of adoption. Cloud computing adoption augments the effect of organizational assets that enable CIO strategic focus at an individual level (Malladi & Krishnan, 2012) and the ability to overcome barriers to acceptance, infusion, and routinization at an organizational level (Conboy & Morgan, 2012). Case studies (Aggarwal et al., 2015; Conboy & Morgan, 2012; Karunagaran et al., 2016; Khalil et al., 2017; Wulf et al., 2019) and surveys (Ghoshal et al., 2014; Li et al., 2012; Malladi & Krishnan, 2012; Messerschmidt & Hinz, 2013; Saya et al., 2010) were found to be equally popular for understanding the benefits, challenges, barriers, and strategic factors related to adoption. Venters and Whitley (2012) identified the service dimensions of cloud computing implied by technological dimensions in the literature. Service dimensions ensure the optimization of cost and time, simplification of business processes, reinforcement of innovation, and development of end user commitment (Gannon, 2013; Guo et al., 2019; Xiao et al., 2020). Beyond service dimensions, this review highlights individual factors that contribute to the adoption of cloud computing. Shared IT service adoption factors that hamper vendor profits and subsequently diminish overall social welfare are underscored in literature (M. Chen et al., 2021).

How to Govern Cloud Services in Business Practice?

The increasing adoption of cloud services in organizations challenges the traditional role of IT departments because of dominion governance by cloud vendors. Cloud computing governance involves managing rules and protocols to ensure secure use of cloud resources while aligning with organizational goals. Stakeholders proactively engage in over-subjectification to advocate for partnership-specific needs, ensuring these are not overshadowed by platform owners' standardization (Hurni et al., 2022). This disruptive effect of technology is largely debated as leading to a transformative IT governance, which, in turn, introduces new issues (Vithayathil, 2018). The current review, as seen in Table 5, presents a differential understanding and perceived value of governance among stakeholders (Guo et al., 2019; Khalil et al., 2017). The study of the organizational impact of cloud computing is still emerging in the literature, making it difficult for practitioners and academics to report governance challenges between businesses and IT departments. For example, Winkler and Brown (2013) examined the organizational impact of application delivery modes (SaaS vs on-premise) on IT governance.

Table 5. Cloud computing governance factors

Governance		
Aspect	**Description**	**Source**
Structures		
Decision authorities	"The major decision areas regarding SaaS refer to application changes, financials and architecture, which is in line with the general domains for IT decisions as well as with standard IT process models such as the IT Infrastructure Library" (Winkler & Brown, 2013).	(Battleson et al., 2016; M. Chen et al., 2021; Chen & Huang, 2014; Choudhary & Vithayathil, 2013; Choudhary & Zhang, 2015; Giessmann & Legner, 2016; Guerin et al., 2019; Guo et al., 2019; Karunakaran, 2017; Khalil et al., 2017; Kumar et al., 2022; Saha et al., 2021; Winkler & Brown, 2013; Wright et al., 2017)
Processes	"High process management maturity of the firm positively moderates the relationship between Cloud Computing adoption and CIO's strategic focus" (Malladi & Krishnan, 2012).	(Choudhary & Zhang, 2015; Giessmann & Legner, 2016; Hurni et al., 2022; Malladi & Krishnan, 2012; Schneider et al., 2018; Schreieck et al., 2021, 2022; Winkler & Brown, 2013)
Metrics	"Metrics are increasingly generated, monitored and shared in real time with customers with some external parties producing similar metrics. Cloud providers believe that allowing customers to view availability statistics, incidence statistics and solution statistics 'builds trust'" (Venters & Whitley 2012).	(Choudhary & Vithayathil, 2013; Guerin et al., 2019; Schneider et al., 2018)
Architecture	"The capabilities of cloud architecture (e.g., resource pooling, elasticity, provisioning) result from such skills and knowledge applied to the operand resource of cloud technology" (Kathuria et al., 2018).	(Kathuria et al., 2018; Schreieck et al., 2022; Vithayathil, 2018; Winkler & Brown, 2013)
Privacy	"[...] recognise that privacy and data protection issues are frequently cited as a reason for failing to move to the cloud and while there are a range of technological measures that can be resolved to address many of the existing privacy concerns" (Venters & Whitley 2012).	(Choudhary & Zhang, 2015; Giessmann & Legner, 2016; Pang & Tanriverdi, 2022; Venters & Whitley, 2012; Vithayathil, 2018)
Roles and responsibilities	"[…] the increasing proliferation of information technology within and across organizations....it involves rethinking and restructuring of roles and responsibilities of the business unit and the IT unit when it comes to IT deployment" (Khalil et al., 2017).	(Khalil et al., 2017)
Parity groups	"[…] it is necessary to involve the IT group in selecting and implementing SaaS solutions, as they have knowledge about issues like choosing architectural options such as single or multi-tenancy design, security and detection of Intruders" (Janssen & Joha, 2011).	(Winkler & Brown, 2013)
Application governance	"We define application governance as the locus of decision rights for a business application" (Winkler & Brown, 2013).	(Choudhary & Zhang, 2015; Krancher et al., 2018; Vithayathil, 2018; Winkler & Brown, 2013)
Task responsibility	"Locus of decision management rights for a specific business application" (Winkler & Brown, 2013).	(Winkler & Brown, 2013)
Scope of use	"Breadth to which an application is used within the organization" (Winkler & Brown, 2013).	(Guo et al., 2019; Vithayathil, 2018; Winkler & Brown, 2013)

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Table 5. Continued

Governance		
Aspect	**Description**	**Source**
Processes		
Compliance management	"The firm will need to ensure that the cloud vendor is in compliance with quality, reliability, and other service attributes or features of its cloud services" (Geissmann and Legner, 2016).	(Giessmann & Legner, 2016; Schneider et al., 2018; Yuan et al., 2018)
IS policy	"A cloud service-level agreement (SLA) for IaaS typically includes dynamic metrics such as infrastructure service availability, performance latency and response delay for emergencies, and a host of medium- to long-term metrics such as data security, privacy, and integrity" (Guo et al., 2019).	(Ackermann et al., 2012; Agudelo-Serna et al., 2017; Bodenstein et al., 2011; Breznitz et al., 2018; Gannon, 2013; Guo et al., 2019; Schneider et al., 2018; Vithayathil, 2018; Yuan et al., 2018)
service level agreements	"A cloud service-level agreement (SLA) for IaaS typically includes dynamic metrics such as infrastructure service availability, performance latency and response delay for emergencies, and a host of medium- to long-term metrics such as data security, privacy, and integrity" (Guo et al., 2019).	(Bodenstein et al., 2011; Choudhary & Vithayathil, 2013; Guo et al., 2019; Saha et al., 2021; Yuan et al., 2018)
Employees		
Qualification	There is a shift from technical issues to expertise and knowledge in sourcing and developing management capabilities to control the relationships.	(Agudelo-Serna et al., 2017; Gannon, 2013; Janssen & Joha, 2011; Vithayathil, 2018)
Stakeholders		
Producer Stakeholder	"Innovators, Producers, Developers, Providers" (Bardhan et al., 2010).	(Bardhan et al., 2010; Choudhary & Vithayathil, 2013; Guo et al., 2019; Vithayathil, 2018)
Consumer Stakeholder	"Consumers, Clients, B2B Buyers, Users" (Bardhan et al., 2010).	(Bardhan et al., 2010; Choudhary & Vithayathil, 2013; Choudhary & Zhang, 2015; Gannon, 2013; Guo et al., 2019; Zainuddin, 2012)
Monitor Stakeholder	"Government Regulatory, Standard groups, User groups, Consultants" (Bardhan et al., 2010).	(Bardhan et al., 2010; Choudhary & Vithayathil, 2013; Gannon, 2013)
Intermediary Stakeholder	"Value-Added Resellers, Intermediaries, Brokers" (Bardhan et al., 2010).	(Bardhan et al., 2010; Gannon, 2013; Vithayathil, 2018; Zainuddin, 2012)

