

# Correlation Between ICT Investment and Technological Maturity in Public Agencies

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**Abstract.** This article shows the results obtained with a model to assess the digital maturity of a government at country level. The model is based on maturity model concepts with focus on the digital strategy of the country. The application of the model to public agencies shows the weaknesses of the digital strategy that should be improved as country, but more interesting is the correlation that exists between the ICT investment in a public agency and its maturity.

**Keywords:** Maturity model · E-government · ICT investment

## 1 Introduction

The e-government survey of the United Nations [1], divides the evaluated countries in 4 categories: Low income countries; Lower Middle income countries; Upper Middle income countries; and High income countries, giving an idea that there is a correlation between level of development of the country and Information and Communication Technologies (ICT) investment at country level. Unfortunately, there is no information related to the ICT investment at country level.

As a fact, the UK Government based its ICT strategy [2] ensuring it is vital for the delivery of efficient, cost-effective public services which are responsive to the needs of citizens and businesses.

As example, in Kuppusamy, Raman and Lee [3], the empirical results suggest that ICT has had a significant impact on Malaysia's economic growth during the period 1992–2006, suggesting good payoffs from the investment.

The Australian Department of Finance released (in January 2015) a revised set of Whole-of-Government ICT Investment Principles. The Principles are high-level statements of best practice aimed to ensure that ICT investment aligns with whole-of-government vision, strategy and policy [4].

This article presents a study that was carried out between February and July 2015, with the main objective of measuring the degree of maturity of the capacities to manage the ICT of the central State agencies, with the purpose of guiding the development of digital government strategies. To this end, a maturity model was developed to diagnose the digital governance capacities in the main axes that drives the Digital Government development strategy [5].

Section 2 presents the **Maturity Model of Digital Government (MMGD)** that was applied in a massive way to 121 agencies of the central government for which the information was collected through a web tool developed for these purposes. Section 3 shows the scheme used to classify agencies by segment according to reality in terms of ICT investment and their budget.

Section 4 presents the descriptive results of the evaluation process of the captured data. The analysis is presented from the point of view of the average maturity of the 121 state agencies that participated in this self-assessment. As a result, an **average maturity level of 2.3** was obtained, which on an organizational maturity scale corresponds to the level of maturity 2. This level is defined as a level of **incipient development**, which is the average level of the state agencies that participated in the study. The description of the results is carried out following the logic of the model, but is analyzed by segment to allow a comparison of critical success factors for agencies to implement their digital governance strategy.

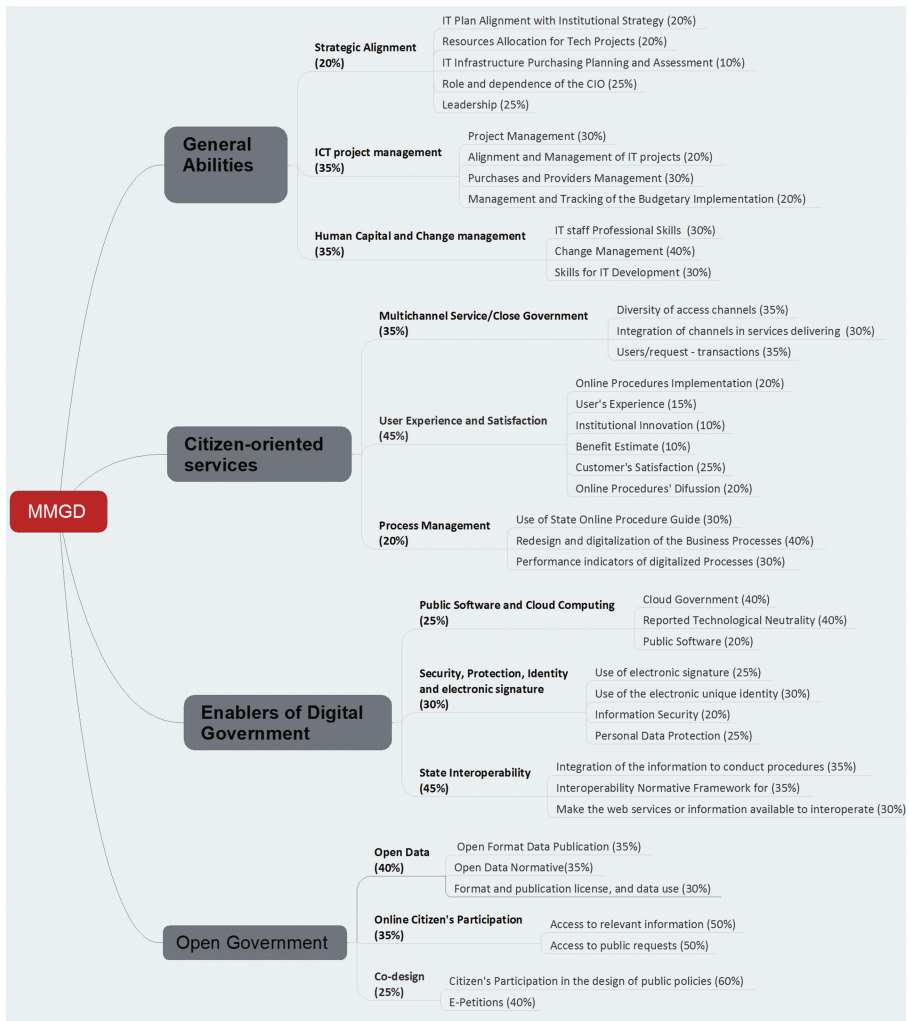
Finally, Sect. 5 provides the general recommendations of the variables that were identified as those that can add value, and present opportunities for improvement, as well as institutional challenges.

