Investigating the impacts of PMIS quality on project management performance

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Abstract

Project Management Information System (PMIS) is a special purpose information system that is created to provide useful information for project managers and participants to make effective and efficient decision making during projects. The use of PMIS is increasing in project based industries such as construction, defense, manufacturing, software development, telecommunication, etc. It is generally known that PMIS helps to improve the quality of decision making in project management, and consequently improves the project management performance. However, how much and which parts of project management performance are affected by PMIS still need to be studied further. The purpose of this study is to investigate the impact of PMIS on project management performance. In our research model, the PMIS quality affects project management performance, and in turn user satisfaction and reuse intention. Five hypotheses are established and tested by using statistical methods.

PMIS quality variables are adopted from DeLone and McLean (1992, 2003) and they are system quality, information quality, and service quality. Nine project management performance variables are adopted and modified from the PMBoK (2013) that are considered necessary to manage projects successfully. Also, industry and project characteristics are used to test the environmental effect on the use and efficiency of PMIS by the users, and they include industry types, project size and project duration. We assume that the effects of PMIS will be different depending on the industry types and will be greater, i.e., more useful, as the project size becomes bigger and the duration longer.

Data were collected by using a survey questionnaire from those people who had experience of using PMIS in various project related industries such as construction, defense, manufacturing, software development and telecommunication. The survey questionnaire consists of 5 point scale items and were distributed through e-mails and google drive network. A total of 181 responses were collected, and 137 were used for analysis after excluding those responses with missing items. Statistical techniques such as factor analysis and multiple regression are used to analyze the data.

Summarizing the results, among the three dimensions of PMIS quality, the two dimensions of system quality and information quality are found to have significant impact on the project management performance. In turn, the overall PM performance is found to have positive and significant impacts on both user satisfaction and reuse intention. However, examining the details reveals that only two individual measures, that is, 'processing time reduction' and 'communication within PM team', out of nine PM performance measures seem to affect user satisfaction and reuse intention. Furthermore, user satisfaction is found to have a positive and significant influence on reuse intention although it does not play a mediating role between PM performance and reuse intention. It is found that the impact of PMIS quality on the PM performance is different depending on the industry where PMIS is used. System quality seems to be more important for improving the PM performance in construction industry while information quality seems more important for manufacturing industry. As for the ICT and R&D industries, PMIS seems to have relatively lesser impact compared to construction and manufacturing industries.

The contribution of this research is that it helps to clarify the logical relationship from PMIS quality to the PM performance, and to user satisfaction and reuse intention. Also, it helps us to understand what aspects of PMIS are considered beneficial and important to the users. These findings can help the PMIS developers to design a better information system by reinforcing the important quality factors which PMIS users regard highly.

Keywords: Project Management Information System (PMIS), Project management performance, Information system quality

Introduction

The use of Project Management Information System (PMIS) is increasing in project management industries such as construction, defense, manufacturing, software development, telecommunication, etc. It is generally known that PMIS helps to improve the quality of management control and decision making in project management, and consequently improves the project performance. However, how much and which parts of project management performance are affected by PMIS still need to be studied further.

The review of the previous research on PMIS reveals that the research was done on the relatively limited areas of discipline such as construction industry (Froese, 2010; Lee and Yu, 2012; Love and Irani, 2003; Stewart, 2007). Also, most research focused on the system performance from the perspectives of information system (Braglia and Frosolini, 2014; DeLone and McLean, 1992 and 2003; Jaafari and Manivong, 1998; Liberatore and Pollack-Johnson, 2003). However, PMIS seems to affect the project management performance before it has any impact on user satisfaction and other benefits. Then, the adoption of the PMIS by the users will be based on the PMIS effect on the project management

performance. Thus, the assessment and evaluation of the PMIS must consider how PMIS affect project management performance, and it is necessary to examine the effects of PMIS from the perspectives of project management participants who are concerned about project management performance such as scope, time, cost, quality, communication, integration, etc.

The purpose of this study is to investigate the impact of PMIS on project management performance, and further on the user evaluation of the PMIS in terms of user satisfaction and reuse intention. The research questions are as follows:

1. Does PMIS quality positively affect the project management performance?
2. Are the impacts of PMIS quality on the PM performance different depending on the industry types and project characteristics?
3. Does the PM performance affect user satisfaction about the PMIS?
4. Does the PM performance affect the user's intention to reuse/recommend about the PMIS?
5. Is user satisfaction related with the user's intention to reuse/recommend about the PMIS?

