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A Multicriteria Evaluation of Local E-Government in Terms of Citizen Satisfaction

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Abstract

Any strategy to improve local public administration gives paramount importance to the development of electronic administration (E-Local Government) to facilitate interaction with citizens promoting efficiency, local participation, and sustainable development. This explains the numerous contributions to evaluating websites of local authorities, but they do not focus on modeling the citizen satisfaction induced by their use. This is why three research questions are addressed by this paper: how can such satisfaction be modeled, which attributes be considered and described and how to assess the relative importance assigned by citizens to each attribute?

The level of satisfaction is found to depend on the easiness of use of each site and of the available functionalities to share information, to provide services, and to promote participation. A model based on the Multiattribute Theory and using the OptionCards method is developed to estimate the relative importance assigned by each citizen to each attribute and it is successfully applied to a focus group.

The answers presented by the authors to these questions are applied to a sample of Portuguese websites allowing their benchmarking and the identification of a road map for im-provement. This instrument is applied to a set of Portuguese municipalities revealing a high level of disparity and confirming how important can be its application to assess inter-municipalities benchmarking, to diagnose their LGS major shortcomings and to support the design of a road map for improvement.

Keywords: E-Local Government, Citizen's satisfaction, Multi-Attribute Utility Theory, Attributes tree, OptionCards, Portuguese Municipalities, Benchmarking of websites

1. Introduction and Literature Review

The development of E-Government has been one of the most important lines of development of Digital Society and of Public Administration modernization as it has been shown by many authors emphasizing their key benefits not just in terms of accessibility by reduction of the number of trips and permanent availability as well as of efficiency by reducing transaction costs and waiting times (See, e.g, Piotrowski, 2009 & Wong et al, 2011) but also due to positive impacts on transparency, accountability and reputation of public authorities. (See, e.,g., López et al, 2018, Jun et al, 2014 , Spirakis, 2010, Kim & Lee, 2012).

Local E-Government is a key element of digital cities (see, Ergasakis, 2011) and it is particularly significant because local authorities are supposed to be the branch of public administration in closer interaction with citizens and because they cover quite a wide spectrum of services and competencies connected to all sectors of governmental activity. However, such a wider spectrum tends to be also quite challenging due to the broader diversity of services and the need for integration with many sectors of central administration (Pazalos, 2012, Bromberg & Manoharan, 2015).

Furthermore, since the approval of the famous Agenda 21 during the UN Conference on Environment and Development of 1992 (UN, 1992), local authorities should have an agenda pursuing sustainability and Local E-Government plays a key role to promote a wide range of initiatives, to reduce emissions and to avoid paperwork (Saha, 2009). The success of the contribution of Local-E-Government implies a favourable evaluation

not just of citizens but also of all stakeholders, namely public sector employees (Miranda, 2018).

This increased importance explains the long list of contributions evaluating Local E-Government websites in many countries (see, namely, Australia: Sterrenberg, 2017; Canada: Reddick, 2012; Europe: Perez-Morote et al, 2020; India: Kumar & Sareen, 2012; Japan: Wong et al, 2011; Jordan: Alomari et al, 2012; Macao (RPC): Lai & Pires, 2010; Malaysia: Wong et al, 2011; New Zealand: Asgarkhani, 2005; PRC: Jun et al, 2014; South Africa: Kaisara & Pather, 2011; South Korea: Kim & Lee, 2012; Spain: Cegarra-Navarro et al, 2012; Sri-Lanka: Deng et al, 2011; Turkey: Karkin & Janssen, 2014; UK: Carter et al, 2016; USA: Carbo & Williams, 2004; etc.) but they tend to focus either :

a) on the website features (see, e.g., Falco & Kleinhans, 2018) including a long list of features without any hierarchical structure (see, Sa et al, 2016)

or

b) on the organizational aspects of E-Local Government including models of quality of service (see Asgarkhani, 2005; Lee & Kim, 2014 & Muthu et al, 2016).

However, they do not focus on the satisfaction level of citizens using the websites of Local e-Government but the major mission of E-Local Government is fulfilling the citizen's needs and so this explains why the objective of the research presented in this paper is the development of a satisfaction model of citizens to evaluate Local E-Government websites (LGS).

2. The Three Research Questions

The need to develop an instrument to evaluate the websites of E-Local Government based on the citizens' satisfaction justifies the three main research questions addressed by this paper:

a) How can be modeled the citizens' satisfaction and which attributes of the websites should be considered?

b) How can such attributes be described and which scores can be adopted?

c) How can the relative importance assigned to the attributes of the website by the citizens be estimated?

The proposed answers to these three questions are presented in Sections 3, 4, 5 and 6.

Furthermore, an application of the proposed model to evaluate a sample LGS of Portuguese municipalities is presented confirming its utility to carry out benchmarking analyses and promoting road maps of improvement.

3. The Satisfaction Model

Citizen satisfaction due to the use of a website can be described in terms of the easiness of the website use and the benefit stemming from its use. These two perspectives should be modeled in terms of a set of attributes, j=1, …, N, and for each attribute, a descriptor and a score function should be specified.

Then, the problem of integrating the evaluation of such attributes by the citizen has to be solved. There are several statistical techniques to solve this problem such as Principal Components, Factor Analysis or Cluster Analysis (see OECD, 2008; and Mazziotta and Pareto, 2013; for a very comprehensive comparative analysis) but they are not adapted to the studied problem because the model to be proposed should be based on the relative importance assigned by the citizens to each attribute and so a multi-attribute approach should be adopted and such relative importance should be elicitated from a sample of citizens. The proposed model is based on the MAUT (Multi-Attribute Utility Theory, Fishburn, 1970, Deyer, 2016 & Roy, 2016), which has a complete theoretical foundation based on the Probability Theory, the axioms of preferences, and the Utility Theory (Loken, 2007). According to the MAUT model, the satisfaction for the website i, U(i) with i=1, …, M being M websites under evaluation, will be given by the weighted average of the scores assigned to each attribute (Keeney, 2009) and so:

$$U(i) = \sum w(j) \, . \, U(i,j) \text{ with } j=1,\ldots J.$$

being U(i) the utility of the site i, U(i,j), the score of the site i according to attribute j, j=1,…, N, and being w(j) the weight assigned to attribute i.

Therefore, the application of this model implies the definition of the attributes, of their descriptors and scores as well as of their weights.

The proposed attributes are based on the tree structure presented in Section 4 and a set of descriptors as well as a scoring system are presented in Section 5.

The estimation of these models is carried out using the OptionCards method (Maia & Tavares, 2013; Tavares &

Arruda, 2022) in terms of a focus group of citizens for a significant set of websites of Local Authorities in Portugal.

4. The Attributes of the Satisfaction Model

Considering previous contributions (Parasuraman et al, 2005 & Nilashi, 2023) the satisfaction of the user (GS) should be modeled in terms of the balance between the effort of using LGS (C) and the benefit from its use (B), as the decision to use such a website and the achieved results will depend on these two components.

Several authors concluded (Selvidge, 1999) that the most relevant indicator of the effort related to using a LGS can be expressed by the time spent downloading the home page (T). So, T is the descriptor adopted to the attribute concerning C.

The formulation of B is complex as the expected outcomes obtained from using an LGS cover a very high number of functionalities and services. Previous contributions have specified long lists of features without any hierarchical structure (e.g., design, emotional appeal, task information, etc, see Sa et al, 2016 & Hien, 2014) and therefore, a sound process to estimate the relative importance assigned by the citizens is virtually impossible to be applied explaining why such results have not been published.

The approach adopted by the authors is completely different as it is based on the multi-stage model of Local E-Government described by Moon, 2002, and suggested by Hiller & Belanger, 2001, considering five stages:

Stage 1: Information dissemination/ catalogs

Stage 2: Two-way communication

Stage 3: Service and financial transaction

Stage 4: Vertical and horizontal integration

Stage 5: Political participation.

The adopted classification includes three major classes of functionalities: provision of information, delivery of services, and participation of citizens corresponding to the first class to stage 1, the second class to stages 2 and 3 besides some of the elements of stage 4. The third class corresponds to other elements of stage 4 and to the stage 5.

