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A Novel Fuzzy Group ANP Model for Global E-government Readiness Assessment from an e-Citizen Relationship Management Perspective

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ABSTRACT

E-government readiness assessment is a significant indicator in measuring citizen satisfaction levels in using E-government services. It provides an opportunity to learn about the government's strengths and weakness on the journey to excellence. Simultaneously, the main goal of E-government is to create an optimized relationship with its citizens. This paper presents an E-Government readiness assessment framework for assessing services from an e-Citizen Relationship Management (e-CiRM) perspective using fuzzy Group Analytic Network Process (FGANP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) approaches. The proposed framework is applicable to assess E-government readiness as the process of government assessment irrespective of size and structure, and sector. The results of this Global assessment allow governments to discern clearly its strengths and areas in which improvement can be made regarding citizen's needs.

Keywords (Required)

Fuzzy Group Analytic Network Process (FGANP), Global E-government Readiness, e-Citizen Relationship Management (e-CiRM), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS).

INTRODUCTION

Electronic government is the process of transformation of the relationships of government with the citizens through the use of the tools of Information and Communications Technology (Satyanarayana, 2006; Accenture, 2004; Department of Economic and Social Affairs, 2008; Gil-Garcı´a and Pardo, 2005; Greenberg, 2006; Grimsley and et al., 2007; Insua and et al., 2003; Veit and Parasie, 2009). Moreover, it is quite useful for countries and states to make a quick E-government readiness assessment (J. Satyanarayana, 2006). A high level of readiness to develop and implement e-government services is a prerequisite for a high performing and innovative public sector that delivers integrated services, making life easier for citizens. E-government readiness is therefore a significant indicator of whether a country is prepared to harvest efficiencies gained from ICT-enabled public administrations (OECD, 2009).

Therefore, the major goal of this paper is to assess E-government readiness based on quantitative models from e-CiRM perspective. Several research papers developed models for assessing E-government readiness at country and global levels as well as presenting the factors that can play a role in affecting the E-government readiness level. Bagchi et al (2005) conducted a study regarding E-government readiness, to assess the roles of institutional efficiency and interpersonal trust in determining the level of E-government readiness across countries. A study conducted by Al-Qmari and Al-Omari (2006) shows that there are six important factors to guarantee the success of E-government initiatives and consequently increase the E-government readiness level of a country. These factors are: government organization readiness, leadership and IT governance, customer readiness, accessibility by all, competency and technology readiness, and legal Readiness. Di Maio and et al. (2007) has presented a new E-government assessment framework. OECD (2006) has proposed outline for assessing E-government benefits.

But, previous research was mainly concerned with providing models of E-government readiness assessment without considering dependence systematically among strategic E-government readiness multi-indices and sub-indices for measuring the ability and capacity of E-governments to deliver online services to their citizens from e-CiRM perspective.

On the other hand, Multiple-attribute decision Making (MCDM) methods provide a formal framework for information exchange among the decision makers (DMs) thus enhancing and structuring the decision-making process. A number of decision methodologies in the MADM context have been presented in the MCDM literature. The ANP is one of these MADM methods. ANP is an extension of the analytic hierarchy process (AHP), and Saaty (1999) proposes evaluation of overall cumulative importance of all indicators within an evaluation model by integrating linkages and feedback into the decision system. In addition, the ANP is the mathematical theory that can deal with all kinds of dependence systematically (Saaty, 2003). Therefore, we will develop the ANP method to Fuzzy Group ANP to determine the importance weight of the strategic E-government readiness multi-indices and sub-indices in the proposed E-government readiness assessment framework. Recently, a number of researches in the field of applications of the ANP Approach have been done in the ANP literature. (Saaty and Vargas, 2006; Asan and Soyer, 2005; Ayag and Ozdemir, 2009; Carlucci and Schiuma, 2009; García-Melón and et al., 2009; Gómez-Navarro and et al., 2009 and 2008; Lee and Kim, 2000; Lin and et al., 2009; Jharkharia and Shankar,2007; Razmi and et al., 2009; Wey and et al., 2007; Yazgan and et al., 2009; Yuksel and Dagdeviren, 2007).

But, no researcher has applied the ANP method for assessing E-government readiness in the ANP literature. Furthermore, the applications of the ANP approach have some weakness such as analysis individual in crisp environments.

