

# Identifying criteria for evaluating Cloud Services in the Colombian public sector

*Emergent Research Forum Paper*

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## Abstract

The Colombian e-government strategy, defined by the Ministry of Information Technologies and Communications (MinTIC), advises Colombian public entities to evaluate the possibility of adopting cloud services instead of acquiring and implementing technology infrastructures. In addition, the MinTIC defined the government's reference framework for enterprise architecture, which establishes a set of guidelines to ensure the quality of IT services. Public institutions should comply with these directives even when they contract services with external providers. In this context, this article aims at identifying evaluation criteria to enable Colombian state institutions to assess the convenience of adopting cloud services in compliance with the MinTIC's guidelines. To this end, we review the research literature in the field and analyze the e-government guidelines to extract evaluation criteria. As a result, 48 criteria were found and classified in six evaluation categories.

## Keywords

Cloud service, assessment, adoption, contracting, state entity, public sector

## Introduction

Cloud computing is changing the IT industry (Armbrust et al. 2010). It is also becoming an important tool capable of providing multiple financial, social and technological opportunities to institutions in all industrial sectors (Zhang et al. 2010). An example of these opportunities is the possibility of reducing the operating costs of IT areas. However, cloud computing can also increase risk and impose new constraints. On the one hand, risks are commonly associated with security (e.g., unauthorized access to information) and dependency on cloud suppliers (Subashini et al. 2011). On the other hand, one of the most important constraints stated by IT managers is that there is no guarantee, by the cloud supplier, on the location of the IT resources and capabilities, which creates a sense of loss of physical control on the information (Marston et al. 2011).

In the public sector, state entities are using this sourcing model in order to provide IT services and capabilities to internal stakeholders (e.g., public employees) and external beneficiaries (private companies, citizens, etc.). For example, in most of the public entities of Washington D.C., employees have unlimited access to a corporate document storage service and email service contracted to cloud suppliers. In the same way, the US General Services Administration made in 2009 the transition of the official government portal ([usa.gov](http://usa.gov)), that provides services and information to citizens, to the cloud. Thus, as in other sectors, cloud computing is offering opportunities to public entities such as the possibility of contracting IT capabilities to cloud suppliers instead of implementing and operating their own infrastructure, which allows public entities to focus on their core activities. However, cloud computing can also impose constraints to this kind of entities, such as the risk that cloud providers store confidential information outside the legal and territorial jurisdiction of the state (Venkatesh et al. 2012).

The Colombian public sector is not indifferent to the use of cloud computing. On the one hand, the Colombian Ministry of Information Technology and Communications (Ministerio de Tecnologías de la Información y las Comunicaciones - MinTIC) defined an e-government strategy which advises Colombian public entities to prefer contracting cloud services rather than purchasing technological infrastructures. On the other hand, the MinTIC defined the government's reference framework for Enterprise Architecture

(MinTIC 2013), which establishes a set of guidelines aimed at ensuring the quality of the IT services offered by public sector entities. These guidelines should be fulfilled even when contracting IT services with external providers; that is, contracting cloud services should not prevent state entities from complying with these guidelines. However, in most of the cases, public entities in Colombia do not carry out a formal analysis because of lack of knowledge on the aspects that need to be evaluated during the preliminary stages of the implementation of new IT services. Indeed, using the adequate evaluation aspects before contracting a service could help state institutions to make the best decisions. Thus, our research is intended to answer the following research question: Which evaluation aspects should be considered to evaluate the adoption of cloud services by Colombian public sector entities?

The remainder of this paper is structured as follows: In the next section, we review the research literature in order to identify the main assessment aspects to evaluate cloud services proposed in scientific and academic papers. Section *Analysis of the e-government guidelines* presents a method that extracts evaluation criteria from the Colombian e-government guidelines and compares them with the assessment aspects identified in the literature, in order to establish a set of relevant criteria to the Colombian context. Section *Evaluation criteria for the Colombian public sector* presents the evaluation categories obtained from adding the assessment aspects identified in the literature to the criteria extracted from the e-government guidelines. Finally, the last section presents the conclusion and next steps.