Although the structural aspect of governance has maintained its presence, other aspects stemming from relational dynamics, both internal and external to the organization, are also gaining prominence. Incumbent firms are progressively leveraging digital tools like cloud platforms to reshape their ecosystems. By employing field-level governance mechanisms, Schreieck et al. (2022) addressed institutionalization challenges allowing cloud infrastructure to gain legitimacy among ecosystem actors, consequently leading to ecosystem transformation. Cloud computing transforms the role of the IT department into an external-facing role (intermediary between cloud vendor and internal user) and an internal-facing role (to help internal users gain business value from IT services) (Vithayathil, 2018). The transformational role of the IT department affects governance structure and thereby causes the IT department to move between a cost center and a profit center in terms of organizational structure (Choudhary & Vithayathil, 2013). For instance, basic cloud services face competition among providers and are generally offered for free under the cost-center organizational structure. Well-defined platform governance practices (IPR, rules, and collaboration models) situate service relationships to reduce uncertainty and attain mutual profitability (Giessmann & Legner, 2016; Karunakaran, 2017). Zainuddin (2012) developed a conceptual model based on structural and relational conditions assessing the centrality of IT governance regarding cloud adoption. The optimal (cost- and time-effective) management of virtual infrastructure adopts operational management models, thereby guiding the formulation of service-level agreements (Guo et al., 2019; Yuan et al., 2018).

Beyond technological capacities, relationship driven capabilities such as ecosystem orchestration, platform evangelism, and platform co-selling play a vital role (Schreieck et al., 2021). While technology-related capabilities primarily aid in value co-creation but might weaken the platform owner's value capture position, relationship-driven capabilities balance this by fostering both aspects. Compared to development in other areas, the study of governing factors is still lacking, perhaps because of the general prominence of governance literature on IT outsourcing. There is extensive study of governing processes incorporating IS policies and regulatory compliances in the literature; however, these studies are generally conducted at a peripheral level.

What is the Business Impact of Cloud Services?

Every characteristic of cloud computing has either IT or business benefits showcasing its pragmatic value. Embracing cloud computing not only revolutionizes IT infrastructure but also empowers businesses with increased flexibility, streamlined operations, and holistic transformation. For example, the cloud's on-demand property converts fixed costs to variable costs, offers faster setup time, and removes capacity constraints. Conboy and Morgan's (2012) study of the cloud's perceived benefits to the organization identified cost and time savings as popular features, alongside improvements in process and communication between teams. This review adopts the dimensions articulated in Hoberg et al.'s (2012) previous review while adding 14 new subdimensions. Other studies use concrete measures to evaluate performance (Kathuria et al., 2018), productivity (Luftman et al., 2013), and efficiency (Park et al., 2017) or report on the organizational or individual impacts of cloud services adoption (Agudelo-Serna et al., 2017; Malladi & Krishnan, 2012). In addition to advantages for organizational metrics, cloud computing offers individual benefits like flexibility (no hardware requirements) and convenience (accessibility on low-end devices), distinguishing it from traditional services (Dong & Kumar, 2021).

Longitudinal surveys conducted across several geographies reveal that (1) business-IT alignment, business agility, and business productivity are major management issues, and (2) cloud technology and services have been becoming more influential in recent years and security concerns have been reduced (Luftman & Zadeh, 2011; Luftman et al., 2012, 2013, 2015; Pang & Tanriverdi, 2022). One of the prevalent business impacts of cloud computing services is the attainment of cost reduction through strategies such as optimal resource allocation (Kumar et al., 2022), utility economics (S. Chen et al., 2021), and judicious choice of cost regimes (M. Chen et al., 2021; Saha et al., 2021). Lack of business-IT alignment is attributed to the exclusivity of IT decision rights to either business units or IT units (Winkler & Brown, 2013). Thus, the maturity of alignment depends on the effectiveness of relationships between the units. Cloud capabilities such as integration, service portfolio, and business flexibility affect firm performance and help create business value (Benlian et al., 2018; Kathuria et al., 2018). Benlian et al. (2018) developed a framework using transformative mechanisms of cloud capabilities and suggested strategies to tackle potential disruptive transformation (Bardhan et al., 2010; Kaltenecker et al., 2015; Kranz et al., 2016).

In addition to transformative value, business (Agudelo-Serna et al., 2017; Benlian et al., 2018; Kathuria et al., 2018) and IT value (Benlian et al., 2018; Bodenstein et al., 2011; Retana et al., 2012) are delineated in the literature as important factors that are associated with the economic value of technology. Cloud-based platformization simplifies application implementation on the platform, enhancing the attraction for third-party developers to engage with the platform ecosystem, ultimately contributing to the creation of IT value (Schreieck et al., 2021). The organizational impact of cloud computing has been studied using various concrete and ambiguous measures. The literature is moving