Therefore, the major contribution of this paper is to develop the ANP model to the proposed group ANP model for assessing E-government readiness based on this quantitative model from e-CiRM perspective. Additionally, we will determine the relative closeness to the best practice of E-government by fuzzy group TOPSIS. As researchers can rarely obtain precise information concerning an accurate E-government readiness assessment the new E-government readiness framework is presented in the fuzzy environment.

This paper is organized into three sections. The next two sections present the mathematical notations and the details of the proposed framework and section 3 presents concluding remarks and future research directions.

MATHEMATICAL NOTATIONS AND DEFINITIONS

Let us introduce the following mathematical notations and definitions:

c_i	The i^{th} strategic E-government readiness index
e_{ij}	The j^{th} sub-index of the i^{th} strategic E-government readiness index
N	Number of the strategic E-government readiness indices
p_i	Number of the sub-index of the i^{th} strategic E-government readiness index
m	Number of the E-government readiness committee members
$\tilde{W}_{ij}(k)$	The blocks of the fuzzy individual supermatrix representing the impact of the i^{th} strategic E-government readiness index on the j^{th} strategic E-government readiness index
$\tilde{W}_{ij}$	The blocks of the fuzzy weighted collective supermatrix representing the impact of the i^{th} strategic E-government readiness index on the j^{th} strategic E-government readiness index
$\tilde{w}_{in_i}^{jn_j}(k)$	The fuzzy individual importance of the n_i^{th} sub-index in the i^{th} strategic Egovernment readiness index on the n_j^{th} sub-index in the j^{th} strategic Egovernment readiness index evaluated by the k^{th} E-government readiness sub committee
$\tilde{w}_{in_i}^{jn_j}$	The fuzzy weighted collective importance of the n_i^{th} sub-index in the i^{th} strategic E-government readiness index on the n_j^{th} sub-index in the j^{th} strategic E-government readiness index
$\underline{\tilde{W}}$	The vector of the fuzzy importance weight of the j^{th} strategic E-government readiness index
$\underline{\tilde{W}_j}$	The vector of the fuzzy importance weight of the sub-indices of the j^{th} strategic E-government readiness index
$v(i)$	The voting power of the i^{th} E-government readiness committee member ($i = 1, 2, ..., m$)
$v_j(i)$	The voting power of the i^{th} member of the j^{th} E-government readiness sub-committee ($i = 1, 2, ..., p_j$)
$\tilde{a}_{jj'}^{*}(k)$	The fuzzy individual ideal E-government readiness
$\tilde{a}_{jj'}^{*}$	The fuzzy weighted collective ideal E-government readiness
$\tilde{a}_{jj'}^{-}(k)$	The fuzzy individual nadir E-government readiness
$\tilde{a}_{jj'}^{-}$	The fuzzy weighted collective nadir E-government readiness
G	The relative closeness to the Best Practice E-government

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THE PROPOSED FRAMEWORK

We propose the framework in Figure 1 to assess an E-government readiness from e-CiRM perspective. This framework consists of three main phases: (1), (2), and (3).

Figure 1 **Proposed Framework**

Phase 1: Constructing a structure of three-level hierarchy

In order to construct a structure of three-level hierarchy, this phase is divided into the following four processes.

Process 1-1: Instituting the E-government Readiness Committee

In the first process, it must be instituted an E-government readiness committee. Let us assume that E-government readiness committee members are as follows:

$$Committee = [CM(1), CM(2), \ldots, CM(m)] \quad (1)$$

Next, we assign the following voting power weights to the E-government readiness committee members:

$$\underline{V} = [v(1), v(2), \ldots, v(m)] \quad (2)$$

Process 1-2: Identifying the Strategic E-government Readiness Indices and Sub-Indices for E-government Readiness

In this process, the E-government readiness committee will identify list of the strategic E-Government readiness indices and sub-indices as follows:

Strategic E-government readiness Indices $c = \lfloor c_1, c_2, ..., c_j, \ldots, c_N \rfloor$ (3)

Sub-indices $c_j = \lfloor e_{j1}, e_{j2}, ..., e_{jn_j} \rfloor$ (4)

Process 1-3: Determining Sub-Committee Members for each E-government Readiness Sub-Index

