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A MULTI-CRITERIA APPROACH TO THE EVALUATION OF MALAYSIAN GOVERNMENT PORTAL

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ABSTRACT

National portal is one of the main gateways to e-government entry for providing e-services to citizen. The purpose of this paper is to evaluate a set of factors that influence on Malaysian government portal using Multi-Criteria method. These factors were derived from a previous studies and literature related to the subject matter by Malaysian government to enhance rank of government portals and websites. In addition, obtained factors were considered from all Malaysian government portals and in this research based on them the rank of those were evaluated. In this study we also consider those factors to rank them and show which factors is more important for improving Malaysian government portal based on citizen desires. With regard to the citizen's perception of government portal, a questionnaire was structured to gather their responses for raking the factors using TOPSIS method. Therefore, an MCDM supported study for ranking criteria in government portals. The outcome of this paper assists to Malaysian e-government that considers importance of effective factors for government portal in giving better e-services.

Keywords: *Assessment, Citizen, Multi-Criteria, Malaysian Government Portal, TOPSIS.*

1. INTRODUCTION

Recently e-government issues have been one of the important areas of study in the Information Systems (IS) field that is related with use of Information and Communication Technology (ICT) by the government agencies for delivering its services to citizen electronically. A study of Carter and Belanger (2005) showed the relationship between government and recipients for its electronic services can be characterized as government to citizen (G2C), government to business (G2B), government to employees (G2E) and government to government (G2G) [1].

Governments around the world have spent a remarkable financial plan for IT to implement E-Gov environment in their countries. Also governments around the world are improving advances in Information and Communication Technologies (ICTs) to increase their service delivery mechanism for improving citizen satisfaction towards government.

According to a world e-Government Ranking report, 50 countries were ranked and Malaysia retained at 24th place with the score of 67.37 that Malaysia's score has improved by 3.87. Table 1 shows Malaysia progress in World e-Government ranking by Waseda University.

Table 1. Malaysia Progress in World e-Government Ranking by Waseda University

Year	Ranking	Score
1	24.50	67.37
2	24.40	63.5
3	22.34	63.38
4	18.34	49.4
5	15.32	53.41
6	14.32	NA
7	9.23	0.925(index)

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National portal was one of the 7 main indicators that Waseda University considered for ranking of world e-government. In this ranking 4 of 31 dimensions were mentioned for national portal as Navigation, Interactivity, Interface and Technical.

The study showed that a global average usage of government portal by citizen is about 30% that is very low .They mentioned that Canada is one of the countries that its citizen usage rate for visiting their websites is over 51% so that has highest rate rather than other countries . However, even for the Canadians the majority are not interacting or transacting with the government through it but just obtain information. Table 1 shows a website usage by citizen in different countries.

However, in other developed countries government website usage is comparatively very small as shown in an example in Table 2 [2].

Table 2. Government website usage rate

S/N	Country	Government Website Usage In % of Population
1	Canada	51
2	USA	37
3	France	19
4	Germany	19
5	Italy	30
6	Japan	18
7	Global Average	30

In e-government context, national portals create novel modes of communication between administrative agencies and citizens. Also they aim to establish a close and constructive relationship with governments as well as with citizens. Thus, E-Government websites must consider a structure that satisfies all types of citizen for its e-services.
Through a good portal, Government can further improve their service delivery by offering online services. For this reason, many government agencies provide at least one online service for citizens.
In this case, The Malaysian government is actively trying to increase the value of their government corresponding portals. Furthermore, Malaysian government annually has assessed government portal and websites to offer suggestion for improving their delivery e-services to citizen.

As in the Table 3, national portals in 10 countries were assessed in 2009 and 2010 and it can be observed that Malaysia attained position 4 in 2009 but not in year 2010.

Table 3. National Portal Ranking by Waseda University

Year 2010		Year 2009	
Rank	**Country**	**Rank**	**Country**
1	USA	Singapore	1
2	UK	USA	2
3	Singapore	Korea	3
4	Canada	Malaysia	4
4	Sweden	Sweden	5
6	Estonia	Canada	6
6	Japan	Finland	7
8	Finland	Hong Kong	8
9	South Africa	UK	9
10	Germany	Taiwan	10

According to the annual assessments in Malaysia, the various Malaysian government portals and websites are evaluated against the preset criteria and ranked accordingly from 1 to 5-star rating. Therefore, having awareness about their respective ranks, the government agencies can scheme and target to improve the ranking for the following year of assessment. In these assessments a set of criteria were considered. Table 4 shows criteria of assessments for years 2010, 2011 and 2012.

