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INFORMATION TECHNOLOGY IMPLEMENTATION PRIORITIZATION IN E-GOVERNANCE

- AN INTEGRATED MULTI CRITERIA DECISION MAKING APPROACH

DEBENDRA KUMAR MAHALIK
Post Graduate Department of Business Administration
Sambalpur, Orissa
India
debendra_mahalik@hotmail.com

Abstract

The information and communication technology revolution has changed the manner in which business is conducted and e-governance is no exception. The computerization in relation to the government process may, if implemented in one go, result in failure. E-governance software consists of different processes, termed modules. Researchers are now attempting to prioritize these modules in relation to e-governance implementation. A major issue has arisen for the planners in relation to the priorities involved for these modules with regards to the IT implementation as no clear cut formula exists for the solution to this problem. This paper examines different implementation issues with respect to e-governance in a typical University education system. Two multi-criteria decision making methods (MCDM) viz. analytical hierarchy process (AHP) and technique for order preference by similarity to ideal solution (TOPSIS) are used in the paper. The novelty of the paper lies in its integration of the AHP and TOPSIS methods in relation to the priorities to be adopted in relation to IT implementation.

Keywords: MCDM, AHP, TOPSIS, Prioritization, IT implementation

1. Introduction

The application of Information Communication Technology (ICT) can assist organizations in their drive to become more competitive and is an essential ingredient for business survival and governments are no exception to this rule. ICT application has meant that governance has improved for both the Government concerned and its public. Governments across the globe have deployed ICT for several decades in order to increase both the efficiency and effectiveness of their functions. The increasing growth rate of technology has resulted in a subsequent decrease in the costs associated with information. These technologies have proved to be helpful in the coordination of activities which has resulted in more effective management of the e-governance process.

Literature shows that the use of Information Technology (IT) plays an important role in managing the processes of governance. Early applications were focused on building management information systems for planning and monitoring. Many large projects have been undertaken and there have been a number of prominent failures, which have involved a system either never being implemented or being implemented but immediately abandoned. There have also been some partial failures [Heeks, 2003] but only a minority of the projects can be considered as being total successes. [Heeks and Bhantnagar, 2002; Fulton, 2003; UNDESA, 2003]. There are many reasons for the failure of these projects and this includes poor project management, the manner in which it is implemented, badly defined requirements, poor communication, bad risk management, technology which is too new, an inability to grasp the business environment which the system is to support politics and commercial pressures. The point to be made in this case is that it is no longer a possibility for the government system to continue making mistakes as this involves the use of resources including money and time. E-governance software consists of different processes termed modules. Generally, these modules are implemented singly and thus it may not prove possible for employees to be totally involved in the change from a traditional environment to a computerized environment.

However, it is generally accepted that such a significant shift may require the workforce to alter such aspects as its mindset, culture, tradition etc. and if this change of style is not properly planned it increases the chances of failure. Thus, many implementations have adopted a modular approach, in which different modules are selected in a phase-wise manner as the different modules have different requirements. The introduction can thus proceed in a slower manner until all the modules have been implemented. This strategy allows for sufficient time to introduce change and enables the user to give priority to particular modules. Researchers are now attempting to develop a model which has the ability to prioritize these modules for e-governance implementation. However, this might also serve as a tool in order to identify the perceptions and beliefs of a large user set in terms of what is deemed to be important and, based upon this, to select a priority area. Thus the ability to prioritize an IT implementation is a major issue for planners as, at present, there is no clear cut formula available to solve this problem.