Methodology

Research Model and Hypothesis

In our research model, the PMIS quality affects project management performance, and in turn user satisfaction and reuse intention. The research model is constructed as Figure 1.

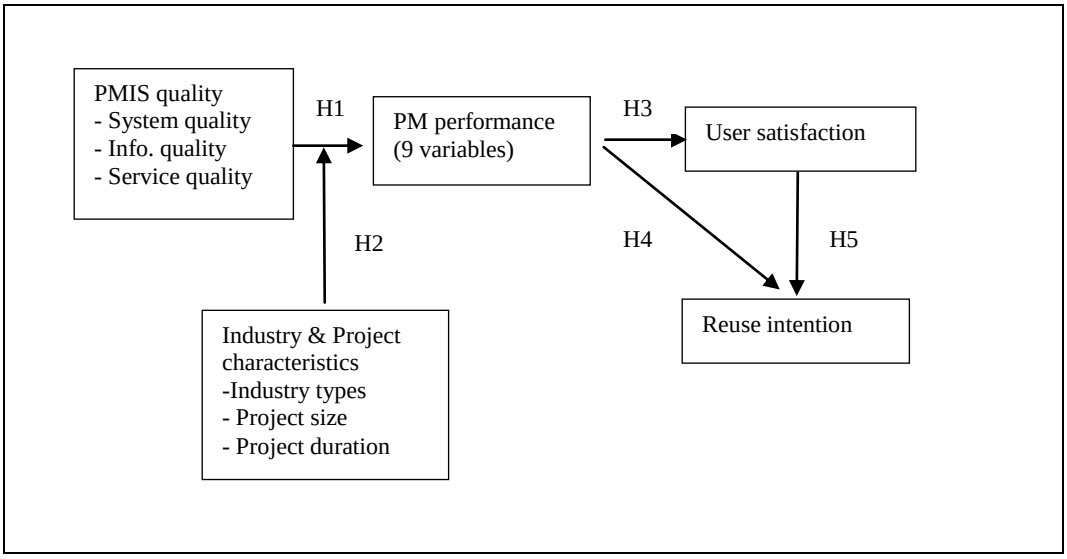

Figure 1. Research model

Hypotheses are developed to investigate the impact of the PMIS quality on the PM performance, user satisfaction, and reuse/recommendation intention. They are set as follows:

H1. The three dimensions of PMIS quality will have positive impacts on the PM performance.

H1a. System quality of PMIS will have a positive impact on the PM performance
H1b. Information quality of PMIS will have a positive impact on the PM performance.
H1c. Service quality of PMIS will have a positive impact on the PM performance.

H2. The impacts of PMIS on the PM performance will be different depending on the project environment and project characteristics.

H3. PM performance will have positive impacts on user satisfaction.

H4. PM performance will have positive impacts on reuse intention.

H5. User satisfaction will be positively related with reuse intention.

Data Collection and Variables

The measurement tool in the form of questionnaire to measure the degree of PMIS quality, PM performance, and other variables were developed based on the theories developed in the previous research (DeLone and McLean, 1992 and 2003; Petter et al., 2008 and 2013; PMI, 2013) PMIS quality is measured by three dimensions in 24 questions, and PM performance is measured by 9 questions. 5 point Likert scale is used for most of the variables except for the industry and project characteristics.

The variables are defined in Table 1 as follows:

Table 1: Definition of variables

Variables	sub variables	contents
PMIS quality	System quality (11)	availability, stability, processing speed, functionality, security, fool proof, screen design, easy to input, easy to learn, interface,
	Information quality (7)	accuracy, contemporariness, timeliness, richness, usefulness, sufficiency, relevance
	Service qualtiy (6)	quickness, reliability, training provided, user manual, professinalism, supplier reputation
PM performance	- time reduction - work accuracy - cost management - team communication - stakeholder communication - decision making - risk management - progress management - overall control	represents the performance by the project management team.
Industry & project characteristics	Industry types Project size (participants, budget) Project duration (in months)	represents the project environment that might affect the impacts of PMIS on the project management performance.
user satisfaction	user satisfaction	indicates the degree of satisfaction recognized by

		the PMIS users.
Reuse/ recommendation intention	reuse intention recommend to others	represents the intention to reuse the PMIS by the users, and/or the intention to recommend the PMIS to other people.