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Table 4. Criteria of assessments for years 2010, 2011 and 2012

Year 2011		Year 2010		Year 2012	
Criteria	Sub-Criteria	Criteria	Sub-Criteria	Criteria	Sub-Criteria
Content	17	Citizen Interaction	16	Content	12
Usability	6	Citizen Insight Generation	8	Usability	13
Security	5	Citizen Services	3	Security	2
Parti-cipation	2	Citizen Support	4	Partici-pation	2
Services	3	Content Management	5	Services	4
Bonus	6	-	-	Bonus	3

The objective of this paper is ranking of criteria that have been considered for assessing portals and websites for Malaysian government in years 2010, 2011 and 2012. Therefore based on Table 4, we considered 9 parameters of all. Table 5 shows the selected parameters for ranking in TOPSIS method.

Table 5. Criteria for using in TOPSIS method

Criteria No.	Criteria
1	Citizen Interaction
2	Citizen Insight Generation
3	Citizen Support
4	Content
5	Usability
6	Security
7	participation
8	Services
9	Bonus

2. MULTI-CRITERIA DECISION MAKING (MCDM)

MCDM is one of the popular decision making method that enables to make choice amongst multiple alternatives that have a common purpose. Principally, MCDM is based on a logic that ranks analytically the alternatives that meet the requested multiple criteria fully. Today MCDM methods widely in various areas are used for example in management, engineering and mobile data system designs [3][5].

3. TOPSIS

TOPSIS, one of the known classical MCDM methods, was first developed by Hwang and Yoon [4] that can be used with both normal numbers and fuzzy numbers.

TOPSIS has been applied to a number of applications, although it is not nearly as widely applied as other multiattribute methods [6][7][8]. The only subjective input needed is weights.

Given a set of alternatives, $A = \{A_i \mid i = 1, \cdots, n\}$ and a set of criteria, $C = \{C_j \mid j = 1, \cdots, m\}$.

Where $\tilde{X} = \{\tilde{x}_{ij} \mid i = 1, \cdots, n; j = 1, \cdots m\}$ denotes the set of fuzzy ratings and $\tilde{W} = \{\tilde{w}_j \mid j = 1, \cdots, m\}$ is the set of fuzzy weights.

The first step of TOPSIS is to calculate normalized ratings by

$$\tilde{r}_{ij}(\mathbf{x}) = \frac{\tilde{x}_{ij}}{\sqrt{\sum_{i=1}^{n} \tilde{x}_{ij}^2}}, \quad i = 1, \cdots, n; \quad j = 1, \cdots, m \tag{1}$$

And then to calculate the weighted normalized ratings by

$$\tilde{v}_{ij}(\mathbf{x}) = \tilde{w}_j \tilde{r}_{ij}(\mathbf{x}), \quad i = 1, \cdots, n; \quad j = 1, \cdots, m. \tag{2}$$

Next the positive ideal point (PIS) and the negative ideal point (NIS) are derived as

$$PIS = \tilde{\mathbf{A}}^{+} = \{\tilde{v}_1^{+}(\mathbf{x}), \tilde{v}_2^{+}(\mathbf{x}), \cdots, \tilde{v}_j^{+}(\mathbf{x}), \cdots, \tilde{v}_m^{+}(\mathbf{x})\} = \{(\max_i \tilde{v}_{ij}(\mathbf{x}) \mid j \in J_1), (\min_i \tilde{v}_{ij}(\mathbf{x}) \mid j \in J_2) \mid i = 1, \cdots, n\} \tag{3}$$

$$NIS = \tilde{\mathbf{A}}^{-} = \{\tilde{v}_1^{-}(\mathbf{x}), \tilde{v}_2^{-}(\mathbf{x}), \cdots, \tilde{v}_j^{-}(\mathbf{x}), \cdots, \tilde{v}_m^{-}(\mathbf{x})\} = \{(\min_i \tilde{v}_{ij}(\mathbf{x}) \mid j \in J_1), (\max_i \tilde{v}_{ij}(\mathbf{x}) \mid j \in J_2) \mid i = 1, \cdots, n\} \tag{4}$$

