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The Linkage Between Software Risk Management Practice and Peoject Success: Evidence from Thai Software Firms

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THE LINKAGE BETWEEN SOFTWARE RISK MANAGEMENT PRACTICE AND PEOJECT SUCCESS: EVIDENCE FROM THAI SOFTWARE FIRMS

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ABSTRACT

Software risk management has been around at least since it was introduced in mainstream of software management process, in 1989 [1-3]. Review of literature has shown that there is a great deal of interest in the effects of software risk management on project success. 29 publications, from 1997 to 2009, were found in the literature review work for empirical evidence of the contribution of risk management to IT project success of Bakker et al. [8]. This research explored the relationship between the actual organizational software risk management practice and project performance success in Thai software industry. The findings of this study show that the risk management practices are positively correlated with performance success in meeting both the reliability of the application and the completion of the application within the schedule. This is different from the finding of Raz et al. [21] that project risk management practices are more correlated to schedule and budget goals than in product performance measures.

Keywords: Software project management, software risks management, software risks management practice, software project success, software risk management and project success, Thai software industry.

INTRODUCTION

Software risk management is a complex activity and also believed to be a major contributor to the software project success. Since it was introduced in mainstream of software management process, in 1989 [1-3], both the academic and the software industry are well aware of its significance. Research about risk dimensions, risk factors, top ten risk management and a number of established standard models, frameworks and theories have been suggested [4-7].

Review of literature has shown that there is a great deal of interest in the effects of software risk management on project success. 29 publications, from 1997 to 2009, were found in the literature review work for empirical evidence of the contribution of risk management to IT project success of Bakker et al. [8]. Researchers encourage the need to provide evidence for the linkage between risk management practice and project success to justify the risk management effort [9]. However, the empirical knowledge for the relationship between software risk management and project success is still anecdotal. The knowledge of the effects, instead of finding how it is actually used in project practice, it is largely based on how risk management is assumed to work [8].

Review of empirical literature shows a mixed result of the linkage between software risk management and project success. Additional observations are that convenience sample survey of project managers was often used. Also, the perception of the importance or the impact of the practice are often employed to determine the software risk management practice instead of assessing the actual software risk management practice. These methodologies may hinder the analysis and discovery of relation between actual organizational risk management practice and organizational project success.

The objective of this research is to explore the relationship between the actual organizational software risk management practice and project success in Thai software industry. Understanding the linkage between state of the practice and the project success will give incitements which hopefully will help ensuring the practice of risk management and the future software project success.

This paper is organized as follows. Section II gives the review of literature related to software risk management and the linkage between software risk management practice and the project success. Section III discusses the research methodology. Section IV presents the findings of the analysis and the conclusion and discussion are given in section V.

OVERVIEW OF RELATED LITERATURE

This section reviews the literature related to the proposed research objectives i.e., software risks, software risk management, software risk management process model, and the empirical study of the linkage between software risk management practice and project success.

Software Risks

The term risk is generally used in many different domains. In the "software" context, several definitions can be found. For example, Leihman and VaanBuren [10] defines risk as "A possible future event that, if it occurs, will lead to an undesirable outcomes." PM-BOK (Project Management Body of Knowledge) defines risk as: "an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives [11]." Whereas PRINCE2, the UK government sponsored project management standard defines risk as: "the chance of exposed to the adverse consequences of future events." And in all, risks are related to 2 key elements: future events, and may cause effects [12]. Software risk management is a complex activity. It has to deal with uncertain events of the software project and their causes. Researchers have tried to overcome this obstacle by suggesting the fundamental steps or phrases to handle them. This is known as "software risk management process model

[6].”The top and bottom margins for the text should be 2 centimeters. Those for left and right are 1.5 centimeters.

Software Risk Management

Software risk management can be defined as “the way to handle risks in a software project”. Its objective is to reduce uncertainties and impacts associated with certain tasks in the project. The fundamental software risk management consists of 4 major processes: 1) risk identification, 2) risk analysis, 3) risk planning, and 4) risk monitoring and control [6], [11], [13].

