

A Systematic Review of Technology Adoption Models in Cloud Computing Research: A Decade of Evidence (2014–2023)

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Abstract

Cloud computing has changed the way individuals and companies' access, provision and use computing resources, providing scalable, on-demand services with minimal capital outlay. Despite a substantial and expanding body of empirical studies, the literature remains divided across theoretical lenses and application contexts, and there is no consensus on the drivers that promote adoption. This work proposes a systematic literature review (SLR) using the PRISMA 2020 guidelines of the technology adoption models used in cloud computing research published from 2014 to 2023. Mainly based on the Semantic Scholar database, complemented with Web of Science (ISI) and IEEE Xplore, we employed a systematic search and a transparent screening methodology, which resulted in a final corpus of 55 peer-reviewed articles and conference papers. The corpus was coded and examined by frequency analysis and descriptive cross-tabulation by model type, application context, unit of analysis and publication year. The results show that the Technology Acceptance Model (TAM) is the most used lens (36.4%), followed by the Technology-Organization-Environment (TOE) framework (25.5%), the Unified Theory of Acceptance and Use of Technology (UTAUT) (20.0%), Diffusion of Innovation (DOI) (9.1%), mixed/extended models (5.5%), and Theory of Planned Behaviour (TPB) (3.6%). Model selection is highly context-dependent: TAM and UTAUT are favoured for individual-level investigations, but TOE and DOI are favoured for organisational studies. Further analysis of the publishing trend also shows that TOE-, UTAUT-, and integrated-model research have increased in relative proportion since 2020, indicating a slow move from single, user-centric models to multi-level and combined models. The review synthesises findings from business, education, end-user, IT-professional, healthcare and government settings, records the absence of a common determinant set and suggests an integrative route for future study.

Keywords: *cloud computing; technology adoption; systematic literature review; TAM; UTAUT; TOE; DOI; TPB*

1. Introduction

Cloud computing is a model of provision over the Internet that enables convenient, on demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service-provider interaction (Mell & Grance, 2011). These resources are pooled, virtualised, elastic and quickly provisioned and metered, enabling customers to consume computing as an operational expense rather than a large capital investment (Marston et al., 2011). The paradigm provides hardware and software on demand, regardless of device or location, and has evolved from a nascent technology in the late 2000s (Nasir & Niazi, 2011) to a mainstream foundation of contemporary digital infrastructure.

The last decade has seen a rapid global adoption. Industry reports show that most companies are now using at least one cloud service, multi-cloud strategies have become the norm to avoid vendor lock-in, and small and medium-sized enterprises (SMEs) are migrating at record rates due to cost-effectiveness and scalability. At the same time, ongoing concerns about data privacy, security, regulatory compliance and integration continue to drive adoption decisions, especially in regulated and resource-constrained environments.

There has been much research on cloud computing adoption in various application areas including business organisations (Güner & Sneiders, 2014; Gupta et al., 2013), end users (Alotaibi, 2014; Shin, 2013), IT professionals (Opitz et al., 2012; Phaphoom et al., 2015; Wu, 2010) and education (Sabi et al., 2016; Van Der Schyff & Krauss, 2014). The adoption behaviour has been explained by scholars using a variety of theoretical models: the Technology Acceptance Model (TAM; Davis, 1989) e.g. Burda and Teuteberg (2014), Opitz et al. (2012), Shin (2013); the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003) e.g. Cao et al. (2013), Lian (2015); the Diffusion of Innovation theory (DOI; Rogers, 1995) e.g. Lin and Chen (2012); the Technology–Organization–Environment framework (TOE; Tornatzky & Fleischer, 1990) e.g. Borgman et al. (2013), Picoto et al. (2014); the Theory of Planned Behaviour (TPB; Ajzen, 1991) e.g. Arpaci et al. (2015); and combinations of these models resulting in integrated frameworks (Gangwar et al., 2015; Oliveira et al., 2014; Stieninger & Nedbal, 2014).

1.1 Research Gap and Rationale

However, this review is motivated by three shortcomings. First, whereas individual studies and various narrative reviews have contributed to the understanding of cloud adoption, First, the evidence base is theoretically fragmented. Studies use different models, operationalise variables differently, and identify diverse significant determinants . There is no cohesive explanation of what matters and under what conditions. Secondly, the existing reviews tend to take one perspective, most often the organisational, business-oriented perspective (e.g. Alkhater et al., 2014; Stieninger & Nedbal, 2014). The individual, educational, IT-professional, healthcare and governmental perspectives are relatively under-synthesised within one analytical frame. Third, many previous syntheses are pre-date the last decade of cloud

development, and a transparent and reproducible assessment of model usage evolution through 2023 is missing.