## 2 Digital Government Maturity Model (MMGD)

The areas considered in the design of the MMGD model are aligned with the lines of action of Digital Government, being these: General Capacities, Citizen-centered Services, Enablers of Digital Government, and Open Government. In this way, four (4) domains were defined, 12 subdomains in total (3 for each domain) and 41 variables distributed in the 12 subdomains, based fundamentally on the objectives and goals of the digital government development strategy, such as interoperability, single key, electronic signature, and open data policy, among others (see Fig. 1).

The evaluation process corresponds to a self-assessment scheme carried out by each agency, and therefore does not require means of verification. Consequently, with the results obtained it is not possible to “determine” the specific level in which each variable is found, but is an approximation coming from the perception of what each agency responds. The results indicate an adequate level of validity, given the overall knowledge of the level of development of each variable in the central State at present.

For each variable of the model there is a scale of measurement of increasing levels of development from 1 to 4, ranging from a level 1 called “no development” to a maximum level 4 of “advanced development”.



**Fig. 1.** Digital government maturity model: domains, subdomains and variables.

### 3 Classification

We first present the classification that was made to group the agencies of similar characteristics in order that the results of the evaluation are compared between pairs of similar level of development.

In this way, the Public Agencies (PAs) has been segmented so that when applying the maturity model, the results of the agencies can be compared between PAs that have similar characteristics between them.

The *Australian Government Information Management Office* (AGIMO) calculates a range of benchmarking metrics, which vary depending on the size of the agency.

AGIMO categorizes agencies by the size of their ICT expenditure (large: greater than \$20 m; medium: \$2 m–\$20 m; small: less than \$2 m) and collects a different set of metrics for each cohort [4].

In our proposal, we consider that an absolute amount of investment in ICT is not a good indicator of the importance it has in each agency, since a certain absolute amount can mean 50% of the total budget of an agency, or less than 1% in other. For this reason, we propose another way of performing this classification, trying to leave similar PAs in the same group.

The Bureau of Budgets (DIPRES) of the Ministry of Finance provided the following information:

- List of PAs
- Total Budget of the PA
- Budget in ICT of each PA
- Staffing

Where:

- Total PA Budget: The budget used in the classification corresponds to the Public Sector Budget Law published in the official journal.
- ICT Budget of each PA: Information pertaining to the ICT budget, granted by the Bureau of Budgets of the Ministry of Finance, associated to the executed budget.