## Literature review

With the purpose of finding potential research works for evaluating cloud services in the public sector, the Scopus database was used by introducing the following criteria:

- Search terms: (Assessment or Evaluation or Evaluating or Evaluate) and (Methodology or Framework or Model or Method) and (Adoption or Contract) and (Saas or Paas or Iaas or Cloud) and (Public sector or Government or Public institution or Public entity or E-government)
- Search area: Computer Science
- Document type: Conference paper or Journal paper
- Search field type: Abstract, title and keywords
- Language: English

With these criteria, the Scopus search engine returned 48 candidate articles. To reduce the number of articles, firstly, a review of the article titles was carried out. This filter reduced the number to 39. Secondly, a reading of articles' abstracts was undertaken to filter those works that do not present evidence of answering any of the review questions that are presented below. This filter limited the number of articles to 17 works. Thirdly, a complete reading of the articles was performed to select the final works set made up of 10 articles which were identified and included in the analysis. The literature review used the following review questions whose answers and conclusions are listed as follows:

- *To which industrial sector does the research work apply?* The literature focuses on the public sector. However, some researchers started their study with private entities and then analyzed and adapted its findings to public entities.
- *What is the main objective of the research work?* Two common objectives were found: (i) To identify evaluation criteria to assess the convenience and viability of adopting cloud services. (ii) To evaluate the adoption of cloud services by using a set of evaluation criteria previously identified.
- *How can practitioners evaluate the economic feasibility of adopting cloud services?* Important economic aspects to be estimated before adopting cloud services are: (i) operational efficiency gains for the public entity, (ii) investment reduction in acquiring software, hardware and other IT infrastructures, (iii) costs reduction in human resources and maintenance of IT infrastructures, (iv) increase in bandwidth costs to access the cloud services.

- *Are there other assessment aspects in addition to the economic one?* Additional aspects are grouped into four sets: (i) social and cultural aspects, (ii) technological and security aspects, (iii) user environment perception aspects, and (iv) political and regulatory aspects.

In order to define a set of criteria to evaluate the possibility of complying with the e-government guidelines when contracting and adopting cloud services, we propose the analysis methodology presented in the next section.

## Analysis of the e-government guidelines

### Description of analysis methodology

The following methodology is proposed in order to extract evaluation criteria from the e-government guidelines and compare them with assessment aspects identified in the literature review:

1. *Presentation of the e-government guideline* as described in the Colombian reference framework for Enterprise Architecture issued by MinTIC (MinTIC 2013) which is aimed at ensuring the quality of the IT services offered by the public sector.
2. *Interpretation of the e-government guideline* in the context of the cloud service sourcing model. To this end, we use the process oriented approach proposed in the Information Technology Infrastructure Library (ITIL)(OGC 2011), which provides the best practices most used in the industry.
3. *Extraction of evaluation criteria* to assess the technological and organizational capabilities of the customer (the IT department of the state entity), and the cloud provider according to the guideline interpretation.
4. *Comparative analysis of the extracted evaluation criteria and the assessment aspects* identified in the literature review, in order to determine potential equivalences between them. This analysis can be depicted as shown in Figure 1.

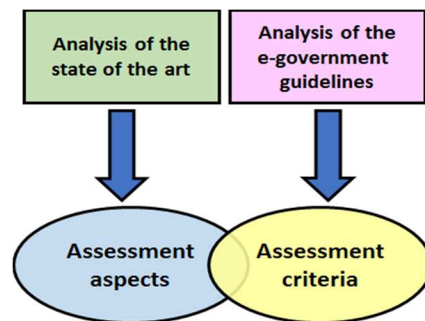


Figure 1. Comparative analysis of the extracted evaluation criteria and the assessment aspects

### Application of the methodology

The Colombian Enterprise Architecture framework includes 27 guidelines which are grouped into four fields:

- Technological services architecture
- Technological services operation
- Technological services support
- Quality and security management of service

We illustrate below the application of the analysis methodology previously described to one of the guidelines, namely, *technological services directory*, which belongs to the first field.

1. *Presentation of the e-government guideline*: The public institution IT department must maintain a portfolio of its IT services to evaluate the viability of implementing new services or reusing the current

- ones in order to satisfy the requirements of business processes and customers (MinTIC 2013).
2. *Interpretation of the e-government guideline*: according to the ITIL best practices, the guideline previously described can be interpreted in the context of the cloud service sourcing model by the following:
    - To contract the service, the IT department should maintain an updated IT service catalogue and implement a catalogue management process in order to present the contracted services to internal users. The catalogue and the management process aim at allowing internal users to consume the services or ask for new ones.
    - To provide a service, the cloud provider should maintain an updated IT service portfolio and implement a portfolio management process, with the objective of managing the lifecycle of the provided services. The portfolio and the management process aim at allowing the cloud provider to analyze the possibility of reusing existing services or their configuration elements in order to propose a more efficient offer to customers.
  3. *Extraction of evaluation criteria*: the identified assessment criteria, according to the guideline interpretation, are:
    - The IT department maintains an updated IT service catalogue and has a catalogue management process.
    - The IT provider maintains an updated IT service portfolio and has a portfolio management process for its IT services.
  4. *Comparative analysis of the extracted evaluation criteria and the assessment aspects*: there are no equivalent aspects in the research works.

