Risk Factors in Software Development Projects

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Abstract: - The increase in complexity of software development has become critical to the organizations to comprehensively identify and manage the risks involved in the software development projects. In identifying and further developing the projects, project managers must be aware of the risks or inherent risks affecting the projects. This paper presents empirical findings on the risk factors that significantly contribute to project failure. The findings demonstrate that effective communication in software project development environment was poor. The poor communication among the developers, users and project managers might be caused by lack of ability to be good listeners. The effective communication among project team is one of the most important factors in minimizing project failure. Thus, the findings and the discussion in the research could help project managers and practitioners incorporate the risk factors into their software development methodologies.

Keywords: - Software Projects; Project Failure; Risk Identification; Risk Factors; Risk Ranking; Risk Management

1 Introduction

Malaysia intends to transform into an information and knowledge-based society by year 2020 to enable it to move rapidly into the Information Age. The MSC (Multimedia Super Corridor) is the catalyst for this massive transformation whereby the Malaysian Government has targeted seven multimedia applications for rapid development. These flagship applications are Electronic Government, Telemedicine, Smart Schools, Multipurpose Card, R&D Clusters, Worldwide Manufacturing Web and Borderless Marketing Centres. The flagships will lead to a development of leading edge software application that can increase the productivity and competitiveness of Malaysia. In creating high quality software, an effective development and application of risk management principles and strategies are essential.

In developing meaningful risk management strategies, risk must first be identified. In order to identify the risk involved in software development projects, there are several methods that can be used. Some of the methods are checklist, interview, periodic meeting, review, routine input, survey and brainstorming [9]. During risk identification, not only risks are identified but also the relative importance should be established in order for managers to focus on the areas that constitute the greatest threats [12].

The objective of this paper is to present empirical findings on the software risk factors that contributed to project failures particularly that involved projects in public sectors. The findings would provide important inputs for those researchers on software risk management as well as practitioners of software project management. Acceptance and broader understanding of risk factors in software project development by organizations are critical for the risk management to be adopted when developing software projects.

2 Software Risk Factors

In response to the increasing number of software projects failures, many researchers

have become interested in researching the factors that were associated with these failures. This research led to the identification of variables or factors that could potentially influence the success or failure of a project [15,5,3,16, 19,2]. The fist stage in managing project failure is to identify the risk factors. Many literatures have been published concerning risks associated with the project failure [3, 11, 19, 18, 12]. As a result there have been various lists of risk factors with some similarities and some differences. However, the main point is not to provide an exhaustive list of risk factors, but to access the risk factors present in any system development environment. The knowledge of how identified risk factors change over time is valuable in order to develop suitable risk management methods. Risk factors change overtime due to the development technology and organizations. That is why researchers should from time to time conduct rigorous risk studies.

Complete and comprehensive checklists have been developed on risk factors to be considered when planning, developing and managing software projects [3, 19]. However, less is known about the extent to which these risk checklists are suitable in all software development projects in Malaysia or whether there are different risks list needed for different agency.

Therefore, it was necessary to identified the major risk factor that significantly important and frequently contribute to the software projects failure in the Malaysian public sector.

3 Research Methodology

An empirical study using a combination of questionnaire survey and interview was applied in this research. The interview sessions were conducted only when requested by respondents who require guidance in answering the questionnaires.

4 Research Model

Research model in Figure 1 is built based on the combination of several past literatures instead of a single research model. The research model discusses the categories and factors that contributed to the project failure. The six risk categories were organization environment [7, 18], project team [12, 14, 15, 5, 11], user [12, 6, 11] project requirement [17, 12], project complexity [13, 8], and project management [10, 4]. Factors that contributed to each of the risk categories were also shown in Figure 1.

Based on the six risk categories, the research has formed the following hypotheses:

H1:There is positive relationship between organization risk and project failure

H2:There is positive relationship between project team risk and project failure

H3:There is positive relationship between user risk and project failure

H4:There is positive relationship between project requirement risk and project failure

H5:There is positive relationship between project complexity risk and project failure

H6:There is positive relationship between project management risk and project failure

With regards to the risk factors that contribute to the project failure, the importance of these factors was measured by asking the respondents to rank pre-determined factors using *Likert-scale*. Factor analysis was used for data analysis.