In this process, the E-government readiness committee identifies members of each sub-committee for E-government readiness sub-indices. Let assume that this committee has identified the following members:

$$The\ j^{th}\ Sub-Committee = [SM_j(1), SM_j(2), ..., SM_j(p_j)] \quad j = 1,2,\ldots,N \tag{5}$$

Next, the following voting power weights are assigned to the members of the E-government readiness sub-committees:

$$\underline{V_j} = [v_j(1), v_j(2), \ldots, v_j(p_j)] \quad j = 1,2,\ldots,N \tag{6}$$

Process 1-4: Constructing a Structure of Three-Level Hierarchy Based on the Top-Down Approach

We divide this process into the following two procedures**:**

Procedure 1-4-1: Identifying Relationships between the Strategic E-government Readiness Indices at the Structure of Three-Level Hierarchy

In this procedure, the E-government readiness committee will identify direct and indirect relationships and feedbacks between the strategic E-government readiness indices at the first level of the structure of three-level hierarchy.

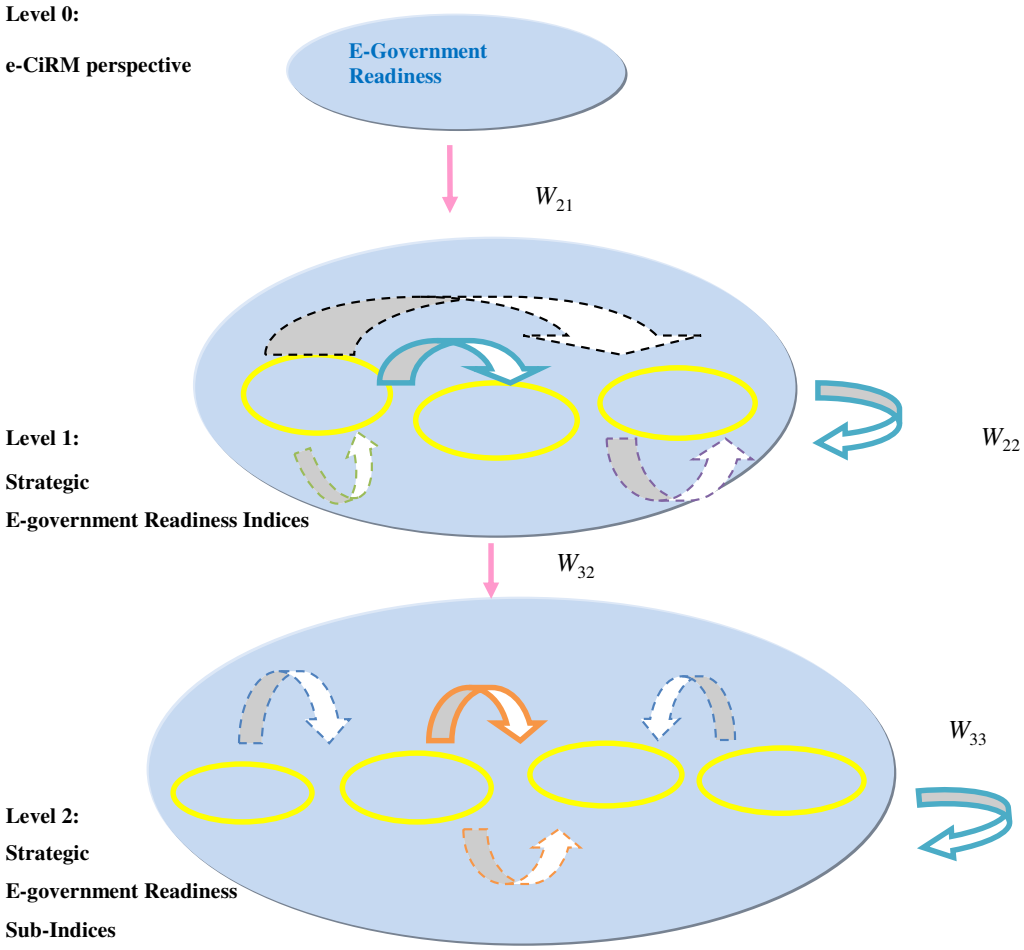

Figure 2: The structure of a three level hierarchy

Procedure 1-4-2: Identifying Relationships between the E-government Readiness Sub-Indices at the Structure of Three-Level Hierarchy

In this procedure, the E-government readiness sub-committees will identify direct and indirect relationships and feedbacks between the E-government readiness sub-indices at the second level of the structure of three-level hierarchy.