The ICT budget considers the following items:

*Item 1:*

- Telephone Service:
  - Fixed Telephony
  - Cellular Phones
  - Internet access
  - Telecommunications Links
- Leasing of Computer Equipment
- Computer Services
- Computer Inputs, Spare Parts and Accessories
- Maintenance and Repair of Computer Equipment
- Technical and Professional Services - Computer Services

*Item 2:*

- Computer and peripheral equipment
- Communication Equipment for Computer Networks
- Information Systems
- Computer Programs

In order to formulate a classification of the PAs that participated in the application of the MMGD model it is suggested based on the information given to classify as follows:

## (a) Classification Criteria

Each PA is classified relating the budget dedicated to ICT and total budget that has that agency. The results reflect the level of technological infrastructure that this PA has to develop its services offering with citizens and with the rest of the actors that interrelate with the public sector (Eq. 1).

$$\text{ICT percentage} = (\text{ICT budget} / \text{Total Budget}) * 100 \quad (1)$$

## (b) Segments:

From the ICT percentage of each agency, four (4) segments were identified and distributed as shown in Table 1.

**Table 1.** Classification of agencies

Segment	Range percentage in ICT	Number of agencies
I	>5%	24
II	2–5%	34
III	0.5–2%	35
IV	<0.5%	28
		<b>121</b>

The results of this segmentation reveal that:

- 24 agencies have an ICT budget above 5%.
- Some highly specialized ones such as the Financial Analysis Unit, the Purchasing and Public Procurement Department and the Superintendence of Gambling Casinos.
- Segments II and III have a balanced number of agencies, 34 and 35 respectively.
- Segment IV corresponds to 28 agencies that have an investment of less than 0.5% in ICT.

## 4 Descriptive Data Analysis

This section presents a descriptive analysis of the results in the massive application of the MMGD model to 121 state agencies. Results are presented by segment according to the level of ICT investment and analysis of critical success factors for agencies to implement their digital development strategy.

### 4.1 Outcome of Maturity of State Agencies

Recalling that the objective of the study is to measure the capacity of public agencies to implement the digital development strategy, as a result of the self-assessment of the 121

state agencies that participated, an average level of maturity of 2.3 was obtained. On an organizational maturity scale, it corresponds to the level of maturity 2, which is defined as an incipient level of development, that is to say, that is the average level of the state agencies that participated in the study.

The average maturity of self-assessed public agencies is the average of the results obtained in the four domains of the model: General Capacities, Citizen-centered Services, Digital Government Enablers, and Open Government. All domains have the same importance in defining the maturity state.

As for the domains, the following was obtained: The Domain for Citizen-centered Services is the most developed domain of the State with an average maturity of 2.5. The domain Digital Government Enablers has an average maturity of 2.3, and Open Government with an average of 2.2. Finally, the General Capacities domain has the lowest level of development of all domains, with an average maturity of 2.1.

## 4.2 Relation of ICT Budget and Degree of Maturity

As part of the study, a classification of agencies was carried out to group similar characteristics so that the results of the evaluation are compared among agencies of similar size.

From the results obtained, it can be verified that segment I, where the agencies with the greatest investment in ICT in relation to their budget are the segment where the largest number of mature agencies are located, considering that there are 4 agencies with level of maturity above level 3.

Segment II has a single agency with an average of more than 3, which is actually the one with the highest maturity among all agencies surveyed, with an average level of 3.4. The other two segments, III and IV, do not have any agency with maturity level greater than 3.

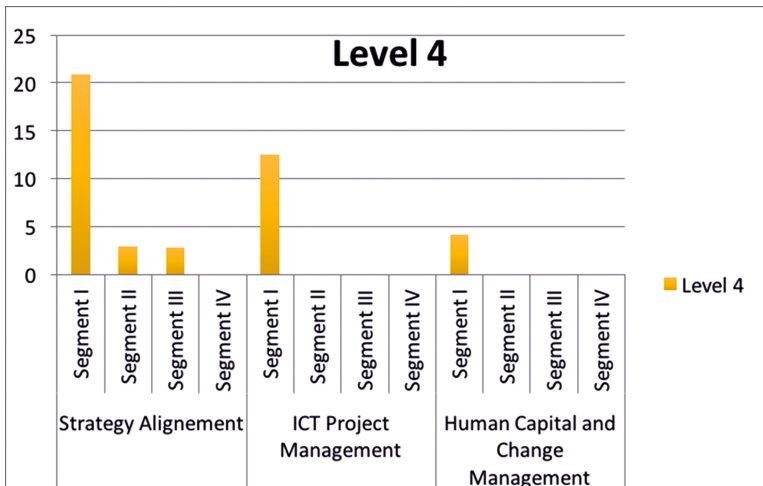
It is possible to verify that 70.8%, corresponding to 17 agencies of the 24 that compound the segment I, have a maturity less than 2.5. This ratio increased to 79.4% (27 of 34 agencies), and in segments III and IV, the ratio increased to 94% (33 out of 35 agencies) and 93% (26 out of 28 agencies).

