Cloud Computing Adoption in Public Sector: A Literature Review about Issues, Models and Influencing Factors

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Introduction

A wide number of academics and practitioners argue that cloud computing represents the emergence of a new computing paradigm (Cegielski et al., 2012; Nayak & Yassir, 2012; Vaquero et al., 2008) that is rapidly changing the conventional way IT products and services are delivered.

Wang et al. (2016) and Branco et al. (2017) consider cloud computing as a "hot" topic that draws the attention of both academics and professionals. Moreover it is argued that, since cloud computing adoption is in relatively early stage, the need for scientific research and additional knowledge on the topic is going to grow in the following years, especially in areas considering theoretical models, adoption, impact and influencing factors (Amron et al., 2017; Branco et al., 2017; Senyo et al., 2018; Wang et al., 2016).

The adoption of cloud computing offers significant advantages and can be applied to various sectors, formulating a growing market and a crucial driver for economic growth, with serious impacts for users of cloud computing services, providers and the society as a whole (Nanos et al., 2019). In public sector, cloud computing not only has the potential to offer significant advantages, but is expected to be a fundamental part of e-government strategy in the upcoming years and lead to the digital transformation of governments at every level (central, regional, local) (Nanos et al., 2019).

However, initiatives for cloud computing adoption in public sector are in early stage and relatively slow, comparing to initiatives for adoption in private organizations (Krogstie & Veld, 2015; Nanos et al., 2017). According to El-Gazzar and

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Wahid (2015), the reasons for this lag are: (1) the fact that cloud computing benefits are not yet fully understood, (2) the concerns about the privacy and security of citizens' data and (3) the restrictions deriving from the laws and regulations, such as General Data Protection Regulation (GDPR). Other reasons refer to the lack of knowledge, the lack of technological standards, the poor internet connections in some geographical areas, the "lack-of-control" fear, the switching cost to the new technologies, the immature market of cloud providers in local level and the risk in the selection of the proper solution (Alshomrani & Qamar, 2013; Buyya et al., 2009; Paquette et al., 2010; Shin, 2013; Zissis & Lekkas, 2011). Finally, Jones et al. (2017) argue that there is a lack of research about benefits, risks and critical success factors that influence the decision-making process in local governments to adopt cloud computing solutions.

The aim of this paper is to perform a review that will identify, categorize and analyze existing literature about cloud computing adoption in public sector. Through this review, theoretical-conceptual models are identified, classified, analyzed and discussed, together with issues and influencing factors that are examined by these models.

Literature Review

The systematic literature review performed in this study is based on methodologies proposed by Bandara et al. (2011) and Okoli (2015) and consists of three stages: i) research design, ii) paper selection and iii) analysis.

Research Design

The aim of the research is to identify and analyze the existing literature about cloud computing adoption in public sector, in order to contribute to the scientific knowledge about the topic and constitute a basis for conducting a future empirical research.

The research questions are the following:

RQ1: which models are used-applied for the study of cloud computing adoption in the public sector?

RQ2: which factors that influence cloud computing adoption in the public sector are examined through these models?

RQ3: which of these factors are mostly examined when it comes to the study of cloud computing adoption in local government?

For the identification of the existing literature, the following online databases were selected (in alphabetical order): ACM Digital Library, AIS Electronic Library (AISeL), Emerald Insight, ERIC Institute of Education Sciences, SAGE Journals,

Science Direct, Scientific Research Publishing, Scopus, Springer, Wiley Online Library.

The main research criteria in the above mentioned databases were the language of the paper (English) and the existence of full-text. The search terms-keywords that were applied were:

[Keywords: Cloud Computing] AND [abstract: Adoption].
[Keywords: Cloud Computing OR SaaS OR IaaS OR PaaS] AND [abstract: Adoption]
[Title: Cloud Computing] OR [Title: SaaS OR IaaS OR PaaS] AND [abstract: Adoption]
[Keywords: Cloud Computing] AND [keywords: Adoption]

In order for a paper to be included for further analysis, the following inclusion criteria were set: i) no duplicates, ii) the topic of the paper should be about cloud computing adoption and more specifically in the public sector, excluding papers concerning private sector, iii) the paper should propose the use of a theoretical-conceptual model and iv) the paper should include an empirical research. For the support of the research, Mendeley, MS Excel and Acrobat Reader were used.

Paper Selection

The initial number of papers identified until 2019, was 1316. After the cross-checking, the deletion of duplicates and a short review of each paper abstract, the number of papers was reduced to 79. With the application of all the inclusion criteria mentioned above, the number of the papers for further study was limited to 24 (see Fig. 1).