1) Risk Identification

Risk identification deals with the process of determining which software risk factors that might affect the software project. The software risk factors can be elicited using various techniques. These include:

a) interviewing/brainstorming with project team members, experts, customers, and other stakeholders, or

b) Delphi method – a technique to reach the consensus of participants on software risk factors anonymously.

In the elicitation process, in order to determine the related risk factors, the process may use various tools, including risk checklists [4-5][14], the top ten software risks check lists [1], or risks dimensions/categories [15]. One may use the risk checklists available from the literature or from organization own repository of risk lists. Many risk checklists can be found in the literature [7].

In their recent experimental study, Han and Huang [5] gave a comprehensive review on software risk lists. Risks were reviewed from 12 studies. Table 1 shows the details of the studies and number of risks reviewed from [5].

Table 1 Summary of the Software Risk Research [5]

AUTHOR(YEAR)	DIMENSION OF RISKS	NUMBER OF SOFTWARE RISKS
McFarlan (1981)	3	54
Boehm (1991)	0	10
Barki et al. (1993)	5	55
Summer (2000)	6	19
Longstaff et al.(2000)	7	32
Cule et al. (2000)	4	55
Kliem (2001)	4	38
Schmidt et al. (2001)	14	33
Houston et al. (2001)	0	29
Murti (2002)	0	12
Addision (2003)	10	28
Carney et al. (2003)	4	21

Finally, the software risk factors that all the parties involved agreed upon should be released and recorded in a “risk register”.

2) Risk Analysis

The next process is to analyze and prioritized the identified software risk factors (Risk Prioritization). The process is to assess the impact and the probability that the identified risk will lead to the undesirable outcomes. The risk exposure is then obtained by multiplying the risk impact with its probability. The analysis may use different techniques such as risk sensitivity analysis, decision tree and scenario analysis [11]. The identified risks are then ranked according to the risk exposure calculated to create the prioritized risk list and confirmed by the stakeholders [6], [11], [13].

3) Risk Planning

The following step is the process of developing a risk response or risk management plan. The risk response plan consists of strategies, options or alternative actions and actions in response to the prioritized risks. Generally the risk response strategies aim at reducing or eliminating the probability of the prioritized risks, or minimize the impact of the risks if it is realized. There are four common strategies in response to the software risks --acceptance, avoidance, mitigation, and transference.

Risk acceptance is to accept or do nothing to deal with a particular risk.
Risk avoidance is to take action to prevent risk events from occurring so that if it occurs there will be little impact.
Risk mitigation is to take early action to reduce the risk probability or to protect from its impact.
Risk transference is to shift the responsibility of the consequences of a risk to a third party.

Besides the risk response plan, control and monitoring plan and contingency plan may be included in the risk planning process. The control and monitoring plan describes relevant procedures and measures in order to control and monitor the risks. Contingency plan defines a secondary or alternative course of action to be taken in the event that the primary approach fails to function as it should.

4) Risk Monitoring and Control
Risk monitoring and control is the process of keeping track of the registered risks according to the control and monitoring plan. The purpose is to make sure that all risk responses have been implemented, observe the risk status and take action as specified in the risk response plan and record the risk status in the risk register.

However, in addition to these fundamental 4 steps above, two more processes are also suggested --5) risk sign-off and 6) risk post-mortem analysis [6].

5) Risk Sign-off
The status of the risk likelihood and impact should also be monitored in the risk register. For the risk that is mitigated, this process is to update the status and removes it from the risk list and sign it off. Sometimes, this step may be seen as a part of the risk monitoring and control.

6) Risk Post-Mortem Analysis
This process is to evaluate the risk management process and its results when a project has been completed. Review should be conducted to see the effectiveness on how the risks identified, analyzed, planned, managed and monitored. The lessons learned can then be used on the other projects to aid their risk management.