2. Literature Survey

The E-governance can be defined by "Establishing a Networked Government for greater transparency and accountability in delivery of public services to facilitate moral & material progress of all citizens" (http://orissa.gov.in). E-governance is the application of electronic means in order to improve the interaction between a government and its citizens; and to increase the administrative effectiveness and efficiency within the internal government operations. Additionally, it is the application of IT to the Government processes to bring Simple, Moral, Accountable, Responsive, and Transparent (SMART) governance (e-Governance concept paper, Government of India). The strategic objective of e-governance is to support and simplify governance for the e-governance community which is comprised of citizens, civil society organizations, private companies, government lawmakers, and network regulators [Tapscott and Agnew, 1999]. In the opinion of Backus [2001] the formal mechanisms of e-governance should be more than the creation of an on-line presence. E-Governance is defined as the process of enabling transactions to take place between concerned groups and the government through multiple channels by linking all transaction points, decision points, enforcing/implementation points and repositories of data using information and communication technologies to improve the efficiency, transparency, accountability and effectiveness of a government [Backus, 2001]. Thus e-governance has similarities to system development methodology.

Many system development methodologies have been used over the years to analyze, define, design, test, implement, and maintain custom computer applications. These approaches include [Jacobsen et al., 1999; Sliger, 2006, Turban and Volonino 2009; Woodward 2009] and also discussed by [Todd, 2009]. "A system development methodology refers to the framework that is used to structure, plan, and control the process of developing an information system. A wide variety of such frameworks have evolved over the years, each with its own recognized strengths and weaknesses. These software development approaches are: Waterfall Approach: linear framework type Prototyping Approach: iterative framework type, Incremental Approach: combination of linear and iterative framework type, Spiral Approach: combination of linear and iterative framework type, Rapid Application Development (RAD) Approach: Iterative Framework Type Extreme Programming Approach. One system development methodology is not necessarily suitable for use by all projects. Each of the available methodologies is best suited to specific kinds of projects, based on various technical, organizational, project and team considerations. Every software development methodology framework acts as a basis for applying specific approaches to develop and maintain software (https://www.cms.gov). In our case, an iterative application development was selected, in which the development and implementation proceeded in a phase-wise manner. In order to proceed in phase, it was vital to select the correct sequence of modules and to adopt a multi-criteria approach in relation to the module prioritization problem.

Multi criteria decision making (MCDM) problem is a discipline aimed at supporting decision makers who are faced with numerous and sometimes conflicting evaluations. The aim of MCDM is to highlight these conflicts and to derive a means of arriving at a compromise and by using a transparent process. Preferences differ so the outcome depends on the decision maker and their particular goals and preferences [Saaty, 2005]. Many MCDM methods exist today and these include: Aggregated Indices Randomization Method (AIRM), Analytic hierarchy process (AHP), Analytic network process (ANP), Data envelopment analysis (DEA), Dominance-based rough set approach (DRSA), ELECTRE (Outranking), The evidential reasoning approach, Goal programming, Grey relational analysis (GRA), Inner product of vectors (IPV), Multi-Attribute Global Inference of Quality (MAGIQ), Multi-attribute utility theory (MAUT), Multi-attribute value theory (MAVT), New Approach to Appraisal (NATA), Nonstructural Fuzzy Decision Support System (NSFDSS), Potentially All Pair wise Rankings of all possible Alternatives (PAPRIKA), PROMETHEE (Outranking) , Superiority and inferiority ranking method (SIR method), Value analysis (VA),Value engineering (VE), Weighted product model (WPM), Weighted sum model (WSM) All claim to be able to accurately solve this type of problem. However, it is often the case that different methods yield different results for exactly the same problem and thus different solutions for simple problems may be suggested from the same data (i.e., those with very few alternatives and criteria). Different authors are also adopting various combinations of these method such as Fuzzy AHP, Fuzzy ANP, Fuzzy DEA etc.

A case has been chosen in to analyze the IT implementation priority issue, using Factor analysis, AHP and TOPSIS as the quantitative technique.