5 Findings and Results

The survey questionnaire and interview captured background data of respondents profile as well as their project profile. This section discusses the importance of risk factors, their ranking and also the hypotheses results.

5.1 Respondents' profile

Respondents' profile characteristics examined were organization name, current position, working experience and age. The demographic profiles of the respondents were categorized into designation, year of working experience and age. The survey was distributed by hand or by email to thirty government agencies located in Klang Valley with an average of three survey forms per agency.

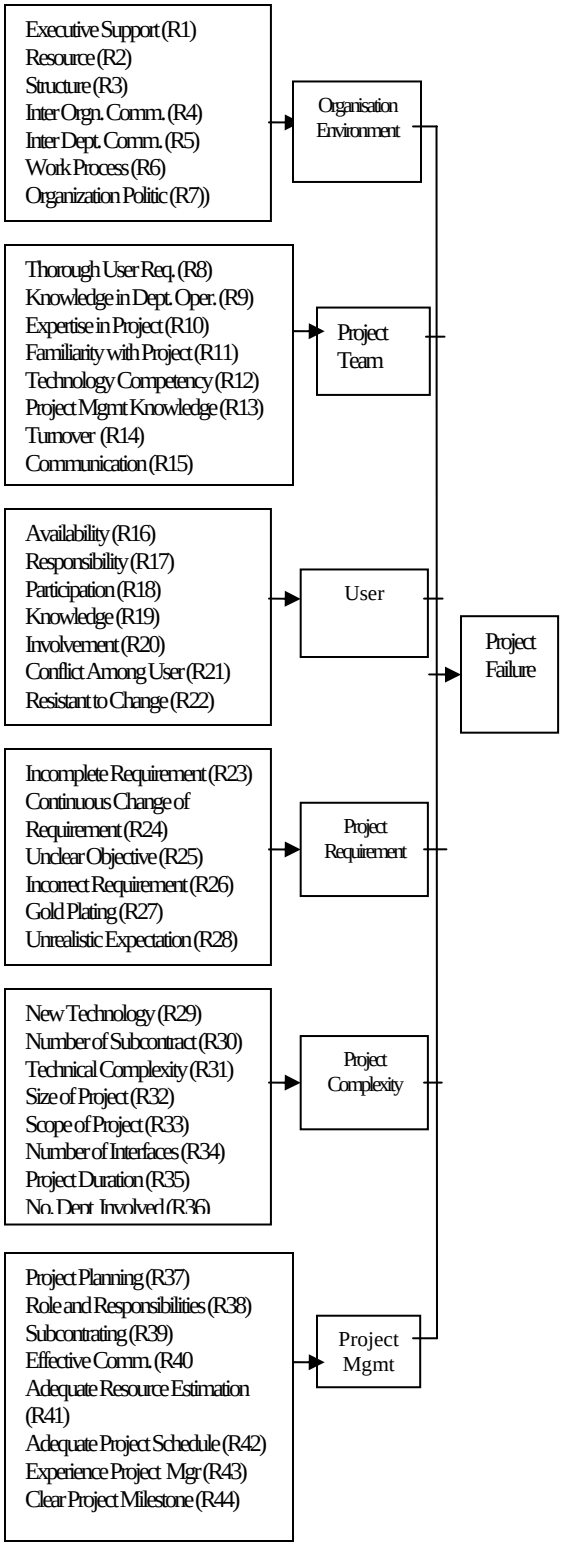

Figure 1 Research Model on the Risk Categories and Factors that Contributed to Project Failures

Only 25 agencies with a total of 50 respondents returned the survey forms. When analysing the respondents' responses, it was noted that 42.0 percent and 40.0 percent of the respondents were Chief Assistant Director and Assistant Director respectively. The next highest respondents were Project Manager with 8.0 percent, followed by Deputy Director with 6.0 percent and 4.0 percent of the respondents were Directors and IT Manager respectively. The majority of the respondents (58.0 percent) have more than ten years of working experience. The highest response was received from project managers in the age group between 40-49 years old (60.0 percent of the total respondents).