Table 6. Business impact of cloud computing

Business impact		
Aspect	**Description**	**Source**
IT benefits		
Scalability	"The desire to receive a service which is scalable to meet demand[...] Scalability describes the ability to quickly add or remove resources in varied granularity to allow the better matching of resources to workload. In this context, elasticity is a measure of the rapidity of such scalability" (Venter & Whitley, 2012).	(Schreieck et al., 2022; Venters & Whitley, 2012)
Reduction of complexity	"Cloud computing plus open standards, open rapid development technologies, the whole web services concept, the browser or the mobile interface or application platform. All of those together make it easy to develop and deploy IT services in a rapid way" (Conboy & Morgan, 2012).	(Conboy & Morgan, 2012; Gannon, 2013; Schneider et al., 2018; Venters & Whitley, 2012; Wright et al., 2017)
IT agility	"IT resources are dynamically provisioned to meet the current needs of customers" (Conboy & Morgan, 2012).	(Battleson et al., 2016; Benlian et al., 2018; Conboy & Morgan, 2012; Kathuria et al., 2018; Krancher et al., 2018; Luftman et al., 2012, 2013; Schneider & Sunyaev, 2016)
Transformative value	"Interplay between the cloud's inherent capabilities and its transformative value" and how cloud computing affects the "capabilities of internal and external IT [and business] functions" (Kathuria et al., 2018).	(Benlian et al., 2018; Breznitz et al., 2018; Kaltenecker et al., 2015; Kathuria et al., 2018; Luftman et al., 2015; Pang & Tanriverdi, 2022; Vithayathil, 2018)
Cloud integration capability	"Cloud integration with legacy systems is an important means for service capabilities, business flexibility and performance to be enabled" (Kathuria et al., 2018).	(Kathuria et al., 2018)
Technological disruption	"A disruptive technology is a technological innovation that changes the market and industry infrastructure; gives rise to new business processes and software applications; and supports the displacement of current technologies, products, and services while creating a new basis for products, services, infrastructures, and applications that will become dominant in future markets" (Bardhan et al., 2010).	(Bardhan et al., 2010; Gannon, 2013; Kaltencker et al., 2013; Kaltenecker et al., 2015; Kranz et al., 2016)
Reliability	"Providing services at the promised time; Providing services right the first time; Showing sincere interest in reliably solving our problems; Fulfilling the obligations to the contract" (Xiao et al. 2020).	(Guo et al., 2019; Kranz et al., 2016; Luftman & Zadeh, 2011; Luftman et al., 2012; Xiao et al., 2020)
IT Value	"IT value that largely focuses on the economic value of IT within or between specific firms or organizations" (Benlian et al., 2018).	(Benlian et al., 2018; Bodenstein et al., 2011; S. Chen et al., 2021; Pang & Tanriverdi, 2022; Retana et al., 2012; Schreieck et al., 2021)
Business benefits		
Cost reduction	"[…] there had been approximately $100 million of savings as a result of Cloud, and I think that is just an example of the overall trend that is clearly driving efficiencies across the industry" (Battleson et al., 2016).	(Battleson et al., 2016; Bodenstein et al., 2011; Böttcher et al., 2022; M. Chen et al., 2021; S. Chen et al., 2021; Conboy & Morgan, 2012; Guerin et al., 2019; Hosseini et al., 2020; Joe-Wong & Sen, 2018; Kumar et al., 2022; Luftman et al., 2013, 2015; Schneider & Sunyaev, 2016; Venters & Whitley, 2012)
Market value	"The results indicate that cloud computing adoption announcements are associated with positive increases in the market value of the firm" (Son et al., 2011). "Performance may be measured in various ways including accounting measures such as sales or output, Return on Assets (ROA), market measures such as market value" (Vithayathil, 2017).	(Chen & Wu, 2012; Choudhary & Zhang, 2015; Gannon, 2013; Luftman & Zadeh, 2011; Luftman et al., 2012, 2013)
Business/IT alignment	"[…] business and IT representative share the view that through the new governance arrangements related to SaaS, overall IT alignment has improved and both parts of the organization are empowered to perform their new tasks regarding the application" (Winkler et al., 2011).	(Bardhan et al., 2010; Choudhary & Vithayathil, 2013; Gannon, 2013; Giessmann & Legner, 2016; Kathuria et al., 2018; Kranz et al., 2016; Luftman & Zadeh, 2011; Luftman et al., 2012, 2013; Winkler & Brown, 2013; Wright et al., 2017)

continued on following page

Table 6. Continued

Business impact		
Aspect	**Description**	**Source**
Market share	"Sales of individual firm /industry aggregate sales in the same GIC" (Chen & Huang, 2014).	(Chen & Huang, 2014)
CIO strategy	"Cloud computing adoption has the potential to reduce the number of ideas a CIO has to work on and use his/her attention to focus on strategic activities…if cloud computing adoption can in fact enable CIO strategic focus" (Malladi & Krishnan, 2012).	(Malladi & Krishnan, 2012)
Optimization of IT system operation	"[…] (i) the system characteristics and in particular the lead time that is required to reconfigure the system and (ii) the user behavior that may exhibit workload processes with different degrees of variability. Both factors determine how accurate the different operation strategy functions can optimize the IT system operation" (Hedwig et al., 2012).	(M. Chen et al., 2021; Hedwig et al., 2012; Kumar et al., 2022)
Energy efficiency	"The utilization of cloud computing can improve a client industry's energy efficiency by both reducing energy consumption and increasing operational efficiency of the client industry" (Park et al., 2017).	(Kumar et al., 2022; Park et al., 2017)
Gross margin	"Gross Margin = (Sales – Cost of Sales)/Total Sales)" (Chen & Huang, 2014).	(Agudelo-Serna et al., 2017; Benlian et al., 2018; S. Chen et al., 2021; Kathuria et al., 2018)
Business Value	"Relationships among platform owners, complementors, partners, competitors, and consumers are context-specific units of analysis. Therefore, depending on crucial contextual factors, cloud computing may generate business value through a single mechanism or a combination of two or all three mechanisms" (Benlian et al., 2018).	(Agudelo-Serna et al., 2017; Benlian et al., 2018; Böttcher et al., 2022; Kathuria et al., 2018; Pang & Tanriverdi, 2022)
Firm's performance	"For sustained performance, a firm needs higher order capabilities that can create, extend, or modify its lower-order capabilities. Such capabilities are dynamic; they "govern the rate of change of ordinary capabilities" (Kathuria et al., 2018).	(Kathuria et al., 2018; Luftman et al., 2015)
Business productivity	"IT leaders seem to be responding to this recession by focusing on IT as an enabler/driver of business productivity for the rest of the business" (Luftman et al., 2011).	(Hurni et al., 2022; Luftman et al., 2015; Luftman & Zadeh, 2011; Luftman et al., 2012, 2013)
Process reengineering/ Management	"BPR by definition is 'process-centric'. More recently, BPM has emerged as a more holistic approach focusing on integrating all aspects of the organization. It has become an important tool to take advantage of BPR initiatives. BPM is utilized to streamline end-to-end management of the whole enterprise (enterprise-centric)" (Luftman et al., 2012).	(Gannon, 2013; Luftman et al., 2015; Luftman & Zadeh, 2011; Luftman et al., 2012, 2013)

beyond standard capabilities such as scalability, on-demand service, and cost reduction toward the performance and innovation-driving capability of cloud computing. Another domain receiving attention is the Green-IT capabilities of the cloud. Regulatory enactment and the optimized allocation of cloud resources are two strategies crucial for achieving energy-efficient cloud computing (Kumar et al., 2022; Park et al., 2021). Hedwig et al. (2012) develops a model for energy conservation and the sensible utilization of information system resources, promoting the environmental value of technology.