3. Methodology

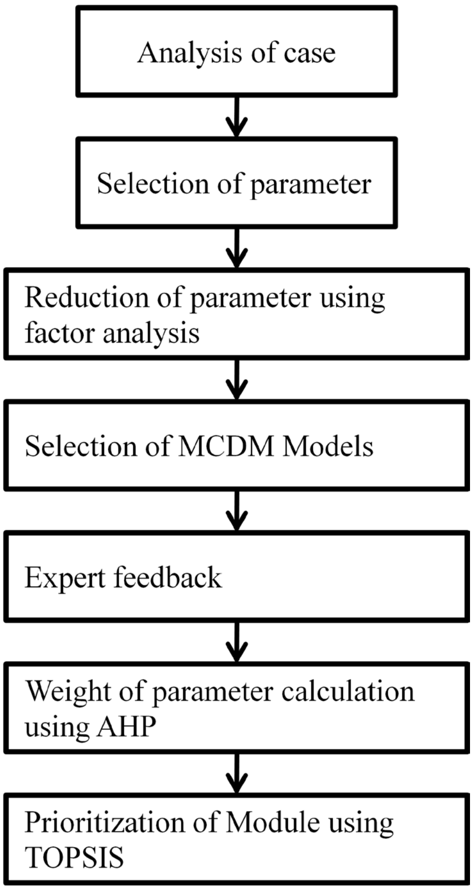

Figure 1. Proposed multi-criteria decision making process.

The above diagram in Figure 1 represents the model that has been proposed for the multi-criteria decision making process, which is to be used in order to prioritize the module implementation for the e-governance. The model uses factor analysis and AHP, TOPSIS technique in an integrated manner in its quest to solve the prioritization problem. In this paper the priority problem for IT implementation is addressed by using two methods namely the multi-criteria decision making method (MCDM) viz. analytical hierarchy process (AHP) and a technique to determine order preference by means of its similarity to an ideal solution (TOPSIS). The weights associated with the criteria and the alternatives are calculated using the AHP method, which is being used as an input for TOPSIS analysis. Thus, the paper attempts to demonstrate an integrated method in order to prioritize various processes for IT implementation.

3.1. Analytic Hierarchy Process (AHP) Application

The Analytic Hierarchy Process (AHP) deals with complex systems and enables a choice to be made from several alternatives. It also provides a comparison in relation to the considered options. This method was first presented by Saaty [1980]. The decision contains many social and economic factors, which must be evaluated by using linguistics variables and, it has been discovered that AHP has been applied to a variety of problems [Paulson, 1993]. The method is based on the subdivision of the problem into a hierarchical form and can assist the analysts to organize the critical aspects of a problem into a hierarchical structure in a similar manner to that of a family tree. The method reduces complex decisions to a series of simple comparisons and rankings, after which the results are synthesized. This process, not only assists the analysts in arriving at the best decision, but also provides a clear rationale for the choices made. The objective of using an analytic hierarchy process (AHP) is to identify the preferred alternative and also to determine a ranking for the alternatives when all the decision criteria are considered simultaneously [Saaty, 1980]. Recently there has been an increase in the use of AHP within different areas of management such as SCM and one such application has been conducted by [Min, 2007]. Others [Jing, 2006; Milind, 2007; Jukka, 2001; Felix, 2008; Jig Yuan, 2006] have also applied AHP within a supply chain evaluation.

The detailed step-wise procedure for the use of AHP is as follows:

Step-1: Define the decision criteria in the form of a hierarchy of objectives. The hierarchy is structured on different levels: from the top (i.e. the goal) through the intermediate levels (criteria and sub-criteria on which subsequent levels depend) to the lowest level (i.e. the alternatives);

Step-2: Weigh up the criteria, sub-criteria and alternatives as a function of their importance for the corresponding element in the higher level. For this purpose, AHP uses simple pair-wise comparisons to determine weights and ratings so it is possible for the analyst to concentrate on just two factors at any one time.

Step-3: After a judgment matrix has been developed, a priority vector to provide weights for the elements of the matrix is calculated.

