The Importance of ICT in Local Governments: Results from a Survey on the Characterization of the ICT Function in Portugal

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Abstract. This work presents the results of a project developed to characterize the role of ICTs in Portuguese municipalities, providing a picture of the efforts and successes reached using ICTs to improve their internal functioning and their interaction with the residents. Results here presented refer to some of the technical aspects surveyed among all 308 Portuguese municipalities. The findings encompass a comprehensive description of the ICT function in terms of seven dimensions, covering the characterization of the municipality, financial resources allocated to the ICT function, ICT infrastructure, organization and governance of the ICT function, digital applications and services, and regulations and guidelines. Globally, data show how vital the ICT function is for the Portuguese cities, but also reveal how much it can improve, with many aspects to enhance and promote.

Keywords: e-Government · Portugal · Municipalities · ICT characterization

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1 Introduction and Background

The digital government trend has gained ground in the last two decades. Worldwide efforts put in place strategies and measures under this umbrella with many purposes, namely to reduce the administrative burden, ease the relationship with stakeholders, encourage e-participation and foster transparency in information sharing, to name a few. These are vehicles to improve trust in government and public institutions and increase confidence in their policies and actions [20].

Tolbert and Mossberger [17] sustain a positive link between e-government and political trust, showing that readily accessible information available on government websites facilitates citizen access, promotes greater transparency of local government and empowers citizens to monitor government performance more closely. Pina, Torres and Royo [9] suggest that frequent and timely disclosure of information online increases the transparency of local government and empowers citizens to monitor government performance more closely. Others highlight the role of Information and Communication Technologies (ICTs) in helping governments restore confidence in public institutions, create greater involvement, and foster greater interaction and political participation [3,6,20]. Although there is extant literature addressing the positive effects of transparency and data availability by governments, the same enthusiam is not found in these reflections around local e-government.

The local level is of utmost importance. It entails basic service delivery with direct impact in citizens' everyday life, not only providing information and services that are essential for different stages of a person's lifetime cycle, but also in terms of problem's resolution. In a nutshell, it is the most direct interface of citizens with government. Its importance is grounded on the local government's closeness to citizens and on a related sense of belonging [15,16].

ICTs are core for the digital government advances. They have been playing a pivotal role in organizations as a determining factor in the development and transformation of the economy and societies, while contributing to the achievement of the Sustainable Development Goals proposed by the UN [18]. As they can provide deep integration, interoperability, and effective information sharing, many countries worldwide have been resorting to them [12]. The public sector in general and municipalities in particular, are no exceptions to this phenomenon. Indeed, citizens' increasing expectations of public services have required constant administrative modernization to streamline processes, reduce costs, provide information and services in a friendlier and more agile way [5,10]. Aware of this reality, and although at different rates and following different strategies, local governments have been using ICT to improve their performance, both regarding internal processes and in their relationship and interaction with citizens and stakeholders [7,19].

The work presented in this paper draws on the data collected and analysed within the umbrella of a series of biennial studies about the internet presence of Portuguese municipalities, published since 1999. These studies and the most recent data are available online and show how information technologies in general, and web technologies in particular, are used by local governments to inform

citizens and make publicly available information regarding the municipality and its management, to facilitate navigation and interaction with the website, to make available online services as well as to foster e-participation and launch initiatives that can engage citizens in decision-making processes and municipal public policymaking [14]. In this case, understanding the ICT function in local governments is crucial for the overall study aiming at knowing and understanding their web presence maturity. Indeed, ICT adoption and usage to promote digital government is a good indicator of a closer and more citizen-aware government [11].

Web presence is, however, one facet of the use of ICTs by local governments. Indeed, ICTs have a much broader existence and application comprising a set of systems, applications, infrastructures, and resources that support all municipality operations. Understanding the size and organization of these infrastructures, systems, applications and resources is therefore considered a crucial aspect when looking for a holistic picture of the state of development of e-government at the local level [2,4].

