

# Public ICT Governance: A Quasi-systematic Review

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Keywords: ICT Governance, Public, Good Practice.

Abstract: This work performs a quasi-systematic review in a structured way to identify, characterize and summarize the main evidence on Public ICT Governance in order to analyse the methods, techniques, models, framework, guides and / or Public ICT Governance good practice to describe its application in an IT environment, helping ICT managers through a secondary study. A research question was raised and an initial study of 4870 works was adopted. Among these, 21 were selected for the construction of this study through a characterization of three components (Leadership, Strategy and Control) which encompasses the dimensions that define the level of maturity of a public organization (iGovTI). In this analysis and characterization, it was identified that the methods techniques, models, framework, guides and/or good practice found were the most mentioned at the Academy, as COBIT, ITIL and CMMI, as also others who are not known.

## 1 INTRODUCTION

Corporate Governance is a process that involves a set of relationships between managers and best practices for the planning, acquisition, implementation, monitoring and supporting of organizational information, to ensure alignment among organizational goals. Based on the concept of Corporate Governance, Information and Communication Technology (ICT) Governance is a part of Corporate Governance which provides the alignment of ICT processes, ICT resources, ICT information with the organization's strategies. (Janahi; Griffiths; Al-Ammal, 2015b).

The Governance of ICT and the alignment of ICT management go along with strategic planning as a way to add value to the use of the products and services of ICT through the ideal investment to obtain competitive advantage and financial returns, more related concepts in most cases, in private companies and not in public sector agencies (Briciu et al., 2011).

Increasing the efficiency of public ICT Governance is one of the objectives of Brazil, according to a survey carried out by the Court of Audit (TCU), the ICT Governance in public organizations is in bad governance (Brasil, 2015).

Thus, improving the maturity of Public ICT Governance in organizations involves the adoption of good information technology practice, which requires the use of modern ICT management tools and associated acquisition of goods and services (França et al., 2016).

Even though there is a great recognition of the importance of ICT governance and its role in organizations, how to put it in practice is still a challenge and depends on each case. The application to public organization makes the case even more specific and complex. Therefore, it is necessary to investigate the implementation of ICT Governance in the real environment, following the close process to identify real problems, plan solutions, make changes and reflect on the results (Mauro; Augusto, 2010).

In this context, a survey of the methods techniques, models, framework, guides and/or good practice in Public ITC Governance mentioned in the technical literature was conducted. This has the goal of achieving a level of scientific rigor, by means of a systematic review (Kitchenham, 2004). The systematic review is different from conventional literature reviews, in which the researcher does not follow a defined process for its conduction. A systematic review is performed in a formal manner

complying with a predetermined protocol. Compared to informal literature reviews, systematic reviews require more severity in its realization. On the other hand, the result tends to be more reliable, since they make use of a strict methodology and detailed description, facilitating an audit or repetition (Wohlin et al., 2000).

This way, a study was carried out to analyse or good practice in Public ITC Governance so as to characterize the type of good practice under the point of view of organization managers in IT in the context of checking which have better adaptation in public organization. From this analysis, it is expected to present a comprehensive overview of good practice Public ITC Governance, as well as the characterization and application of inspections for quality assurance. This enables the identification of the most appropriate good practice Public ICT Governance for the implementation.

In the present study, 21 good practice Public ICT Governances are described, with possible applications to improve the index of ICT Governance maturity in Organizations (iGovTI), through the Leadership components, Strategy and Control. Each of the good practices with their way of comprehensiveness, be it academic and industrial, are also described.

This paper is divided into 4 sections. Section 2 describes the planning of the quasi-systematic review and the protocol prepared for it. Section 3 describes the conduct of this review and the results obtained. Section 4 presents the results of the quasi-systematic review making use of proposed categorization for the methods and techniques found. Section 5 discusses the results of the analysis and points out directions for future work.

## 2 PLANNING OF QUASI-SYSTEMATIC REVIEW

A systematic review of the literature is characterized as a means to identify, evaluate and interpret all available research and relevant topic, research, area or element of interest to a particular search. Individual studies such as surveys, case studies, experiments (Pai et al., 2004) contributing to a systematic review are characterized as primary studies. The systematic review is characterized as a secondary study (Biolchini et al., 2005).

