

Assessing e-Governance Maturity through Municipal Websites – Measurement Framework and Survey Results

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Abstract. The paper presents a measurement framework for assessing the e-Governance maturity level of countries through the analysis of municipal websites. The paper also introduces the results of a survey carried out to apply and validate the framework. Applied to municipal websites of different countries, the framework considers websites content and design. For each country, the sample included three websites of local governments belonging to regions with low, medium and high population, respectively. The country measure was calculated based on the average obtained by the municipal websites adjusted by a correction factor based on the compliance of general features. The numerical values obtained by countries allow comparing their degree of e-Governance maturity and ranking them accordingly. The contribution of this paper is to present a novel approach for assessing e-Governance maturity of countries based on analyzing how electronic public services are delivered through municipal websites to citizens living in different populated areas.

Keywords: e-Governance, Accessibility, Friendship, Navigability, Usability

1 Introduction

One way to define Electronic Governance (e-Governance) is through its objectives. e-Governance objectives according to the Argentinean government agency ONTI [8] (National Office of Information Technology) are the following: "to provide better services to citizens, to improve efficiency and effectiveness in public administration, to reduce costs, and to increase transparency and participation for a more integrated and developed society". In practical terms, it means providing accessible and useful electronic public services, and moreover, empowering citizens through participation.

The difference between e-Government and e-Governance is that the former concentrates on the electronic delivery of public services, while the latter also considers active citizen participation in government decision-making processes. In order to promote citizen participation, governments need to facilitate access to information and enable knowledge acquisition by citizens. In turn, these initiatives contribute to increase transparency and at the end to deliver better governance.

In order to promote citizen participation, governments deliver various types of services through their websites, like e-mails to contact government officials, surveys assessing citizen opinion about service delivery, forums for citizens to raise opinions on different issues, like policies, environment, etc. However, delivering such services through government websites is not enough. In addition, services and information should be accessible easily, intuitively and fast.

Based on the above premises, the measurement framework presented in this paper was defined. The framework includes metrics for assessing websites design and content considering the following features:

- 1) *Information* – websites should include informative text enabling users to acquire knowledge about the institution or the services provided by it.
- 2) *Functionality* – services offered through the website, such as tax payment, state of debts, consulting administrative procedures, etc.
- 3) *Truthfulness* – quality of information published on the website. Government websites should provide real, relevant and up to date information.
- 4) *Citizen Participation* – offered services which increase the degree of interaction between government and citizens. Assessing two-way interaction services motivates government to advance from the informational stage, where government simply publishes information online (one-way interaction) and citizens passively consumes such information.
- 5) *Friendship* – assesses the user-friendliness of websites. Government websites should be friendly to anybody who visits them, regardless the user literacy or expertise. The language used by government websites should be simple [4].
- 6) *Usability* – measures user efforts for interacting, learning how to navigate, or accessing content and services offered through the website [7].
- 7) *Accessibility* – measures the degree in which a website can be accessed by people, despite the limitations of individuals or usage context.
- 8) *Navigability* – assesses user efforts for browsing the website pages.

It can be noticed that all metrics associated with web design, can be used to evaluate any website, not necessarily government websites. However, those metrics measuring which and how services are provided are key for assessing the maturity of e-Governance. In addition, since most public services are delivered by local governments, the research team decided to assess municipal websites.

The rest of this paper is structured as follows. Section 2 explains the metrics used by the framework. Section 3 introduces how the framework results can be used for ranking countries. Section 4 outlines the methodology used for conducting the survey, while Section 5 presents the results. Finally, Section 6 draws some conclusions.

2 Origin of Metrics

The framework includes three types of metrics: i) those published by international organizations or national governments, ii) those defined by researchers and practitioners, extracted from the literature, and iii) those proposed by the authors who participated in the research team. The origin of metrics is explained below.

- 1) *Standards* – some metrics were extracted from the standards adopted by the World Wide Web Consortium (W3C) [16], while others were derived from recommendations published by ONTI [8] in Argentina. The latter includes metrics related to website content and design [16], [19].
- 2) *Academic and Government Publications* – after reviewing the existing literature, metrics for assessing municipal websites were extracted from publications from: Spain [5], United States [11], New Zealand [6], Chile [2] and Australia [1].
- 3) *Proposed by the Research Team* – new metrics related to web design and web development, particularly targeted to measure features of municipal websites were proposed by the research team.

Figure 1 shows the composition of metrics according to their origins.