This work presents the results of a research to characterize the role of ICTs in Portuguese local governments, providing a complete and integrated picture of the efforts and achievements deployed regarding the use of ICTs to improve their internal functioning and their interaction with citizens and stakeholders. Results here presented refer to some of the technical aspects surveyed, trying to answer to the question: *"Which technical aspects are limiting the ICT function at the local government level?"*. The main objective is to understand how the technical components of the ICT function are described and considered by municipalities within the realm of local e-government objectives.

This paper is organized as follows: the survey methodology is described in Sect. 2; quantitative results and comparisons are presented in Sect. 3; conclusion remarks and initial recommendations are summarized in Sect. 4.

2 Methodology

Data was gathered through a survey addressed to all 308 municipalities in Portugal. The questionnaire was developed based on literature review and similar instruments (questionnaires and other, as scientific and technical guidelines) to help in the identification of the dimensions and the specific questions to cover. It was sent to the Mayor', Mayors' offices or to the general e-mail addresses found in the respective websites. It included 93 questions, most of them closed and mandatory, organized in nine main dimensions: characterization of the municipality, characterization of the respondent, characterization of the responsible for the ICT function, human resources allocated to the ICT function, financial resources allocated to the ICT function, ICT infrastructure, organization and governance of the ICT function, digital applications and services, and regulations and guidelines.

This paper presents the results of 63 questions and excludes the characterization of human resources, which have been analyzed in a separated work.

Thus, it covers the following aspects: characterization of the municipality, financial resources allocated to the ICT function, ICT infrastructure, organization and governance of the ICT function, digital applications and services, and regulations and guidelines.

Regarding the first dimension - Characterization of the Municipality - as it is related to information publicly available on trusted repositories, the answers were previously filled, so the respondents should only indicate if they agreed with the presented values and, if not, inform the correct data.

The questionnaire was made available to municipalities through the *LimeSurvey* platform for five months. The data collected were exported and submitted to a careful "cleaning" process, aiming to detect information that could indicate invalid answers, and for that reason, should be excluded from the analysis. Two such cases were identified and after some phone contacts with the respective municipalities to clarify the doubts, they were excluded. Thus, from the 141 submitted questionnaires, 139 were considered valid and used for the final analysis.

There are a few questions for which the number of valid answers is lower than 139. It happens for one of two reasons: (i) some municipalities did not provide an answer to that specific question, or (ii) the provided answer presented an incoherent and dissonant value with the question and the answers provided to some of the remaining questions; as such, it was considered that it resulted from an inaccurate interpretation from the respondent of what was asked. In these cases, only the specific answer was removed, and not the full municipality reply.

During the analysis, some data were aggregated, to better visualize the obtained results.

3 Findings

The findings reported in this paper include a brief characterization of respondent municipalities, the results related to financial resources, ICT infrasctructure, organization and governance of the ICT function, digital applications and services, and regulations and guidelines. As previously indicated, the results of the dimension on human resources shall be published separately.

3.1 Characterization of the Municipality

Of the total 308 municipalities targeted, which represent all municipalities in the country, 139 (45%) successfully submitted questionnaire. Table 1 presents the data analysis of the municipalities by populational dimension (large, medium, small)[1]. Among these respondents, more than half (53%) are of small dimension, with 20.000 inhabitants or less. However, this number represents only 40% of

[1] For the purpose of this study, a small municipality is the one with a population inferior or equal to 20.000 people. In contrast, a medium municipality is the one with a population superior to 20.000 people and inferior or equal to 100.000 people, and a large municipality is the one with a population superior to 100.000 people.

the total number of small municipalities in the country, while 71% of the large municipalities replayed to the questionnaire.

Table 1. Dimension of municipalities (n = 139).

Dimension category	# of Municipalities in the country	Answers		
		# of answers	% of answers	% in the category
Large municipality	24	17	12%	71%
Medium municipality	98	48	35%	49%
Small municipality	186	74	53%	40%

Most of the Portuguese municipalities (138 out of 308) are located in the interior of the country, while 41% are in the coastline and the remaining in the islands. Accordingly, most of the answers came from municipalities placed in the interior of the country (52%), while those in the islands registered the lowest response rate (9 municipalities out of 30).