Phase 2: Calculating the Importance Weights of the Strategic E-government Readiness Indices and Sub-Indices

In this phase, the proposed FGANP approach is utilized to calculate the importance weights of the strategic E-government readiness indices and sub-indices for Global E-government readiness assessment from e-CiRM perspective. We divide this phase into the following three processes.

Process 2-1: *Constructing the Fuzzy Individual Supermatrices*

The fuzzy individual supermatrix evaluated by the members of the E-government readiness sub-committees will be as follows:

		e-CiRM perspective	***E-government readiness indices***			***E-government readiness sub-indices***		
			c_1	$\cdots$	c_N	e_{i1}	$\cdots$	e_{Nn_N}
e-CiRM perspective		0	0	$\cdots$	0	0	$\cdots$	0
E-government readiness indices	c_1	0	$\tilde{w}_1^1(k)$	$\cdots$	$\tilde{w}_1^N(k)$	0	$\cdots$	0
	$\vdots$	$\vdots$	$\vdots$	$\cdots$	$\vdots$	$\vdots$	$\cdots$	$\vdots$
	c_N	0	$\tilde{w}_N^1(k)$	$\cdots$	$\tilde{w}_N^N(k)$	0	$\cdots$	0
E-government readiness sub-indices	e_{i1}	0	$\tilde{w}_{i1}^1(k)$	$\cdots$	$\tilde{w}_{i1}^N(k)$	$\tilde{w}_{i1}^{i1}(k)$	$\cdots$	$\tilde{w}_{i1}^{Nn_N}(k)$
	$\vdots$	$\vdots$	$\vdots$	$\cdots$	$\vdots$	$\vdots$	$\cdots$	$\vdots$
	e_{Nn_N}	0	$\tilde{w}_{Nn_N}^1(k)$	$\cdots$	$\tilde{w}_{Nn_N}^N(k)$	$\tilde{w}_{Nn_N}^{j_1}(k)$	$\cdots$	$\tilde{w}_{Nn_N}^{Nn_N}(k)$

Table 1: The fuzzy individual supermatrix

Process 2-2: *Constructing the Fuzzy Weighted Collective Supermatrix of the Structure of Three-Level Hierarchy*

We will aggregate the fuzzy individual supermatrices to the following fuzzy weighted collective supermatrix:

		e-CiRM perspective	***E-government readiness indices***			***E-government readiness sub-indices***		
			c_1	$\cdots$	c_N	e_{i1}	$\cdots$	e_{Nn_N}
e-CiRM perspective		0	0	$\cdots$	0	0	$\cdots$	0
E-government readiness indices	c_1	0	$\tilde{w}_1^1$	$\cdots$	$\tilde{w}_1^N$	0	$\cdots$	0
	$\vdots$	$\vdots$	$\vdots$	$\cdots$	$\vdots$	$\vdots$	$\cdots$	$\vdots$
	c_N	0	$\tilde{w}_N^1$	$\cdots$	$\tilde{w}_N^N$	0	$\cdots$	0
E-government readiness sub-indices	e_{i1}	0	$\tilde{w}_{i1}^1$	$\cdots$	$\tilde{w}_{i1}^N$	$\tilde{w}_{i1}^{i1}$	$\cdots$	$\tilde{w}_{i1}^{Nn_N}$
	$\vdots$	$\vdots$	$\vdots$	$\cdots$	$\vdots$	$\vdots$	$\cdots$	$\vdots$
	e_{Nn_N}	0	$\tilde{w}_{Nn_N}^1$	$\cdots$	$\tilde{w}_{Nn_N}^N$	$\tilde{w}_{Nn_N}^{j_1}$	$\cdots$	$\tilde{w}_{Nn_N}^{Nn_N}$

Table 2: The fuzzy weighted collective supermatrix

Where:

$$\tilde{w}_{ij} = \frac{\sum_{k=1}^{p_i}\left(v_i(k)\right)\left[\tilde{w}_{ij}(k)\right] + \sum_{k=1}^{p_j}\left(v_j(k)\right)\left[\tilde{w}_{ij}(k)\right]}{\sum_{k=1}^{p_i} v_i(k) + \sum_{k=1}^{p_j} v_j(k)} \tag{7}$$