To conceive a question of well-formulated research, it is necessary to describe its population, the factor under study (intervention) and the expected

result for the review. The protocol for a systematic review should include (Biolchini et al., 2005): formulation of one or more research questions; identification of the need to conduct a systematic review; comprehensive search, with inclusion of primary studies; assessment of the quality of included studies; data extraction; summary of the study results; interpretation of results to determine its applicability and written report.

Systematic reviews have a well-defined research method that aims to get as much relevant bibliographic material as possible. Before performing the search of primary studies, it is necessary to define the systematic review protocol that will be used to perform the review. The protocol defines the inclusion and exclusion criteria for each primary study and documents the search strategy performed, allowing readers (researchers) to identify without degree of accuracy the veracity of the information (Mafra; Travassos, 2005). To (Kitchenham; Mendes; Travassos, 2007), "A systematic review has a research topic of evaluation as its goal, as it utilizes a rigorous review methodology, reliable and susceptible to audit".

The study in question has the purpose of characterization, i.e., if it has no prior knowledge as achieving comparisons. Thus, we called a quasi-systematic review, according to (Kitchenham; Mendes; Travassos, 2007).

The conduction of this quasi-systematic review aims to examine methods, techniques, models, framework guides and/or good practice existing in ICT Governance, through a secondary study. Thus, we followed the method proposed by (Kitchenham, 2004) and used the available protocol by (Wohlin et al., 2000).

In the following subsections, we have the detailed protocol developed. Thus, it becomes possible to evaluate and repeat the review by other investigators.

### 2.1 Goal Definition

The goal of this quasi-systematic review was AND formalized using the GQM model proposed by (Basili; Weiss, 1983) and presented by (Van Solingen et al., 2002): **Analysing** methods, techniques, models, framework, guides and/or good practice of ICT Governance **with the purpose of** characterization **regarded to** the criteria for the used methods, techniques, models, framework, guides and good practice **from the point of view** of managers of ICT and public organization **in the context of** the method(s), technique(s), model(s), framework,

guide(s) and/or good practice(s) that process better application in public organization.

## 2.2 Research Question

To achieve the goal defined the following question to the quasi-systematic review:

- **Question:** What are the existing methods, techniques, models, framework, guides and/or good practice to the Public ICT Governance?
- **Intervention:** methods, techniques, models, framework, guides and/or good practice.
- **Results:** methods, techniques, models, framework, guides and/or good practice.

## 2.3 Strategy used to Search the Primary Studies

The search strategy makes explicit the scope of the survey, as well as the terms to be used in it, which are used to compose the search strings. The definitions of these terms are through the population, intervention and expected results, which were defined in the research question.

**Scope of search:** search in electronic databases, including journals and conference proceedings.

**Sources:** Scopus. The periodic portal from CAPES ([www.periodicos.capes.gov.br](http://www.periodicos.capes.gov.br)) was used to download the articles without restrictions on both databases. The Scopus database was chosen because it is one of the largest sources of technical and scientific literature of reference, since it includes items from various databases (ACM, IEEE, ScienceDirect and others). In order to help researchers find published information in all countries with a constant update, Scopus conveys credibility on a scientific research. These databases that support the Scopus are frequently used by Computer Science researchers. ("Scopus", 2016).

The terms used in the search (in English): Governance, method, techniques, models, framework, guides, good practice, IT, ICT, Information, communication and technology.

The search string was generated by combining the key terms. The string used for the database was defined as: (("Governance") AND ("public") AND ("information communication technology") OR ("ICT") OR ("IT") OR ("Information technology")) AND ("method\*" OR "technique\*" OR "model\*" OR "framework" OR "guide\*" OR "good practice\*")

## 2.4 Selection Criteria and Study Procedures

Inclusion criteria for the study were:

- Studies on Public ICT Governance;
- Studies that were published after 2006.

Study exclusion criteria:

- Studies on Public ICT Governance in other contexts;
- Duplicate studies;
- Studies which were not available for full-text display.

## 2.5 Data Extraction Strategy

For each item selected for the full selection process, a researcher extracted the following data:

- Standard reference information.
- To the question:

Specification e Description of the method, techniques, models, framework, guides and/or good practice Public ICT Governance.

For the process of preliminary selection, it was decided that a researcher applies the search strategy to identify primary studies. The results will be reviewed by two other researchers involved and any disagreements will be discussed and resolved. If a consensus on a particular study is not reached, it will be included.