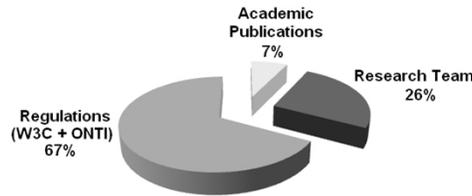


Fig 1. Origin of Framework Metrics

3 Measurement Framework

The framework includes 152 metrics grouped according to the eight features presented in the Introduction: 1) Information, 2) Functionality, 3) Truthfulness, 4) Participation, 5) Friendship, 6) Usability, 7) Accessibility and 8) Navigability. Each metric can be considered by more than one feature. For example, the metric "The main menu is maintained in the rest of the pages" is considered by Friendship, Usability and Navigability, since it affects all of them. However, the same metric may influence each feature in a different degree. Therefore, a weight value was defined for measuring how the metric affects the feature. The possible values are: high (5 points), medium (3 points) and low (1 point). Intermediate values are also used in order to achieve greater accuracy. It is possible that a metric does not influence a feature at all. In such case, no weight value is assigned.

The complete list of metrics defined by the framework along with the weight values assigned for each feature is available in [19].

The procedure for applying the framework is explained as follows. First, an initial value is calculated for each website by adding the weights of all features of the satisfied metrics. For example, suppose a website only satisfies the four metrics shown in Table 1 – i) the website does not contain private advertisement, ii) the website does not use frames, iii) all features are available without leaving the site, and iv) the website provides information about possible transports that can be used to reach the municipality. The columns of Table 1 correspond to the eight features considered by the framework: Friendliness (FR), Navigability (NA), Usability (US), Accessibility (AC), Information (IN), Truthfulness (TR), Functionality (FU), and Participation (PA). The included values are the weight defined by the framework for the feature/metric. Therefore, adding all the weights of individual metrics, results in 24 (5 + 5 + 10 + 4 = 24). The initial value for this website is defined as 24.

Table 1. Example for calculating the score for a municipal website

	FR	NA	US	AC	IN	TR	FU	PA	Total
It has no private advertisements						5			5
Do not use frames				5					5
All features are available without leaving the site	3	4		3					10
Transport information to reach the municipality					4				4
Total by Feature	3	4		8	4	5			24
TOTAL SCORE									24

The Framework also enables to calculate the total amount of points by columns (see Table 1) showing the total score obtained by the website for each feature.

To facilitate the calculation of scores by country, a software tool was developed that allows recording the compliance of metrics for each site. The tool automatically adds the weights for each feature/metric producing the final score for the website.

Figure 2 shows the procedure for calculating the final value for a country.

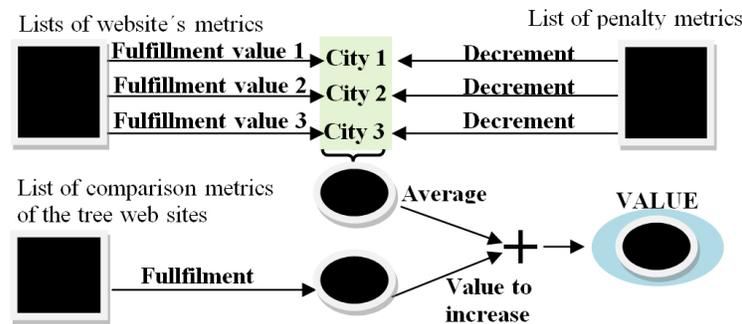


Fig. 2. Procedure for determining the country value

First, three municipal websites are assessed and their score is calculated, as explained above, obtaining the *Fulfillment values 1, 2 and 3*. All fulfilled metrics contribute with a positive value, while unfulfilled metrics give no value. However, the framework defines that unfulfilling a set of metrics (*List of penalty metrics*) at the

same time causes a penalty, since in such case the quality of the site dramatically decreases. The penalty is expressed by a *Decrement value*. After calculating the score for each of the three websites and considering the decrement of the penalties, an average is calculated. At the end, a final value is calculated adding or subtracting points to the average, based on comparing the results of metrics of the three websites.

Following, we illustrate and explain some of the penalty metrics.