Process 2-3: *Calculating the Importance Weight of the Strategic E-government Readiness Indices and Sub-Indices*

The importance weights vector of the strategic E-government readiness indices and sub-indices for E-government readiness will be calculated for Table 2 based on the eigenvector method as follows:

$$\underline{W} = \begin{bmatrix} w_1 & w_2 & \cdots & w_N \end{bmatrix}^T \tag{8}$$

$$\underline{W_j} = \begin{bmatrix} w_j(1) & w_j(2) & \cdots & w_j(n_j) \end{bmatrix}^T \tag{9}$$

Where:

$$\begin{aligned} &\left|\tilde{W}_{ij} - \lambda.I\right| = 0 \\ &\tilde{W}_{ij}.\underline{W} = \lambda_{\max}.\underline{W} \end{aligned} \tag{10}$$

$$\begin{bmatrix} \tilde{w}_{i1}^{(j_1)} & \tilde{w}_{i1}^{(j_2)} & \cdots & \tilde{w}_{i1}^{(j_{n_j})} \\ \tilde{w}_{i2}^{(j_1)} & \tilde{w}_{i2}^{(j_2)} & \cdots & \tilde{w}_{i2}^{(j_{n_j})} \\ \vdots & \vdots & \cdots & \vdots \\ \tilde{w}_{in_i}^{(j_1)} & \tilde{w}_{in_i}^{(j_2)} & \cdots & \tilde{w}_{in_i}^{(j_{n_j})} \end{bmatrix} \begin{bmatrix} w_{i1} \\ w_{i2} \\ \vdots \\ w_{in_1} \end{bmatrix} = \lambda. \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} w_{i1} \\ w_{i2} \\ \vdots \\ w_{in_1} \end{bmatrix} \tag{11}$$

Phase 3: Assessing the E-government Readiness from e-CiRM Perspective

In this phase, we use the proposed Fuzzy Group TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) approach to calculate the relative closeness to the best practice E-government. We divide this phase is divided into the following three processes:

Process 3-1: Determining the Individual E-government Readiness at the E-government Readiness Sub-Indices Level

We divide this process into the following two procedures:

Procedure 3-1-1: The Fuzzy Individual E-government Readiness Assessment at the Level of the E-government Readiness Sub-Indices

In this procedure, the members of the E-government readiness sub-committees determine the fuzzy individual E-government readiness assessment values for each E-government readiness sub-index as follows:

No.	The importance weight of the strategic E-government readiness indices	E-government readiness Indices	The importance weight of the E-government readiness sub-indices	The fuzzy individual E-government readiness sub-index Values	The individual ideal e-government readiness	The individual nadir e-government readiness
1	$\tilde{w}_1$	c_1	$\tilde{w}_1(1)$	$\tilde{a}_{11}(k)$	$\tilde{a}^*_{11}(k)$	$\tilde{a}^-_{11}(k)$
			$\tilde{w}_1(2)$	$\tilde{a}_{12}(k)$	$\tilde{a}^*_{12}(k)$	$\tilde{a}^-_{12}(k)$
			⋮	⋮	⋮	⋮
			$\tilde{w}_1(n_1)$	$\tilde{a}_{1n_1}(k)$	$\tilde{a}^*_{1n_1}(k)$	$\tilde{a}^-_{1n_1}(k)$
2	$\tilde{w}_2$	c_2	$\tilde{w}_2(1)$	$\tilde{a}_{21}(k)$	$\tilde{a}^*_{21}(k)$	$\tilde{a}^-_{21}(k)$
			$\tilde{w}_2(2)$	$\tilde{a}_{22}(k)$	$\tilde{a}^*_{22}(k)$	$\tilde{a}^-_{22}(k)$
			⋮	⋮	⋮	⋮
			$\tilde{w}_2(n_2)$	$\tilde{a}_{2n_2}(k)$	$\tilde{a}^*_{2n_2}(k)$	$\tilde{a}^-_{2n_2}(k)$
⋮	⋮	⋮	⋮	⋮	⋮	⋮
N	$\tilde{w}_N$	c_N	$\tilde{w}_N(1)$	$\tilde{a}_{N1}(k)$	$\tilde{a}^*_{N1}(k)$	$\tilde{a}^-_{N1}(k)$
			$\tilde{w}_N(2)$	$\tilde{a}_{N2}(k)$	$\tilde{a}^*_{N2}(k)$	$\tilde{a}^-_{N2}(k)$
			⋮	⋮	⋮	⋮
			$\tilde{w}_N(n_N)$	$\tilde{a}_{Nn_N}(k)$	$\tilde{a}^*_{Nn_N}(k)$	$\tilde{a}^-_{Nn_N}(k)$