This is the normalized eigenvector for the matrix. The use of AHP instead of another multi-criteria technique is based on the following reasons:

1. Quantitative and qualitative criteria can be included in the decision making.
2. A large quantity of criteria can be considered.
3. A flexible hierarchy can be constructed according to the problem. After obtaining all the relevant data in different tables, the AHP analysis has been used to priorities these computerization projects. In this case, Expert choice 11.5 version software has been used for the AHP calculation.

3.2. TOPSIS Application

TOPSIS stands for technique for order preference by similarity to ideal solution and was developed by Hwang and Yoon [1981]. The TOPSIS reduces the influence of an expert's subjective factors to the decision of scheme while simultaneously avoiding complex calculations. It is a very effective method in multi-attribute decision analysis. It uses a normalized matrix to discover both the superior and inferior projects (i.e. the ideal and non-ideal solution) and then calculates the distances of other projects from the ideal and the non-ideal solution. Then the relative closeness to the ideal solution is calculated. The relative closeness can be ranked in descending order. The relative closeness can be place within the range of 0 to 1 and if it falls closer to 1, the project being evaluated is said to be closer to the ideal.

The algorithm for the TOPSIS applications is as follows:

Step-1: Consider Table 5 as an input.
Step-2: In a multi-criteria decision making process there may be 'm' criteria C_1, C_2, ... , C_m which have to be evaluated on n properties and which have performance indices X_1, X_2, …, X_n . This evaluation will give a m × n matrix in Figure 2.

$$
\begin{array}{c} \\ D= \end{array}
\begin{array}{c}
 \\ A_1 \\ A_2 \\ A_3 \\ \vdots \\ A_m
\end{array}
\begin{array}{c}
x_1 \; x_2 \; x_3 \ldots x_n \\
\begin{bmatrix}
x_{11} & x_{12} & x_{13} & \cdots & x_{1n} \\
x_{21} & x_{22} & x_{23} & \cdots & x_{2n} \\
x_{31} & x_{32} & x_{33} & \cdots & x_{3n} \\
\vdots & \vdots & \vdots & & \vdots \\
x_{m1} & x_{m2} & x_{m3} & \cdots & x_{mn}
\end{bmatrix}
\end{array}
$$

Figure 2. Evaluation matrix.

The original data can be normalized in order to obtain the normalized rating r_{ij} which can be calculated using the formula given in Equation 1.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$

Equation 1. Normalization of data.

Table-6 gives the weights for the five alternatives against the five criteria and then calculates the sum of squares column.

Step-3: This step calculates the weighted normalized ratings v_{ij}. The weight of the j^{th} attribute or criterion is taken as w_j . The weighted normalized ratings matrix V is obtained by $v_{ij} = w_i (\cdot) r_{ij}$ shown in Table 7.

Step-4: In this step the positive-ideal solution A* and the negative-ideal solution A^- are calculated. Then the closeness coefficient (CC_i) is calculated for each alternatives as,

$$A^{+} = \{(\max_i v_{ij} | j \in J), (\min_i v_{ij} | j \in J^{'}) | i = 1,2,...m\}$$
$$= \{v_1^{+}, v_2^{+}, ..., v_j^{+}, ..., v_n^{+}\}$$
$$A^{-} = \{(\min_i v_{ij} | j \in J), (\max_i v_{ij} | j \in J^{'}) | i = 1,2,...m\}$$
$$= \{v_1^{-}, v_2^{-}, ..., v_j^{-}, ..., v_n^{-}\}$$
$$where \quad J = \left\{ j = 1,2,...,n | j \quad associated \quad with \quad benefit \quad criteria \right\}$$
$$J^{'} = \left\{ j = 1,2,...,n | j \quad associated \quad with \quad \cos t \quad criteria \right\}$$

$$CC_i = \frac{d_i^-}{d_i^- + d_i^*}, \; i = 1,2, \dots, m$$

Where,

$$d_i = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^{+}\right)^2} \; i = 1,2,...,m$$
$$d_i^{-} = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^{-}\right)^2} \; i = 1,2,...,m$$

It can be noted that

$$CC_i = \begin{cases} 1 & if \; A_i = A^* \\ 0 & if \; A_i = A^- \end{cases}$$

The result of above calculation is shown in Table 8.