There is a need to fill these gaps both theoretically and practically. For researchers, a clear map of model utilisation by context reveals where lenses are over- or under-utilised and where integration is necessary. Practitioners and policy-makers equipped with knowledge of the determinants that are common across contexts can assist more targeted adoption tactics. This review consequently integrates the disparate findings into a unified, cross-contextual synthesis and estimates the relative frequency of rival theoretical perspectives.

1.2 Research Questions

The review seeks to answer three questions, guided by the above gaps:

RQ1. Which technology adoption models are applied in cloud computing research published between 2014 and 2023, and how frequently is each used?

RQ2. How does model selection vary across application contexts and units of analysis?

RQ3. What determinants of adoption recur across models and contexts, and where do they diverge?

2. Theoretical Background and Related Literature

The literature on cloud computing adoption leverages a set of proven theoretical frameworks to conceptualise adoption at either the individual or the organisational level. Each model and representative cloud-context apps from the studied corpus are summarised in the following subsections.

2.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) (Davis, 1989) suggests that perceived usefulness and perceived ease of use are the major antecedents of attitudes and intentions to utilise a technology. It has been employed in cloud research on the individual and the organisational level. Shin (2013) applied TAM to the study of intentions to utilise mobile cloud services, identifying perceived utility as an important predictor. Burda and Teuteberg (2014) supplemented the model with trust and risk variables relevant to enterprise archiving. More recent study continues to verify TAM, sometimes in combination with additional theories to enhance explanatory power (Gangwar et al., 2015).

2.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

UTAUT (Venkatesh et al., 2003) integrates constructs from eight previous models, with an emphasis on four key determinants: performance expectancy, effort expectancy, social impact, and facilitating factors. Cao et al. (2013) employed UTAUT in healthcare cloud adoption to show the importance of social influence. Lian (2015) used UTAUT to study the adoption of cloud-based e-invoicing in SMEs in Taiwan, where the facilitating conditions such as infrastructure preparedness were highlighted.

2.3 Diffusion of Innovation (DOI)

Rogers' (1995) DOI theory describes the diffusion of innovation in a social context through traits such as relative advantage, compatibility, complexity, trialability and observability. Lin and Chen (2012) used DOI to study organisational cloud adoption and found that compatibility was of key importance. Several following studies have integrated DOI with various frameworks to better capture both innovation traits and contextual aspects (Martins et al., 2016; Stieninger et al., 2018).

2.4 Technology–Organization–Environment (TOE) Framework

The TOE (Tornatzky & Fleischer, 1990) concept explains the organisational adoption through three contexts: technological, organisational and environmental. In Portuguese enterprises, TOE was employed by Picoto et al. (2014) who found competitive pressure to be an important motivator, and by Borgman et al. (2013) in major multinationals. TOE is particularly relevant for firm-level adoption choices and is the dominant perspective in organisational studies.

2.5 Theory of Planned Behaviour (TPB)

TPB (Ajzen, 1991) accounts for behaviour by attitudes, subjective norms and perceived behavioural control. Arpaci, Kilicer and Bardakci (2015) applied TPB to the educational use of cloud services and found that subjective norms were a key factor of adoption intention among students.

2.6 Mixed and Extended Models

A growing stream combines two or more theories, e.g. TAM with TOE (Gangwar et al., 2015; Oliveira et al., 2014) or UTAUT with DOI (Stieninger & Nedbal, 2014) to overcome limitations of single-model approaches and to capture individual, organisational and environmental determinants simultaneously. These hybrids tend to have more explanatory power at the expense of parsimony and comparability.

3. Methodology

This study is a systematic literature review (SLR) performed and published in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) declaration (Page et al., 2021). An SLR was chosen as the research questions require a transparent, reproducible and comprehensive appraisal of an established but fragmented body of evidence. The protocol below details the data sources, search strategy, eligibility criteria, selection process and analysis to enable replication and updating of the review.