- 1) *Penalty Aim* - difficulty to reach site content
Penalty Metrics List: a) website has a sitemap; b) website offers search services
Justification - In case both functionalities are missing, the only way to find given information is by opening all pages linked from menus and links. This may discourage users for using the site.
Penalty Value: 5 points.
- 2) *Penalty Aim* - links without the proper signaling
Penalty Metrics List: a) links are underlined; b) links are highlighted when passing the mouse over them; c) links are highlighted with a hand icon when passing the mouse over them.
Justification – If links are not highlighted, users can not distinguish links from regular text.
Penalty Value: 5 points.
- 3) *Penalty Aim* - difficulty to find the website URL
Penalty Metrics List: a) website has a URL related to the organization, and b) website is referred by main search engines, like Google, Yahoo and Alta Vista.
Justification – users may have difficulties in remembering URLs which are not related to organizations and if they are not referred by main search engines.
Penalty Value: 5 points.
- 4) *Penalty Aim* – difficulty to identify the organization through the page banner
Penalty Metrics List: a) banner of the main page includes the organization name, and b) banner of the main page includes the organization logo
Justification – banner is the first thing a user sees when opening a page. A banner not related to the institution can mislead users.
Penalty Value: 3 points.
- 5) *Penalty Aim* - difficulty to return to the website home page
Penalty Metrics List: a) website provides a visible link to the home page; b) browser back button is enabled
Justification – not having a visible option to return back can confuse users, who may have difficulties for navigating through the site.
Penalty Value: 5 points.
- 6) *Penalty Aim* – inconsistent design of website pages

Penalty Metrics List: a) all website pages place menus in the same position and menu options are consistent; and b) font types are used consistently through website pages

Justification - If pages of the same website follow different designs, user may be disappointed while navigating the site or may experience difficulties to learn how to navigate through it.

Penalty Value: 3 points.

- 7) *Penalty Aim* – the website does not facilitate communications with users
Penalty Metrics List: a) website provides the municipality address; b) website provides phone numbers; c) website provides e-mail address or contact form.
Justification – providing contact details facilitates communication with users
Penalty Value: 4 points.
- 8) *Penalty Aim* – facilitating two-way interactions with citizens
Penalty Metrics List: a) website offers a chat; b) website offers a forum; c) surveys are conducted through the website; and d) website manages complaints.
Justification – enabling chats in government websites enable to initiate dialogue with citizens; while forums and surveys enable citizens to express their opinions.
Penalty Value: 4 points.

Finally, the value obtained by calculating the score of the three municipal websites can be increased in case the three websites fulfill a set of pre-defined metric. Such metrics are called comparative metrics, and some of them are explained below.

- 9) *Comparative Aim* – municipal websites domains follow predictable naming
Justification – choosing domain names following a standard makes it easier for users to remember them.
Comparative Added Value: 3 points.
- 10) *Comparative Aim* – consistent country-wide municipal websites
Justification – if municipal websites follow national standard conventions for web design, users can easily apply the knowledge learnt while navigating one website to other government websites. In addition, a national, consistent look and feel is promoted.
Comparative Added Value: 5 points.

The following section explains the survey carried out for applying the framework.

4 Survey

4.1 Methodology

From the 152 metrics of the framework, there are a set of metrics that are measured manually by simple website inspection. For example: links highlighted when passing

the mouse over them, website has music, etc. In addition to manual assessment, there are various software tools that enable measuring some other metrics, such as W3C validators [14][15][16], Xenu software - offering a report of broken links, weight and image resolution, etc. These tools avoid manual inspection of websites for measuring for example, if the weight or resolution of website images exceeds the metric bound. Based on our experience, the results of using the mentioned tools have shown 100% reliability. Finally, other metrics were inspected analyzing the source code of the web pages, i.e. usage of tables for schematization, use of relative units, use of frames, etc.

Prior to analyzing the websites, detailed guidelines were specified for carrying out website inspection. In particular, a procedure was defined explaining how to inspect each of the 152 metrics, with emphasis on those metrics who might have different interpretation, so that the measurement process is independent of the evaluator point of view [1].

4.2 Selected Countries

After defining the measurement framework and the guidelines for its application, a list of websites was selected. The methodology for selecting websites follows.

- a country is randomly chosen
- information of the capital city of the selected country is seek determining the geographical region where is located
- the more recent official census of the country is analyzed to determine if the capital city is located in a high, low or medium density region.
- the capital city of a selected country is always part of the survey. To complete de survey two more geographical region are taken (eg. if capital city is located in a high population density region, lower and medium density regions of the country are chosen)
- the most important city of each of the two selected regions are selected.
- municipal websites of each of the three selected cities are inspected.

This methodology ensures equal selection criteria for all countries.

Table 2 shows selected cities for each country (capital city is remark in bold).