The final selection process: copies of all articles included as the initial search results will be revised entirely by at least one of the researchers. With this revision of article being included, the process is concluded. If there is some disagreement about the revised articles, there will be a discussion to find a solution. If the agreement is not reached, the item will be included.

For the assessment of the quality of the material, no procedure was prepared. The review aimed to look for good practice Public ICT Governance. The only issue to be considered is that the article includes a description of the methods, techniques, models, framework, guides and/or good practice, once this description will be part of the data to be extracted.

## 3 CONDUCTING OF THE QUASI-SYSTEMATIC REVIEW

Advanced filtering tools were used for the execution of the search at the database of Scopus, considering the summary (abstract) of articles, languages

(Portuguese and English) and research area (Computer Science and Business, Management and Accounting), in order to minimize items which did not contemplate the scope of the good practice of Public ICT Governance. The following is a summary on the implementation of search in database:

**Scopus: (1)** ABS(((“Governance”) AND (“public”) AND (“information communication technology”) OR (“ICT”) OR (“IT”) OR (“Information technology”))) AND (“method\*” OR “technique\*” OR “model\*” OR “framework” OR “guide\*” OR “good practice\*”) AND (LIMIT-TO(SUBJAREA, “BUSI”)) AND(LIMIT-TO(SUBJAREA, “COMP”))).

A string had been chosen, but the results were few. It was decided to choose two more. In the first string the search was made for the abstracts, in the second the search was done by keywords and the last one was made to search by title, which are these:

**(2)** KEY(((“Governance”) AND (“public”) AND (“information communication technology”) OR (“ICT”) OR (“IT”) OR (“Information technology”))) AND (“method\*” OR “technique\*” OR “model\*” OR “framework” OR “guide\*” OR “good practice\*”) AND (LIMIT-TO(SUBJAREA, “BUSI”)) AND(LIMIT-TO(SUBJAREA, “COMP”))).

**(3)** TITLE(((“Governance”) AND (“public”) AND (“information communication technology”) OR (“ICT”) OR (“IT”) OR (“Information technology”))) AND (“method\*” OR “technique\*” OR “model\*” OR “framework” OR “guide\*” OR “good practice\*”) AND (LIMIT-TO(SUBJAREA, “BUSI”)) AND(LIMIT-TO(SUBJAREA, “COMP”))).

The planning of the quasi-systematic review took place in September, 2016. The search with the search strings was held in September, 2016.

For the search on the database of Scopus only keywords in English were used and the result was 4870 returned articles.

Once the searches were finished, the selection of the articles began, based on criteria and procedures of selection.

With the adoption of inclusion and exclusion criteria of the articles, the evaluations were conducted to answer the question. From the 4870 articles found, 5 were duplicated and 21 were selected for the answer to this review.

During the execution of the search process and selection of articles, detailed analysis were performed with the purpose of identifying the items that best suited with the proposed objective.

By applying the string search and keywords in the databases, 4870 articles were found. After the adoption of the inclusion and exclusion criteria, 21 articles were found. With the 21 articles, the summaries reading, description of the good practice and conclusion were held. It was noticed that there

was a large reduction in the number of articles. This reduction was achieved through the exclusion criteria focusing on the article context in which only 21 articles were selected in Scopus database. Full identification of the primary studies can be found in the References section of this article.

After the completion of the selection, the primary studies were directed to the reading of the good practice and analysis. The results of this stage can be found below.

## A. Results Obtained with the Review Execution

In Table 1, we listed the selected items and briefly described the good practice Public ICT Governance.

The methods, techniques, models, frame, guides and / or good research practices addressing Public ICT Governance showed variation in the number of publications. It demonstrates that the good practice began to be created or studied with greater emphasis in recent years (2015 and 2016), with eleven publications, five in 2016 and six in 2015. However, in 2010, there is great interest in the area with three publications. In the years 2014 and 2013, both obtained two publications. In 2011, 2009 and 2008 only one publication in this area was found for each year. In 2012, no publication in the area was found, featuring as the worst year of contribution (Figure 1)



Figure 1: Statistical graphic of evolution by Public ICT Governance practices over the past decade.