4. Case Analysis: Case of XYZ University

A University can generally be accepted as an institution which delivers the educational requirements of society. It is essential that they form good links with the public. According to Goddard et al. [2006], the universities have played a strategic role in the economic and social development of the country and of the regions in which they are located. Universities have also found it necessary to improve their efficiency in both their teaching and research activities and have been at the forefront in relation to improvements to their ICT and this has also led to the implementation of e-governance within the university sector. An ideal model of e-governance can be executed by the implementation of four main dimensions [Leitner, 2003]: (i) Adaptation and coordination of the public policies; (ii) Participatory democracy (of the majority of representative players in relation to the concerns associated with the services supplied); (iii) Creation of cooperative networks (for the implementation of public policies for development); (iv) Access to clear and open informative systems of governance. Despite the tremendous efforts in e-governance, provision by various governments in both the developing and developed countries have been envisaged in relation to problems of both a technological and organizational nature [Heeks, 2003; Holliday, 2002; Pacific Council on International Policy, 2002; Strejeek & Theil, 2002; Wescott, 2001]. These problems are related to People, Process, Culture, and Technology.

This paper considers a state owned University named XYZ which is operating in Orissa, and which provides Higher Education for the citizens of that state. In line with a number of other such institutions, there are, several departments and associated work departments, some of which have similarities and some of which do not. Some transactions are conducted in a computerized environment such as result processing, the payroll, and the library. However, there are three different systems associated with the above transactions and there is no integrated system able to cover all three. In order to improve efficiency and to simplify the process, the Orissa government wanted to introduce an integrated system of computerization by implementing the e-governance system. As the University lacked sufficient expertise and know how, an external agency was hired in order to implement the e-governance system. Based on the similarities and differences, the consultant has suggested that the total work be categorized into the eight different modules shown below, which was felt to cover the majority of the University requirements. However, as the three areas discussed above were each running separate systems, the decision was taken not to implement the new system, but this will occur at a later stage. The reason behind this decision was that the implementation of e-governance is seen as being a difficult task. It was, however, decided that the other five modules should be implemented.

Academic (M-1), Hostel (M-2), Library (M-3), Fixed Asset (M-4), Pay roll (M-5), Financial Accounting (M-6), Humane Resource (M-7), File Tracking (M-8)

Problem identification:

The development of these took a year and the decision was that two years would be allocated to their implementation. Past attempts at introducing computerization at one go has not proved to be possible for a variety of reasons. These have included opposition from employees who have found it very difficult to cope with a new situation, thus, the consultant suggested that the implementation should take place using a step-wise method. However, the problem remained as to how to identify the first module to be computerized from the five when it was the case that the modules were not related to each other but were being placed depending upon similar requirements. The general practice is to select a module based on some functional head, and then the sequence of modules is decided based on their convenience. This problem leads to multi-criteria decision making, where decisions are taken with respect to several variables. According to Raghuram and Rangaraj [2000], there are 15 reasons to pursue computerization. The important reasons can be - Security, Speed, Accuracy, Easy, Reliability, Cost, Process Improvement, Corporate image, Focus on core work, Resources utilization, Information availability, Transparency, Environment, Productivity. However, as this involves a significant number of variables a Factor analysis has been used as a reduction technique in order to achieve a reasonable set of variables for further analysis.