Table 3: The fuzzy individual E-government readiness at the E-government readiness sub-indices level

Procedure 3-1-2: The Identification of the Individual Ideal and Nadir E-government Readiness

In this procedure, the members of the E-government readiness sub-committees identify the individual ideal and the nadir E-government readiness, $a^*_{jj'}(k)$ and $a^-_{jj'}(k)$, based on benchmarking e-governments, that indicate the most preferable values and the least preferable values for each E-government readiness sub-index as shown above in table 3.

Process 3-2: Determining the Fuzzy Weighted Collective E-government Readiness at the E-government Readiness Sub-Indices Level

We divide this process into the following two procedures:

Procedure 3-2-1: The Fuzzy Weighted Collective E-government Readiness Assessment at the Level of the E-government Readiness Sub- Criteria

In this procedure, we will aggregate the fuzzy individual E-government readiness assessment values to the following fuzzy weighted collective E-government readiness assessment values as follows:

No.	*The importance weight of the strategic E-government readiness indices*	*E-government readiness Indices*	*The importance weight of the E-government readiness sub-indices*	*The fuzzy weighted collective E-government readiness sub-index Values*	*The weighted collective ideal E-government readiness*	*The weighted collective nadir E-government readiness*
1	$\tilde{w}_1$	c_1	$\tilde{w}_1(1)$	$\tilde{a}_{11}$	$\tilde{a}^*_{11}$	$\tilde{a}^-_{11}$
			$\tilde{w}_1(2)$	$\tilde{a}_{12}$	$\tilde{a}^*_{12}$	$\tilde{a}^-_{12}$
			$\vdots$	$\vdots$	$\vdots$	$\vdots$
			$\tilde{w}_1(n_1)$	$\tilde{a}_{1n_1}$	$\tilde{a}^*_{1n_1}$	$\tilde{a}^-_{1n_1}$
2	$\tilde{w}_2$	c_2	$\tilde{w}_2(1)$	$\tilde{a}_{21}$	$\tilde{a}^*_{21}$	$\tilde{a}^-_{21}$
			$\tilde{w}_2(2)$	$\tilde{a}_{22}$	$\tilde{a}^*_{22}$	$\tilde{a}^-_{22}$
			$\vdots$	$\vdots$	$\vdots$	$\vdots$
			$\tilde{w}_2(n_2)$	$\tilde{a}_{2n_2}$	$\tilde{a}^*_{2n_2}$	$\tilde{a}^-_{2n_2}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
N	$\tilde{w}_N$	c_N	$\tilde{w}_N(1)$	$\tilde{a}_{N1}$	$\tilde{a}^*_{N1}$	$\tilde{a}^-_{N1}$
			$\tilde{w}_N(2)$	$\tilde{a}_{N2}$	$\tilde{a}^*_{N2}$	$\tilde{a}^-_{N2}$
			$\vdots$	$\vdots$	$\vdots$	$\vdots$
			$\tilde{w}_N(n_N)$	$\tilde{a}_{Nn_N}$	$\tilde{a}^*_{Nn_N}$	$\tilde{a}^-_{Nn_N}$

Table 4: The fuzzy weighted collective E-government readiness at the E-government readiness sub-indices level

Procedure 3-2-2: The Identification of the Weighted Collective Ideal and Nadir E-government Readiness

In this procedure, the fuzzy individual ideal and nadir E-government readiness, $\tilde{a}^{*}_{jj'}(k)$ and $\tilde{a}^{-}_{jj'}(k)$, will be aggregated to the fuzzy weighted collective ideal and nadir E-government readiness, $\tilde{a}^{*}_{jj'}$ and $\tilde{a}^{-}_{jj'}$, as shown in table 4 above.