Thus, a synthetic taxonomy is proposed considering a tree structure of three major groups of attributes denoted by j=1;2;3, respectively: B_1 - provision of information; B_2 - delivery of services; and B_3 - promotion of participation (Figure 1).

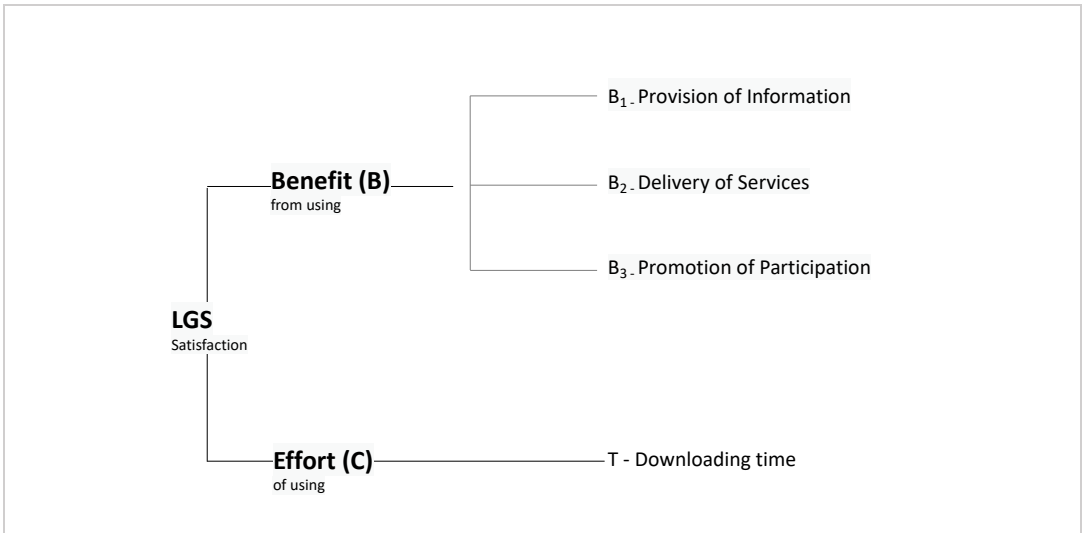

Figure 1. Tree structure representing the major groups of attributes for Local E-Government websites (LGS)

The provision of information (Figure 2) includes disseminating relevant information concerning all sectors such as tourism and culture, economy and opportunities, health and sport, environment and sustainability, etc.

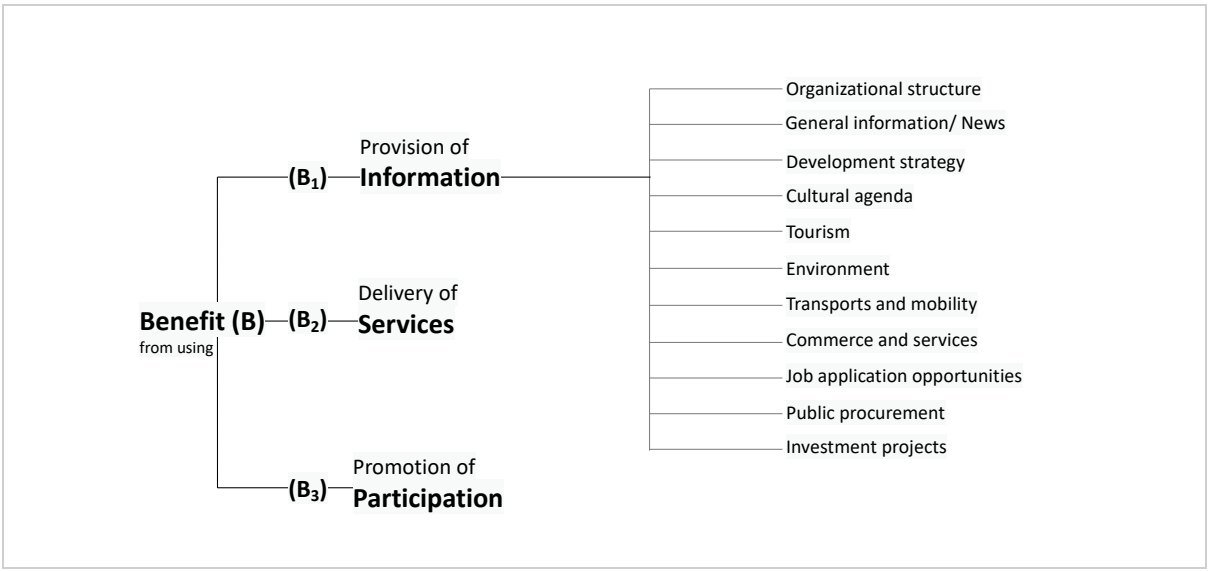

Figure 1. Provision of information

The second perspective (Figure 3) considers the wide variety of services provided by the municipalities, including the application of their administrative powers (certification, licensing, issue of permits, etc.) as well as the provision of services required by the citizens in all sectors ranging from mobility and accessibility to water supply, drainage, and environment.

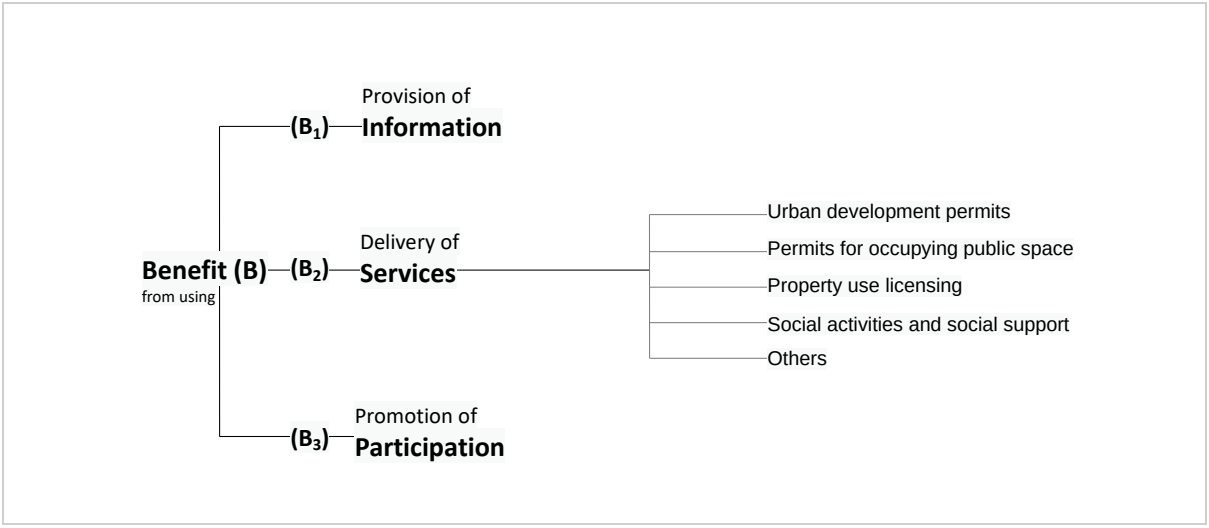

Figure 2. Delivery of services

The third perspective (Figure 4) concerns the modern challenge of promoting and facilitating the participation of citizens according to the modern paradigm of participative public administration, which is considered essential not just to the pursuit of Civic and Democratic principles but also to achieving high levels of effectiveness and efficiency of public services.