Software Risk Management Process Model or Framework
Software risk management process models specify stepwise tasks in order to manage risk of the software project [16]. There are variations in software risk management models which usually center around the principle and practice of four major processes mentioned before –1) risk identification, 2) risk analysis, 3) risk planning, and 4) risk monitoring and control. Whilst the software risk management process model in Kajko-Mattsson and Nyfjord [5] comprises of 6 phrases --risk identification, risk analysis, risk planning, risk monitoring and control, risk sign-off and risk post-mortem analysis. Well known risk management model or framework includes Boehm [1], SEI's software management model [17] and Kontio's Riskit methodology [18-19].

According to Boehm [1] risk management consists of two steps –risk assessment and risk control. Risk assessment contains risk identification, risk analysis, risk prioritization whereas risk control involves risk management planning, risk resolution procedure, and risk monitoring. Riskit [19] consists of risk management mandate, goal review, risk identification, risk analysis, risk control planning, risk control and risk monitoring. SEI's software management model [17] encompasses identify, analyze, plan, track, control, and communicate. These frameworks also recommend different techniques, for example, identifying risks for software project Boehm [1] recommended risk checklists, decision drivers, assumption analysis, or decomposition. Riskit [19] recommended brainstorming, checklist or benchmarking whereas SEI recommended risk taxonomy questionnaire method [17].

There are many prominent risk management standards, models, or guidelines available in literatures. Example models are CMMI (RSKM model), Continuous risk management (CRM), ISO/IEC guide, ISO 9000, ISO 9001:2000, Project Management Body of Knowledge (PMBOK), Prince 2, and IEEE [5] [16].

Empirical Study of the Linkage between Software Risk Management Practice and Project Success
The 2004 Standish Group CHAO Report stated that 53% of the software projects failed to deliver software with the required specification on time, and within budget. And 18% of the software project were cancelled (Standish Group International 2004) [20]. Bakker et al. [8] have shown that there is a great deal of interest in the effects of risk management. 29 publications, from 1997 to 2009, were found in their review of literature for empirical evidence of the contribution of risk management to IT project success. The relation between risk management and project success is implied in the publications but the empirical evidences are still anecdote. Only two papers reported some positive risk management activities on issues such as timely project delivery, the estimation of the resources required to perform the task and the number of task failures.

In 2002, Raz et al. [21], in order to answer the question "Do risk management practices have any effect on project success?" 127 questionnaires returned from project managers of variety of industries at a seminar were analyzed. The correlation between the extent of use of 5 project risk management practices and four project success dimensions were calculated. The 5 project risk management practices are systematic risk identification, probabilistic analysis of risk levels, detailed plans for uncertainty reduction, methodic trade-offs and appointing a risk manager. The 4 project success dimensions are functional specifications, technical specifications time schedule and planned budget. Only planned budget success were found significantly correlated with 3 management practices --systematic risk identification, methodic trade-offs and appointing a risk manager. The author concluded that project risk management practices are more correlated to schedule and budget goals than in product performance measures.

In 2004, Verner and Cerpa [22] survey 42 software developers on the software development practices and the software

outcomes in order to determine the factors that lead to project success. Each developer reported on a different software development or maintenance/enhancement project. Three questions of risk practices were asked – 1. Were potential risk identification at the start of the project? 2. Were risks incorporated into the project plan? and 3. Were the risks managed throughout the project? The results show no correlation between risk practices (the 3 questions) and software project performance.

Wallace et al. [4], in 2005, identified six dimension of software risk guided by sociotechnical systems theory. An exploratory model was also devised to test the linkage between the six dimensions of software risk and the software project performance. A survey of members of the Information System Special Interest Group (ISSIG) of the Project Management Institute was conducted. 507 respondents filled out the web survey. The results show the support for the model, i.e. the relation between the six dimension and the software product performance and software process performance existed.

Han and Huang [5], in 2007, the web based questionnaire from 115 software project managers on the perception of the probability of occurrence and the impact of the six risk dimensions embracing 27 software risks were analyzed. The results shows that there is no positive correlation between the probability of occurrence and the impact among the six risk dimensions. The results also indicates that the "requirement" dimension of risk is the principle factors affecting the project performance (seven project performance measures were used).