CO-OCCURRENCE MATRIX

This literature review evaluated 101 research articles categorized into four major areas, 17 dimensions, and 126 subdimensions. The authors' observation of overlapping research themes (e.g., area characteristics, adoption, business impact) in each reviewed article motivated their multidimensional mapping. They employed rigorous manual scrutiny by positioning each research article in a 126*126 subdimensional matrix to summarize concurrent themes. The co-occurrence matrix builds the understanding of research trends at subdimensional (microlevel) and dimensional (or area, macrolevel) levels. This matrix is useful to researchers and practitioners because it offers (a) an interpretation of the popularity of research between two dimensions or subdimensions, (b) research gaps, and (c) research possibilities using the matrix. For example, SaaS and pricing are much more popular, compared to PaaS or IaaS. The co-occurrence matrix highlights few studies with business impact in terms of governing structural factors other than governing processes. In the next section, the authors describe their deployment of a popular bibliometric method to interpret the co-occurrence matrix for cloud computing.

Multidimensional Scaling

Multidimensional scaling (MDS) is a popular spatial representation technique used for bibliometric and scientomentric data (Ramos-Rodríguez & Ruíz-Navarro, 2004). This technique is commonly used in co-citation analysis to understand knowledge sharing (Fouroudi et al., 2020; Garfield & Merton, 1979; Samiee & Chabowski, 2012). Another application of MDS is co-word analysis in which different word clusters explain the relationships between core and peripheral research themes (Fu & Zhang, 2017; Peters & van Raan, 1993a; Rip & Courtial, 1984). The results of co-word analysis have visual similarity to the authors' method, but the core method of matrix development is vastly different. While the authors apply a manual method of matrix development as explained above, most of the co-word matrices are obtained through empirical data extraction from known databases. The authors argue that their method explains the co-occurrence of concepts directly, as opposed to co-word analysis where keywords are compared to concepts without contextual awareness. Co-word analysis is very promising in terms of obtaining larger matrix and study themes with developed literatures. The authors' method of situating articles between various conceptual themes guarantees positioning based on major or prominent concepts. Empirical keyword extraction can overemploy some minor or irrelevant concepts because it lacks interpretation and is solely focused on word frequency. One particular strength of manual development is that it can obtain abbreviations and some unique less popular terminologies describing similar concepts, which might be missed by automated data extraction. For example, automatic data extraction for "smart city" might miss references to "digital city" or "information city" (Fu & Zhang, 2017). Since academics are interested in the discovery of new terminologies, this type of error is more likely with automatic data extraction techniques. The authors quantify their co-occurrence matrix based on the count of articles to apply MDS. They explore both opportunities within the four areas of CC.

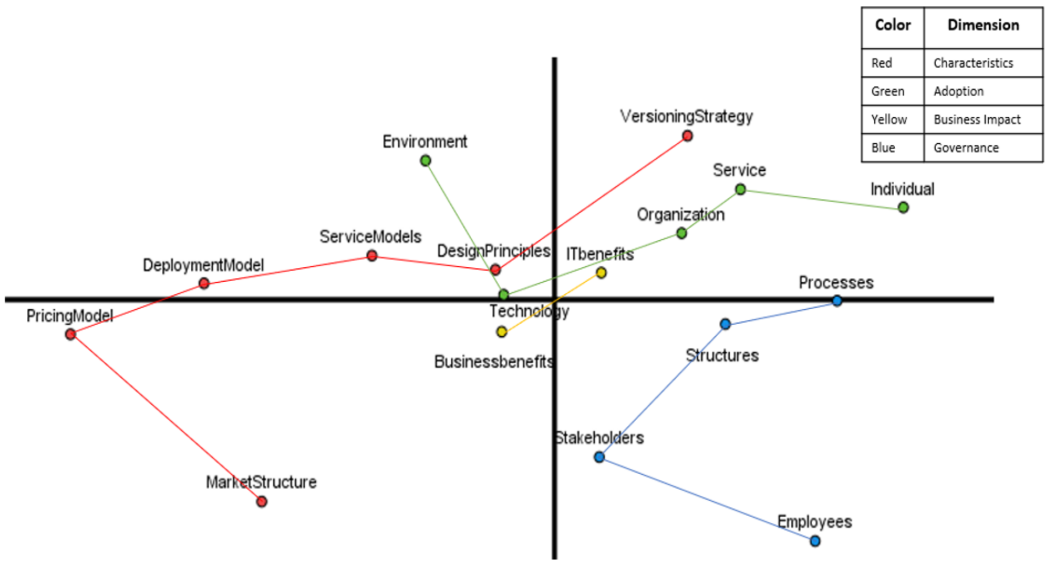
Thematic Structure in 17 Dimensions

The authors used SPSS's ALSCAL routine to perform multidimensional scaling with specification of similarity for their proximity matrix. With this technique, it is possible to define a distance model for dimensions that co-occur in reviewed articles. Dimensions that more often occur together in articles have higher magnitude than those that do not occur together (dissimilar). This distance model can be used to identify the focus of extant research in terms of important dimensions of cloud computing (Peters & van Raan, 1993a). Distance model interpretation can be performed by defining clusters for various dimensions. Figure 2 shows the result of multidimensional scaling for the dimensions extracted in the review. With a low critical stress value (0.1436; i.e., stress < 0.20) and a within a permissible range of RSQ coefficient (0.8480; i.e., RSQ > 0.70) the authors were able to present specific results. With only a few exceptions, it is not surprising that all the areas were found to distinctly represent defined quadrants (Ramos-Rodríguez & Ruíz-Navarro, 2004). This observation suggests that dimensions within each area displayed a discernible degree of structure or pattern in their similarities, a fact that is both apparent and corroborating.

Cluster A (Business Benefit, IT Benefit, Technology, Design Principles, and Organization)

The authors consider the most central dimensions of the distance model to be their Cluster A. The central cluster indicates many linkages with other peripheral clusters (Peters & van Raan, 1993b).

Figure 2. Euclidian distance model for cloud computing dimensions (Note: Stress: 0.1435 & RSQ=0.8480)



Given that the review covers research on cloud computing from a business perspective and within the information systems domain, it is ideal to have business and IT benefits as central dimensions. Most of the design principles/characteristics are inaugural to technological research. Previous reviews have highlighted the need for IS professionals and researchers to solve the biggest threat to CC research, described as attitudinal rather than technical challenges (Marston et al., 2011). Hence, it is gratifying to observe organizational adoption of technology as the core area for research. Cluster A dimensions are well defined and have the greatest number of subdimensions, indicating diversification and depth in terms of research. Cluster A covers five dimensions, representing 57% of the total subdimensions. The authors were not surprised to find that adoption dimensions of technology and organization were the most diversified, consisting of 56% of the cluster's (cluster A) subdimensions. This is due to the multifaceted and interdependent nature of technology and organizational factors influencing cloud adoption, leading to a broader range of subdimension representation. Some of the major themes in Cluster A features articles developing models to study business value in the organization (Benlian et al., 2018; Kathuria et al., 2018; Schreieck et al., 2021), cloud adoption and continuance behavior for end users (Aggarwal et al., 2015; M. Chen et al., 2021; Zainuddin, 2012), and development of conceptual models (Fahmideh et al., 2019; Hosseini et al., 2020; VanderMeer et al., 2012). The interaction between technological attributes, organizational alignment, design decisions driven by business needs, and collaborative value creation has facilitated widespread adoption.