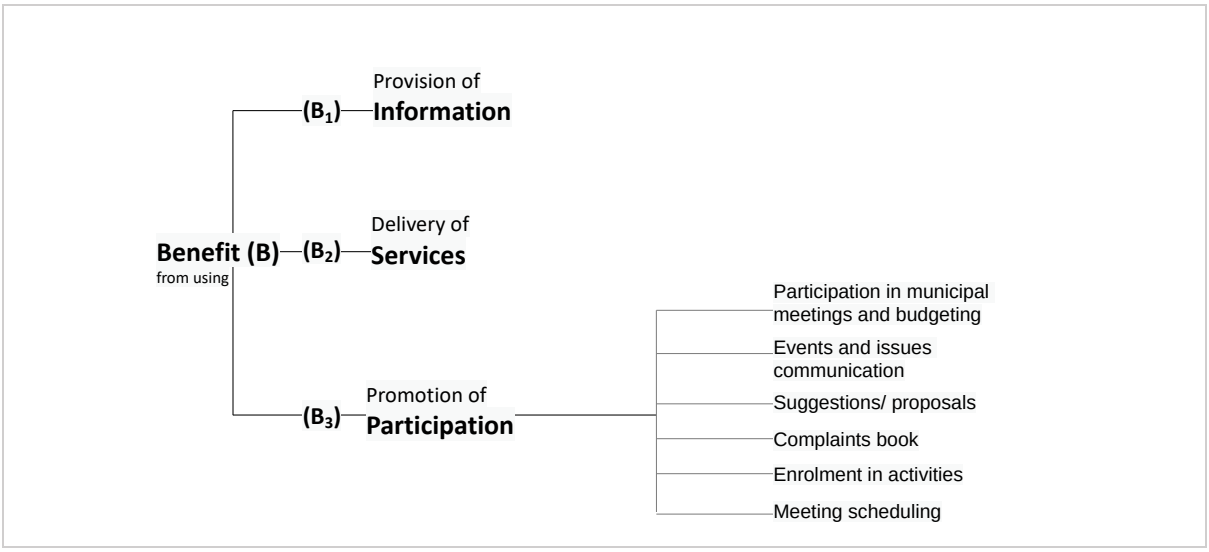

Figure 3. Promotion of participation

5. The Proposed Descriptors and the Scoring System

The application of the MAUT model to this formulation can be given by:

- $U(i) = w(C) \cdot U(i, C) + w(B) \cdot U(i, B)$, and
- $U(i, B) = \Sigma_j w(i, B_j) \cdot U(i, B_j)$, with
- j =1; 2; 3 for
- i =1, …, N

being N the number of websites evaluated and where:

- U(i, C) is the score estimated for C and website LGS(i);
- $U(i, B_j)$ is the score estimated for LGS (i), and B_j is the attribute j=1,…,3 corresponding to B_1; B_2; B_3, respectively;
- w(C) and w(B) are the weights related to B and C with $w(B) + w(C) = 1$ and with $0 \leq w(B), w(C) \geq 1$;
- $w(B_j)$ is the weight corresponding to j being $0 \leq w(B_j) \leq 1$ and $w(B_1) + w(B_2) + w(B_3) = 1$.

The score per attribute C and B_1, B_2, B_3 is estimated using always the same Likert scale (Joshi, A., 2015; Likert, 1932), ranging from 1 (worst evaluation) to 5 (best evaluation):

The score U(i, C) is estimated using a standard metric system to evaluate the downloading time of the website (Metrics available through https://gtmetrics.com/) assigning **1** if $T \geq 30$ seconds and **5** if $T \leq 1$ second considering the recommendations of (Selvidge, 1999). A linear function is used to obtain the scores for intermediate values of T between 1 and 30 seconds.

The score $U(i, B_j)$ with j= 1; 2; 3 will be estimated considering that score 1 corresponds to the absence of functionality **j**, score 5 if it is fully developed.

The estimation of $U(i, B_j)$ for j=1;2;3 assumes that the sub-attributes presented in Figures 3, 4, and 5 are equally important, so $U(i, B_j)$ is estimated by the average scores calculated for such sub-attributes. The third key problem to be studied is now how to estimate the weights and this issue is addressed in the next section.

6. The Estimation of the Weights Assigned by the Citizens to the Attributes

6.1 The OptionCards Method

Modeling the citizens' satisfaction implies estimating the relative importance assigned to each attribute, which is expressed in the MAUT model by the weights assigned to the attributes.

This topic has been extensively studied in Decision Theory (Tavares et al, 1997 & Roy, 2016) and discussed by several authors, suggesting alternative approaches (Mousseau, 1992) and discussing the issues of applicability, vulnerability (Belton & Stewart, 2002), interpretation (Borcherding et al, 1991) and friendliness (Riabacke et al, 2009).

Several approaches can be used, but there is evidence (Tavares, 1984) showing that elicitation of weights is less

subject to subjectivity if it is based on pairwise comparisons between specific pairs of alternatives, as is the case of the OptionCards method (Maia & Tavares, 2013; Tavares & Arruda, 2022).

Actually, the elicitation of weights according to this method is based on the elicitation of preferences of the decision-maker between given alternatives adopting the MAUT model as it can be exemplified for the case of three attributes:

$U(i) = w(1) . U(i,1) + w(2) . U(i,2) + w(3) . U(i,3)$ and $w(1) + w(2) + w(3) = 1$ with $0 \leq w(1,2,3) \leq 1$.

For a specific pair of alternatives, (i,k), the indifference between them corresponds to the linear equation:

$U(i) = U(k)$

and this equation can be represented in a 2-dimension space

$(w(1), w(2))$

because

$w(1) + w(2)+w(3) =1$.

The domain of points corresponding to possible weights (S) in such space is confined by:

$0 \leq w(1), w(2) \leq 1$ and by $w(1) + w(2) + w(3) = 1$.

Thus, for an example with two alternatives, i=1 and i=2 being:

Table 1. Two Alternatives

Alternative	*U(i,1)*	*U(i,2)*	*U(i,3)*
i = 1	4	1	2
i = 2	1	4	2

one has the line (R1) represented in Figure 5 equally subdividing S.

If the decision-maker is indifferent between i=1 and i=2, then $w(1) = w(2)$, but if he prefers i=1, then $w(1) > w(2)$, corresponding to the sub-domain S_2. On the contrary, if he prefers i=2, then $w(1) < w(2)$ corresponds to the sub-domain S_1.

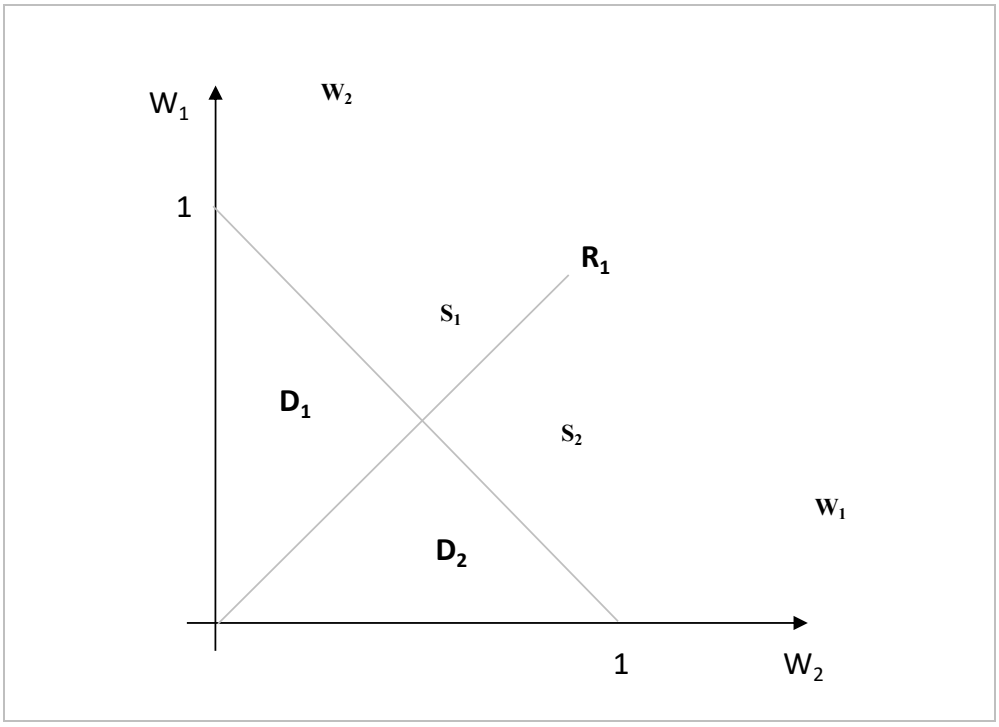

Figure 5. Representation of an indifference line in the weights space

New sets of pairs of alternatives can be used to ask similar questions and reduce the areas of the corresponding sub-domains of weights obtaining a sequence of binary options represented by the tree structure included in Figure 6. This process can include any number of stages, and at the end of the process, the estimated weights are

given by the average coordinates of the corners of each final sub-domain as shown in Figure 7 and in Table 2.