According to the data, it is observed that few countries are contributing in publications in Public ICT Governance area. Malaysia is the country that is researching this area with 8 (eight) articles found. Portugal 4 (four) and Sweden with 3 (three) also demonstrate great interest in the area. Countries like Bahrain and United Kingdom both have 2 (two) articles. Countries like Brazil, Ecuador, Indonesia, Romania and the Tanzania are initiating their research in the area, both with 1 (one) article, as shown in Figure 2.

Table 1: Selected Results.

Reference	Good Practice Public ICT Governance
(Hamid; Sulaiman, 2016)	Describe a model of maturity for the Department of Public Service Malaysia, this model was built based on questionnaire formalized per Control Objectives for Information and Related Technology (COBIT) 4.1 and answered by two groups of people – Personnel Management and business. The model helps to improve the level of maturity of ICT processes with bases on its strategic objectives and organizational needs.
(Ajayi; Hussin, 2016)	The authors describe a model experiment carried out in a higher education institution of Malaysia, which describes that to achieve a degree of maturity IT governance is taken three categorized capabilities in structures, processes and relationships.
(França et al., 2016)	It used the methodology of learning stories and proposes a method to raise and systematize the knowledge based on past actions, in an informal way, in organizations. It allows an improvement in institutional governance with the formalization of the entire project for the development of departmental systems; and greater responsiveness of ICT, enabling prioritization to fulfill the demands that are more strategically relevant.
(Montenegro; flores, 2015)	It is proposed an integrated model for Governance and ICT Management, based on Model Strategic Alignment Model (SAM) proposed by Henderson and Venkatraman. The COBIT is adopted with general practice for Governance and Management.
(Umaroh; Surendro, 2015)	This study proposes a framework formulation of IT usage policies by modifying existing policy framework in some theories related to politics. The proposed framework takes a holistic approach to IT use policy in the organization, and also combines the concept of Wies political hierarchy and Peter Weill IT Governance Jeanne W. Ross.
(Janahi; Griffiths; al-Ammal, 2015a, 2015b)	This study contributes to knowledge in the field of IT Governance presenting a dynamic, interdependent, and holistic model to implement an ICT governance framework in any organization. The maturity of the organization will remain the first step to progress. The model defines human resources, IT resources and strategic objectives as three elements and explores the interconnection among them.
(Razak; Zakaria, 2015)	The authors' proposal consists in a method that checks factors and sub-factors for success in ICT governance practices. The proposed definition can be a benchmark in strengthening of IT Governance practices. It can be a standard reference for strengthening Governance ICT practices.
(Bianchi; de Sousa, 2015a, 2015b)	It is developed a model that incorporates practices for structures, processes and mechanisms proper to public universities using the 6 steps of DSR (Design Science Research): Identification and motivation of the problem; Defining the solution objectives; Design and development; Demonstration; Evaluation; Communication. The model is created based on COBIT and Information Technology Infrastructure Library (ITIL).
(Al Qassimi; Rusu, 2015)	IT governance practices are identified in the governmental organization using framework IT Governance addressing the structure, process and relationship. Such items will promote the provision of ICT project accounts and contribute to effective implementation of ICT Governance in the organization.
(Ahlan; Arshad; Ajayi, 2014; Arshad; Ahlan; Ajayi, 2014)	The study explores ICT Governance issues and suggestions for smart decisions for support system Governance. Held in a public university in Malaysia, its results were generated through interviews. The results are aligned related the COBIT. This decision support system enables educational public institutions optimal use of IT resources.
(Nunes; Rosa; Silva, 2013)	It proposes a model for strategic planning of ICT in public agencies through the COBIT and IT Capability Maturity Framework (IT-CMF). For the model design, the Plan-Do-Check-Adjust cycle (PDCA) was used. This model aims a sustainable and formal improvement of the Portuguese Public Administration.
(Nfuka; Rusu, 2013)	It proposes a framework for IT governance implementation for the public organizations in Tanzania. The framework was developed based on research and studies with executives of these organizations and industry.
(Briciu et al., 2011)	The author suggests a new internal control model for public institutions that deals with the receipt of taxes and has the responsibility to turn them into services for the population. Comparing models such as Committee of Sponsoring Organizations (COSO), Order of the Ministry of Public Finance (OFMP) and International Standard on Auditing (ISA) 315 the author was able to include new objectives such as risk management and effective control, taking into account potential future risks.
(Nfuka; Rusu, 2010)	It adopts 15 COBIT processes in public organizations in Tanzania to establish maturity in ICT Governance.
(Maidin; Arshad, 2010)	Based on interviews, it proposes a theoretical model of ICT Governance practices with the public sector in Malaysia. The model consists in the involvement of the Senior Management in IT, corporate performance measurement systems, enterprise communications systems, risk management, strategic alignment, value delivery, ethics / compliance culture and management capabilities.
(Abdul latif; Md Din; Ismail, 2010)	It performs an evaluation with the practices of ICT service levels; they are ITIL and Capability Maturity Model Integration (CMMI) for public organizations in in Malaysia.
(Gomes; Ribeiro, 2009)	The authors use COBIT as a framework to implement the ICT Governance in a public education institution, demonstrating earnings by 25% in the TI governance in organization.
(Nabiollahi; Sahibuddin, 2008)	Identifies the ITIL V3 as part of IT Governance and Service Strategy, based on three elements: structure (provides necessary guidance to the organization's IT governance structure), process (Define the processes that fulfill the IT goals) and communication (Define key roles and responsibilities, to perform communication in IT).