According to another territorial classification[2], 55% of the municipalities located in the North region of the country replied to the questionnaire, while in other regions (namely Alentejo, Center and Lisbon), approximately 50% of the municipalities in each region submitted valid answers.

3.2 Financial Resources Allocated to the ICT Function

The analysis of the financial resources allocated to the ICT function focused on the amount of the budget set aside for the ICT function, presented as a percentage of the global budget of the 135 municipalities that provided this information, as well as an analysis of the segmentation of the overall ICT budget by specific headings.

As Fig. 1 shows, in 65% of the municipalities, the budget allocated to the ICT function is less than 2% of the municipality global budget, and in 21% of the cases, it is less than 1%. Only in 9% of the cases, the budget exceeds 5% of the municipality global budget. It is worth noting that in one municipality, located in the continental coastline of the region Center, and of small size, the budget allocated was reported as being 11.9% of the municipality global budget.

Also, it was possible to notice the distribution of the ICT budget by headings, considering the 129 municipalities that provided that information. On average, the percentage of the budget allocated to "acquisition of goods (equipment and software)" is 24%, followed by expenses with human resources (17%). "Employee training" is the heading with the least weight in the allocated budget (2%).

[2] NUTS - Nomenclature of Territorial Units for Statistics, established by Regulation (EC) N° 1059/2003 of the European Parliament and of the Council of 26 May 2003.

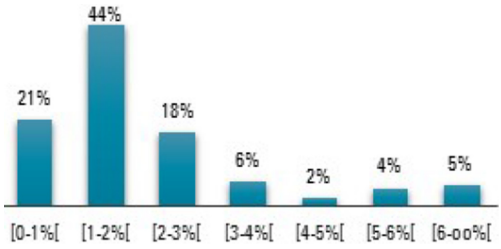

Fig. 1. Percentage of global budget allocated to the ICT function (n = 135).

3.3 ICT Infrastructure

This section aims to characterize the ICT infrastructure available and the tools used by the surveyed Portuguese municipalities.

The most frequent types of equipments available in the municipalities are desktop computers (85% on average) and the least frequent are tablets (2% on average). Two municipalities reported having just desktops (100% of the available equipment), while two others stated not having notebooks, and 48 not having tablets. Regarding the network structure, all 139 municipalities reported having wired internet connections, although 23 of them do not have wireless connections.

Microsoft Windows is the predominant operating system, running on more than 75% of the computers of 136 municipalities (95%). Apple macOS has a residual usage in 59 cities (43%). Regarding open-source operating systems, Linux has a residual usage in 57% of the municipalities, while Unix is residually used by 37% of the cities. Eight municipalities reported also using other operating systems, like Android, iOS, BSD, DOS, and Synology DSM 6.3.

As to the most used programming languages to perform development, maintenance, and operational activities, SQL and PHP represent more than 50% of the programming effort in 22% and 12% of the municipalities, respectively. Considering that these programming languages can be used to manage databases and develop websites, this data may indicate the concern of those cities to develop and provide online services to the citizens.

Server virtualization technologies are very used by the Portuguese municipalities, as 106 (76%) of them make intensive use of it, and 23 (17%) make reasonable use. Only 2% of the cities reported not using this technology. A different situation can be seen in the use of cloud computing, which is used by only 45 municipalities (32%), with 20 of them recurring to private external solutions, while only 12 store their files in an internal cloud server. Regarding the most used services on the cloud[3], Fig. 2 shows that Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) are the main ones.

[3] IaaS: Infrastructure as a Service; PaaS: Platform as a Service; DaaS: Desktop as a Service; SaaS: Software as a Service; CaaS: Communication as a Service; XaaS: Everything as a Service; DBaaS: Data Base as a Service; SECasS: Security as a Service; FaaS: Function as a Service; MBaaS: Mobile "Backend" as a Service.