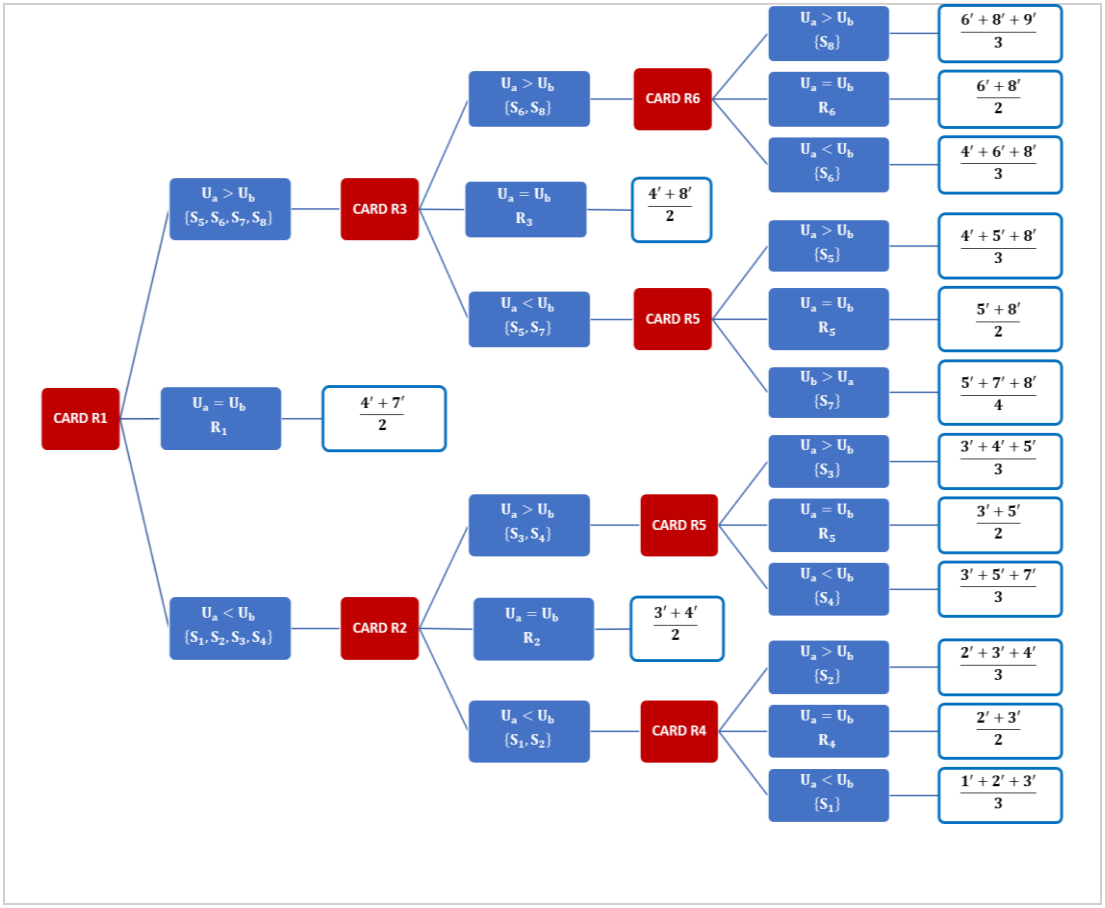

Figure 6. Tree structure of the Option Cards method

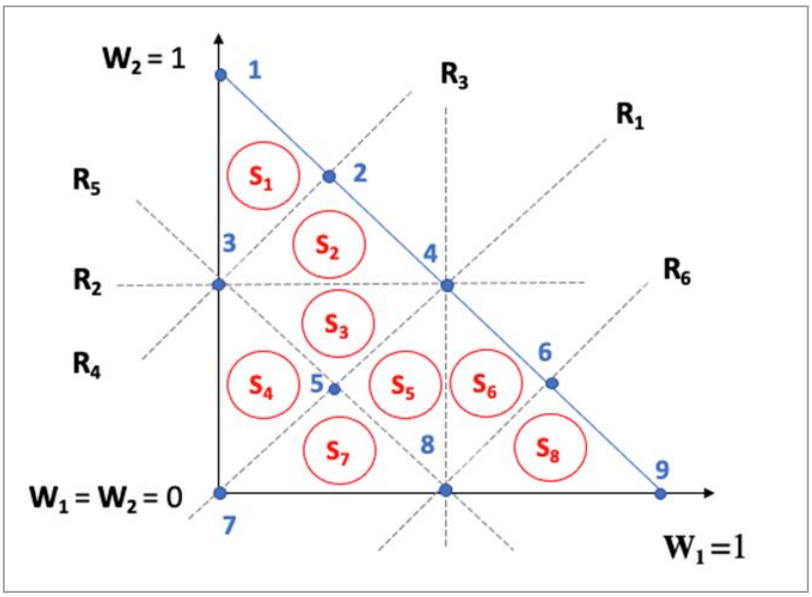

Figure 7. Representation of the subdomains of the estimated weights

Table 2. OptionCards Coordinates

Point	*Weight 1*	*Weight 2*
1	0	1
2	1/4	3/4
3	0	1/2
4	1/2	1/2
5	1/4	1/4
6	3/4	1/4
7	0	0
8	1/2	0
9	1	0

6.2 The Application of the OptionCards Method

a) Relative importance of C and B

The pairwise comparison can be formulated in terms of these two alternatives, 1 and 2

1: U(1, C) = 1 ; U(1, B) = 5

2: U(2, C) = Z ; U(2, B) = 3

And the question is: What is the lower limit of **Z**, denoted by L being $1 \leq L \leq 5$, to have 2 preferred to 1?

Thus, w(B) and w(C) can be estimated by:

- w(B) = w(C) . (L-1)/2, and
- w(C) = 1 - w(B), implying that
- w(C) = 2/(1+L)

b) Relative importance of B_j with j=1; 2; 3

The estimation of $w(B_1)$, $w(B_2)$, and $w(B_3)$ are carried out by the application of the OptionCards method as it is presented in the next section.

c) Focus Group

The OptionCards method is applied through a survey sent to a focus group belonging to the selected population. The citizens belonging to the so-called "Millennials" and Z generations (Strauss & Howe, 2000) born during the eighties and nineties are particularly important because they prefer to use digital media. Citizens belonging to such generations and higher education backgrounds are particularly important for municipalities because they contribute to increasing their development and job generation.

This is why the selected focus group was set up including 40 respondents with the following features:

- Portuguese,
- Graduates,
- With ages ranging between 23 and 44.

This survey was implemented through Question Pro Software (https://www.questionpro.com/pt) and it was distributed via social media canals (Facebook and Instagram) and by email.

Initially, the estimation of the weights corresponding to the relative importance given by the users to the effort of using an LGS (C) (expressed by the time spent downloading the home page (T)) and the benefit stemming from its use (B) (measured by the quality of different functionalities and services the LGS provides) was carried out.

With such purpose, the following question was asked to each respondent (k = 1, … 40) about the threshold of indifference, Z_k between the two alternatives A and B as shown in table 3.

Table 3. Importance of loading a page on an LGS

Website	*Effort (C) - Downloading time (T)*	*Benefit (B)*
A	1	5
B	$\mathbf{Z_k}$	3

The obtained answers are presented in (Figure 8) and the estimated average is **3.2**, implying that the weight of the relative importance of Downloading time (T) is 0.48, and the Benefit (B) is 0.52. The estimated standard deviation is 0.93 and so the estimated coefficient of variation is equal to 11.59 meaning that the group of respondents has not homogeneous answers.

