Identifying Risk Factors in for E-governance Projects

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ABSTRACT

E-governance system development suffers from cost and time overrun and unmet functional specifications due to inherent risk in it. It is expected that the employment of proper risk assessment techniques in the management of such projects will reduce the threats imposed by various risks that are surrounded by these projects. A questionnaire was developed and 205 project managers were surveyed. The factor analysis was conducted with the data that was collected through questionnaire. The analysis produced five factors of risk dimensions and two factors on project performance. Based on this empirical study, a risk assessment model is developed. Further, with the use of structural equation modeling, this model is intended to characterize the risk and serve as a predicting model. This model will not only assess but also prioritize risk that will help in driving risk mitigation strategies

Keywords: E-governance; Risk Assessment; Risk Dimension; Project Performance

1. Introduction

Government agencies are insisting heavily on e-governance projects with the hope to develop electronic systems that provide information, services and tools for the public, businesses and various levels of government. Even with widespread use of advanced tools, these project development still suffers an alarmingly high failure rate (Meyer, 1998). Billions of dollars are lost on canceled projects, late delivery, over-budget delivery, and limited functionality. Standish Groups' survey showed that 52.7% of software projects miss their schedule and financial targets, 31.1% of all projects are canceled, and only 16.2% of the projects are completed on time and within the budget (Hayes, 1997). Estimates of the failure rate in large-scale software development since the early 1980s go as high as 85% (Ambler, 1999). According to Arnott, (2003) the cost of cancelled or over-budget UK government IT projects has topped £1.5 billion in the last six years. For example, just a single cancelled e-Government project on smart cards resulted in a loss of £698 million to the British government. Similar situations may be avoided or at least better handled through appropriate risk assessment methodologies that may be able to enhance decision-making by turning threats into opportunities.

Much research effort focused on identifying risk factors that threaten the success of the project. Unfortunately, risk assessment framework has received little attention in the literature of e-governance project. However, on software project risk Wallace et al (2004) and Hyatt et al (1997) have proposed risk assessment models for process and product development. This paper describes a novel framework that will help project managers and engineers for successful development of e-governance project on local and national level of governments. e-Governance projects are unique undertakings that involve degree of

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uncertainty and inherently risky, since these projects are complex and have a broad scope , risks can be found in many diverse areas. The development and implementation of these projects can be a daunting task, since it can involve many factors of risk that could threaten the success of the project. There are various steps in development of e-Governance Projects such as feasibility study, requirements analysis, design, coding, integration and system testing, delivery and maintenance. There are two distinct types of risks such as generic risks, and product specific risk. Genetic risks are a projection threat to every e-governance project. Product specific risks can be identified only by those with a clear understanding of the technology, the people and the environment that a specific to the project. To identify product specific risks, the project plan and e-governance project statement of scope to be examined and answer to the following question. What special characteristics of the product may threaten our plan? One method of identifying the risks is to create the risk items checklist. This checklist can be used for risk identification and focuses on some subset known and predictable risk.

The cost for developing a software is a cost of resources used such as manpower, hardware, software and other supporting resources. The software development is a labor intensive activity, hence the cost of other resources are quite low. The majority of the techniques currently that have apparent and delimited objectives, there exist at least one key to the problem at hand, timeline and resources can be precisely stated before the project starts, the operational environment can be well defined and quality matrix can be quantified for the project. These assumptions rarely occur in large projects like e-Governance project. The development of projects for application domain with high requirements volatility, the need for domain integration, ambiguity, complexity, discontinuity, diseconomy of scale, and complex feedback loops that are the characteristics of large projects. These characteristics weaken the assumption of traditional techniques, which can work in theory, but can't be directly applied in practice. However, due to some success resulted from using these techniques in the past, managers tend to take their reinforcement as assumptions for granted in every project. These misconceptions are very common but risky in e-governance project management. A manager defines the document, the expected performance for a project at planning phase. During implementation of the project, some uncertain events can influence the expected performance of the project. Most e-Governance projects inevitably involve various types and degrees of uncertainty, hence these projects can easily run out of control and consume significant additional resource. The risk assessment provides feedback about these uncertainties that can challenge the success of the project (Choudhari et al., 2005).

2. Risk Dimensions in E-governance Projects

To support a framework, categorization of various risk dimensions to be needed that are surrounded by e-governance projects. This part of the paper will introduce main risk dimensions that affects the performance of the project. The review of literature shows that some researchers have attempted to classify the risk dimensions. According to the Wallace et al (2004) , risk are classified in six dimensions, namely: i) complexity ii) organizational environment iii) system requirement iv) planning and control v) users vi) development team. Evangelidis (2004) distinguished the five areas: i) social ii) Technical iii) Economical iv) political v) security. Further more, Tchankova (2002) proposed seven classes of risk, namely: i) physical ii) social iii) political iv) operational v) economic vi) legal vii) cognitive environment. Baccarini et al (2004) categorized in seven classes: i) commercial and legal relationship ii) economic circumstances iii) human behavior iv) political circumstances v) technology and technical issue vi) management activities and control vii) individual activities.