3.1 Data Sources and Search Strategy

The main bibliographic database was Semantic Scholar, chosen for its comprehensive coverage of computer science, information systems and management literature across publishers and its open metadata. To increase coverage and avoid single-source bias, the search was supported by Web of Science (ISI) and IEEE Xplore, and by hand searching of pertinent conference proceedings. The last search was conducted in December 2023 for the 2014-2023 publication window. The Boolean search string combined cloud, adoption, and theory terms:

("cloud computing") AND ("adoption" OR "acceptance" OR "intention to use") AND ("model" OR "framework" OR "factors" OR "determinants" OR "technology acceptance model" OR "unified theory of acceptance and use of technology" OR "technology, organization, environment" OR "diffusion of innovations" OR "theory of planned behaviour")

Searches were carried out on title, abstract and author keywords. The reference lists of included studies and of previous reviews were checked for further suitable records (backward snowballing).

3.2 Eligibility Criteria

Studies were appraised against pre-defined inclusion and exclusion criteria.

Inclusion criteria:

- Full conference papers or peer-reviewed journal articles published between 2014 and 2023
- Research that mainly explores the adoption, acceptance or behavioural intention of using cloud computing services.
- Studies that explicitly use one or more known models or frameworks of technology adoption.
- Studies that report empirical evidence (quantitative, qualitative or mixed) or systematic synthesis.
- Publications written in English.

Exclusion criteria:

- Editorials, abstracts, posters, technical reports, theses and non-peer-reviewed material
- Research on cloud technical architecture or security engineering without a focus on adoption.
- Research without an established adoption model or theoretical framework.
- Duplicate records. Publications without full-text.

Seminal model-defining works outside the 2014–2023 window (e.g., Davis, 1989; Rogers, 1995; Tornatzky & Fleischer, 1990; Venkatesh et al., 2003) were maintained as theoretical references but not included in the analysed corpus, which comprises empirical and synthesis studies within the review window.

3.3 Study Selection

Database search yielded 731 entries. Adding the 196 duplicates resulted in 535 records being screened on title and abstract, of which 421 were discarded as off-topic or out of scope. Remaining 114 full-text papers were screened for eligibility, and 59 were rejected due to not using an adoption model, not having empirical or synthesis content, or not being available in full text. This resulted in a final corpus of 55 research. The selection procedure is summarised in Table 1 (PRISMA flow).

Table 1. PRISMA 2020 study selection flow

Stage	Records (n)
Records identified (Semantic Scholar, ISI, IEEE, proceedings)	731
Duplicates removed	196
Records screened (title/abstract)	535
Excluded at screening	421
Full texts assessed for eligibility	114
Excluded at full-text stage	59
Studies included in the review	55

3.4 Data Extraction and Coding

For each of the 55 studies included, a structured coding scheme was applied to capture the main adoption model, secondary or extended model, a normalised model category, the application context/sector, the unit of analysis (individual or organisational), the region, the research method, the main significant determinants reported, and the publication outlet and indexing source. The whole coded data set and codebook are available as supporting information (Dataset S1).

3.5 Data Analysis

Consistent with the descriptive objectives of the review, analysis used a combination of frequency analysis and descriptive cross-tabulation. We quantified the prevalence of each model category (RQ1) through frequency analysis. We characterised patterns of model selection through cross-tabulation of model by context and by unit of analysis (RQ2). We identified recurring and divergent factors across models and contexts through thematic aggregation of the coded determinants (RQ3). All counts can be reproduced from the extra dataset.

4. Results

4.1 Prevalence of Adoption Models (RQ1)

The main adoption model used in each of the 55 studies is summarised in Table 2. TAM is the most used model (36.4%) followed by TOE (25.5%) and UTAUT (20.0%) DOI accounts for 9.1%, TPB 3.6% and mixed/extended models 5.5%.

Table 2. Frequency of primary adoption models in the corpus (N = 55).

Model	Number of Studies	Percentage (%)
TAM	20	36.4
TOE	14	25.5
UTAUT	11	20.0
DOI	5	9.1
Mixed / Extended	3	5.5
TPB	2	3.6
Total	55	100.0

4.2 Model Selection by Context (RQ2)

Table 3 Cross-tabulation of model category and application context The pattern is evident: TAM dominates individual-level and educational settings, where perceived usefulness and ease of use are key; TOE and DOI dominate organisational and business settings, where technological, organisational, and environmental factors guide firm-level decisions; and UTAUT is seen across both individual and organisational contexts, including healthcare and government. This divide is a reflection of the underlying level of analysis of each theory rather than a reflection of any intrinsic superiority of one paradigm.

Table 3. Distribution of adoption models by application context (study counts)

Context / Sector	TAM	TOE	UTAUT	DOI	TPB	Mixed	Total
Business / Organisations	5	13	3	4	0	3	28
Education	7	0	4	0	1	0	12
End users / Individuals	5	0	2	0	0	0	7
IT professionals	2	0	0	0	1	0	3
Healthcare	1	0	1	0	0	0	2
Government / Public	0	1	1	1	0	0	3

Note. Counts reflect dominant context coding; a small number of studies span more than one sector. Column totals correspond to Table 2.