Where:

$$\tilde{a}^{*}_{jj'} = \frac{\sum_{k=1}^{p_j}\left(v_j(k)\right)\left[\tilde{a}^{*}_{ij}(k)\right]}{\sum_{k=1}^{p_j} v_j(k)} \tag{12}$$

$$\tilde{a}^{-}_{jj'} = \frac{\sum_{k=1}^{p_j}\left(v_j(k)\right)\left[\tilde{a}^{-}_{ij}(k)\right]}{\sum_{k=1}^{p_j} v_j(k)} \tag{13}$$

Process 3-3: Calculating the Score of E-government Readiness

In this process, we define the relative closeness to the Best Practice E-government as:

$$G = \frac{D_j^{-}}{D_j^{*} + D_j^{-}} \tag{14}$$

Where:

$$D_j^{*} = \frac{\sum_{j=1}^{N} \tilde{w}_j . d_j^{*}}{\sum_{j=1}^{N} \tilde{w}_j} \tag{15}$$

$$D_j^{-} = \frac{\sum_{j=1}^{N} \tilde{w}_j . d_j^{-}}{\sum_{j=1}^{N} \tilde{w}_j} \tag{16}$$

$$d_j^{*} = \sqrt{\sum_{j'=1}^{n_j} \tilde{w}_{jj'} . E\left[\tilde{a}\left(e_{jj'}\right) - \tilde{a}^{*}\left(e_{jj'}\right)\right]^2} \qquad j = 1,2,\ldots,N \tag{17}$$

$$d_j^{-} = \sqrt{\sum_{j'=1}^{n_j} \tilde{w}_{jj'} . E\left[\tilde{a}\left(e_{jj'}\right) - \tilde{a}^{-}\left(e_{jj'}\right)\right]^2} \qquad j = 1,2,\ldots,N \tag{18}$$

Now, if the relative closeness to the best practice E-government is close to 1, the E-government planners will implement an E-government framework as a strategic IT investment opportunity. Otherwise, if this relative closeness is close to zero, the

proposed E-government readiness framework will provide a reasonably reliable estimate, which will able the E-government planners to identify the area that need improvement.

CONCLUSIONS

The proposed framework provides a highly structured, fact based approach for identifying a government's strengths and areas for improvement and assessing E-government readiness from a perspective of citizen orientation in E-government. In order for identification of direct and indirect relationships and feedbacks between strategic E-government readiness indices and sub-indices of the structure of three-level hierarchy, we integrated a top-down approach in three levels with the proposed FGANP approach to calculate the importance weights of strategic E-government readiness indices and sub-indices. After that, the relative closeness to the best practice E-government was determined by fuzzy group TOPSIS. As one can rarely obtain precise information concerning the accurate E-government readiness assessment, we presented the new E-government readiness framework in the fuzzy environment. A novel framework was applicable at four levels: national, regional, state/provincial and local.