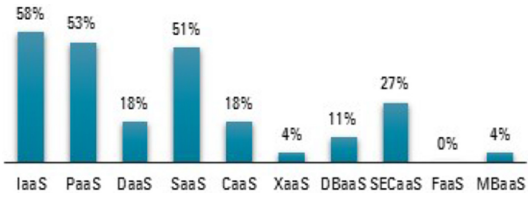

Fig. 2. Services used on the cloud (n = 45).

3.4 Organization and Governance of the ICT Function

Concerning the decision to perform some of the main ICT functions in-house or to outsource them, it was presented a list with 15 different functions and asked where they were performed. 40% of the municipalities indicated to fully perform them in-house, while in 13% of the cases, more than 50% of the ICT function was outsourced. Systems development is the most outsourced activity, followed by auditing, compliance, and risk management. On the other hand, outsourcing management, IT operations, service management, and planning are the activities most cities (on average, 59%) perform entirely in-house.

Regarding the adoption of ICT frameworks and methodologies, 113 municipalities (81%) reported not applying any of the 13 presented[4], nor any other than those. The alleged reason, in 69% of the cases, was the lack of knowledge of their existence. However, of the municipalities that do adopt some framework and methodology, Fig. 3 shows that 22 use ITIL, five use Agile Scrum, and four use COBIT5. A similar result was observed regarding the adoption of standards. Most municipalities (60%) reported not applying any of the six presented[5]. In 41% of the cases, it was because they were unaware of the existence of those standards. ISO 9001:2000 is the most adopted standard, used by 39 cities. The other five cities reported to use ISO 9001:2015, and one to use ISO 9001:2008. Figure 4 summarizes the results.

3.5 Digital Applications and Services

This section aims to describe a set of elements that allow characterizing how ICT is being used to offer public services by the municipalities. Providing online services to citizens is one of the significant goals that municipalities have been pursuing, with more encouraging results in some cases and less in others.

From the data gathered, it can be concluded that, on average, the percentage of services that the municipalities provide exclusively online[6] is about 12% of their total services. Further analysis of the answers also show that 99 of the 136

[4] COBIT5, Six Sigma, CBPP, Prince2, CMMI, CISM, TOGAF, Edison, SNABOK, Agile Scrum, HFI, ISTQB, and ITIL.

[5] ISO 20000, ISO 27000, ISO 27001, ISO 9001:2000, ISO 10303, ISO 37120:2017.

[6] For this study, a service is provided exclusively online if there is no equivalent service offered in person.

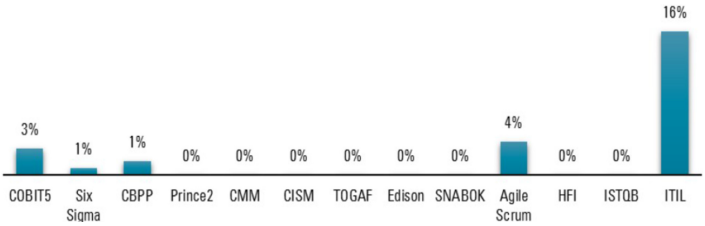

Fig. 3. Percentage of municipalities that adopt ICT frameworks and methodologies (n = 139).

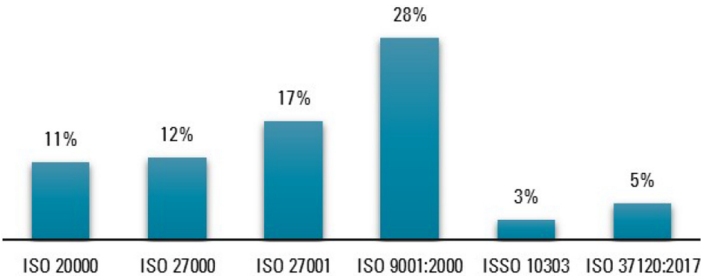

Fig. 4. Percentage of municipalities that adopt ICT standards (n = 139).

municipalities that validly answered this question (73%) provide less than 10% of their total services exclusively online, with a very substantial part of them (72) not providing any services this way. Only 11 municipalities (8%) indicated doing so in more than 50% of their services.