Factor Analysis:

Factor analysis is a statistical method used to describe variability among observed variables in terms of a potentially lower number of unobserved variables called *factors*. In other words, it is possible, for example, that variations in three or four observed variables mainly reflect the variations in a single unobserved variable, or in a reduced number of unobserved variables. Factor analysis searches for such joint variations in response to unobserved latent variables. The observed variables are modeled as linear combinations of the potential factors, plus "error" terms. The information gained about the interdependencies between observed variables can be used later to reduce the set of variables in a dataset. Factor analysis originated in psychometrics, and is used in behavioral sciences, social sciences, marketing, product management, operations research, and other applied sciences that deal with large quantities of data. The advantage of factor analysis is reduction of number of variables, by combining two or more variables into a single factor". (www.wikipedia.com/factoranalysis). In the case discussed above, there are fifteen variables which may be the reasons for computerization. In order to determine the important factors for the computerization, a structured questionnaire has been prepared containing these fifteen variables. The questionnaire is distributed to one hundred thirty employees of the university, from which fifty six provided a completer response. The data collected is used for two purposes, to reduce the number of variables and to detect structure in the relationships between the variables i.e. is to classify the variables. Therefore, the factor analysis is applied as a data reduction or structure detection method (the term *factor analysis* was first introduced by Thurstone, 1931). The rotated component matrix is shown in Table 1.

Table 1: Rotated Component Matrix.

Items:	Factor		
	1	2	3
Process Improvement	**0.925**	0.207	0.091
Speed	**0.889**	0.22	0.024
Easy	**0.870**	0.256	0.032
Reliable	**0.865**	0.233	0.022
Productivity	**0.857**	0.207	-0.02
Information availability	0.208	**0.88**	-0.022
Accurate	0.234	**0.878**	0.078
Focus on core work	0.096	**0.762**	0.061
Resources utilization	0.28	**0.730**	0.035
Secure	0.462	**0.501**	0.065
Uniform Standard	0.001	0.044	**0.952**
Cost	-0.036	0.016	**0.655**
Transparency	0.335	0.174	0.493
Corporate image	0.274	-0.025	0.477
Environment	-0.132	0.015	0.460
Extraction Method : Principal Axis Factoring			
Rotation Method: Varimax with Kaiser Normalization			

The variables with a factor loading of more than 0.50 were considered as significant in relation to each aspect. The eigen values of the selected factors were greater than 1. Three factors are extracted from the analysis and three variables namely transparency, environment and corporate image are dropped as their factor loading is less than 0.50. It is shown that factors such as transparency, environment and corporate image have no significant impact of on a computerization system. From the factor analysis, three sub factors according to importance were obtained and these were the primary attributes, secondary attributes and tertiary attributes. Table 2 represents the three sub-factors which contribute to the computerization system of the organization.

Table 2. Factors influencing the IT implementation.

Primary Reasons	Secondary Reason	Tertiary reasons
Process Improvement	Information availability	Uniform Standard
Speed	Accurate	Cost
Easy	Focus on core work	
Reliable	Resources utilization	
Productivity	Secure	

Five primary reasons were discovered for the implementation of e-governance into the University. Two methods namely the "analytic hierarchy process" and "technique for order preference by similarity to ideal solution" have been used to determine a priority Implementation for the five variables included in the primary reasons.

The main objective of this analysis was to determine which modules required computerization. In this respect contact was made with three experts from the University XYZ discussed above. These experts have sufficient expertise and are involved in the functional areas such as purchase, finance, production, materials management, distribution and related functions. These experts were initially asked about the level of importance of each criterion under the primary reasons with respect to each other. The response of the experts in relation to each of the criterion is shown in Table 3.

C_1: Process Improvement; C_2: Speed; C_3: Easy; C_4: Reliability ; C_5: Productivity

Table 3. Pair-wise comparison matrix of criteria by experts.