## Evaluation criteria for the Colombian public sector

The analysis methodology was applied to the 27 e-government guidelines. For each guideline, one or several evaluation criteria were extracted depending on the technological and organizational implications, for the customer and the provider, of complying with it. As a result, a total of 48 evaluation criteria were extracted. We group the resulting criteria into three categories: (i) IT service architecture criteria; (ii) IT service operation and support criteria; and (iii) IT service quality and security criteria.

Further, concerning the application of the fourth step, *comparative analysis of the extracted evaluation criteria and the assessment aspects*, we found that there are two assessment aspects sets identified in the literature that are not taken into account by the e-government guidelines. These uncovered aspects are: (i) social and cultural aspects and (ii) financial aspects. However, these two sets of aspects are also fundamental to evaluate the adoption of cloud services for the Colombian context. Therefore, the definition of the evaluation criteria for Colombian public sector needs to include not only the criteria extracted from the guidelines but also the assessment aspects found in the literature without equivalences. As a result, the final categories of evaluation criteria for the Colombian public institutions are described as follows:

1. *IT service architecture criteria*: for the IT department of the public institution, it is referred as the organization current state of the technology architecture, to determine if the organization is ready to adopt cloud services, or conversely, if it has technological or organizational limitations that would cause negative impacts. To the cloud provider, it is related to the capabilities, such as elasticity of its technology architecture, to fulfill the customer needs.
2. *IT service operation and support criteria*: For the IT department of the public institution, it concerns IT processes that are necessary to manage the relationship with the provider. It includes processes such as catalogue management, service level management, and supplier management. For the cloud provider, it is also related to the process for the correct operation and support of the provided services. It includes processes such as capacity management, incident management, etc.
3. *IT service quality and security criteria*: security is related to evaluating how the cloud provider will guarantee the security in terms of encryption, access authentication, anti-virus protection, firewall, and service availability. Quality concerns how the provider will ensure the quality of the service in terms of availability, continuity, etc.

4. *Social and cultural criteria*: concerning internal state entities, it is related to the provision of opportunities to the development of new user capabilities, which could lead to a greater job satisfaction. Respecting external users such as citizens, it is based on equality and justice principles. Under these principles, it is fundamental to educate people about rights and duties when accessing to cloud services
5. *Financial criteria*: this is necessary in order to assure the financial resources to contract the services. Important economic elements practitioners need to estimate before making the decision of adopting cloud services are: (i) operational efficiency gains for the public entity, (ii) decreased investments in acquiring software, hardware and other IT infrastructures, (iii) costs reduction in human resources and maintenance of IT infrastructures.

## Conclusion and Next Steps

This article presents a literature review and an analysis of the Colombian e-government guidelines in order to identify the main evaluation categories to assess the convenience of adopting cloud services in the Colombian public sector. Regarding the literature review, we analyzed how the financial viability is evaluated in the reviewed research works. Therefore, we found that most of the proposed assessment aspects for this category, such as *the decrease in investments in software and other IT infrastructures*, are mainly oriented to reducing costs. Thus, the reviewed works do not show how the adoption of cloud services could be economically viable in terms of generation of economic benefits for communities, general public, and other beneficiaries of these services. In addition, when looking for other assessment aspects, we found that unlike the private sector in which the financial aspect is one of the most important ones, in the public sector additional aspects can be even more important and need to be considered. For example, political and regulatory aspects need to be considered as the public entities are subject to changes in regulation and leadership because of elections and social designations. Concerning the analysis of the e-government guidelines, they are mainly oriented to considerate technology aspects. We group the extracted evaluation criteria in three sets: (i) IT service architecture criteria; (ii) IT service operation and support criteria; and (iii) IT service quality and security criteria. When comparing the criteria in these three sets with the ones proposed in the literature, we found that there are two assessment aspects sets that are not considered by the e-government guidelines. Consequently, we propose the final sets of evaluation criteria for Colombian public institutions by adding the evaluation criteria extracted from the analysis of the e-government guidelines and the assessment aspects identified in the literature review without any equivalence in the guidelines. Even though the five evaluation categories proposed in this paper are like the ones found in the reviewed works, they include criteria that are specific for the Colombian context, as they were extracted from the Colombian Enterprise Architecture framework. In addition, the originality of our approach is that the evaluation criteria were defined by using management mechanism that consider best practices in IT service management. Next steps include the design of a complete evaluation framework from the evaluation criteria identified in this work, and applying it to several public institutions in order to get feedback and prove its effectiveness.

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