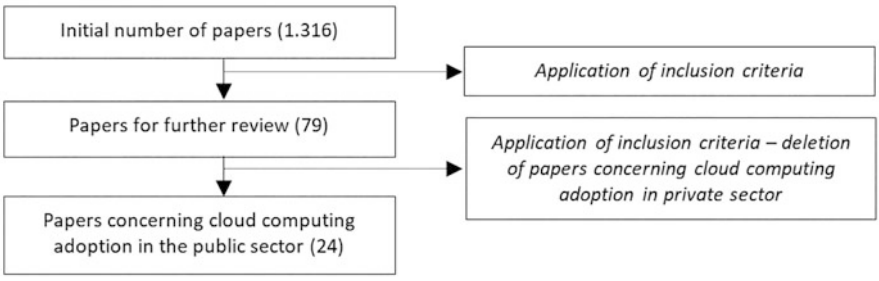

Fig. 1 Paper selection through the systematic literature review

Analysis

The first step of our analysis aimed at identifying and categorizing the conceptual-theoretical models that are used for the study of cloud computing adoption in the public sector. The results show that the Technology Organization Environment (TOE) model, the Diffusion of Innovations (DOI) model and the TAM/TAM2 model are used in most of the cases (see Fig. 2).

It should be noted though, that in some papers/studies only one model was used/applied, while in other papers/studies two or more models were used/applied. In the papers that used more than one model in their research, the combination of TOE and DOI was the most popular. Finally, it should be mentioned that the combination of TOE, DOI and TAM models was not used in any of the papers studied (see Table 1).

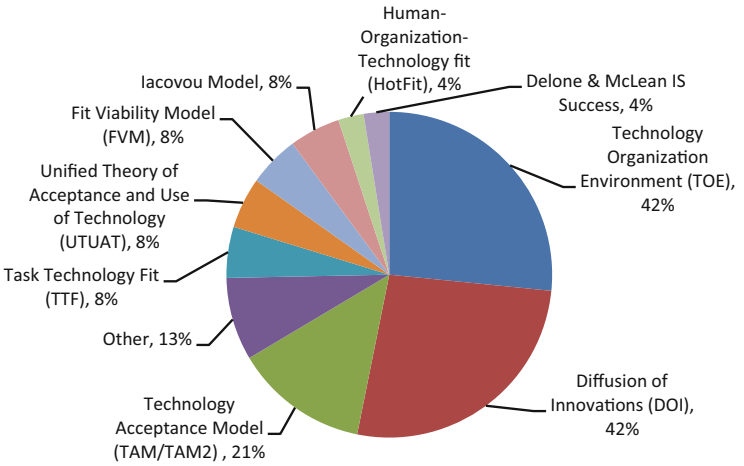

Fig. 2 Use of conceptual-theoretical models for the study of cloud computing adoption in public sector

Table 1 Use of conceptual-theoretical models for the study of cloud computing adoption in public sector

Model used	Number of papers/studies	Percentage
Only TOE	3	13%
Only TAM	2	8%
Only DOI	1	4%
Only UTUAT	1	4%
Other model	3	13%
Combination of models	14	58%
Sum	24	100%