4.3 Temporal Distribution

Publications are spread during the whole review timeframe. Output peaked between 2014 and 2016 when cloud services became widespread and continued consistently with a substantial comeback in 2021-2023 (ten studies) driven by faster digital transformation. Importantly, the character of current production is different from the earlier times. TOE-, UTAUT- and integrated-model studies constitute a bigger part of post-2020 work than in 2014-2016 when single, user-centric TAM studies prevailed. This suggests a maturing of the area to organisational and multi-level explanations. Foundational empirical works from 2010–2013 that are highly cited within the corpus are acknowledged in the supplementary dataset but are not included in the analysed totals.

4.4 Recurring and Divergent Determinants (RQ3)

Perceived ease of use, perceived usefulness, relative advantage, and compatibility are most consistently identified as positive drivers across the corpus, and security and privacy issues, complexity, and cost are most consistently identified as barriers. The divergence is systematic rather than random. Individual-level models highlight utility, ease of use, trust and social impact, while organisational-level models focus top-management support, competitive pressure, technology preparedness and regulatory environment. For example, the same underlying concern, such as security, is operationalised as a perceived-risk construct in TAM-based studies but as an environmental or regulatory factor in TOE-based studies, which is partly responsible for the apparent lack of consensus in the literature.

5. Discussion

The prevalence of TAM suggests that the field level favours parsimonious, user-centred explanations of adoption, especially in individual and educational contexts where ease of use and utility are decisive. The predominance of TOE and DOI in organisational studies suggests that contextual and innovation-attribute elements are more important in explaining firm-level phenomena than individual perceptions alone. UTAUT is situated between individual and organisational determinants, which explains for its application in various sectors. Interestingly, the rate of studies using TOE, UTAUT and the integrated model rose in the 2021–2023 sub-period, indicating that when cloud usage matured, researchers tended to emphasise models that take into account multi-level and contextual factors rather than single, individual-level models.

The main result that there is no common set of determinants throughout the literature should be seen as a failure of theory-context alignment rather than a failure of the evidence. Models vary in amount of analysis and in the way they operationalise overlapping factors (particularly security, trust and cost) confounding comparisons between studies. This is in favour of a larger use of integrated frameworks (e.g. TAM-TOE) that combine individual perceptions with organisational and environmental context. This calls for more construct standardization so that determinants may be compared across studies.

The results have implications for practice in terms of matching adoption interventions to the level of decision making: usability, training and trust building for individual users; and business-case articulation, leadership commitment and management of competitive regulatory pressures for organisations. Cost and technology readiness are particularly important in the context of emerging economies and SMEs, which continue to be relatively under-represented.

5.1 Limitations

There are some caveats to bear in mind. The corpus is limited to the selected databases, the restriction to English-language work and the period 2014–2023, so some relevant work may be missed, although it is methodically picked. One reviewer performed coding and classification, which introduces potential subjectivity. Independent double coding and inter-rater reliability assessment would be advantageous for future updates. As a descriptive review, the analysis measures model use and synthesises factors but does not conduct a quantitative meta-analysis of effect sizes. Finally, the literature's focus on developed economies limits the generalisability of findings to emerging markets.

6. Conclusion and Future Research

This systematic review integrated a decade of research on the adoption of cloud computing (2014–2023) over 45 papers and a range of application contexts. It finds that the most dominant theoretical lens is TAM, followed by TOE and UTAUT, and that there is a high patterning of model selection by unit of analysis: individual-level studies go to TAM and UTAUT, whilst organisational studies tend to TOE and DOI. The apparent lack of unanimity with regard to the factors of adoption is due to a difference in theoretical level and concept operationalisation, rather than due to contradictory facts.

Three directions for further work are. First, academics should design and empirically validate integrated, multi-level frameworks that combine individual perceptions with organisational and environmental aspects. The standardising of the measurement of cross-cutting constructs such as security, trust and cost should also be addressed. Second, the field should pay more attention to under-represented contexts – emerging

economies, SMEs, public sector and healthcare – and test the boundary conditions of existing models. Third, future assessments should include independent double-coding and, where data allow, quantitative meta-analyses of determinant effects. Addressing these directions would advance the research from descriptive accumulation to a cumulative, comparative, and practically actionable theory of cloud computing adoption.

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