In that manner and for the purposes of this research study, this paper proposes the following high level classification of risk dimensions that surround e-governance projects. Keeping in view that e-governance projects are little different in character that bring in unique experience in handling such projects. Factors related to bureaucracy, political leadership support and government organization culture are some of the

important aspects that require close investigation and understanding the concept of risk.

- *System Specification:* This relates to the risks from the system requirement specifications, for example incorrect specifications provided or not freezing of the specification before development work stats.
- *Planning*: referring to the risks that erupt from estimation of cost, schedule and milestones. This may be also due to not undertaking of certain activities at feasibility stage like configuration, software quality assurance, project monitoring and risk assessment methodologies.
- Technology and Technical Aspects
  Technology: The risks concerning the information and communication technologies and its complexity and production system.
  Technical Aspects: The risks arise from the design of software.
- e-Governance Organization: The risks relating to change in structure and procedures in an e-governance organization. Risk may also arises from the leadership at political and managerial level.
- Stakeholders: Risks that are arose from the government employees, government policies, development team members and citizens at large.

3. The Performance Variables with respect Risks

The project performance variable relates to the two key issues: product performance and process performance. "It is important to study both aspects: product performance and process performance because a delivered project may meet project goals and business objectives but exceed time and cost projections. On the other hand, a project may meet specific time and cost but with low quality or do not meet with project objectives" (Saarinen , 1996)

Process Performance: Process performance is a performance matrix for development process and can be described by the learning that occurs during the course of implementation and project was completed on schedule and within budget (Na et al, 2004). The process matrices are used to quantify the characteristics of development process being used to develop the software. The development process consist of various phases such as requirement analysis, designing, coding, integration and testing. Phase wise attributes are given here. Requirement: ambiguity, completeness, understandability, trace ability. Design: module architecture and coupling. Coding: maintainability, reusability. Testing: correctness and reliability. The process metrics in each phase of development cycle measure productivity, cost, resource requirement, effectiveness of quality assurance measure and effect of development techniques and tools.

Product Performance: Product performance is a performance matrix that captures the performance of a finished product in term of quality and can be described by the technical performance of the software, the degree to which the software conforms to the user needs, degree to which software is flexible in supporting the new product and changing user needs (Keil et al, 2000). The quality of product is measured against the system requirement specifications including specified standards and ease of use. The attributes that affect the quality of software are: correctness, reliability, usability, integrity, efficiency, portability, reusability, interoperability, maintainability, flexibility and testability.

4. Research Approach

To obtain the data for this study, a survey instrument was designed, pre-tested and sent to a sample of about 600 project managers located across India. This questionnaire was developed on the basis of inputs from Wallace et al (2004), Baccarini et al (2004), Hyatt et al (1997), Keil et al (2000), Okat Uma (2005) and other relevant literature on the subject. The questionnaire, which was distributed either personally or via e-mail The questionnaire consisting of three sections i.e .A, B and C. Section A of questionnaire asked the respondents about the real data on the characteristics of project. The section B listed items to evaluate risk

and project performance. The respondents were asked to indicate the degree of agreement/disagreement on a seven point Likert type scale that ranged from strongly disagree to strongly agree (Strongly disagree, disagree, partially disagree, neutral, partially agree, agree, and strongly agree). Section C solicited personal information about respondents, such as name (optional), designation, name of organization, age, and experience. At the end of the survey period, a total of 208 responses were received. Out of these three questionnaires were about half filled, therefore these are not considered for further processing. The remaining 205 responses are found valid and included in the study for a response rate of 34.11 percent. This response rate is normal for such surveys. The survey included multiple item measures for each of the five dimensions of risk and two dimensions of performance. The validity of constructs were assessed by mean of factor analysis and reliability of scales were judged using Cronbach alpha.

5. Construct validity by Factor Analysis

A factor is an underline dimension of several observed variables. The factor analysis provides subset of data matrix and finds correlation among variables. One of the most powerful methods to test construct validity is factor analysis (Kerlinger, 1986). Stewart (1981) suggested that Bartlett's test of sphericity and Kaiser Meyer Olin (KMO) measure of sampling adequacy be examined to assess whether or not a set of variables are appropriate for factor analysis. This test indicates whether correlation matrix comes from a population of variables that are independent. Measure of sampling adequacy provides a measure of the extent to which a set of variables belong to a group. Kaiser and Rice (1974) provided a calibration of Measuring of Sampling Adequacy (MSA) measure with regards to the degree of suitability of using factor analysis on a set of measurement items: a value of 0.80 and above as meritorious, values between 0.60 and 0.80 as mediocre and values below 0.50 as unacceptable.