Regarding the availability of services simultaneously online and in person, the data showed that, on average, the percentage of services offered simultaneously by these two channels is 37% of the total services of the municipalities. Moreover, in this case, there are still municipalities (16%) that claim not to have any services offered to citizens simultaneously in both directions, as shown in Fig. 5.

Among municipalities providing services to citizens simultaneously online and in person, the data collected showed that, on average, 34% of them are fully available online[7], and the others only partially available, *i.e.*, require some form of presential interaction and eventual use of paper.

The previous data may have some influence on the percentage of online requests of services made by citizens. The analysis of the 121 municipalities that stated to have online services available shows that, on average, only 11% of all requests received throughout 2018 were made online, and 13 municipalities had less than 1% of requests made online.

As regards to the mechanisms available to citizens who wish to make online requests of services, 51% of the municipalities declared to request a previous

[7] For the purpose of this study, a service is fully available online when it does not require any face-to-face interaction and without the use of paper.

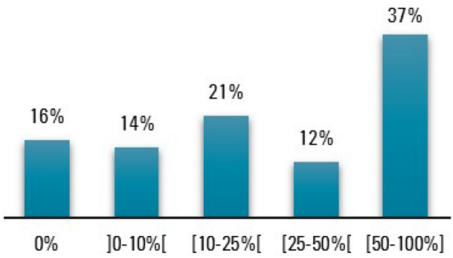

Fig. 5. Percentage of municipalities with simultaneous online and in person services (n = 139).

registration, based on personal data provided by the citizens. The authentication using "Digital Mobile Key" (Chave Móvel Digital - CMD)[8] is not accepted by most municipalities, with 126 (90%) alleging not to accept this method without previous registration, and 130 (93%) declaring not to accept it even combined with the provision of additional data by the citizens.

Concerning the forms of payment available for services requested online, the most used is face-to-face payment, accessible in 121 municipalities, followed by the ATM system[9], used by 56% of the municipalities, and other online payment services, like credit card and PayPal, used by only 11 municipalities.

A little more than half of the municipalities keep their websites mobile-friendly (57%) and send SMS messages to residents (55%). None use applications like WhatsApp or Telegram to communicate with citizens. And regarding access channels available to citizens to interact with the municipalities, data shows that, on average, 60% of the calls are made by personal assistance. The telephone is the chosen channel, on average, in 12% of the cases, while traditional mail (letters) are sent in 8% of times, on average. Electronic access channels, like web portals and social networks, are used only in 6% of the calls.

The low use of social networks as an access channel for citizens to interact with the municipalities is surprising, given the high attention all Portuguese cities give to these platforms, with more than 85% of them having a Facebook account and more than 50% having a YouTube account, as observed by [13].

Another intriguing remark from data analysis is related to the acceptance of qualified electronic signatures by the municipalities, as 65% of them alleged to accept documents with qualified electronic signatures in all circumstances in which the citizen wishes to do so, and the law permits. However, four municipalities reported not accepting documents with qualified electronic signatures in any circumstance.

[8] The Digital Mobile Key (CMD) is an alternative method of authentication of citizens in Portuguese Public Administration Internet portals and sites using the mobile phone, where, after a previous registration, the citizen can authenticate using the telephone number, a personal PIN, and a security code received via SMS.

[9] Portugal's Multibanco System is a fully integrated interbank network that offers a wide range of services, including online payment.

3.6 Regulations and Guidelines

This section aims to characterize how the Portuguese municipalities (i) observe and act under a set of laws, regulations, standards and good practices that have been published in the country, and (ii) adopt a set of tools that have been developed in Portugal in the field of e-governance.