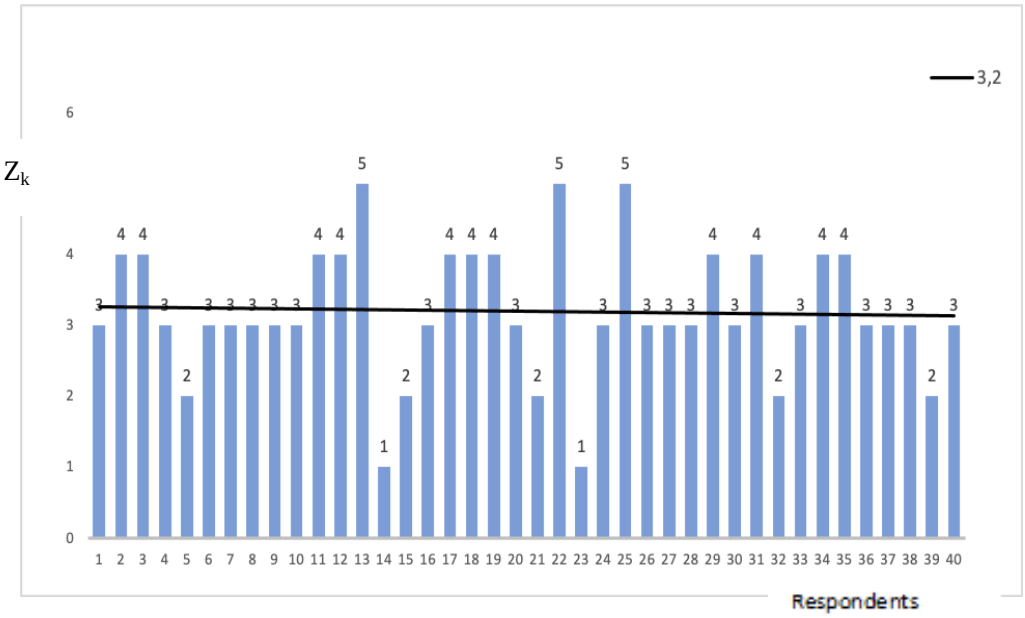

Figure 8. Chart showing the responses on the weight of the Downloading time (T) of a website page

The estimation of the weights of the three attributes used to express the benefit stemming from the use of an LGS (B_1, B_2, B_3) was carried out in terms of the 40 results obtained from the focus group, as shown in Table A1 included in Appendix A: Results of the survey.

These results were obtained from the tree structure already presented in Figure 6, showing the tree structure of the OptionCards method and the coordinates of each point representing the estimated weights of the citizen were also already presented in Figure 7 and Table 2.

Thus, the estimated results can be presented in Table 4 and Figure 9, where the size of the circles is proportional to the number of answers. Again, the estimated coefficients of variation mean that the group of respondents is far from being homogeneous.

Table 4. Results obtained from the application of the OptionCards method

Results of OptionCards tree	*Coordinates (W_1; W_2)*		*Number of inquired respondents per coordinates*	*Identification of each inquired per coordinates*
(4 ⁄+7)/2	0,25	0,25	7	1/7/11/18/20/23/27
(3 ⁄+4 ⁄+5)/3	0,42	0,25	11	2/3/5/10/14/16/17/19/24/29/40
(4 ⁄+5 ⁄+8)/3	0,25	0,42	6	4/6/8/12/36/37
(1 ⁄+2 ⁄+3)/3	0,75	0,08	5	9/28/31/33/35
(2 ⁄+3 ⁄+4)/3	0,58	0,25	3	13/30/32
(3 ⁄+5 ⁄+7)/3	0,25	0,08	2	15/38
(3 ⁄+4)2	0,50	0,25	2	21/39
(2 ⁄+3)/2	0,63	0,13	1	22
(6 ⁄+8 ⁄+9)/3	0,08	0,75	2	25/26
(4 ⁄+6 ⁄+8)/3	0,25	0,58	1	34
Total	**15,9**	**11,04**	**40**	
Average	0,40	0,28		
Standard deviation	0,20	0,21		
Coefficient of variation	0,51	0,75		

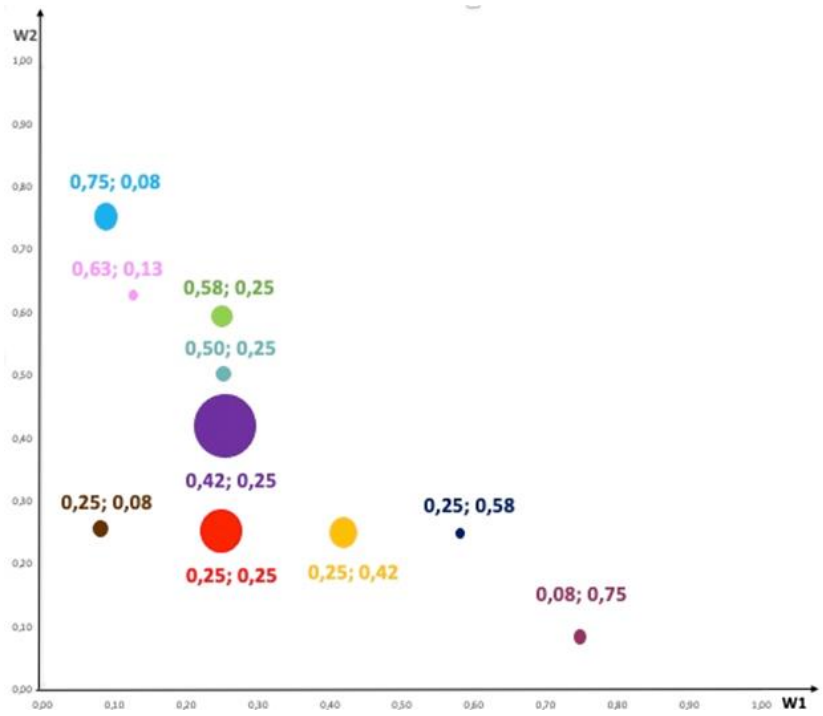

Figure 9. Estimated weights for the 40 respondents

average, the total of the respondents (40) assigned their preference to the Provision of information (B_1) (0.40), followed by Promotion of participation (B_2) (0.33). Finally, the last preference goes for the Delivery of services (B_3) (0.28).

Obviously, other populations of citizens with different features can assign different relative importance to the studied attributes and so these results show how convenient is the developed method to estimate the level of satisfaction of citizens but should be not generalized to represent the preferences of other groups.

7. The Evaluation of a Significant Set of Websites of Municipalities in Portugal

7.1 A sample of Portuguese Municipalities

Portugal is a unitary and still very centralized State (OECD, 2019) and it has two levels of government, the central and the local one, which is based on the 308 existing municipalities (278 on the mainland) and two autonomous regions (the islands of Madeira and Azores). The creation of regions with legal status in law, although contemplated in the Portuguese Constitution of 1976, never materialized. A referendum on regionalization failed in 1998. Instead, on Portugal's mainland, five decentralized regional governance agencies were established (named as *Commissions for Coordination and Regional Development* - CCDR) to coordinate the central government services in five administrative regions (*Norte, Centro, Lisboa e Vale to Tejo, Alentejo and Algarve*). Furthermore, 23 Inter-Municipal Communities were formed (CIM) to enhance inter-municipal cooperation. More recently, decentralization reforms emerged again as a response to structural problems of economic development and lack of territorial cohesion, mainly between the coastal and hinterland areas coping with well-known problems (see OECD, 2020).

With the European integration in 1986, the Portuguese territory was also redefined under a system of statistical regions and subregions known as the Nomenclature of Territorial Units for Statistics (NUTS). Mainly used for collecting statistical information, these territorial units follow many of the country's administrative borders: on Portugal's mainland, NUT II corresponds to the five mentioned administrative regions. These regions are then subdivided into 23 groups of municipalities, the referred CIMs, corresponding to the NUT III level. At last, the municipalities correspond to the NUT IV level.