5.1 Risk factors

Risk factors are the latent variables that are responsible for the failure of the project. These latent variables are the risk dimensions that need to be examined for risk assessment. For measurement of items considered for risk dimension construct, Bartlett's test of sphericity led to a rejection of the null hypothesis of variable independence at a level of significance of 0.000. The measure of sampling adequacy was computed to be 0.868 and suggested that the items were appropriate for factor analysis. To examine the validity of risk dimension construct, the Principal Component Factor Analysis with Varimax rotation was conducted. The analysis produced nine factors. After deleting the items with factor loading of less than 0.50, a five factor solution emerged. All five factors are collectively explaining 79.288% of the variance. Table 1 presents the summary of results of factor analysis on risk dimensions.

Factor one is characterizing the risk dimension pertaining to stakeholders that has 21 measures. Some of the measures were used to assess level of specialization skill of team members and their commitment to the project. Other measures are used to access the degree of expectation of citizens, users attitude and participation, government support in term of policies and procedures.

Second factor describes the technology and technical aspects of risk in a project. Measures such as: whether the architectural design of application software is complex, whether the component level design of application software is inflexible, whether the project involves the use of new technology, whether the performance of production system (software engineering environment) was poor, whether developing wrong software functionality, whether the design of application architecture is inadequate to support multi-channel service delivery are included in this factor.

Third factor covers the risk relating to the e-governance organization. Lack of political commitment and leadership, lack of bureaucratic support, lack of formal change management process, lack of single point accountability, litigation in protecting intellectual property, lack of agreement and sign of criteria in PPP

projects, failure to have timely review the progress of the project, inadequate assessment of user needs and lack of streamlining of government processes are included to determine the impact of risk.

Table 1: Factor Analysis of Risk Dimensions

Construct	Number of Measures	Eigenvalues	Variance Explained	Minimum Factor Loading
System Specifications	13	11.993	15.990	0.753
Project Planning	6	5.141	6.854	0.674
Technology and Technical Aspects	16	14.291	19.055	0.739
e-Governance Organization	19	12.632	16.843	0.616
Stakeholders	21	15.410	20.546	0.647

Fourth factor pertains to the system specifications. The various measures like difficulties in providing the relationship between input and output of the system, response time and throughput is not specified, specification document is ambiguous, system specifications are not adequately identified, inadequate details on standards compliance and security measures and continuous change in system specifications are included in this factor.

Fifth factor refers to the risk erupted from the project planning. There are six measures to evaluate the risk of this factor. There are: project milestones are not clearly defined, risk activity and quality assurance are not undertaken during project planning, lack of effective project management methodologies, inadequate estimation of project duration and cost of the project

5.2 Project Performance Variables

The project performance variable relates to the two key issues: product performance and process performance. For measurement of items considered for Project Performance Construct, Bartlett's test of sphericity led to a rejection of the null hypothesis of variable independence at a level of significance of 0.000. The measure of sampling adequacy was computed to be 0.812 and suggested that the items were appropriate for factor analysis. To examine the validity of project performance construct, the Principal Component analysis with Varimax rotation was conducted. The analysis produced two factors with Eignvalues >1.0 that accounted for 60.764% of the total variance. Table 2 presents the summary of results of factor analysis on performance variables.

Table 2: Factor Analysis of Performance Variables

Construct	Number of Measures	Eigenvalues	Variance Explained	Minimum Factor Loading
Product Performance	6	3.733	37.326	0.715
Process Performance	4	2.344	23.438	0.720

First factor in the project performance is product performance: meeting the project objectives and system quality. It was measured using six items. The system developed meets functional specifications, the system design conforms the specified standards, application developed is reliable, system meets intended throughput and response time, system meets user expectation with respect to ease of use, system meets security requirements and overall quality of application developed is high were included to measure the degree to which the quality of product is met.

Second factor relates to the process performance: how well the project development process has been undertaken. It contains four measures that assesses the degree of success of development process in completion of the project. These are: the system developed is flexible to support new product and changing

user needs, application developed is reliable, the project was completed on schedule, the system was developed within budget.

5.3 *Reliability of Scales*

The Cronbach alpha coefficient is commonly used for assessing the reliability (Cronbach., 1951). Nunnally (1978) recommends that this value of alpha should exceed 0.70. High value of Cronbach alpha indicates high internal consistency of the multiple items measuring the construct. Table 3 shows the multiple item constructs, the number of measures and the measurement properties. The reliability of risk dimensions and performance constructs was assessed using Cronbach alpha and scales were judged to illustrate evidence of adequate reliability. Five of the constructs have reliabilities greater than 0.80 that indicates high level of reliabilities. The remaining two of the constructs; process performance and e-Governance organization, have the reliabilities of 0.75, 0.79 respectively

Table 3: Reliability of Scales

Constructs	Number of Measures	Mean	Standard Deviation	Cronbach's Alpha (α)
System Specifications	13	5.6703	1.53720	0.815
Planning	6	4.8559	1.78721	0.923
Technology and Technical aspects	16	5.6410	1.51126	0.902
e-Governance Organization	19	4.2405	1.97416	0.792
Stakeholders	21	5.2674	1.62435	0.883
Product Performance	6	4.2484	2.39111	0.878
Process Performance	4	3.2933	2.59850	0.757

These values are acceptable for the empirical research of similar nature as this meets Nunnally (1978) criteria of alpha value which indicates that the value of alpha should be more than 0.70.