In conclusion, the empirical studies from the literature show a mixed result of the relation between software risk management and software project success. Furthermore, the observations are that convenience sample survey of any project managers were used for all the surveys. The perception of the important or the impact of the practice are often employed to measure the software risk management instead of the actual software risk management practice. These approaches may hinder the analysis and discovery of relation between actual organizational risk management practice and organizational project success.

RESEARCH METHODOLOGY

Survey Design

The survey method was used to obtain the information of the software risk management practice and project success from the Thai software firms. In order to discover the relation between actual organizational risk management practice and organizational project success, about 200 software company member of Software industry club of The Federation of Thai Industries (FTI) were used for the survey frame. In the data collection process, names, addresses and contacts of software firms were obtained from FTI. An officer at The Federation of Thai Industries (FTI) was asked to help contacting and soliciting in order to increase the response rates. The software firms were contacted by e-mail and asked to participate in the research. If the software company agreed to participate, the questionnaire was sent for the software project risk management data needed. 141 companies agreed and 40 questionnaires were returned which make a response rate of 28 percent.

Questionnaire Design

General information about the software firms and the respondents were obtained from the first part of the questionnaire. Questions include organization name, organizational size (number of employee and number of developers), respondent position, experience (number of year) in project management. The second part of the questionnaire was designed to obtain the information regarding the software risk management practice of the software firms. Software risk management process model in [5] comprises of 6 phrases --risk identification, risk analysis, risk planning, risk monitoring and control, risk sign-off and risk post-mortem analysis and two sub-process -- risk prioritization and risk resolution were utilized to capture the software risk management practice. The respondents were asked to rate how they practice project risk management (1. every project (100%), 2. almost all (80 – 99 %), 3. some (60 – 79 %), 4. a few (40 – 59 %), and 5. very few (less than 40 %)). The following part of the questionnaire was designed to obtain the information regarding the project performance of the software firms. The project performance measures were adopted from [5] which comprises of five product performance measures two process performance. The five product performance measures are 1) the application developed is reliable, 2) the application is easy to maintain, 3) the users perceive that the system meets intended functional requirements, 4) the system meets the user expectation with respect to response time, and 5) the overall quality of the developed application is high. The two process performance measures are—1) the system is completed within budget, 2) the system is completed within schedule. The respondents were asked to rate the degree the respondents believe on the project performance of their most completed software from 5) strongly disagree, 4) disagree, 3) indifferent, 2) agree, to 1) strongly agree.

The Profile of the Samples and Respondents

As shown in Table 2, of the 40 questionnaires returned, 31 companies (77.5%) answered that their organizations have a software risk management process. Therefore the other 9 organizations that answered that they do not have software management process will be excluded from further analysis.

Profile of the 31 companies and respondents are given in Table 2 Most of the companies are of small to medium size. 48.39 percent of the companies have the number of employees of 1 to 16 and 29.03 percent of the companies have the number of employees of 17 to 32. 48.39 percent of the companies the companies have the number of developers: 1-6, and 25.81 percent

of the companies the companies have the number of developers of 7-12.

Most of the respondents are project managers (45.16%). 54.84 percent have the experience in project management from 1 to 5 years and 29.03 percent have the experience in project management from 6 to 10 years.

Table 2 The Number of Companies with Risk Management Practice

Risk Management Practice	Frequency	Percentage
Risk management process is embedded in the project management process	29	72.5
Risk management process is maintained as a separate process	2	5.0
Do not have risk management process	9	22.5
Total	40	100.0

Table 3 The Companies' and Respondents' Profile

	Frequency	Percentage
Number of Employees		
1 - 16	15	48.39
17 - 32	9	29.03
more than 32	6	19.35
Missing	1	3.23
Number of Developers		
1 - 6	15	48.39
17 - 12	8	25.81
more than 12	8	25.81
Position		
Manager	14	45.16
Committee	1	3.23
Consultant	2	6.45
Employee	13	41.94
missing	1	3.23
Work Experience (Years)		
1 – 5	17	54.84
6 - 10	9	29.03
More than 10	2	6.45
missing	3	9.68

FINDINGS

Risk Management Practice and Project Performance

Firms Risk management Practice

Table 4 shows the state of practice software project risk management process of the 31 companies. From observation of the frequency, the state of practice can be divided into three groups. The first group --risk identification, risk Analysis and risk management planning, the frequency is about 30 out of 31 while the second group -- risk prioritization, risk resolution and risk monitoring, the frequency is about 25 out of 31. The last group --risk sign-off and risk post-mortem analysis, the frequency are 20 and 15 out of 31 respectively.