Concerning the adoption of good practices proposed in the usability guide developed by the Portuguese Agency for Administrative Modernization (AMA)[10], only 9% of the municipalities reported fully adopting the practices set out in the guide, while most cities (41%) alleged to adopt it partially. The lack of adoption of good practices by 27% of the cities is because they are unaware of its existence. A similar situation occurs with the adoption of accessibility recommendations issued by law[11]. Most cities (64%) reported to partially adopt it, while 13% not adopting it for being unaware of its existence.

The adoption of standards presented in the procedure manual about the application of the "once only" principle aims to ensure the procedural right of citizens to ask to be released from delivering information already held by the Public Administration bodies. Regarding that, only 2% of the cities alleged to fully apply this principle according to the manual, while 44% of the municipalities stated not adopting it for being unaware of its existence.

Regarding open data publication, only 31 cities (22%) stated to publishing datasets in the Portuguese Public Administration's open data portal (*dados.gov.pt*).

About the application of the EU General Data Protection Regulation, 47% of the municipalities reported being in an early stage and without a designated Data Protection Officer (DPO). All other cities alleged to have a designated DPO, although they are still on different implementation levels of the regulation.

4 Discussion and Conclusions

Globally, the results from the survey show how vital the ICT function is for the Portuguese municipalities, but also reveal how much it can improve, with many aspects to enhance and promote.

Adequate level of financial resources for training IT officers allows a higher level of knowledge and skills in technical activities, *e.g.*, system development and maintenance [8]. However, the budget allocation in the Portuguese cities is still low, with 65% of them applying, on average, less than 2% of the total budget for ICT-related activities, and only 2% of that amount is allocated for staff training.

The data presented in this paper shows that of the available ICT budget, $\frac{1}{4}$ of the total is focused on acquiring goods (equipment and software). However, without adequate training, these goods may not be used in their full potential. It

[10] Within the objectives of the *usabilidade.gov.pt* initiative.

[11] Stated in Decree-Law n° 83/2018 of October 19, that implemented Directive (EU) 2016/2102, on the accessibility of the websites and mobile applications of public sector bodies.

would be interesting to follow up the level of allocated financial resources and its distribution within the surveyed headings, to see if an increase in the investment in this sector by the Portuguese municipalities, reflecting the importance of these functions to better provide digital services to the citizens.

A better trained ICT personnel may impact the municipality's online presence and digital performance, as well as facilitate the adoption of ICT frameworks and methodologies, which represents a considerable gap identified in the survey. It may also contribute to the availability of new digital services offering.

Mobile communications in Portugal are in constant growth in the last years, where the number of mobile lines effectively used in 2019 reached 120 per 100 inhabitants, and about 76% of the population use mobile Internet [1]. However, the adoption by the municipalities of services through mobile devices is shallow, as described in Sect. 3.5. There is here an excellent opportunity to develop new ways for the municipalities to interact with citizens.

An increased availability of online services may represent a reduction of operational costs, administrative burden, and bureaucracy, eliminating the need of personal interactions and paper-based procedures. As the Portuguese national government incentivizes the use of the Digital Mobile Kye (CMD) for personal authentication on various online services, both public and private, and for signing digital documents, it should be adopted by a growing number of municipalities, in order to ease the interaction of its citizens with the services they offer.

In the last years, Portugal has developed a regulatory framework to assist the adoption of user-friendly tools by the municipalities, but as identified in this work, most cities still are not aware of them. Further efforts must be made, not only to disclose these regulations but also to encourage their adoption.

The municipalities can use this work as an opportunity for improvement and as an evidence-based tool for internal decision-making. It allows performance assessment and peer comparison. This comparison, in conjunction with their general strategic priorities, can lead the way in informing the process of defining a digital transformation policy.

For national policymakers and governance structures, this work contributes for a clear perspective on the *status quo* of local ICT use and to think of national strategies and recommendations for e-Government globally, and targeted to the needs and interests of entities at all levels of government, so that conditions are created for the gradual and convergent development of digital governance in the country.

Also, this work is equally important both for academics and researchers in the field of digital governance, for showing how ICTs can be used to transform country governance mechanisms, as well as for ICT companies and service providers, particularly those with management as one of the main sectors of activity.

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