Cluster B (Service Model, Pricing Model, Market Structure, Deployment Model)

This cluster consists of dimensions that depict the characteristics of cloud computing. The positioning of dimensions shows good interrelation between dimensions of characteristics, as they are represented closer in the model and provide more diversification in terms of research than any other area, as they seem to cover major areas in the graph, as seen in Figure 2. For better comprehension, the authors can categorize dimensions in the cluster under two labels: (a) developed characteristics, and (b) developing characteristics from a business perspective. The authors assume that academic research reflects developments in the industry. The developed dimension of this cluster is service models, and all other dimensions in the cluster are developing characteristics. As previously discussed, there is increasing interest in exploring service models beyond SaaS toward IaaS and PaaS. Based on development studies such as the construction of design theory for PaaS (Giessmann & Legner, 2016), formulating decision models for resource provisioning in IaaS (Bodenstein et al., 2011), and studying the impact of PaaS on software development (Krancher et al., 2018), service model research is expanding in IS literature. Although deployment models have not been explicitly studied or compared in the literature, the authors observed minor contributions that should be highlighted. For example, Guerin et al. (2019) explained the costs and benefits of having a private cloud versus a public cloud for medium and heavy IT operators in terms of computational, storage, and network cost savings. A recent study by M. Chen et al. (2021) investigated a shared IT service deployment model wherein governments collaborate to consolidate their individual IT resources into a unified service as opposed to deploying separate IT services. Similarly, the authors found little research focused on monitoring, evaluation, or impact among various stakeholders of a market, which represents a promising avenue for future business research on CC (Bardhan et al., 2010; Demirkan et al., 2010). Lastly, the development of pricing models (S. Chen et al., 2021; Saha et al., 2021) also offers an interesting topic for IS researchers, with the management of cloud resources and cost optimization being core research areas (Cheng et al., 2016; Hosseini et al., 2020; Joe-Wong & Sen, 2018; Yuan et al., 2018). However, pricing has been studied more from a resource provisioning (Guo et al., 2019; Kumar et al., 2022; Yuan et al., 2018), geographical dynamics (Cheng et al., 2016), organizational adoption (Choudhary & Vithayathil, 2013), and strategic implementation (Zhang et al., 2020) perspective, likely because of technical limitations precluding IS researchers from adequately understanding the nuances of characteristics. The positioning of pricing model and market structure dimensions outside the central focus of cloud computing research is rooted in their limited interrelation with sub-dimensions of other clusters. The authors observe that market structures lack comprehensive coverage, and articles exploring econometric pricing models are predominantly concentrated on a restricted set of sub-dimensions within cluster A.

Cluster C (Structures, Processes, Stakeholders, and Employees)

The dimensions in this cluster relate to IT governance of cloud computing. Research in this cluster explores the governing mechanisms (Vithayathil, 2018), sourcing capabilities (Gannon, 2013; Vithayathil, 2018), stakeholder value (Bardhan et al., 2010; Schreieck et al., 2021), and compliance processes (Guo et al., 2019; Yuan et al., 2018). Structures involve organizational architecture, and processes orchestrate cloud enabled IT. They inherently engage stakeholders and employees in a collaborative effort to create value. Structural and process governance capabilities pertain to internal governance activities encompassing interactions between business and IT, as well as decision-making and monitoring processes (Choudhary & Zhang, 2015; Hurni et al., 2022; Schreieck et al., 2021). In addition to the essential capabilities for orchestrating IT within an organization, field-level governance mechanisms grant legitimacy upon the transforming institutional infrastructure (Schreieck et al., 2022).

Designing Service Level Agreements (SLAs) for the cloud computing resources is a critical role considering diverse factors such as performance metrics, availability assurances, data security, and scalability provisions. For example, Bodenstein et al. (2011) made strategic suggestions for designing service-level agreements to improve cost efficiency. Another study found that application-level governance was positively associated with the business knowledge of IT employees (Winkler & Brown, 2013). The emergence of this cluster is likely an indication of the intuitive interrelation between various governance structures and processes (Haag & Eckhardt, 2014). One of the core emphases of these dimensions is to understand the disruptive and transformative value of cloud computing. The impact of new IT governance structures on role transformation and firm performance has been holistically studied using various information theories (Vithayathil, 2018). This clustering shows the holistic nature of governance, wherein these dimensions collaboratively shape and impact one another, forming an effective for cloud management strategies.

Cluster D (Versioning Strategy, Service, and Individual)

The dimensions in this cluster involve the research intersections between cloud inherent characteristics and its adoption. Research in this cluster explores the measurement of service parameters (Xiao et al., 2020), individual-level adoption factors (Aggarwal et al., 2015), and versioning strategies (Schreieck et al., 2022; Zhang et al., 2020). The choice between on-premise and cloud sourcing necessitates the consideration of contextual factors at decision-specific, environmental, organizational, group, and individual levels (Schneider et al., 2018). Articles in this cluster typically cover studies in cloud computing that investigate not only the technical aspects of service quality and efficiency but also how individual preferences influence versioning strategies. Choudhary and Zhang (2015) found increasing consumer utility enables SaaS vendors to raise prices, resulting in elevated revenue compared to on-premise software vendors. The decision to transition from on-premise to cloud-based software involves a careful evaluation of technical, operational, and strategic factors. The pivotal role of incumbents' ability to transition from on-premise to on-demand software services depends not only on their technology-related absorptive capacity but also on their capacity to assimilate market-related knowledge (Kranz et al., 2016). As observed in Figure 2, the dimensions within this cluster wield a substantial influence over dimensions present in all other domains.