	C_1	C_2	C_3	C_4	C_5
C_1	1	3	4	3	3
C_2	1/3	1	2	3	2
C_3	1/4	1/2	1	3	5
C_4	1/3	1/3	1/3	1	2
C_5	1/3	1/2	1/5	½	1

The issue now remains to prioritize the computerization of various modules involved in the project. Each computerization is taken as a separate project and each of the projects is being compared with respect to each of the (five) different criteria /factors mentioned above using a Likert type 1-9 scale. The alternatives are presented as follows:

***A_1*:** **e-governance** implementation in Humane Resource;
A_2 : **e-governance** implementation Hostel
A_3: **e-governance** implementation Fixed asset
A_4: **e-governance** implementation File Tracking
A_5: **e-governance** implementation Financial Accounting

The comparison of each of the alternatives against each other for various criteria is provided in Table 4, and these values were obtained from a group of experts from the e-governance implementation team.

Table 4. Comparison matrix of alternatives on each criteria.

Criteria	Alternatives	A_1	A_2	A_3	A_4	A_5
C_1	A_1	1	3	1/3	3	1/3
	A_2	1/3	1	1/3	1/2	1/3
	A_3	3	3	1	3	3
	A_4	1/3	2	1/3	1	1/3
	A_5	3	3	1/3	3	1
C_2	A_1	1	3	1	3	2
	A_2	1/3	1	1/3	3	1/3
	A_3 A_4	1 1/3	3 1/3	1 1/3	3 1	2 1/3
	A_5	½	3	1/2	3	1
C_3	A_1	1	2	1/2	2	2
	A_2	1/3	1	1/2	3	2
	A_3	2	2	1	3	1
	A_4	½	1/3	1/3	1	1/3
	A_5	½	1/3	1	3	1
C_4	A_1	1	2	1/3	2	2
	A_2	½	1	1/3	2	2
	A_3	3	3	1	2	2
	A_4	½	1/2	1/2	1	1/3
	A_5	½	1/2	1/2	3	1
C_5	A_1	1	2	1/3	3	2
	A_2	½	1	1/2	4	3
	A_3	3	2	1	3	3
	A_4	1/3	1/4	1/3	1	½

Expert Choice 11.5 has been used for the AHP analysis and using Table 3 and Table 4 data as the input, the various weights associated with the different criteria C1 to C5 with respect to alternatives A_1 to A_5 are represented in the summary provided in Table 5.

Table 5. Weights of criteria and alternatives.

	A_1	A_2	A_3	A_4	A_5	Consistency
C_1 (0.444)	0.166	0.074	0.40	0.096	0.259	0.09
C_2 (0.225)	0.303	0.116	0.303	0.073	0.206	0.05
C_3 (0.166)	0.244	0.199	0.300	0.080	0.176	0.08
C_4 (0 .075)	0.215	0.165	0.372	0.097	0.151	0.09

Issues such as consistency may require special attention and thus if criterion A is considered as being just as important as criterion B, then the pair-wise judgments for A and B with regards to any other criterion should be identical. If this does not occur in the judgment process inconsistencies may arise. Saaty [1994] suggested that the error in these measurements is tolerable only if it is of a lower order of magnitude (10%) than the actual measurement itself. Consistency ratios (CR) can be calculated and compared to indices derived from random judgments. As long as the CR is less than 0.10, the analysis can proceed. Saaty also emphasized that greater consistency does not imply greater accuracy. In all our analysis the consistency ratios are found to be less than the specified level.

The bracketed value shows the weight of the criterion and the cell values show the weight of alternatives against each criterion. This table is used as the input for the TOPSIS analysis and the results are represented in Tables 6 and 7. The Table 6 and Table 7 values are obtained by following step-2 and 3 of the TOPSIS, explained above.

Table 6. Weights of alternatives against criteria.

	C_1(0.444)	C_2(0.225)	C_3(0.166)	C_4(0 .075)	C_5(0.090)
A_1	0.166	0.303	0.244	0.215	0.338
A_2	0.074	0.116	0.199	0.165	0.148
A_3	0.40	0.303	0.300	0.372	0.239
A_4	0.096	0.073	0.08	0.097	0.172
A_5	0.259	0.206	0.176	0.151	0.103
Sum of square of column	0.52283	0.49481	0.47593	0.494	0.48317

Table 7. Weighted normalized rating matrix.