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Where J_1 and J_2 are the benefit and the cost attributes, respectively. Similar to the crisp situation, the following step is to calculate the separation from the PIS and the NIS between the alternatives. The separation values can also be measured using the Euclidean distance given as:

$$\tilde{S}_i^+ = \sqrt{\sum_{j=1}^{m} [\tilde{v}_{ij}(x) - \tilde{v}_j^+(x)]^2}, i = 1, \cdots, n \quad (5)$$

$$\tilde{S}_i^- = \sqrt{\sum_{j=1}^{m} [\tilde{v}_{ij}(x) - \tilde{v}_j^-(x)]^2}, i = 1, \cdots, n \quad (6)$$

$$\max\{\tilde{v}_{ij}(x)\} - \tilde{v}_j^+(x) = \min\{\tilde{v}_{ij}(x)\} - \tilde{v}_j^-(x) = 0. \quad (7)$$

Then, the defuzzified separation values should be derived using one of defuzzified methods, such as COA to calculate the similarities to the PIS.

Next, the similarities to the PIS is given as

$$C_i^* = D(S_i^-) \Big/ [D(S_i^+) + D(S_i^-)], i = 1, \cdots, n \quad (8)$$

Where

$$C_i^* \in [0,1] \quad \forall i = 1, \cdots, n \quad (9)$$

Finally, the preferred orders are ranked according to C_i^* in descending order to choose the best alternatives. Figure 1 presents the stepwise procedure of Hwang and Yoon (1981) for implementing TOPSIS.