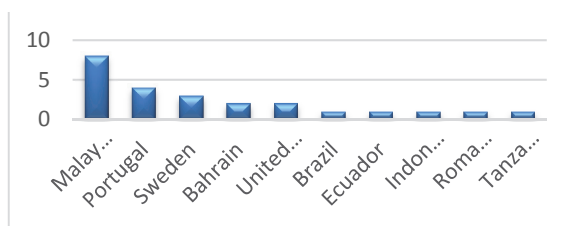


Figure 2: Ranking of the main countries researching in the Public ICT Governance field.

#### 4 CATEGORIZATION OF THE METODOS, TECHNIQUES AND GOOD PRACTICE FOUND

Following the execution of the selection of the results of systematic quasi-review, method, techniques, models, framework, guides or good practice found were classified based on three components (Leadership, Strategy and Control), to facilitate the organization in choosing the method, techniques, models, framework, guides and correct or good practice to improve their maturity index iGovTI. The proposed components are:

**Leadership** – (yes/no) indicates if the good practice or proposed cover the related set of practices defined dimensions TCU as Leadership Senior Management and People. The practices belonging to the component "Leadership" are those that comprise the following macro activities: ICT Risk Management, ICT Portfolio, ICT Committee and People Management.

**Strategy** – (yes/no) indicates if the good practice or proposed cover the related set of practices defined dimensions as TCU Strategies and Plans and

Processes. The practices belonging to the component "Strategic" are those that comprise the following macro activities: Organization's Strategic Planning and IT, Software Processes, Information Security, Project Management, Service Level Management and Contract Management.

**Control** - (yes/no) indicates if the good practice or proposed cover the related set of practices defined dimensions TCU as information and results. The practices belonging to the component "Control" are those that comprise the following macro activities: Organizational Information, Information Transparency, accessibility of current information and past results.

**Scope of Use** – (Industrial environment/academic environment) reports if the good practice in question were used only in academic projects or has been used in real projects, industry or other organizations – according to information obtained by the end of the research and the sources previously established.

Table 2 shows the classification of good practice according to the proposed criteria. After the categorization of method, techniques, models, framework, guides or good practice, it was possible to perform the following analysis on the criteria, according to the graph on Fig. 3.



Figure 3: Classification of good practice.

Classification of good practice.

Table 2: Classified method, techniques, models, framework, Guides and/or good practice.