Table 4 also shows that the robustness of the practice of software risk process. Most of the answered to these phrases fall into every project, almost all, and some except the practices of risk sign-off and risk post-mortem are spread out.

Table 4 Risk Management Practice

	Risk Management Practice Level							
Risk Management Process	Every project	Almost all (80 – 99 %)	Some (60 – 79 %)	A few (40 – 59 %)	Very few (less than 40 %)	n/a	Total	Mean
Risk Identification	12	7	6	2	1	2	30	2.04
Risk Analysis	11	9	4	2	2	2	31	2.10
Risk Prioritization	9	4	5	2	1	3	24	2.14

Risk Planning	9	9	4	3	3	2	30	2.36
Risk Resolution	7	6	5	1	4	2	25	2.52
Risk Monitoring	8	8	3	2	4	1	26	2.44
Risk Sign-off	6	5	5	-	3	1	20	2.42
Risk Post-Mortem Analysis	2	2	3	4	3	1	15	2.79

Firms' Performance

Table 5 shows the seven firms' performance measures adopted from [5]. Most of the respondents agreed or strongly agreed on the project performance of their most recent completed software that 1) the application developed is reliable, 2) the application is easy to maintain, and 3) the users perceive that the system meets intended functional requirements. The mean value of the rating of these 3 performance measures are higher than 4. However, the other 4 performance measures are in between 3 and 4.

Table 5 Project Performance

	Project Performance Level							
Project Performance	Strongly disagree	disagree	Indifferent	Agree	Strongly agree	n/a	Total	Mean
The application developed is reliable (P01)	-	-	5	17	7	2	31	4.07
The application is easy to maintain (P02)	-	-	3	21	5	2	31	4.07
The users perceive that the system meets intended functional requirements (P03)	-	-	4	20	5	2	31	4.03
The system meets the user expectation with respect to response time (P04)	-	1	11	16	1	2	31	3.59
The overall quality of the developed application is high and two process performance (P05)	-	-	9	18	2	2	31	3.76
The system is completed within budget (P06)	-	4	11	11	3	2	31	3.45
The system is completed within schedule (P07)	1	5	11	8	3	3	31	3.25

The Linkage between Risk Management Practice and Project Success

To test if organizational risk management practice have any relations with project success, the correlation between the organizational risk management practice and project success were calculated. Since the respondents were asked to rate how they practice project risk management where 1 is for every project (100%), 2 for almost all (80 – 99 %), and so on, in order to ease the finding and understanding the correlations, the answer 1 will be given value to 5 , the answer 2 will be given value 4 and so on. The correlations between risk management practice and project performance are presented in Table 6.

Table 5 shows that risk identification is positively and statistically correlated with P01 (The application developed is reliable), (P02) the application is easy to maintain and P07 (The system is completed within schedule), while risk analysis is positively and statistically correlated with P01, and P07, risk prioritization is positively and statistically correlated with P07, risk management planning are positively and statistically correlated with only P01, and risk sign-off is positively and statistically correlated with only P01. The correlations range from -.440 to .592 which is considered moderate.

The correlations suggest that risk management practice are more correlated with success in meeting the reliability of the application (P01) and the completion of the application with schedule (P07).

In order to investigate further, a new aggregated measure of project success was constructed by adding up all performance indicators P01 to P07 to represent project performance success as a whole. The correlation between the organizational risk management practice and this project success measure were calculated as shown in Table 7.