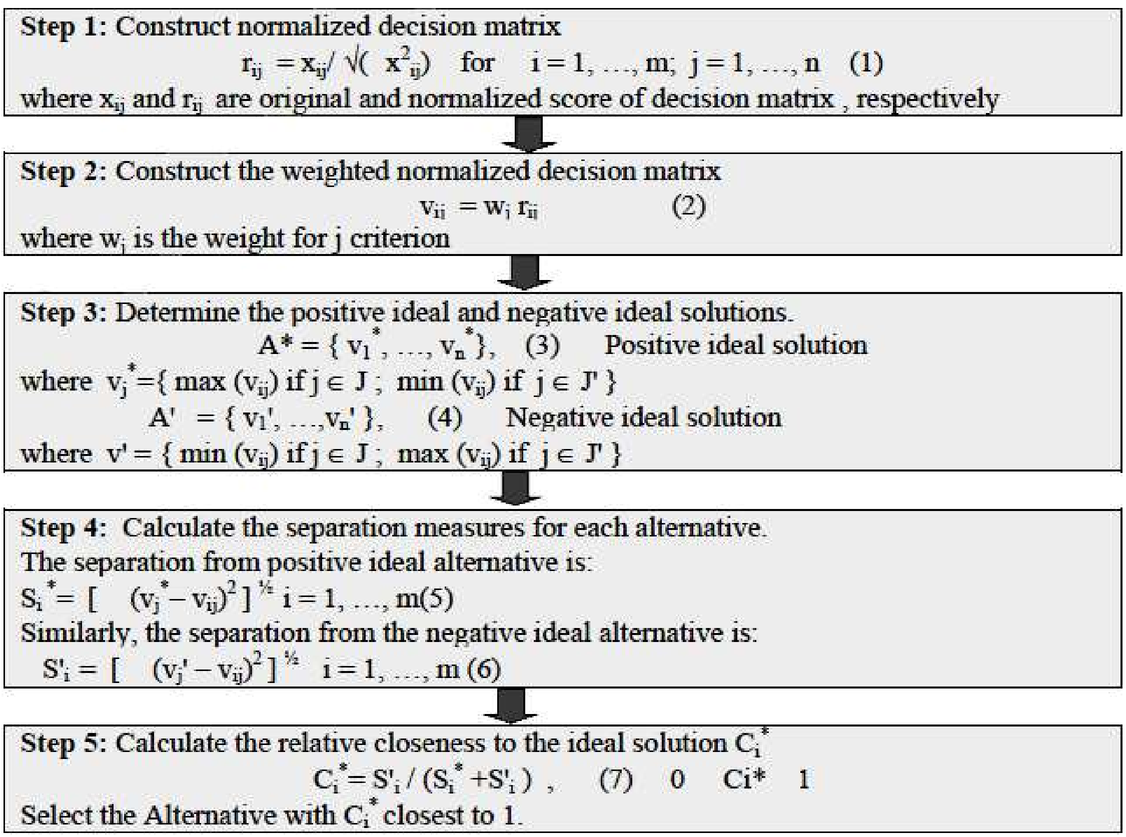

Figure1. Stepwise procedure for performing TOPSIS methodology

4. RANKING CRITERIA USING TOPSIS METHOD

In this research according to reviewing the literature on assessment of Malaysian government portals, a proposed hierarchical structure of criteria in Table 4 has been shown in figure 1. The goal is to rank the sub-criteria in this hierarchical structure.

In this research TOPSIS was used for ranking mentioned fact` hierarchy structure in previous section, a questionnaire was developed for gathering data from 200 citizens. Afterward, TOPSIS was applied for ranking .Table 6 show results of respondents' responses categorized by their importance.

Journal of Theoretical and Applied Information Technology
30th June 2012. Vol. 40 No.2

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Table 6. The result of questionnaire

	Not Important	Low Important	Moderate	Important	Very Important
Question No.	1	2	3	4	5
1	7	13	30	50	100
2	1	10	40	49	100
3	12	13	40	50	85
4	12	15	8	87	78
5	10	16	20	30	124
6	8	30	31	51	80
7	2	20	50	48	80
8	8	13	17	86	76
9	4	16	50	46	84

As can be seen in the Table 5, the question

$$W_j = \frac{d_j}{\sum_{k=1}^{n} d_k} \qquad (13)$$

number 1 that about 7 people answer it as not important, 13 people answered it as low important, 30 people answered it as average, 50 people answered it as important and 100 answered it as very important.

In first step of the TOPSIS each cell should be multiplied by itself and accordingly square and also sum of results of square in each column should be calculated .Therefore n_{ij} matrix was calculated by equation

$$n_{ij} = r_{ij} / (\sum_{i=1} (r_{ij})^2)^{1/2} \qquad (10)$$

Afterward, by using entropy method, objective weights were calculated. The following equation Calculates entropy measure of every index.

$$E_j = -K \sum_{i=1}^{m} [n_{ij} Ln(n_{ij})] \Rightarrow \left\{ \begin{matrix} \forall j = 1,2,..n \\ K = \frac{1}{Ln(m)} \end{matrix} \right\} \qquad (11)$$

The degree of divergence dj of the intrinsic information of each criterion C (j= 1, 2, …, n) may be calculated as

$$d_j = 1 - E_j \qquad (12)$$

The value dj represents the inherent contrast intensity of cj. The higher the dj is, the more important the criterion cj is for the problem. The objective weight for each criterion can be obtained. Accordingly, the normalized weights of indexes may be calculated as

In first step of the TOPSIS method each cell should be multiplied by itself and accordingly square and sum of results of square in each column should be calculated and the second step nij matrix can be caluclated as Table 7.

Table 7. Matrix nij calculated by equation 10

Question No.	nij				
	1	2	3	4	5
1	2.024171	3.286669	8.654645	14.36521	36.68225
2	0.04131	1.944775	15.38604	13.79635	36.68225
3	5.948584	3.286669	15.38604	14.36521	26.50293
4	5.948584	4.375743	0.615441	43.4921	22.31748
5	4.130961	4.978623	3.846509	5.171475	56.40263
6	2.643815	17.50297	9.241238	14.94556	23.47664
7	0.165238	7.779098	24.04068	13.23897	23.47664
8	2.643815	3.286669	2.779103	42.49803	21.18767