A sample of municipalities was designed to apply the developed model to evaluate the LGSs. Two features were considered for such sampling following previous studies (Ferreira et al, 2010) and based on the percentage of the urban population and the stronger or weaker connection to the sea coastline. Urban populations tend to be more digitally oriented, and the type of services requested by citizens to Local Governments depends on the extension

of urban or rural areas. The second criterion was used because Portugal is a country with great differences between the coast and the interior, namely of social, economic, and cultural nature, but also because the sea connection is relevant as most of the international tourism is located near the coast and so these populations have a more multilanguage and multi-cultural behavior due to more interaction with other countries and social groups, diversifying cultures and promoting digital behaviors.

In each NUT II, the groups of NUT III including or not a coastline were identified and in each group, the most rural and urban municipalities were selected.

The most rural ones are defined by the highest percentage of the population living in places with less than 2.000 inhabitants and the most urban municipalities are those with the highest percentage of the population living in areas with more than 10.000 inhabitants, following the contributions of Portuguese National Statistics Institute (INE, 2021).

The map of Portugal's mainland is presented in Figure 10 including the selected 16 municipalities identified by the four types defined: Coastline/ Urban (C/U); Coastline/ Rural (C/R); Hinterland/ Urban (H/U); and Hinterland/ Rural (H/R).

NUT II	NUT III	Municipality	*Type*
North	Porto Metropolitan Area	Porto	(C/U)
North	Terras de Trás-os-Montes	Bragança	(H/U)
North	Douro	Penedono	(C/R)
North	Cávado	Terras de Bouro	(H/R)
Center	Médio Tejo	Entroncamento	(H/U)
Center	Coimbra Region	Coimbra	(C/U)
Center	Leiria Region	Castanheira de Pêra	(C/R)
Center	Médio Tejo	Vila de Rei*	(H/R)
AML	AML	Lisboa	(C/U)
AML	AML	Mafra	(C/R)
Alentejo	Coast Alentejo	Sines	(C/U)
Alentejo	Central Alentejo	Évora	(H/U)
Alentejo	Down Alentejo	Barrancos	(H/R)
Alentejo	Coast Alentejo	Odemira	(C/R)
Algarve	Algarve	Alcoutim	(H/R)
Algarve	Algarve	Faro	(C/U)

Note*: Because the Website of *Vila do Rei* wasn't online during the period of evaluation (FEB-MAR, 2022), this municipality was replaced by *Vila Velha de Ródão*.

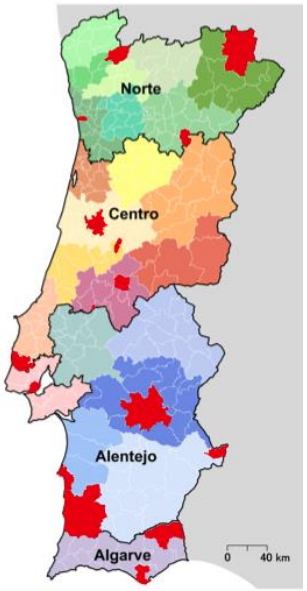

Figure 10. The 16 municipalities on Portugal's mainland, by location in NUT II, NUT III and Type

7.2 The evaluation of the websites of the selected municipalities

The proposed model was applied to the selected websites and so the criteria used for the evaluation are:

- Provision of information
- Delivery of services
- Promotion of participation
- Downloading time

As it was explained before, a discrete cardinal scale was used to score the three types of benefit, where:

0 - Corresponds to the absence of functionality

5 - Corresponds to a high-performance functionality

and intermediate evaluations correspond to intermediate scores, such as 3.

For the loading speed, a score of 1 was given for a maximum loading time of 30 seconds and a score of 5 was given for a full loading in 1 second (Selvidge, 1999).

The obtained scores for the provision of information, delivery of services, and promotion of participation are presented in Figures 11, 12, and 13.

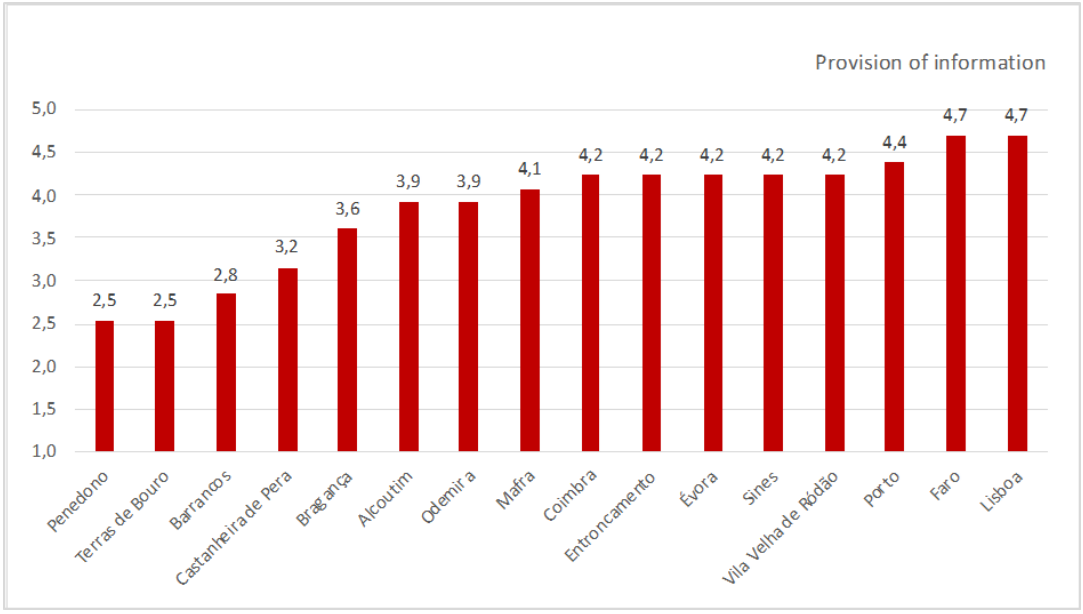

Figure 11. Evaluation according to the attribute provision of information (B_1)

Lisbon, the capital of Portugal, and Faro in the Algarve region (the main touristic area in the country) score the best performance in terms of provision of information closely followed by Porto (the second largest city in Portugal). The municipalities of Penedono and Terras de Bouro, both rural municipalities have the lowest scores.

The results concerning the delivery of services show higher disparity including an advanced group of four municipalities (Vila Velha de Ródão, Lisboa, Mafra and Évora) being the performance of the other municipalities much lower.

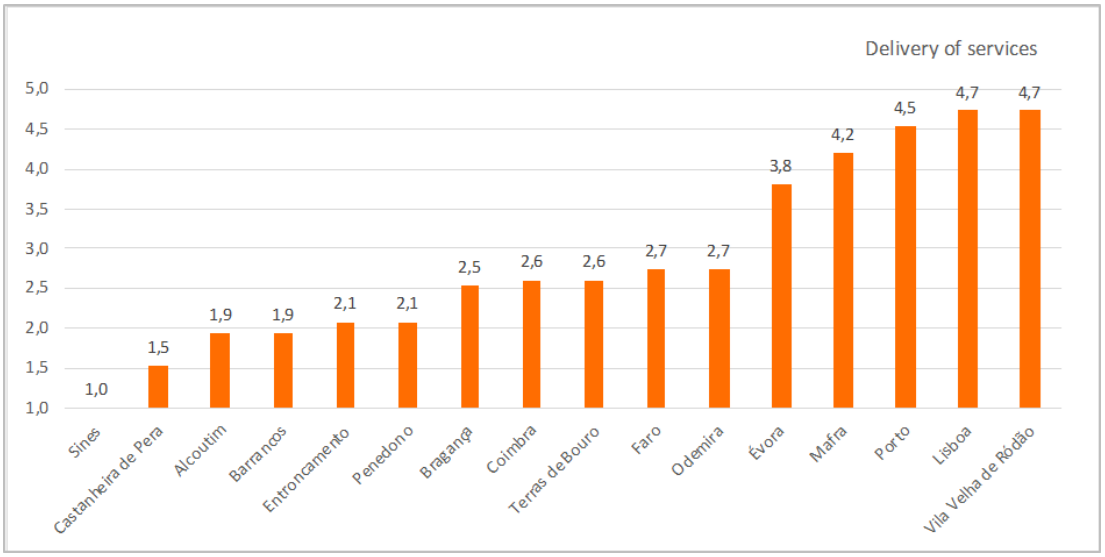

Figure 12. Evaluation according to the attribute delivery of services (B_2)

The results concerning the promotion of participation show also a significant level of disparity but following a more continuous pattern.