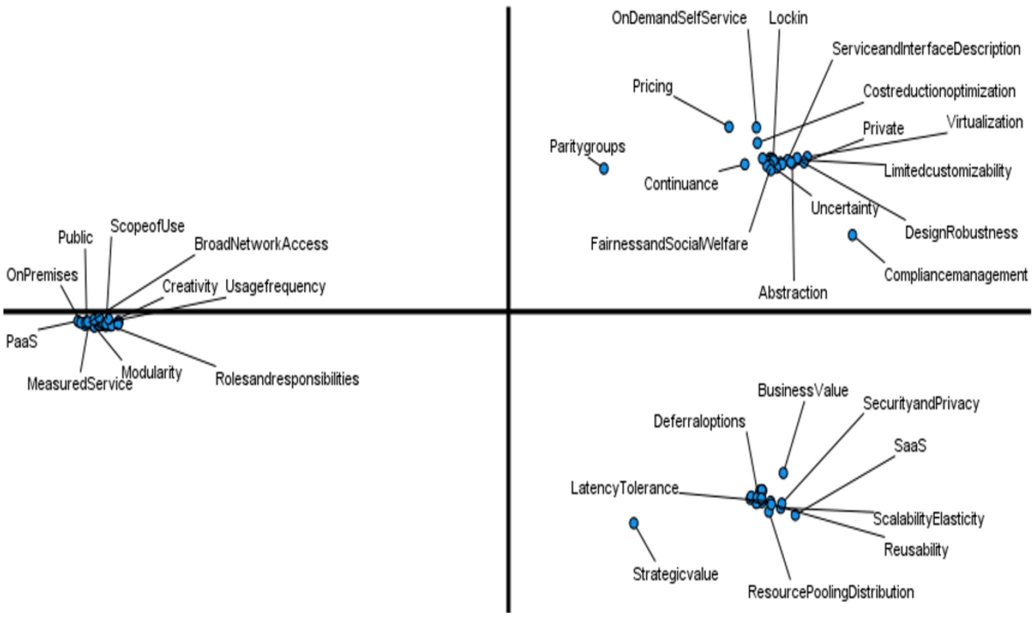
Thematic Structure in 126 Subdimensions

The authors used the ALSCAL technique to study the subdimensions of cloud computing and arrived at three major clusters. Because of the limited scope of analysis of SPSS, which is restricted to 100 dimensions, the authors reduced certain dimensions that were repetitive or had slight contextual differences between various areas. This resulted in a final developed matrix of 98*98 after the elimination of 28 dimensions. The authors initially thought of an approach that would have replaced dimensions that were not part of a cluster in order to give every subdimension an equal chance of representation. However, this approach did not work; since the clusters were extremely densely populated with subdimensions, it made the visual replacement of subdimensions unfeasible. Hence, the authors decided to apply interpretive reduction by removing equivalent terms. The thematic structure obtained in subdimensional analysis was not as inferential as that obtained in Figure 2 (dimensional analysis). Figure 3 depicts multidimensional scaling results for the subdimensions of cloud computing. As shown in the figure, three clusters are prominent. Due to limited spatial representational capacity, the authors are unable to fully represent the cluster subdimensions.

Cluster A (Quadrant 3) represents primarily dimensions under the area of characteristics, particularly those derived from the "design principle" dimension. Most of these characteristics depict more technical subdimensions of cloud computing that address major business concerns (Luftman et al., 2015) or showcase organizational transformation (Vithayathil, 2018). The cluster B (Quadrant 1) represents subdimensions from the areas of adoption and characteristics. For example, S. Chen et al. (2021) proposed and assessed a discounting scheme for cloud services aimed at cost optimization and mitigating underutilization of resources. This cluster focuses on research examining cloud-native properties and identifies the enablers and barriers to adoption. Cluster C (Quadrant 4) represents cloud attributes and the corresponding business value they generate. An example of an article in the cluster is Pang and Tanriverdi (2022), which highlighted that organizations can mitigate security risks linked to legacy IT systems by embracing IT modernization and transitioning to cloud-based solutions. This cluster offers concrete evidence of how cloud characteristics directly contribute to enhancing business operations, efficiency, and overall value.

Another peculiar observation from the results is that the area of governance is underrepresented in the literature; the authors thus call for more attention devoted to this area. The governance mechanisms of cloud implementation are crucial for addressing major management concerns. Relational governance and associated capabilities plays a vital role in guiding service-level agreements and understanding social interactions in an organization (Goo & Huang, 2008; Lasica & Firestone, 2009; Schreieck et al., 2021). Previous reviews have also identified the lack of attention to governance in the cloud

Figure 3. Euclidean distance model for cloud computing sub-dimensions (Note: Stress=0.301 and RSQ=0.71)



computing literature (Hoberg et al., 2012; Marston et al., 2011). Because of the massive amount of research devoted to the areas of characteristics and adoption, all other subdimensions are suppressed in terms of representation. Future research should focus on and report underrepresented areas to drive the development of the cloud computing literature. In order to perform a critical analysis of extant knowledge and provide some actionable research pathways, the authors took some recommendations from Steininger et al.'s (2022) review.

DISCUSSION

The intent of this review was to understand the developments in business perspective of cloud computing. Like many previous reviews, Yang and Tate's (2012) analysis of cloud literature found technology-focused articles outnumbering business-focused ones (Hoberg et al., 2012; Marston et al., 2011; Yang & Tate, 2012). These old reviews unanimously urged scholars to investigate adoption and governance challenges, as practitioners despite realizing the technological potential were unable to successfully implement technology (Smith & Anderson, 2019). These calls were answered by popular information systems literature utilizing outsourcing theories (Battleson et al., 2016; Kathuria et al., 2018; Schneider & Sunyaev, 2016; Susarla et al., 2010; Tebboune & Urquhart, 2016; Winkler & Brown, 2013), adoption models (Karunagaran et al., 2016; Wright et al., 2017; Zainuddin, 2012), and governance mechanisms (Karunakaran, 2017; Vithayathil, 2018; Zainuddin, 2012). Recent reviews seem to concentrate solely on adoption determinants (Benlian et al., 2018; Ogunlolu & Rajanen, 2019; Polyviou & Pouloudi, 2015; Schneider & Sunyaev, 2016; Wulf et al., 2021), or business-IT impact (Chuang et al., 2015; Müller et al., 2015). Cloud computing research emerging after pandemic reveals a nuanced grasp of its societal role, delving into energy efficiency, equitable deployment strategies, flexible utilization, and improved resource economics. This led to the authors' motivation to understand overall business perspective development. Their analysis of literature agrees to a degree with Wulf et al.'s (2021) report of dearth on the adoption determinants of IaaS and PaaS delivery models; however, from a comparative standpoint, the authors observe substantial progress in the cloud adoption area vis-à-vis Hoberg et al.'s (2012) review. The previous reviews' calls for a better understanding of governing mechanisms and their impact on business value have been addressed in more recent studies (Hurni et al., 2022; Schreieck et al., 2021, 2022). Early reviews indicated cloud technology at a convergence of two major trends of information technology: IT efficiency and business agility (Malladi & Krishnan, 2012; Marston et al., 2011). The authors' analysis of review establishes another defining trend of cloud computing as its transformative value. Transformative value can be distinguished from traditionally viewed IT value, which was more concerned with economic advantages of technology use achieved through IT efficiency, business effectiveness, and innovation (Benlian et al., 2018; Joe-Wong & Sen, 2018; Kathuria et al., 2018; Schreieck et al., 2022). Transformative value indicates more indirect and temporally delayed impacts of widespread diffusion of cloud technology on the real world. For cloud technology realization of transformative value has temporal delay due to inhibitors like information privacy, security, and other regulatory standards (Lansing & Sunyaev, 2013). This temporal delay reason outs why transformative value remains unrecognized in previous reviews. Also, from a business-IT maturity perspective, cloud technology has predominantly shown level 1 (business efficiency, 41%) and level 2 (business effectiveness, 40%) benefits, as opposed to only 19% of the reviews studied reporting level 3 (innovate business transformation) benefits (Müller et al., 2015). The authors' analysis is unable to make an exact comparison of level of maturity; however, from MDS clustering they observe cost reduction, scope of use, and social welfare at the core of the cluster indicating substantial progress in maturity from Müller et al.'s (2015) review. The authors observe transformative value and business-IT alignment outside the core cluster as establishing integration capabilities and value appropriation is identified as a major gap in cloud research (Kathuria et al., 2018). There have been continual calls for research on business perspectives from early reviews (Hoberg et al., 2012; Venters & Whitley, 2012; Yang & Tate, 2012) to some of the latest ones (Bayramusta & Nasir, 2016; Müller et al., 2015; Wulf et al., 2021).