## 6. Towards a theoretical model for Risk Assessment

Based on the results, one can start to define a Risk Assessment model. Figure 1 proposes such a model. The results suggest some support for the basic structure of this model.

The factor analysis clearly revealed five dimensions of risk and two dimensions of performance, thereby the model consist of two sub systems, namely: Risk Dimensions and Performance factors that are interdependent. As explained in introduction, such model is not available in literature on e-governance project risk. The purpose of this risk assessment model is to provide a methodology for efficient qualitative risk assessment in e-governance project development that provide a holistic view of an e-Governance project development activities, the risks involve in development process and supports decision-making at the feasibility stage of the project. Further, with the use of structural equation modeling, this model is intended to characterize the risk and serve as a predicting model for assessment of project risk. It will not only assess the risk but also prioritize it that will help in driving risk mitigation strategies. It is also expected that this model would enhance awareness on the various threats and opportunities that are normally associated with e-Government projects

7. Concluding Remarks

Before discussing the implications, it is important to comprehend the limitations. Risk is a complex construct and this research may not have captured all major aspects of e-governance project risk. The project characteristics that also influence the performance of the project had not been identified. Finally convenience samples were used, with responders self selected. Therefore, external validity and generalizability of this study may be limited. However, it is believed that this study has important implications. The exploratory factor analysis was done with the data that was collected through questionnaire to validate the information statistically. Before factor analysis, sampling adequacy was

examined with the help of Bartlett's and Kaiser Meyer Olin (KMO) test, this test indicated that the data was suitable for factor analysis. Sampling adequacy predicts if data are likely to factor well, based on correlation and partial correlation. Bartlett's test of sphericity computed sampling adequacy of 0.812 for project performance factors and 0.868 for risk factors.
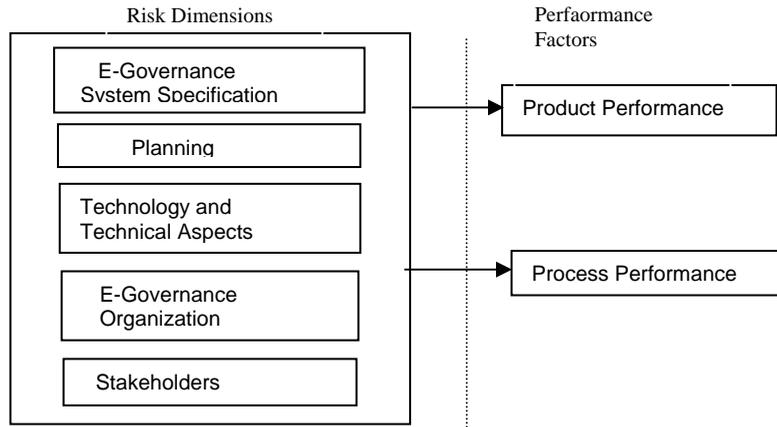
Figure 1: Risk Assessment Model

Construct validity was tested by factor analysis, to examine the validity of risk dimension construct, the Principal Component Analysis with Varimax rotation was conducted. The analysis produced nine factors, after deleting the items with factor loading of less than 0.50, a five factor solution emerged. All five factors are collectively explained 79.288% of the variance. Similarly, to examine the validity of project performance construct, the Principal Component analysis with Varimax rotation was conducted. The analysis produced two factors that accounted for 60.764% of the total variance. Reliability of Instrument was tested with the help of Cronbach alpha coefficient. Five of the constructs have reliabilities greater than 0.80 that indicates high level of reliabilities. The remaining two of the constructs have the reliabilities of 0.75 and 0.79 respectively. Based on this empirical study, a risk assessment model is developed. Further, with the use of structural equation modeling, this model is intended to characterize the risk and serve as a predicting model for assessment of project risk. This model will not only assess but also prioritize risk that will help in driving risk mitigation strategies. It is also anticipated that it would enhance awareness on the various threats and opportunities that are normally associated with e-Government projects. The employment of risk assessment methodology in a systematic manner are also expected to improve the control on project costs, quality and time that are extremely important factors, since they are the precursors for the balancing of side-effects such as citizens satisfaction, public authorities image and e-Government as well.

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