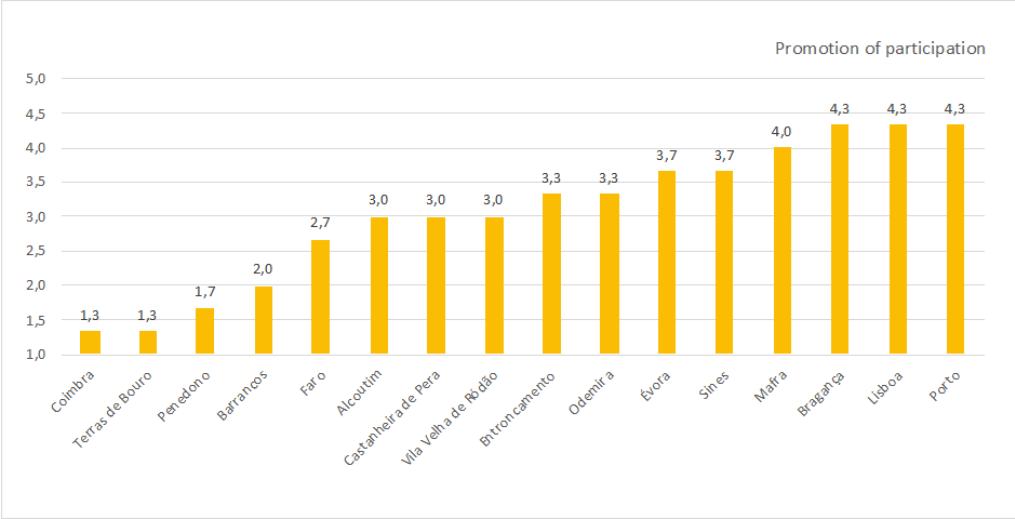

Figure 13. Evaluation according to the attribute Promotion of participation (B_3)

The results concerning the attribute downloading time are presented in Figure 14 confirming also significant disparity and including quite a backwards group: Coimbra, Sines and Vila Velha de Ródão.

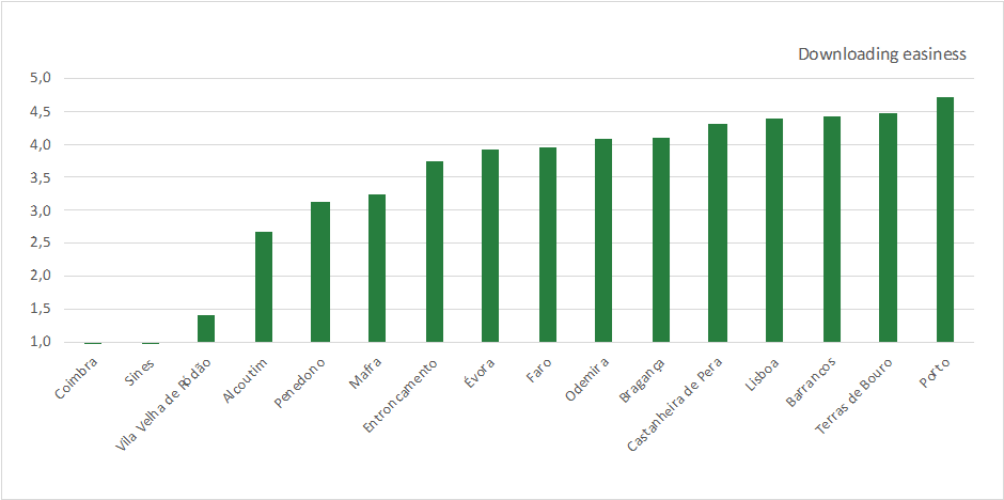

Figure 14. Evaluation according to the attribute Downloading time (T)

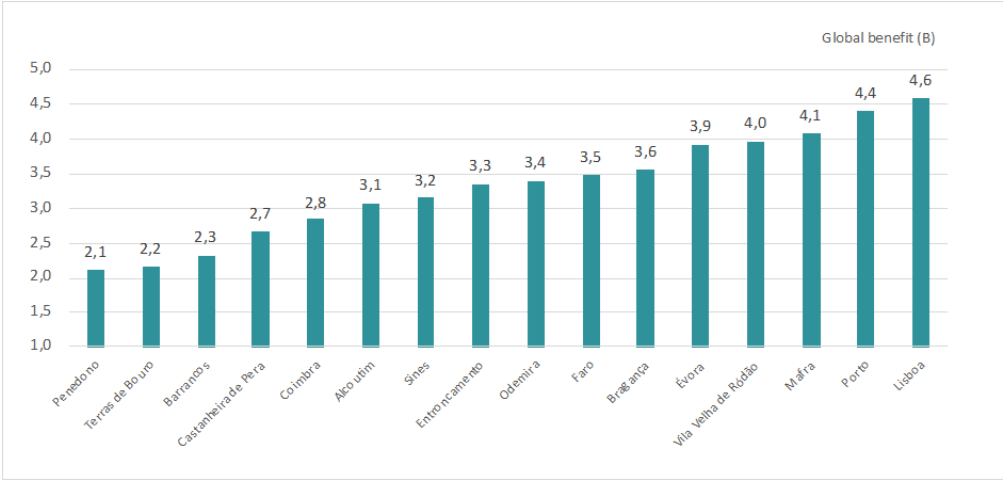

Figure 15. Evaluation according to the benefits

The benchmarking corresponding to the benefits, B, (Figure 15) was calculated using the weights estimated by the OptionCards method: 0.40, 0.33 and 0.28 for B_1, B_2 and B_3, respectively.

Finally, the benchmarking concerning the global satisfaction, GS, in terms of the balance between the benefit coming out from the use of local E-Government websites and the effort of using it adopting the weights estimated by the OptionCards method (0.48 and 0.52 for T and B, respectively), can be obtained and it is presented in Figure 16. The top performances of Lisboa and Porto are not a surprise as they include the two most important cities but the quite low performances of Sines and Coimbra, well behind the intermediate group of 12 municipalities (from Évora to Penedono) are an unexpected result because Coimbra includes the third Portuguese city and Sines include a key harbor not far from Lisboa.

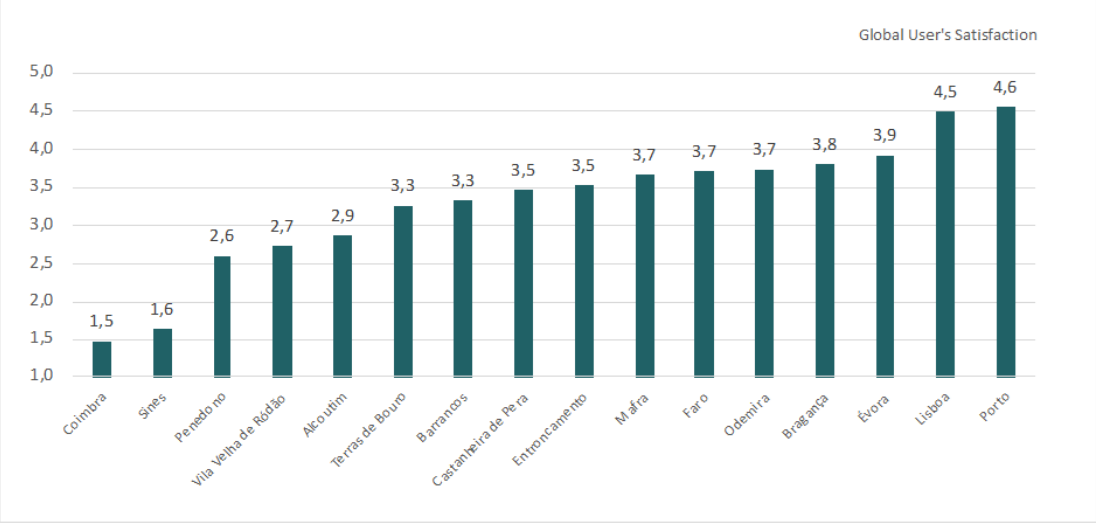

Figure 16. Evaluation according to the global satisfaction (GS)

The average score obtained for the four types of municipalities (C/U; C/R; H/U; and H/R) is presented in Table 5 showing that urban municipalities located in the Coastal areas of Portugal's mainland score better for B_1 and B_2 but urban hinterland municipalities score better for B_3 and T.