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9	0.660954	4.978623	24.04068	12.15871	25.883

$$E_1 = -k\sum_{i=1}^{m}(n_{ij}\ln(n_{ij})) = -11.0232$$

$$E_2 = -k\sum_{i=1}^{m}(n_{ij}\ln(n_{ij})) = -112.551$$

$$E_3 = -k\sum_{i=1}^{m}(n_{ij}\ln(n_{ij})) = -231.373$$

$$E_4 = -k\sum_{i=1}^{m}(n_{ij}\ln(n_{ij})) = -421.412$$

$$E5 = -k\sum_{i=1}^{m}(n_{ij}\ln(n_{ij})) = -442.431$$

$$w_1 = 0.006073$$

$$w_2 = 0.055107$$

$$w_1 = 0.104991$$

$$w_4 = 0.403406$$

$$w_5 = 0.430423$$

$$\sum w_i = 1 \Rightarrow w_1 + w_2 + w_3 + w_4 + w_5$$
$$= 0.006073+0.055107+0.104991$$
$$+0.403406+0.430423 = 1$$

Therefore matrix w can be defined as :

$$w = \begin{bmatrix} 0.006073 & 0 & 0 & 0 & 0 \\ 0 & 0.055107 & 0 & 0 & 0 \\ 0 & 0 & 0.104991 & 0 & 0 \\ 0 & 0 & 0 & 0.403406 & 0 \\ 0 & 0 & 0 & 0 & 0.430423 \end{bmatrix}$$

$$V = N_d \times w_{n\times n} =$$

$$\begin{bmatrix} 0.0183 & 0.2972 & 1.6545 & 4.9646 & 12.6772 \\ 0.0004 & 0.1759 & 2.9413 & 4.7680 & 12.6772 \\ 0.0537 & 0.2972 & 2.9413 & 4.9646 & 9.1593 \\ 0.0537 & 0.3957 & 0.1177 & 15.0307 & 7.7128 \\ 0.0373 & 0.4502 & 0.7353 & 1.7872 & 19.4925 \\ 0.0239 & 1.5827 & 1.7666 & 5.1651 & 8.1134 \\ 0.0015 & 0.7034 & 4.5957 & 4.5753 & 8.1134 \\ 0.0239 & 0.2972 & 0.5313 & 14.6871 & 7.3224 \\ 0.0060 & 0.4502 & 4.5957 & 4.2020 & 8.9451 \end{bmatrix}$$

To specify positive ideal and negative ideal:

$$\text{Positive Ideal} = A+ = \{(\max Vij), (\max Vij), i = 1,2,..,m\} = \{V1+, V2+, \ldots Vn+\} \quad (14)$$

Max Vi1	Max Vi2	Max Vi3	Max Vi4	Max Vi5
0.0537	1.5827	4.5957	15.0307	19.4925

Table 8. Max row of matrix V

$$\text{Negative Ideal} = A+ = \{(\min xVij), (\min Vij), i = 1,2,..,m\} = \{V1-, V2-, \ldots Vn-\} \quad (15)$$

Min Vi1	Min Vi2	Min Vi3	Min Vi4	Min Vi5
0.0004	0.1759	0.1177	1.7853	7.3224

Table 9 . Min row of matrix V

Positive Ideal and negative Ideal of V has been shown in Table 8 and Table 9. These tables show the maximum and the minimum of each column of matrix V in two rows. A+ is all the maximum numbers and A- is all the minimum numbers.

To calculated the distance the following equation used for positive and negative ideal:

$$\text{Distance i from positive Ideal} = \{\sum_{j=1}(v_{ij^-} - v_{j^+})^2\}^{1/2} \quad (16)$$

$$\text{Distance i from negative Ideal} = \{\sum_{j=1}(v_{ij^-} - v_{j-})^2\}^{1/2} \quad (17)$$

Table 10 shows the sum and square of five $(v_{ij^-}v_{j+})^2$ and $(v_{ij^-}v_{j-})^2$. Square is shown as di+ or distance i from positive ideal and di- or distance i from negative Ideal. Also, in last column sum of the di+ , di- has been calculated.