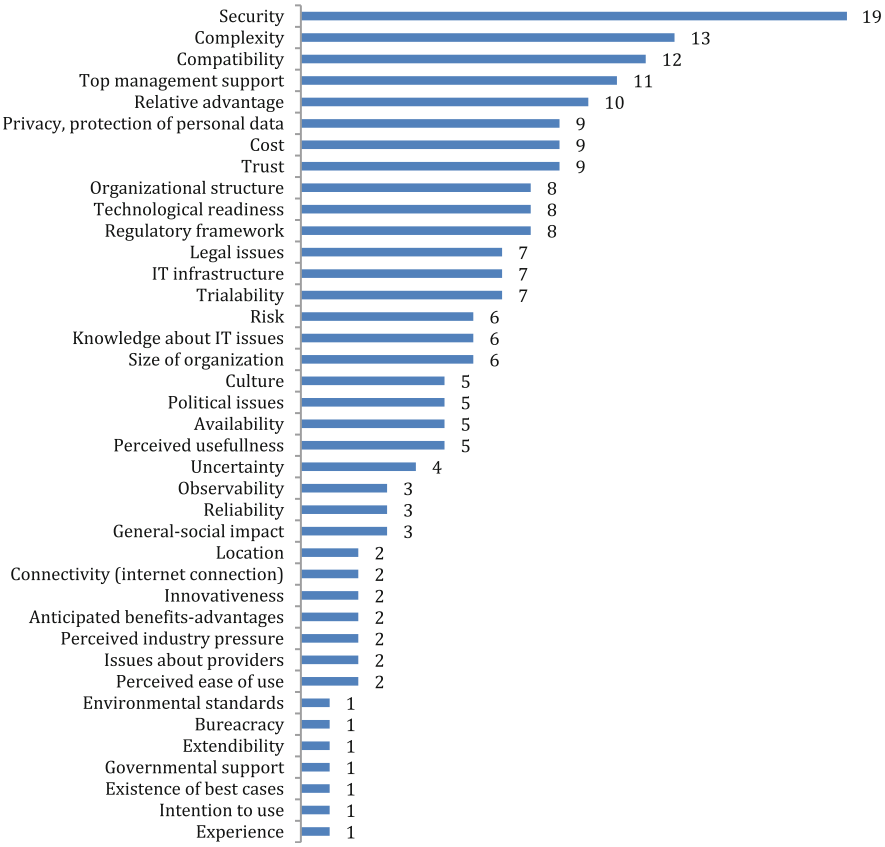

Fig. 3 Factors that influence cloud computing adoption in the public sector

The second step of our analysis aimed at identifying and categorizing the factors that influence cloud computing adoption in the public sector and are examined through the above mentioned conceptual-theoretical models.

In the following figure, the identified factors are presented and classified according to the frequency (number of times) that they were used in the papers that were analyzed in our study (see Fig. 3).

Finally, when it comes to the study of cloud computing adoption in local government, the frequency ranking of the top-11 above factors is different (see Table 2).

Table 2 Frequency ranking of factors studied in the study of cloud computing adoption in local government vs factors studied in public sector in general

Frequency ranking	Public sector (in general)	Frequency ranking	Local government
1	Security	1	Security
2	Complexity	2	Compatibility
3	Compatibility	3	Knowledge about IT issues
4	Top management support	4	Cost
5	Relative advantage	5	Issues about providers
6	Privacy, protection of personal data	6	Privacy, protection of personal data
7	Cost	7	Complexity
8	Trust	8	Top management support
9	Organizational structure	9	Organizational structure
10	Technological readiness	10	Availability
11	Regulatory framework	11	Reliability

Discussion

From the analysis of the systematic literature review, the research questions are answered as follows:

- *RQ1: which models are used-applied for the study of cloud computing adoption in the public sector?*

In the papers examined in our review, the conceptual-theoretical models that are mostly applied for the study of cloud computing adoption in public sector are: TOE, DOI, TAM/TAM2, TTF, UTUAT, FVM, Iacovou Model, HotFit, Delone & McLean IS Success. These models are used either individually or, in most cases, combined. When used individually, the models that are most frequently used are TOE, DOI and TAM/TAM2. When combined, at least one of TOE, DOI and TAM/TAM2 model is always used. Although these three models are widely used alone or in combination with another model, there were no papers that applied/used all the three models (TOE + DOI + TAM).

- *RQ2: which factors that influence cloud computing adoption in the public sector are examined through these models?*

As, in most cases, the study of cloud computing adoption in the public sector is examined through TOE, DOI and TAM/TAM2 models, most of the identified influencing factors are related to those models. The most widely examined factor is security of cloud computing applications, followed by complexity (of cloud solutions), compatibility with existing-internal applications, top management support, relative advantage (that cloud computing adoption will bring to the organization), privacy-protection of personal (employee and citizen) data, cost (of cloud solutions), trust (on cloud technology, cloud solutions and cloud service providers),

organizational structure, technological readiness, regulatory framework, legal issues, IT infrastructure, trialability (ability of using cloud applications in trial version) etc.

- *RQ3: which of these factors are mostly examined when it comes to the study of cloud computing adoption in local government?*

In the study of cloud computing in local government, the "popularity" of the factors examined is different as opposed to the study in public sector in general. For example, factors such as IT knowledge, cost and issues (concerns) about providers, are more frequently examined in the case of local government.

Conslusions

Cloud computing is a topic of growing interest and more research is needed, especially in cloud computing adoption in the public sector. Empirical studies in this field will enhance scientific knowledge among academics and facilitate practitioners and managers in the decision-making process for adopting cloud solutions or migrating existing systems and applications to the cloud.

From the results of our systematic literature review about cloud computing adoption in public sector, it is evident that although most of the existing studies use/apply one or more of TOE, DOI and TAM/TAM2 models, the combined use of TOE and DOI and TAM/TAM2 models is not yet sufficiently attempted. This indicates an area that needs further exploration, since cloud computing (and ICT in general) adoption is influenced by a large number of factors that are not examined adequately by using one or even two of the above-mentioned models.

Finally, our research identified, classified and presented a detailed list of influencing factors that should be examined and confirmed in future academic empirical studies through the use of an extended-combined theoretical model and taken into account from managers and practitioners that will lead computing adoption in the public sector and more specifically in local government authorities.

In the following years and as the adoption of cloud computing grows and matures, it would be extremely interesting for another research to proceed further and perform a literature review about the impact of cloud computing in public sector.

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