The authors' analysis reveals noteworthy progress in articles that address post-adoption challenges. These challenges encompass a range of issues, including network congestion (Saha et al., 2021), value co-creation (Schreieck et al., 2021), service failure discount schemes (S. Chen et al., 2021), institutionalization challenges (Schreieck et al., 2022), and considerations pertaining to social welfare. Cloud technology seems to democratize computing resources with small and medium enterprises (SMEs) leveraging compatibility, switching cost, and technology integration to compete with large firms (Karunagaran et al., 2016). This diversification of competition has invited studies that make rental cost optimization, organizational capabilities, legacy system migration, and versioning strategies a core focus area in the literature. While cloud providers offer standard configurations, scholars have evaluated switching computing resource instead of best single computing resource can optimize rental cost by 15-20% (Hosseini et al., 2020). Similarly, efforts that direct towards cost effective decisions both for customers, such as backup resource provisioning (Guo et al., 2019; Yuan et al., 2018), and for vendors such as SaaS market release time (Choudhary & Zhang, 2015; Liu et al., 2015).

Adoption of new technology requires knowledge of organizations' existing capabilities. Based on a firm's working capital and level of R&D capability they decide whether to develop in-house or externally sourced SaaS solutions. However, the decision has been shown to produce only short term impact on the firm's performance (Chen & Huang, 2014). Adoption of cloud technology has shown some contrasting favorability with the larger size of IT departments and higher human capabilities on one hand, and lower IT budget and resource scarcity on the other (Messerschmidt & Hinz, 2013). The focus extends beyond technology-related capabilities to encompass relationship-driven capabilities, including the examination of ecosystem orchestration, platform evangelism, and platform co-selling. These capabilities demonstrate how they empower platform owners in achieving a harmonious equilibrium between value co-creation and value capture within an emerging platform ecosystem (Schreieck et al., 2021). With cloud technology, a firm attains dynamic capabilities, giving them the ability to build, integrate, and reconfigure tangible and intangible assets (Battleson et al., 2016; Teece et al., 1997). Beck and Toenker (2012) identified and developed virtualized high performance compute capacity as a dynamic capability for organizations to change their strategies based on the business environment. Cloud native characteristics of multi tenancy and virtualization help organizations develop new capabilities. However, organizations also need to internally develop cloud integration and cloud service portfolio capabilities to achieve performance benefits (Kathuria et al., 2018). Cloud adoption is also challenged by lack of vendor capabilities such as low customization capability (Zhang et al., 2020), customer service (Schneider & Sunyaev, 2016), and security capability (Ackermann et al., 2012). Migration capabilities can arise from strategic sequencing of functional changes, optimizing legacy components and implementing adaptability mechanisms for addressing incompatibilities (Fahmideh et al., 2019; Giessmann & Stanoevska, 2012). For business models to adapt to technological migration, firms not only require technology related absorptive capability but also the absorption of market related knowledge (August et al., 2014; Kranz et al., 2016; Zhang et al., 2020).

Some of the slow progress in cloud computing literature can be explained by the similarity of basic principles, benefits, and challenges with IT outsourcing literature (Benlian & Hess, 2011; Leimeister et al., 2010). Thus, an understanding of their similarities and differences helps to situate research inquires that are robust and demand no further investigation. Cloud computing produces an advanced form IT outsourcing governance with short-term use-based contracts for standardized services (Chen & Wu, 2012; Malladi & Krishnan, 2012; Schneider & Sunyaev, 2016). These short-term contracts offer more flexibility and control to clients compared with traditional outsourcing. This governance model expresses a predefined ownership (provider owned), mode (single/multiple vendors), and degree as a specialized form of outsourcing. Scholars have utilized outsourcing theories and their attributes to understand cloud sourcing decisions (Kathuria et al., 2018; Susarla et al., 2010; Tebboune & Urquhart, 2016; Winkler & Brown, 2013). For example, Battleson et al. (2016) utilized resource-based theory to propose four strategies that help organizations develop dynamic capabilities using cloud computing. These strategies required dynamic commitment of resources, designing processes that are modular and provide environment understanding, and the designing of context-specific governance. From a relational perspective, trust in cloud technology and positive attitude towards outsourcing have a strong influence on intention to adopt (Lansing & Sunyaev, 2013; Messerschmidt & Hinz, 2013; Walter et al., 2014). Lack of trust can be attributed to privacy concerns (Stieglitz et al., 2014), assistance from vendors (Walter et al., 2014), responsiveness, credibility, and accountability issues (Karunakaran, 2017). Cloud native characteristics such as on-demand self-service, dynamic scalability, rapid responsiveness, and multi tenancy that are insufficiently explained by outsourcing theories, thus, inviting research avenues. Schneider and Sunyaev (2016) identify that inconsistencies between ITO and cloud computing are a function of the changing role of IT departments, a difference in service models, coercive and normative pressure, and technical specificity. Thus, future research measuring CC sourcing determinants with a control of these influencing factors will assess these inconclusive results. In the next section the authors investigate research gaps to make a call for future research.

RESEARCH GAPS AND FUTURE RESEARCH

Cloud computing research has undergone significant developments—in particular, the literature on adoption and organizational impact. IT governance literature under cloud computing is undergoing a relatively slow development, as most of the governing practices from the IT outsourcing literature are valid for this topic and there is a scarcity of technology impact literature (Battleson et al., 2016; Schneider & Sunyaev, 2016; Tebboune & Urquhart, 2016). The major management issues—i.e., business-IT alignment, business flexibility, and reliability—demand the development of a governance mechanism based on inherent cloud capabilities. The adoption of cloud technology is largely focused on organizational and technological factors, whereas continuance or post-adoption is dependent on individual factors that are underrepresented in the literature. Considering the absence of indigenous theories in cloud computing, the authors propose that future literature reviews should engage in theory-building endeavors.

The authors used a co-occurrence matrix to identify research gaps and opportunities. Since relevant subdimensions are clustered together, they identified sections of the matrix with no co-occurrence. The co-occurrence matrix identifies several research gaps; however, the authors label four major gaps as potential avenues for research. First, design factors such as modularity, reusability, and robustness could be studied to understand the organizational and individual adoption of cloud technology. Second, researchers could explore service efficiency and simplicity for the purpose of reinforcing adoption under different governance practices. Third, how governance structural and process factors instill organizational compatibility, innovativeness, and transformative value is a topic deserving of future research. Fourth, it would be interesting to further explore business impact from individual adoption factors in post-adoptive technology continuance settings. Subsequently, the authors will discuss future directions in cloud computing research derived from their findings through multi-dimensional scaling analysis. Based on their analysis, they anticipate a reduction in articles centered on implementation challenges due to the extensive understanding of cloud computing adoption. Conversely, they foresee a rise in the exploration of post-adoption dynamics, encompassing challenges, and the derived value. Next, the authors delve into research directions specific to each area within the domain of cloud computing.