In fact, the average maturity by segment is 2.4 for segment I, 2.2 for segment II, and for segments III and IV, the maturity averages are 2.0 and 2.1, respectively, recalling that they are the segments with investment levels lower than 2% in ICT.

In segment I we have a single subdomain with an average less than 2, which increases to 3 subdomains in the case of segment II, and passes to 5 subdomains and 4 subdomains in the case of segments III and IV, respectively.

### Percentage of Agencies per Segment that have a Level 4

Figure 2 shows the distribution by subdomain of the percentage of agencies per segment that have a level 4 evaluation in that subdomain. As an example, it is observed that:



**Fig. 2.** Percentage of agencies in level 4 of development in domain general capacities.

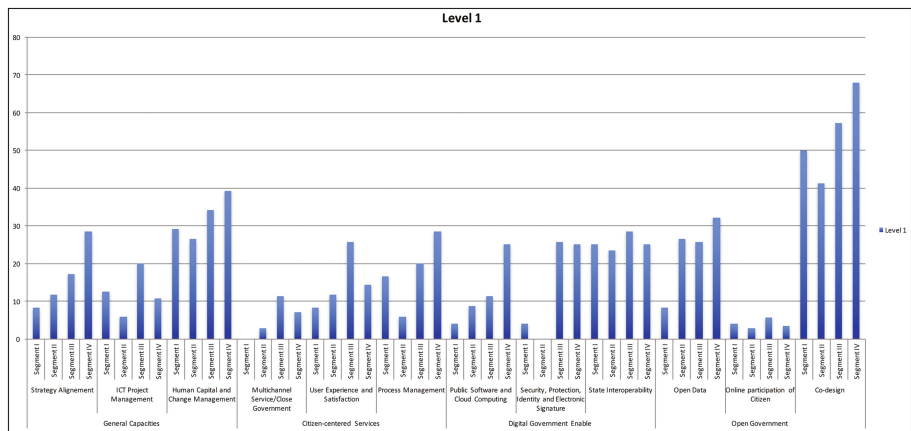
- Segment I is the one with the highest percentage of agencies in level 4 in all subdomains that have reached this level.
- In the sub-domains “ICT Project Management” and “Human Capital and Change Management”, segment I is the only one that has agencies with a level of development 4.
- In segment III, some agencies have a level 4 in the subdomains “Strategic Alignment” (3%).

Figure 2 shows that in all subdomains of the “General Capabilities” domain, i.e. “Strategic Alignment”, “ICT Project Management” and “Human Capital and Change Management”, some agencies in the segment of highest ICT budget are at the highest level of development. This would explain why it is necessary to have adequate resources.

### Percentage of Agencies per Segment that have a Level 1

Figure 3 shows the subdomain distribution of the percentage of agencies per segment that have a level 1 evaluation in that subdomain. As an example, it is observed that:

- Segment IV has the highest percentage of agencies in level 1 in more subdomains (but only reaches 6 subdomains).
- In almost all subdomains there are agencies with level 1, except for the subdomain “Multichannel Service/Open Government”, where in segment I there are no agencies with this level of development, and being the subdomain with fewer agencies at that level, and the subdomain “Security, Protection, Identity and Electronic Signature”, where in segment II there are no agencies with this level of development.
- Within the Open Government domain there is a very dispersed behavior of its subdomains. On the one hand, two of the subdomains are evaluated as the worst-developed in all segments, in particular, the subdomain “Co-Design”, which is the worst subdomain in all segments.



**Fig. 3.** Percentage of agencies with level 1 of development in some subdomain

- The other badly evaluated subdomain is “Open Data”, which contrasts with the subdomain “Citizen Online Participation”, which is among the well-evaluated subdomains in each segment.

In relation to Fig. 3, agencies with lower ICT budget are in a lower degree of development (level 1) in the subdomains of “Strategic Alignment”, “Human Capital and Change Management”, “Process Management”, “Public Software and Cloud Computing”, “Open Data” and “Co-Design”, where government probably have to work on introducing these topics at a more basic level.