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30th June 2012. Vol. 40 No.2

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Table 10. The negative and positive ideal (id-, id+)

Sum $(v_{ij^-}v_{j+})^2$	**d i+**	**SQRT**	**Sum Of** $(v_{ij^-}v_{j+})^2$	**d i-**	**SQRT**	**Sum of d i+ and d i-**
260.4547	d 1+	16.138609	199.0433	d 1-	14.108271	30.2468796
2561.3388	d 2+	50.609671	310.2344	d 2-	17.613472	68.2231431
423.0454	d 3+	20.568067	163.4555	d 3-	12.784972	33.3530391
333.6223	d 4+	18.265331	134.8677	d 4-	11.613255	29.8785859
306.4445	d 5+	17.505556	233.3554	d 5-	15.275975	32.7815309
261.8534	d 6+	16.181885	111.2344	d 6-	10.546772	26.728657
240.8663	d 7+	15.519868	109.8865	d 7-	10.482676	26.0025441
229.3456	d 8+	15.144161	245.8554	d 8-	15.679777	30.8239374
245.4566	d 9+	15.667055	163.4564	d 9-	12.785007	28.4520614

In the last step, distance between Ai and ideal solution, will be calculated in order to rank all the 9 parameters of government portals.

The similarities to the positive ideal solution is given as

$$cli = \frac{d_1^-}{d_1^- + d_1^+} 0 \le cli \le 1 \qquad i = 1,2,...m \qquad (18)$$

Table 10 shows the distance between Ai and ideal solution for final ranking.

Table 11. The distance between Ai and ideal solution for final ranking

cli +	$\frac{d_1^-}{d_1^- + d_1^+}$	**Ranking**	**Sub Criteria No.**
cl 1 +	0.466437	0.258174	2
cl 2 +	0.258174	0.383323	3
cl 3 +	0.383323	0.388682	4
cl 4 +	0.388682	0.394587	6
cl 5 +	0.465993	0.40314	7
cl 6 +	0.394587	0.449353	9
cl 7 +	0.40314	0.465993	5
cl 8 +	0.508688	0.466437	1
cl 9 +	0.449353	0.508688	8

5. CONCLUSION

The Government portals and websites have become mainstreamed with E-Government. In the light of this, it is recommended that the portals/websites are developed and maintained to cater the need of citizen.

This study utilized normal TOPSIS to rank the parameters that affect on government portals quality based on Malaysian citizen perceptions.All parameters was identified from previous assessment of malaysian government portals in years 2010,2011 and 2012 .

According to the ranking, the ranks one to nine belong to services ,citizen interaction , usability , bonus , participiaction, security , content ,citizen support and citizen insight generation. Figure 2 demonstrates the most

important nine criteria that ranked by TOPSIS method.

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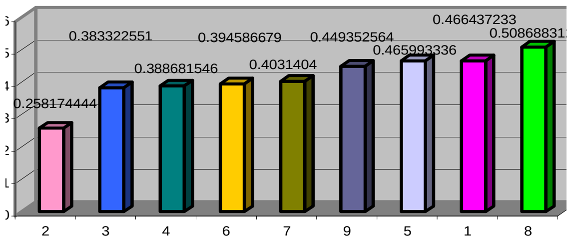

Figure 2. The most important nine criteria that ranked with TOPSIS method

Figure 3 is a kind of pie chart that shows the weight of each parameter as a slice of a circle, as it is obvious the biggest slice is belong to the first ranked that is services that means the degree of variety services provided by government to citizen with the weight of 0.508688 that in the pie chart below has about 13% percent of the whole pie.

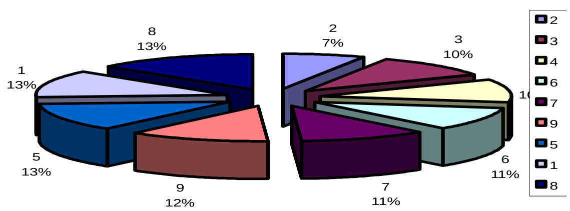

Figure 3. Pie chart of the result of parameter ranking

Therefore, Malaysian government must notice to ranking of these factors that consider them for citizen satisfaction of government portal. For future research, it could be possible to rank affected criteria and sub-criteria on government portal by fuzzy multi-criteria methods such as Fuzzy-TOPSIS with more accuracy in ranking.

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