Table 2. Countries and cities of the survey

Country	Selected City	Country	Selected City
ARGENTINA	Ciudad Autónoma de Buenos Aires San Juan Ushuaia (Tierra del Fuego)	UNITED STATES	California Kentucky Columbia
AUSTRALIA	New South Wales Western Camberra	FRANCIA	París (Ile-de-Francie) Picardie (Amiens) Corse (Ajaccio)
BOLIVIA	La Paz Chuquisaca (Sucre) Veni (Santa Ana del Yacuma)	LUXEMBURG	Tirana Diekirich Vianden
CHILE	Santiago de Chile Rancagua (Cachapoal) Coyhaique	MEXICO	México DC San Luis Potosi Colima

COLOMBIA	Bogotá Agua Chica (Cesar) Cumaribo (Vichada)	NIGERIA	Kano Ondo Abuja
COSTA RICA	San Jose Heredia Guanacaste (Cañas)	PERU	Lima Callao Moquegua
ECUADOR	Quito Santa Elena Galapagos (Santa Cruz)	PUERTO RICO	San Juan Camuy Vieques
SPAIN	Madrid Albacete Teruel	VENENEZUELA	Caracas Alberto Adriani (Merida) Atabaco (Amazonas)

5. Survey Results

Applying the measurement framework enables to obtain a numeric value for each country. Such value indicates the country e-Governance maturity level, assessed through municipal websites. Based on the defined framework, the maximum score a country can obtain is 1183. Figure 3 shows the final scores obtained by the surveyed countries.

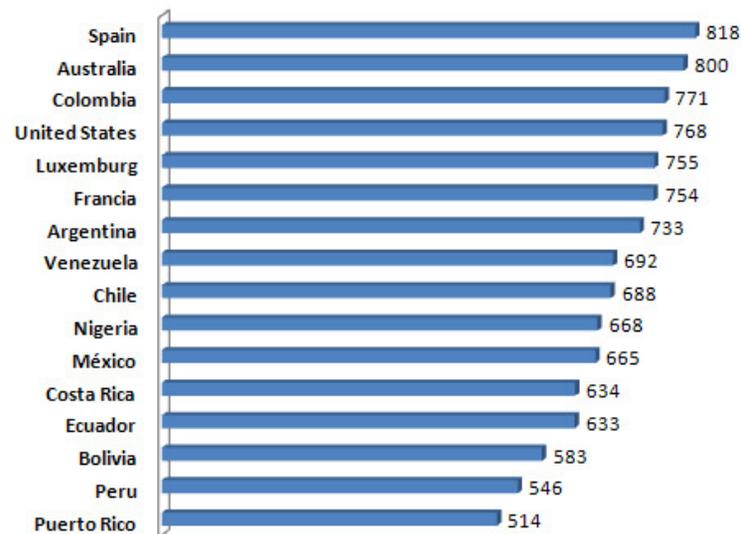


Fig. 3. e-Governance Ranking

While the best positioned countries shown in Figure 3 have obtained a score that represents almost 70% of the maximum value, the three countries within the lowest positions does not reach 50% of the maximum score.

Additionally, it is possible to calculate the percentage of fulfillment for each country (country score / maximum score * 100), and also to consider the percentage of fulfillment for those metrics assessing content and those assessing web design. As mentioned, the maximum score of e-Governance is 1183 (969 points belongs to design metrics while 206 belongs to content metrics). Table 3 shows the percentages obtained by the surveyed countries. The table lists countries in descendent order according to the overall e-Governance percentage. The highest percentage achieved in each category is shown shaded.

An interesting feature shown by the table is that the fulfillment of design metrics is greater than the fulfillment of content metrics, excepting México which percentages are almost equal - 56.55 and 56.80.

Table 3. Percentages reached by each country

Country	e-Governance	Design	Content	Country	e-Governance	Design	Content
Spain	69.15	73.37	51.94	Chile	58.16	59.75	52.91
Australia	67.62	71.21	54.37	Nigeria	56.47	60.78	37.86
Colombia	65.17	70.90	41.26	Mexico	56.21	56.55	56.80
United States	64.92	66.56	60.19	Costa Rica	53.59	57.79	35.92
Luxemburg	63.82	69.25	41.75	Ecuador	53.51	56.76	40.29
Francia	63.74	65.94	56.31	Bolivia	49.28	52.53	35.92
Argentina	61.96	65.12	49.51	Perú	46.15	48.19	39.32
Venezuela	58.50	63.78	36.41	Puerto Rico	43.45	47.27	26.21

Finally, the information shown in Table 3 is graphically depicted in Figure 4. The line at the top shows the fulfillment of e-Governance, the one at the bottom the fulfillment of content; while the one in the middle reflects the fulfillment of web design metrics. It is clearly depicted that the fulfillment of design metrics is greater than the fulfillment of content metrics, almost in all cases.