Cloud Characteristics

In summary, the authors' review identifies two distinct categories of characteristics. The first group includes versioning strategy, design principles and service models which have garnered significant attention due to its interconnectedness with other domains. Conversely, the second group remains relatively less explored in terms of its contextual interrelationships with other areas. Thus, a future research trajectory for these two groups is distinctly explained. Future research avenues for the design characteristics of cloud computing could focus on exploring service configurations based on cloud native characteristics. This approach would aid organizations in identifying the optimal regime that aligns with their needs and enables them to maximize the value they derive. A lot of organizations are experiencing post-migration dynamics; thus continuous integration and delivery has already gained relevance. The authors observe recent literature focuses on testing discount schemes for service interruptions providers and other related factors. These strategies not only ensure operational efficiency but also foster customer loyalty by addressing potential disruptions in a more complex setting (such as multi-cloud environment).

The authors also believe in revisiting standardized cloud practices to delve into counterintuitive outcomes stemming from the transitioned post-adoption phase. For instance, a seemingly lower technology cost can occasionally lead to detrimental effects on the buyer, resulting in reduced benefits being passed on to end users. Market structures are under-researched, and there is a need for researchers to focus on roles played by different stakeholders to highlight both their conflicting interests and shared concerns. A future direction would be to look at how these stakeholders contribute to facilitating transformation and driving innovation. In the case of underexplored deployment models like hybrid and community (shared IT services), researchers could conduct empirical investigations to uncover the factors that facilitate or inhibit the emergence of these deployment approaches. For service models, the authors predict a trickle down of research on IaaS and PaaS to topics such as adoption, governance, and business impacts in the near future. Given the ongoing technological advancements and the exploration of new dimensions, the authors do not foresee a reduction in the focus on contextual issues within this area. As cloud computing represents a paradigm shift in IT strategy management, numerous conventional IT strategy concerns will manifest as novel research inquiries dominate the realm of cloud computing.

Adoption Determinants

Adoption dimensions reveal a significant interconnectedness with dimensions from other areas. The authors identify two primary avenues for future research: a) less explored dimensions such as individual and environment, and b) novel or less studied sub-dimensions within established dimensions (like organization size, continuance, and regulatory support). The opportunity exists to understand how individual adoption factors, including IT knowledge, trust, technological competency, and relational capabilities impact the process of value creation and capture. Future researchers can examine how cloud-native features such as on-demand self-service and virtualization contribute to interfere with work-life boundaries of an individual. Clearly, cloud research in terms of adoptions has predominately focused on organizational factors and has offered very little understanding of individual factors. While scholars have explored fairness and social equity concerning the computing capabilities enabled by cloud services, there remain opportunities to delve into the essential competencies and qualifications needed to generate business value especially for small firms. Given the proliferation of diverse pricing options, it becomes imperative to assess these schemes in order to comprehensively understand organizational multi-cloud portfolios. Lastly, to uncover the IT dynamics in the cloud environment, it is essential to understand the array of uncertainties encompassing environmental demand and product factors.

Governance Factors

The cloud computing landscape has brought about a structural transformation in the procurement and delivery of IT services to internal business users. Research endeavors have contributed to uncovering how IT departments harness business value within the context of cloud computing. Evaluation of governance processes and structures often relies on economic theories' attributes (price, quantity) to gauge firm performance within IT services. Future research should expand to explore additional attributes that can enhance understanding and inform both research and practice regarding the impact of cloud computing. While governance mechanisms are employed to provide legitimacy to new institutional infrastructure, there is a need to explain ecosystem transformation for levels of system actors. The impact of intermediary stakeholders and regulatory bodies on value creation within the ecosystem is not yet fully understood. Hence, these directions should contribute to advancing researchers' existing governing frameworks in cloud computing research.

Business Impact

Business impact dimensions play a central role in cloud computing research within the information systems field. Business impact research needs to focus on generalization of findings across organization sizes, geographies, types of vendors, and maturity levels. Communication structures, vendor strategies, and institutional pressures, such as laws and regulations, warrant focus to understand the value co-creation. Recent advancements suggest a more streamlined resource allocation within a cloud environment, thereby enhancing the greener organizational IT infrastructure. Further research possibilities may encompass the utilization of containerization and microservices to enhance resource efficiency, thereby contributing to the development of environmentally friendly cloud solutions. It is imperative to conduct an investigation into the influence of cloud computing technology adoption on various dimensions of business value, including customer-centric and partner-centric capabilities. Other sub-dimensions show that research on the strategic role of top-level management in driving business value from cloud implementation is limited. Exploring this area could entail investigating additional dimensions such as CIO characteristics, organizational IT support, factors within the organizational climate, and relationships within the organization. Despite the significant attention this area has already received the authors anticipate it to maintain a central dimension due to its relevance in alleviating cloud computing research within the Information Systems domain.

CONTRIBUTION AND IMPLICATIONS

This review seeks to replicate and extend comparative development in the literature addressed in previous reviews on the topic of cloud computing. This study increases the understanding of the literature included in Hoberg et al.'s (2012) review by employing a more intensive and broader spectrum of classification. There were two major limitations of Hoberg et al.'s (2012) study: (a) a *premature* literature, and (b) *unidimensional mapping* of each research article. They reported that 48 out of 60 reviewed articles focused on characteristics of cloud computing. Thus, this underdeveloped stage of literature offered few insights into other areas (adoption, governance, and business impact) of cloud computing. Their review methodology employed unidimensional labeling of each research article and offered clear segregation of articles between the areas (characteristics, adoption, governance, and business impact). With the development of literature on cloud computing and the authors' method of scrutinizing each article in terms of all research questions (offering multidimensional labeling), they were able to overcome these limitations. The authors' method highlights emergent factors that are overshadowed by popular factors, which increases and expands the scope of cloud research.

This review provides a holistic outlook of cloud computing research for academics. The co-occurrence matrix maps out the status of cloud research to guide future developments and investigations. The comparative element depicts the progress made by cloud computing in the field of business. The positioning of articles at the intersection of technical and managerial factors in the co-occurrence matrix binds insight together for practitioners. Practitioners can utilize this review to understand the business impact from new dimensions.

The major limitation of this review stems from it being based solely on premium information system journals and the ICIS conference. The authors recognize the importance of developments reported by other information system journals and conferences; however, they nevertheless believe the results of this review are valid for the field as a whole. On a methodical level, another limitation is that they employ contextual definition to aggregate articles under different variables, which could cluster dissimilar factors. Further, multidimensional mapping may highlight minor themes from an article that may sometimes be irrelevant. However, the authors' exhaustive contextual mapping and intensive multidimensional analysis offer strong support for the implications of this study.

COMPETING INTERESTS

The authors of this publication declare there are no competing interests.

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