Reference	Leadership	Strategy	Control	Scope of Use
(HAMID; SULAIMAN, 2016)	Yes	Yes	Yes	Industrial
(AJAYI; HUSSIN, 2016)	Yes	Yes	Yes	Industrial
(FRANÇA et al., 2016)	Yes	Yes	Yes	Industrial
(MONTENEGRO; FLORES, 2015)	Yes	Yes	Yes	Academic
(UMAROH; SURENDRO, 2015)	No	Yes	No	Academic
(JANAHI; GRIFFITHS; AL-AMMAL, 2015a, 2015b)	Yes	Yes	Yes	Academic
(RAZAK; ZAKARIA, 2015)	Yes	Yes	Yes	Industrial
(BIANCHI; DE SOUSA, 2015a, 2015b)	Yes	Yes	Yes	Academic
(AL QASSIMI; RUSU, 2015)	Yes	Yes	Yes	Industrial
(AHLAN; ARSHAD; AJAYI, 2014; ARSHAD; AHLAN; AJAYI, 2014)	Yes	Yes	Yes	Academic
(NUNES; ROSA; SILVA, 2013)	No	Yes	No	Academic
(NFUKA; RUSU, 2013)	Yes	Yes	Yes	Academic
(BRICIU et al., 2011)	Yes	Yes	Yes	Academic
(NFUKA; RUSU, 2010)	Yes	Yes	Yes	Academic
(MAIDIN; ARSHAD, 2010)	Yes	Yes	Yes	Academic
(ABDUL LATIF; MD DIN; ISMAIL, 2010)	No	Yes	No	Academic
(GOMES; RIBEIRO, 2009)	Yes	Yes	Yes	Academic
(NABIOLLAHI; SAHIBUDDIN, 2008)	No	Yes	No	Academic

**Leadership Component:** this component identifies as the method, techniques, models, framework, guides and good practice that support the ICT Governance in Public Administration, based on the dimensions defined by TCU this component is responsible for activities related to senior management and people. From the 21 articles found, 17 describe some relevant practice for the component.

**Strategy:** the 21 articles related describe practices found in this component, which cooperate with the dimensions Strategy Plan as Processes .It's a significant fact because of the Process dimensions that possess the larger number of practices.

**Control:** Just like Leadership, the Control component also was practiced in 17 articles. This component refers to dimensions Results and Information.

Regarding the Scope of use: the processes used in industrial environments were applied mostly in pilot project by the group that has developed them, resulting in 24% of studies. As for the academic environment there was an aggregation of 76 % of the studies, as shown in Figure 4.

The results of the industrial area report that the methods or techniques still haven't shown a range of usage that allows the ICT Manager to understand or identify the risks associated with their use in real projects.

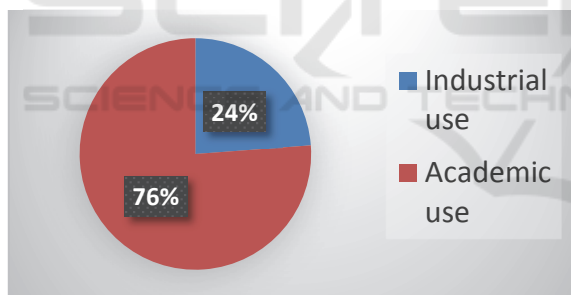


Figure 4: Results by type of coverage.

## 5 CONCLUSION AND DISCUSSION OF RESULTS

We performed a quasi-systematic review in this report aimed to analyze good practice in ICT Governance in order to characterize the type of adaptation from the organizations managers' point of view in context of the check which will help improve the index of maturity of organizations (iGovTI).

The research question was created to guide the quasi- systematic review and after the evaluation of a total of 4870 studies initially returned, 21 were selected as relevant studies for review.

From the analysis of the selected studies were presented mechanisms that help as a guide on the good practice Public ICT Governance. The results show the existence of method, techniques, models, framework, guides or good practice for the components (Leadership, Strategy and Control) defined, with restriction four studies which are Strategy.

The results show that until the date of the systematic quasi-review, it was not possible to identify a method, techniques, models, framework, guides or good practice specific to Leadership and Control components. The studies found that 92% promote the practice of Public ICT Governance, covering all components.

An aspect to be noted is that most of the collected and selected articles were no reports of use of the method, techniques, models, framework, guides or good practice ICT Governance known in academy and widely used in the Brazilian industry, such as: Control Objectives for Information and related Technology (COBIT), Information Technology Infrastructure Library (ITIL) and Capability Maturity Model - Integration (CMMI).

Thus, it is believed that this research presents relevant results to the academy, providing support characterization of method, techniques, models, framework, guides or good practice Governance of Public ICT, becoming an important consulting source for ICT governance in Public Administration Federal of Brazil.

As a future goal, it can be initially highlighted the detailing of the operation of the method, techniques, models, framework, guides or good practice found with the result of this work. The creation of a repository of knowledge on good practices of public ICT Governance, based on these results, helping ICT Managers, for the adoption of correct practice.

Another opportunity is to detail, compare and relate the data that formed the basis for the case studies of these good practice of Public ICT Governance.

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