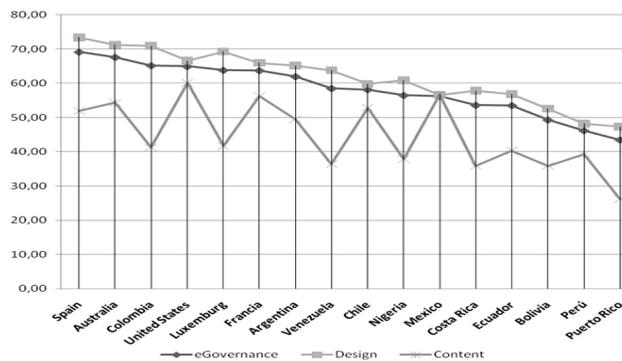


Fig 4. Percentages of e-Governance, Design and Content Fulfillment by Country

6 Conclusions and Future Work

The paper presented an extended version of a measurement framework for assessing country e-Governance maturity level based on analysis of municipal websites. The novel approach of the framework is considering a holistic approach for ranking countries based on how electronic public services are offered by local governments located in different populated areas. The values obtained by the municipal websites are adjusted with values representing more accurate the country-wide situation.

A survey comprising 16 countries was conducted to show the applicability of the framework. Survey results show that municipal websites better fulfill design metrics than content metrics. From the surveyed countries, only 6 reach at least 50% of the maximum score defined for content metrics. This highlights the weak implementation of contents provided in municipal websites.

Future research lines include extending the framework to define different levels of maturity, specifying guidelines for government websites. To achieve this aim, existing e-Governance models will be analyzed to determine their strength and weaknesses.

References

- [1] Department of the Premier and Cabinet, *Guidelines for State Government Websites*, Australia, 2007. Available at: http://www.egov.dpc.wa.gov.au/documents/WebGuidelinesVersion2.1_final.doc
- [2] e-Government Software AG Class, Alianza Sumaq. *Estudio sitio Web Municipales: eGovernment en Chile*, Chile, 2006. Available at: <http://www.cetiuc.cl/wp-content/uploads/2007/01/presentacion-estudio-municipalidades.pdf>
- [3] Krug S., *Don't Make Me Think: A Common Sense Approach to Web Usability*, New Riders, California, USA, 2000, pp. 21-29
- [4] Marcos Mora M., Rovira Fontanals C., *Evaluación de la usabilidad en sistemas de información web municipales: metodología de análisis y desarrollo*, Spain, 2005. Available at: http://www.semanticaweb.net/archives/2005_evaluacion-municipales-isko.pdf
- [5] New Zealand, *NZ Government Web Standards and Recommendations*, Nueva Zelanda, 2007. Available at: <http://www.e.govt.nz/standards/web-guidelines/web-standards-v1.0>
- [6] Nielsen J., Loranger H. *Prioritizing Web Usability*, New Riders, California, USA, 2006
- [7] ONTI, Contents, Available at: <http://www.sgp.gov.ar/contenidos/onti/onti.html>
- [8] ONTI, *Estándares para Sitios y Portales de Internet para la Administración Pública Nacional (ETAP)*, Argentina, 2005. Available at: http://www.sgp.gov.ar/contenidos/onti/productos/pnge/docs/etap_sitios_web_oficiales.pdf
- [9] ONTI, *Plan Nacional de Gobierno Electrónico: Decreto 378/2005*. Available at: http://www.sgp.gov.ar/contenidos/onti/productos/pnge/docs/pnge_decreto_378_2005.pdf
- [10] USA, *Requirements and Best Practices Checklist for Government Web Managers*, 2005, Available at: http://www.usa.gov/webcontent/reqs_bestpractices/checklist/long.pdf
- [11] Rodríguez R. *Countries list*, 2007, Argentina. Available at: http://www.investigamos.com.ar/ge/listado_paises.pdf
- [12] Rodríguez R., Vera P. Trigueros A. *Metrics List*, 2008, Argentina. Available at: http://www.investigamos.com.ar/ge/listado_metricas.pdf
- [13] UNESCO. *Overview on E-governance*. 2002. Available at: http://portal.unesco.org/ci/en/files/6532/10391876090Overview_on_e-governance_working_paper.doc/Overview%2Bon%2Be-governance%2Bworking%2Bpaper.doc
- [14] W3C, CSS. Available at: <http://jigsaw.w3.org/css-validator/>
- [15] W3C, Guiando la web hacia su máximo potencial. Available at: <http://www.w3c.es/>
- [16] W3C, HTML 4.01 Transitional. Available at: <http://validator.w3.org>
- [17] W3C, Links Checker. Available at: <http://validator.w3.org/checklink>