Table 5. Average score by type of municipality

	Provision of Information (B_1)	*Delivery of services (B_2)*	*Promotion of participation (B_3)*	*Downloading time (T)*
C/U	**4,45**	**3,12**	**3,27**	2,61
C/R	3,42	2,63	3,00	**3,69**
H/U	4,03	2,8	**3,78**	**3,92**
H/R	**3,38**	2,8	2,33	3,24

8. Major Results

Local E-Government plays a central role in modern public administration because the interaction with citizens is crucial for economic and social progress as well as to improve quality of life. Many authors have evaluated Local E-Government websites focusing on organizational aspects and the website's technological features but giving less attention to the satisfaction perceived by the citizens.

In this paper these three research questions are studied:

a) How can the citizens' satisfaction be modeled and which attributes should be considered?

b) Which descriptors and which scoring system?

c) How can be estimated the relative weights assigned to the attributes?

The first question is addressed in Sections 3 and 4 adopting the MAUT model and a tree structure of attributes based on preliminary contributions. Such attributes consider the effort of using a local government site, represented by the downloading time (T) and the benefit from its use (B) which is a function of B_1 - provision of

Information, B_2 - delivery of services and B_3 - promotion of participation. Each of these attributes is branched down into a set of sub-attributes directly evaluated for each site.

The second question is treated in Section 5 using a Likert scale and the last question is answered by the application of the OptionCards method (Section 6) to a focus group of 40 respondents for illustrative purposes.

The proposed model was applied to 16 municipalities representing Portugal's demographic and territorial diversity according to two main criteria: the existence of coastline (Coastline/Hinterland) in NUT III and urban intensity (Urban/ Rural), obtaining four types of municipalities.

The estimated results confirm significant disparity between municipalities and between the 4 classes of studied municipalities as the scores of the classes C/U and H/U are the highest for B_1; B_2 and B_3; T, respectively, confirming that the rural municipalities have always lower scores. Such disparity confirms the importance of this type of evaluation as a key instrument to assess the performance of each site and to design a road map of improvement of LCS as a component of the public policies to be adopted by each municipality.

Furthermore, the estimated scores for B_1 tend to be higher than B_2 and B_3 confirming that the provision of information is the first stage of development of LGS as has been mentioned by several authors (see, eg, Seifert, 2003).

9. Managerial Implications

The presented results can support managerial changes to improve the municipalities' websites to attract digital users which can be particularly important to support public policies of development and qualified job generation. Therefore, each municipality should select a focus group representing such target population to estimate the proposed indicators in order that a road map of changes can be designed and the achieved improvements consistently monitored and evaluated. Obviously, the estimation of the number of users and of their satisfaction level should be periodically performed to assess the obtained gains as well as their impacts.

The improvements achieved in each major dimension have different policy and managerial implications:

a) Information

This dimension is quite important for expressing key priorities and options of the municipality as well as to disseminate knowledge about the potential and the opportunities being offered to citizens and business.

b) Services

Improving these attributes is critical to increasing efficiency, accountability, and transparency

c) Participation

This dimension allows the pursuit of more advanced policies and managerial actions to improve quality of life and sustainability objectives.

10. Conclusions

Summing up, the original contribution stemming from this paper is the development of a measuring instrument of citizens satisfaction related to the use of LGS based on a tree structure covering the most relevant attributes. This instrument can be easily applied through the adoption of the OptionCards method and an illustrative application is presented using the results derived from a focus group with 40 elements. This instrument is applied to a set of Portuguese municipalities revealing a high level of disparity and confirming how important can be its application to assess inter-municipalities benchmarking, to diagnose their LGS major shortcomings and to support the design of a road map for improvement.

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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Appendix A

Table A1. Results of the survey

Number	*ID*	*Card R1*	*Direction*	*Response*	*Direction*	*Response*	*Average coordinates of the obtained corners*
1	68956173	Indifferent	TOTAL				$\frac{4' + 7'}{2}$
2	68955979	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$
3	68954130	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$
4	68953983	Website A	Card R3	Website B	Card R5	Website A	$\frac{4' + 5' + 8'}{3}$
5	68953642	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$
6	68952330	Website A	Card R3	Website B	Card R5	Website A	$\frac{4' + 5' + 8'}{3}$
7	68186130	Indifferent	TOTAL				$\frac{4' + 7'}{2}$
8	68153209	Website A	Card R3	Website B	Card R5	Website A	$\frac{4' + 5' + 8'}{3}$
9	68151795	Website B	Card R2	Website B	Card R4	Website B	$\frac{1' + 2' + 3'}{3}$
10	68151240	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$
11	67192018	Indifferent	TOTAL				$\frac{4' + 7'}{2}$
12	67191821	Website A	Card R3	Website B	Card R5	Website A	$\frac{4' + 5' + 8'}{3}$
13	67042359	Website B	Card R2	Website B	Card R4	Website A	$\frac{2' + 3' + 4'}{3}$
14	66851351	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$

15	66832029	Website B	Card R2	Website A	Card R5	Website B	$\frac{3' + 5' + 7'}{3}$
16	66828143	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$
17	66827900	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$
18	66827641	Indifferent	TOTAL				$\frac{4' + 7'}{2}$
19	66827111	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$
20	66209323	Indifferent	TOTAL				$\frac{4' + 7'}{2}$
21	66209114	Website B	Card R2	Indifferent	TOTAL		$\frac{3' + 4'}{2}$
22	65444195	Website B	Card R2	Website B	Card R4	Indifferent	$\frac{2' + 3'}{2}$
23	65423416	Indifferent	TOTAL				$\frac{4' + 7}{2}'$
24	65407922	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$
25	65402729	Website A	Card R3	Website A	Card R6	Website A	$\frac{6' + 8' + 9'}{3}$
26	65398605	Website A	Card R3	Website A	Card R6	Website A	$\frac{6' + 8' + 9'}{3}$
27	65398447	Indifferent	TOTAL				$\frac{4' + 7'}{2}$
28	65398408	Website B	Card R2	Website B	Card R4	Website B	$\frac{1' + 2' + 3'}{3}$
29	65398230	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$
30	65101669	Website B	Card R2	Website B	Card R4	Website A	$\frac{2' + 3' + 4'}{3}$
31	65089766	Website B	Card R2	Website B	Card R4	Website B	$\frac{1' + 2' + 3'}{3}$
32	65081744	Website B	Card R2	Website B	Card R4	Website A	$\frac{2' + 3' + 4'}{3}$

33	65080000	Website B	Card R2	Website B	Card R4	Website B	$\frac{1' + 2' + 3'}{3}$
34	69204234	Website A	Card R3	Website A	Card R6	Website B	$\frac{4' + 6' + 8'}{3}$
35	69205429	Website B	Card R2	Website B	Card R4	Website B	$\frac{1' + 2' + 3'}{3}$
36	69205911	Website A	Card R3	Website B	Card R5	Website A	$\frac{4' + 5' + 8'}{3}$
37	69205971	Website A	Card R3	Website B	Card R5	Website A	$\frac{4' + 5' + 8'}{3}$
38	69206036	Website B	Card R2	Website A	Card R5	Website B	$\frac{3' + 5' + 7'}{3}$
39	69206976	Website B	Card R2	Indifferent			$\frac{3' + 4'}{2}$
40	69350666	Website B	Card R2	Website A	Card R5	Website A	$\frac{3' + 4' + 5'}{3}$