Table 6 Correlations between Risk Management Practice and Project Performance.
(Each cell display the Coefficient of Correlation, Significant Value and the Number of Respondents.)

Risk Practice	P01	P02	P03	P04	P05	P06	P07
Identification	.544**	.465*	.059	.132	.331	.091	.592**
	.003	.013	.767	.503	.085	.645	.001
	28	28	28	28	28	28	28
Analysis	.465*	.347	.047	.036	.271	.012	.440*
	.011	.065	.809	.854	.155	.952	.019
	29	29	29	29	29	29	29
Prioritization	.384	.271	.054	.038	.096	.051	.459*
	.086	.234	.818	.869	.679	.827	.042
	21	21	21	21	21	21	20
Management Planning	.447*	.242	.017	.012	.260	.103	.289
	.017	.215	.931	.950	.182	.601	.136
	28	28	28	28	28	28	28
Resolution	.319	.032	.085	.146	.021	.044	.328
	.137	.88+	.699	.507	.926	.840	.127
	23	23	23	23	23	23	23
Monitoring and Control	.355	.110	.030	.161	.114	.018	.275
	.082	.601	.887	.441	.588	.934	.194
	25	25	25	25	25	25	24
Sign-off	.554*	.261	.044	.090	.249	.113	.431
	.014	.280	.857	.713	.305	.644	.074
	19	19	19	19	19	19	19
Post-Mortem Analysis	.499	.189	.146	.070	.181	.063	.176
	.069	.517	.618	.812	.536	.831	.546
	14	14	14	14	14	14	14

**≤ 0.01, *≤ 0.05

Table 7 Correlations between the Risk Management Practice and the New Project Success Measure

Risk Management Practice	Project Success
Risk Identification	0.50298**
Risk Analysis	0.35539
Risk Prioritization	0.32771
Risk Management Planning	0.29049
Risk Resolution	0.14508
Risk Monitoring and Control	0.19199
Risk Sign-off	0.35636
Risk Post-Mortem Analysis	0.22288

**≤ 0.0

Table 7 shows that risk identification is the only risk management practice positively and statistically significant correlated with project success. The correlation is 0.50298 which is consider moderate.

A combined measure of risk management practice was also constructed by summarizing the practice of each stage to represent the practice of an organization. Table 7 shows the correlation of the combined construct of risk management practice with the project performance (P01 to P07). Table 8 indicates that the combined risk management practice measure is positively and statistically significant correlated with success in meeting the reliability of the application (P01).

Finally, the correlation between both combined constructs was computed as shown in table 9. The finding indicates no significant relation between the two constructs.

Table 8 Correlations between New Risk Management Practice Construct and Project Performance.
(Each cell display the Coefficient of Correlation, Significant Value and the Number of Respondents.)

	P01	P02	P03	P04	P05	P06	P07
New Risk Management Construct	.416*	.180	.198	.185	.326	.111	.171
	.025	.351	.304	.336	.084	.565	.385
	29	29	29	29	29	29	28

*≤ 0.05

Table 9 Correlations between Risk Management Practice and Project Practice

Risk Management Practice	Project Success	
Risk management construct	Correlation Coefficient	.154
	Significant value	.425
	Number of Respondents	29

DISCUSSION AND CONCLUSION

There is a great deal of interest in the effects of risk management. Publications were found in their review of literature for empirical evidence of the contribution of risk management to IT project success. The relation between risk management and project success is implied in the publications but the empirical evidences are still anecdote. Two papers reported some positive risk management activities on issues such as timely project delivery, the estimation of the resources required to perform the task and the number of task failures.

Raz et al. [21] concluded that project risk management practices are more correlated to schedule and budget goals than in product performance measures. The findings of this study shows a bit of different story. The software risk management practices are found more positively correlated with performance success in meeting both the reliability of the application and the completion of the application with schedule.

Researchers encourage the need to provide evidence for the linkage between risk management practice and project success to justify the risk management effort [9]. The empirical findings of this research support the relationship between software risk management and project performance success. However, there are also many other factors affect the project success. But the evidences, at least, reassure that software risk management practice really works.

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