References and Citations

1. Accenture , 2004. E-government Leadership: High Perfomance, Maximum [online] , http://www.accenture.com/xdoc/en/industries/government/gove_egov_value.pdf
2. Al-Omari, A. and Al-Omari, H., 2006. E-Government Readiness Assessment Model, Journal of Computer Science 2 (11): 841-845.
3. Asan, U., Soyer, A., 2005. Identifying Strategic Management Concepts by Analyzing the Relationships Among Them: An Analytic Network Process Approach, 35th International Conference on Computers and Industrial Engineering
4. Ayag, Z., Ozdemir, R.G., 2009. A hybrid approach to concept selection through fuzzy analytic network process, *Computers & Industrial Engineering*, 56, 368–379.
5. Bagchi, K., P. Kirs and G. Udo, 2005. An Empirical Analysis of the Factors Impacting eEnvironment Infrastructure and Use, In , Procs. DSI 2005, San 5.
6. Francisco, California. Carlucci , D., Schiuma, G., 2009. Applying the analytic network process to disclose knowledge assets value creation dynamics, *Expert Systems with Applications*, 36, 7687–7694.
7. Department of Economic and Social Affairs, Division for Public Administration and Development Management, 2008. United Nations E-government Survey 2008: From E-government to Connected Governance, United Nations.
8. Di Maio, A., Mc Clure D. and Harris R. (2007), A New E-government Assessment Framework,
9. Gartner Inc, Stamford.
10. García-Melón, M., Gómez-Navarro, T., Acuña-Dutra, S. 2009. An ANP Approach to Assess the Sustainability of Tourist Strategies for the Coastal NP of Venezuela, 5th International Vilnius Conference.
11. Gil-Garcı´a, J. R., Pardo, T. A. , 2005. E-government success factors: Mapping practical tools to theoretical foundations, *Government Information Quarterly*, 22, 187–216.
12. Gómez-Navarro, T. García-Melón, M., Acuña-Dutra, Si., Díaz-Martín, D., 2009. An environmental pressure index proposal for urban development planning based on the analytic network process, *Environmental Impact Assessment Review*, 29, 319–329.
13. Gómez-Navarro, T. García-Melón, M. Díaz-Martín, D. Acuna-Dutra, S. 2008. Evaluation of urban development proposals: An ANP approach, *World Academy of Science, Engineering and Technology*, 44.
14. Greenberg, S. R., 2006. State E-government Strategies: Identifying Best Practices and Applications, Report for the Congressional Research Service.
15. Grimsley, M., Meehan , A., and Tan, A., 2007. Evaluative design of E-government projects: A community development perspective, Transforming Government: People, Process and Policy, 1 (2), 174-193.
16. Hwang, C.L., & Lin, M.J. (1987). Group decision making under multiple criteria, Lecture Notes in Economics and Mathematical Systems, No. 281, Springer: Berlin.

17. Lee, J. W., Kim, S. H. 2000. Using analytic network process and goal programming for interdependent information system project selection, *Computers & Operations Research*, 27, 367}382.
18. Lin, C.-T., Lee, C., Chen, W.-Y., 2009. An expert system approach to assess service performance of travel intermediary, *Expert Systems with Applications*, 36, 2987–2996.
19. Insua, D. R., Holgado, J., Moreno, R., 2003. Multicriteria e-Negotiation Systems for e-Democracy, *Journal of Multi-criteria Decision Analysis*, 12: 213–218.
20. Jharkharia, S., Shankar, R., 2007. Selection of logistics service provider: An analytic network process (ANP) approach, Omega 35, 274 – 289.
21. OECD, 2009. Government at a Glance 2009 [online],
22. http://browse.oecdbookshop.org/oecd/pdfs/browseit/4209151e.pdf
23. OECD, 2006. OECD E-government project – Proposed Outline for Assessing E-government Benefits, [online], Public Governance Committee,
24. http://webdomino1.oecd.org/COMNET/PUM/egovproweb.nsf/viewHtml/index/$FILE/GOV.PGC.EGOV.2006.1.doc
25. Razmi, J., Rafiei, H., Hashemi, M. 2009. Designing a decision support system to evaluate and select suppliers using fuzzy analytic network process.
26. Saaty, T. L., Vargas, L. G., 2006. Decision Making with the Analytic Network Process: Economic, Political, Social and Technological Applications with Benefits, Opportunities, Costs and Risks, Springer.
27. Satyanarayana, J., 2006. E-government: The science of the possible, Prentice-Hall of India.
28. Veit, D. J. Parasie, N. P. 2009. Can National E-government Standards find Acceptance? Proceedings of the 42nd Hawaii International Conference on System Sciences.
29. Wey, W.-M., Wu, K.-Ya., 2007. Using ANP priorities with goal programming in resource allocation in transportation, *Mathematical and Computer Modeling*, 46, 985–1000.
30. Yazgan , H. Res., Boran, Se., Goztepe, K., 2009. An ERP software selection process with using artificial neural network based on analytic network process approach, *Expert Systems with Applications*, 36, 9214–9222.
31. Yuksel,I., Dagdeviren, M., 2007. Using the analytic network process (ANP) in a SWOT analysis – A case study for a textile firm, *Information Sciences*, 177, 3364–3382.
32. Zadeh, L.A. (1965). Fuzzy sets, Information and Control 8, 338-353.
33. Zadeh, L.A. (1975). The concept of a linguistic variable and its application to approximate reasoning, Information Sciences, 8, 199–249(I), 301–357(II).
34. Zimmermann, H.J. (1991). Fuzzy Set Theory and its applications, 2nd Edition, Kluwer Academic Publishers: Boston.