5.2 Reliability Test

Table 1 Reliability Test

Risk Categories	Item	Cronbach's alpha	N
Organization	7	0.787	50
Project Team	8	0.695	50
User	7	0.815	50
Requirement	7	0.910	50
Project Complexity	8	0.868	50
Project Management	8	0.752	50

Note: Item – Risk factors in each category
N – Total number of respondents

A Cronbach's alpha coefficient is used to test the survey items' reliability in this study. A coefficient value, which is close to 1 is desired. Since all measure items in Table 1 had a reliability of more than 0.60, the scales for these constructs were deemed to exhibit an adequate reliability.

5.3 Results On Important Factors that Contributed to Project Failure

Based on the Research Model Figure 1, Table 2 summarizes all the risk factors according to each factor together with their Eigenvalues and percentage of variance explained. The ratio of Eigenvalues is the ratio of explanatory important factors with respect to the variables. In the extraction process, all components with Eigenvalues greater than 1 are considered significant and all factors with Eigenvalues less than 1 are considered insignificant and are disregarded [8]. Meanwhile factor loading

which is less than 0.5 was not displayed (R12, R13, R22, R36, R43).

Table 2 shows that inter department communication have the highest loading factor, which is 0.876. Inter department communication in one of the item in the organization risk category. This result shows that inter department communication is the most important item that contribute to the project failure. Beside that, communication among project team members also gives a high loading factor of 0.868. In contrast, item effective communication has very low factor loading of 0.516. This low factor loading might be caused by unawareness of most project managers concerning the importance of effective communication in managing project. These two findings showed that even though communication among project team has very high factor loading, however they are not communicating effectively. As such, it can be assumed that the high percentage in software project failure in the public sector might be team member not communicating effectively. This finding is similar to SEI suggestion that effective communication among project team is one of factor that can minimize project failure [20].

Other low factor loadings recorded are inter-organization communication at 0.546, number of interface 0.504, user availability 0.543, user responsibility 0.520, conflict among user 0.566, incomplete requirement 0.544, continuous change of requirement 0.517, and team knowledge in department operation 0.567. All these risks were recognized by respondents as less important in contributing to the failure of software projects. The low factor loading of continuous change of requirement, recorded at 0.517, contradicts [4] finding that identified "continuous change of requirement" as a significant risk. This finding might be caused by low factor loading of user availability and responsibility (0.543 and 0.520). Hence, it can be concluded that the importance of user availability and responsibility towards project success was not stressed in the public sector.

Another interesting finding in the study was that incomplete requirement is also identified as less important by the respondents (0.544 factor loading). This finding shows that the project proceeded regardless of whether the requirement was completed or not. It shows the lack of communication between users and the project managers.

Table 2 Factor Loading for Each Risk Factors

Item	1	2	3	4	5
(R30)	.765				
(R39)	.716				
(R32)	.705				
(R31)	.696				
(R7)	.691				
(R29)	.667				
(R33)	.602				
(R21)	.566				
(R4)	.546				
(R37)		.856			
(R44)		.696			
(R38)		.684			
(R35)		.646			
(R6)		.642			
(R9)		.567			
(R40)		.516			
(R28)			.856		
(R25)			.749		
(R26)			.711		
(R27)			.599		
(R23)			.544		
(R17)			.520		
(R24)			.517		
(R18)				.832	
(R19)				.784	
(R8)				.769	
(R20)				.667	
(R16)				.543	
(R10)					.850
(R11)					.826
TotEV	6.340	6.627	4.242	4.210	3.361
%Var	14.40	10.51	9.640	9.568	7.640

Item	6	7	8	9	10
(R2)	.841				
(R1)	.696				
(R3)	.655				
(R42)		.739			
(R41)		.591			
(R15)			.868		
(R34)			.504		
(R5)				.876	
(R14)					.868
Tot EV	3.082	2.411	2.377	2.086	1.949
% Var	7.004	5.479	5.402	4.742	4.429

Note:
Tot EV: Total Eigenvalues
%Var: % of Variance Explained
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 15 iterations.