	C_1(0.444)	C_2(0.225)	C_3(0.166)	C_4(0 .075)	C_5(0.090)
A_1	0.3175	0.6124	0.5127	0.4352	0.6995
A_2	0.1415	0.2344	0.4181	0.3340	0.3063
A_3	0.7746	0.6124	0.6303	0.7530	0.4946
A_4	0.1836	0.1475	0.1680	0.1964	0.3559
A_5	0.4954	0.4163	0.3698	0.3057	0.2132

In addition, Table 7 is processed by steps 4 and 5 of the TOPSIS explained above and the results are noted in Table-8 and Table-9.

Table 8. Positive and negative ideal solutions.

	C_1	C_2	C_3	C_4	C_5
A_1	0.14097	0.13778	0.09381	0.07224	0.06295
A_2	0.06284	0.05274	0.07651	0.05544	0.02756
A_3	0.34393	0.13778	0.11535	0.12500	0.04451
A_4	0.08152	0.03319	0.03076	0.03259	0.03230
A_5	0.21994	0.09367	0.06767	0.05074	0.01918
A^+:*Positive ideal solution*	0.34393	0.13778	0.11535	0.12500	0.06295
A^-:*Negative ideal solution*	0.06284	0.03319	0.03076	0.03259	0.01918
d^+:*Positive separation measure*	0.20792	0.18155	0.09423	0.29649	0.14777
d^-:*Positive separation measure*	0.16037	0.08593	0.21589	0.09515	0.18766

Table 9. Computation of d_i^-, d_i^* and CC_i

	d_i^*	d_i^-	$d_i^* + d_i^-$	$CC_i = \frac{d_i^-}{d_i^- + d_i^*}$
A_1	0.20792	0.16037	0.36829	0.435445
A_2	0.18155	0.08593	0.26748	0.321258
A_3	0.09423	0.21589	0.31012	0.69615
A_4	0.29649	0.09515	0.39164	0.242953
A_5	0.14777	0.18766	0.33543	0.559461

5. Discussion and Conclusion

It can be concluded from the initial analysis i.e the Factor analysis that the primary reasons involved in relation to the implementation of e-governance include, process Improvement, increased in speed of services, easy of operation, better reliability and increase in productivity in the order of preference. Factor Analysis is a factor reducing technique which can be used to reduce factors with respect to their importance, when a large numbers of variables are involved. It is then possible to remove the less important variables. In this respect Factor analysis can be used as a factor reducing technique and, additionally, in this case the most important reason for computerization in the e-governance system is process improvement. Based on the value of CC_i, the order of preference for the implementation is $A_3 > A_5 > A_1 > A_2 > A_4$. It shows that the most significant process was that of the Computerization of Fixed Assets. The computerization priorities can be stated as follows:

Priority Order	Process	Code
1	**e-governance** implementation in Fixed Asset	A_3
2	**e-governance** implementation in Financial Accounting	A_5
3	**e-governance** implementation in Human Resource	A_1
4	**e-governance** implementation in Hostel	A_2
5	**e-governance** implementation in File Tracking	A_4

Thus, the University should firstly computerize the fixed asset which should be followed by the computerization of Accounting. The next departments, in order, are Human Resources, Hostel and File Tracking respectively. It is has been determined in the past that e-governance does not achieve 100% success, and one reason for this may be the manner in which it is implemented i.e. the implementation of the entire software in one go. It thus appears that scientifically prioritizing results in the success of the e-governance implementation as by means of the step-wise manner the process can be replicated for all modules. It can be concluded that the implementation of the e-governance system in phases, not only reduces the risk of failure but also provides time for capacity building, which in turn can assist in building confidence in relation to the success of e-governance projects.

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