The results of this study show a direct relationship between the level of investment in ICT and institutional maturity, since agencies with higher levels of investment in ICT (by segment) have a higher average level of maturity.

Another aspect that reinforces the above is that the maturity average of the most developed subdomain belongs to segment I, with an average of 2.8 (Multi-channel Service/Close Government), and the less developed subdomain belongs to segments III and IV, being the lowest average of 1.5 for the “Co-Design” subdomain.

### 4.3 Analysis by Segment

Table 2 shows the distribution by segment for each level of the 121 agencies that were self-evaluated in this study. For example, for the first bar showing the Tier 1 distribution, it is indicated that one agency belongs to segment II, 4 agencies are from segment III and 2 agencies from segment IV. It is observed that if 57% of the 7 agencies that are in level 1 belong to segment III, with a low percentage of the ICT budget in relation to the total budget, this could be a factor that would affect the level of maturity in digital government.

In general, from the data collected it can be seen as described in Table 2.

The results of the study reveal that in those agencies where the level of investments in ICT is high, their level of maturity is also high. Therefore, it is highly recommended



**Table 2.** Interpretation by segment/levels

Level 1	<ul style="list-style-type: none"> <li>• There are 7 agencies with this level of maturity and correspond to 6% of the total</li> <li>• At this level there are no agencies (0) belonging to segment I</li> <li>• At this level, 57% are segment III</li> </ul>
Level 2	<ul style="list-style-type: none"> <li>• At this level of maturity are the most agencies (98) account for 81% of the total</li> <li>• They are distributed evenly between segments II, III, and IV, with 28.6%, 29.6% and 24.5%, respectively</li> </ul>
Level 3	<ul style="list-style-type: none"> <li>• At this level of maturity, there are 16 agencies and correspond to 13% of the total</li> <li>• 75.1% is concentrated between segments I and II, with 43.8% and 31.3%, respectively</li> </ul>
Level 4	<ul style="list-style-type: none"> <li>• There are no agencies with this level of maturity</li> </ul>

to suggest that in the budget discussion incorporate the concepts of digital government as an element that increases and contributes to the efficiency of public agencies and increases the public value of benefits to citizens.

As a result we recommend:

- To increase the efficiency of public investment in ICT.
- Implement measures to rationalize the ICT infrastructure through the sharing of resources between administrations that allow to reduce costs and im-pulsate strategies of collaboration between the different agencies.
- Align efforts of the administrations of all services, homogenizing objectives and coordinating measures to optimize the use of resources.
- Maximizing efficiency in the management and allocation of training and training funds for continuing training in ICT for public servants.

## 5 Conclusions

In this section we propose recommendations aimed at increasing the level of maturity of public agencies of the State. The recommendations were elaborated based on the results obtained from the application of the maturity model, the objectives and strategic axes of Digital Government.

The recommendations are organized according to the degree to which public agencies improve their General Capacities, develop Digital Government Enablers, increase Citizen-centered Services and extend the scope of Open Government in public agencies.

We recommend to create an institutional framework that takes charge of incorporating the aspects of the new technologies both at the level of the organization of the State to increase the level of efficiency and at the level of the citizens so that they participate in the discussions related to the changes in the life of the citizen. We recommend to create a Specialized Agency on Digital Government issues, to ensure the good use of State resources, to support the implementation of the digital strategy at the

level of all public agencies, to advise on the design of technological projects of high impact and propose models of digital government governance.

This Agency should encourage the undertaking of open data initiatives and should monitor closely to encourage their use, as well as to improve internal processes. The Agency can also foster an environment of exchange and collaboration between public agencies, citizens, civil society organizations and other stakeholders.

An Agency can help build a key integrated infrastructure, deploy an unified knowledge base, establish common standards, and invest in training to facilitate multi-channel delivery of public services. This, in order to establish common service standards that help guide consistency in service and interoperability needs. Taking into account the concern about data security and privacy of users in cloud systems, it can take advantage of the dissemination, communicate the advantages of availability and the reduction of costs offered by integrated cloud technology.

Finally, another proposal for improvement at the institutional level is the creation of a portfolio of public projects that, to the extent that more agencies are supporting the execution of a project, is a sufficient reason to obtain resources and execute it, for the benefit of all agencies that supported it.

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