5.4 Ranking of the Risk Factors Compared to the Previous Studies

Based on Table 2 above, Table 3 shows the ten most important risk factors as perceived by respondents of this study compared to the study done by Addison [1] and Keil et al. [12].

Table 3 Importance of Risk factors Compared to previous studies

Ranking by this study	Ranking by Keil et al. (1998)	Ranking by Addison (2002)	Rank
Inter department communication	Executive support	Unclear objective	1
Project team turn over	User participation	Incomplete requirement	2
Communication among project team	Incorrect requirement	User participation	3
Project planning	User involvement	Executive support	4
Unrealistic expectation	Incomplete requirement	Incorrect requirement	5
Project team expertise	Unclear objective	Unrealistic expectation	6
Resources	Knowledge and skill	Continuous change of requirement	7
User participation	Continuous change of requirement	Team skill	8
Project team knowledge/skill	New technology	Project planning	9
User Knowledge	Resources	Gold Plating	10

The study showed that ineffective communication was one of the main factors for project failure. Poor vertical and horizontal communications in an organization are responsible for or generate many project problems. Due to the increase number of software projects and its complexity, public sector has taken the initiative to outsource some of their projects. This outsourcing may lead to communication breakdown. Meanwhile, study done by Addison and Keil et al. were more concern on the support of top management and the project requirement. In general, risk factors that contributed to project failure ranking were seen somehow different from study done by Addison and by Keil et al.

5.5 Result of Hypotheses Testing

Pearson's Coefficient Analysis was used to test whether there was positive relationship between the risk factors toward project failure. In order to test these hypotheses, the value of Pearson's Coefficient was calculated. The value of less than 0.5 is considered as having weak relationship, value that is between 0.5 to 0.7 as having moderate relationship and higher than 0.7 as having high relationship. Based on the hypotheses given earlier, Table 4 shows that even though most of the risk factors under project team risk category were important but overall the relationship was only moderate. This result is consistent with previous literature, where project failure has positive relationship with team risk.

Table 4 Association Between the Importance of Risk Factors with Project Failure

	Pearson Coeff.	Sig.	Result
H1	.461**	.000	Weak +ve relationship
H2	.531**	.000	Moderate +ve relationship
H3	.509**	.000	Weak +ve relationship
H4	.690**	.000	Moderate +ve relationship
H5	.770**	.000	High +ve relationship
H6	.490**	.000	Weak +ve relationship

Project complexity seemed to have high positive relationship towards project failure. The high positive relationship between project complexity and project failure might be due to the involvement of many subcontractors, whereby most of the public sector software development projects were outsource projects. Therefore, this could cause significant communication problem among the developers and the outsourcers. Besides, most of the software projects in the public sector were huge in scope and size.

Lastly, the study's results also indicated that for the association between risk categories and project failure, there is a weak positive relationship between project management and project failure. This may be due to respondents' lack of knowledge in risk management and also the fact that many did not practice risk management.

6 Conclusion

The main objective of this study is to identify the most important risk involved in software projects in the public sector. Pertaining to risk factors, the study showed that inter department and team members communications are the significant factors that contributed to software project failure. Poor vertical and horizontal communications in an organization are responsible for or generate many project problems. Two-way communication should be a practice in any organization.

It is critical that project managers understand how to manage risk factors that can contribute to project failure. With proper risk management process, risk, uncertainty and the potential impact of failure can be acknowledged and dealt with forthrightly, not ignored or hidden. Failure to make decisions based on risk can damage the project - often invisibly until it is too late. It is proposed that software risk management be a part of integral process in software development especially in public sector capital projects.

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