PMIS quality variables are adopted from DeLone and McLean (1992, 2003) and they are system quality, information quality, and service quality. The first dimension of PMIS quality is system quality. System quality is the quality of the information system processing which includes availability, stability, processing speed, functionality, security, etc. The second dimension is information quality. PMIS is a special purpose information system that is created to provide useful information for project managers and participants to make effective and efficient decision making. The objectives of PMIS can be accomplished when the information provided by PMIS is accurate, timely, relevant, rich, sufficient and so on. Thus, the information quality aspect of PMIS refers to the quality of information produced by PMIS, and they can be in the form of report and data either printed or on the screen. The third dimension is service quality. PMIS is often developed by outsourced service which is separate from project management team and participants. Various services are required to operate the PMIS properly such as installation, maintenance, training, update, etc.

Project management performance variables are adopted and modified from the PMBoK by PMI (2013) which include 10 knowledge areas that are considered necessary to manage projects successfully. Industry and project characteristics are used to test the environmental effect on the use and efficiency of PMIS by the users, and include industry types, project size and project duration. We assume that the effects of PMIS will be different depending on the industry types and will be greater, i.e., more useful, as the project size becomes bigger and the duration longer. Dependent variables are set to include user satisfaction and reuse and recommendation intention.

Data were collected by using survey questionnaire from those people who had experience of using PMIS in various project related industries such as construction, defense, manufacturing, software development and telecommunication. The survey questionnaire were distributed through e-mails and google network. Although the survey was conducted in Korea and all of the respondents are Korean, some of the respondents have experience in working in overseas projects. A total of 181 responses were collected, and 137 were used for analysis after excluding those responses which contained missing items. Statistical techniques such as factor analysis and multiple regression, analysis of variance are used to analyze the data, and the results are drawn up and discussions are made in the following sections.

Analysis and results

Profile of respondents

The profile of respondents is shown in Table 2. It includes the characteristics of the projects for which the PMIS was used by the respondents such as industry types, project duration, number of project participants, and project budget.

Table 2. The profile of respondents

Item	Value	Frequency	Ratio
Industry types	Construction Manufacturing/Defense	56 31	

	Information & Communication Tech. Research & Development Others Total	36 9 5 137	
Project duration	0 - 6 months 7 - 12 months 13 - 24 months 25 - 36 months 37 - 48 months 49 + months no response Total	17 34 25 20 15 22 4 137	
Project participants	0 - 10 persons 11 - 20 21 - 30 31 - 50 51 - 100 101 + no response Total	52 28 11 11 11 19 5 137	
Project budget (in USD, approximate)	0 - 1 million 1 - 5 5 - 10 10 - 50 50 - 100 100 + no response Total	38 23 12 19 9 30 6 137	

Test of Hypothesis 1

Multiple regression analyses are performed to test the hypotheses presented with the research model, and the results are shown in tables. All the independent variables are tested for multicollinearity and all of them seem to be within acceptable level in terms of tolerance and variance inflation factor (VIF).

H1. The three dimensions of PMIS quality will have positive impacts on the PM performance.

Hypothesis 1 investigates the impact of PMIS quality on the overall PM performance. Two of the three dimensions of PMIS quality are found to have statistically significant impact on the overall PM performance at $\alpha = 0.05$ level. Both system quality and information quality positively affect the overall PM performance.

Table 3. Regression results for H1 tests (PMIS quality -> PM performance)

Model	Unstandardized coefficients		Standardized coefficients	t	p-value	Multicollinearity Statistics	
	B	S.E	Beta			tolerance	VIF
(Constant)	.581	.216		2.691	.008		
System quality	.409	.129	.362	3.182	.002	.242	4.129
Info. quality	.514	.112	.514	4.575	.000	.249	4.024
Service quality	-.083	.099	-.090	-.830	.408	.265	3.775

F = 62.139 (p = 0.000) adjusted R square = 0.574

Test of Hypothesis 2

H2. The impacts of PMIS on the PM performance will be different depending on the project environment and project characteristics.

As a part of the test of Hypothesis 2, it is tested whether industry types affect the relationship between the PMIS quality and the PM performance. Four industries are compared to examine the impacts of the three dimensions of PMIS quality on the nine measures of PM performance, and the results are presented in Table 4. In the table, the PMIS quality dimensions with statistically significant impact on the PM performance measures are marked with asteriks for $\alpha = 0.01$ through $\alpha = 0.10$ respectively.

Table 4. The impacts of PMIS quality on the PM performance by industry types

Industry	PM performance variables	System quality	Information quality	Service quality
Construction	1. reduction in processing time	***		
	2. improve in work accuracy	***	*	
	3. improve in overall project control	***		
	4. improve in budget & cost control	***	*	*
	5. communication within PM team	***		
	6. communication with stakeholders	***		
	7. prompt in decision making	**	*	
	8. efficiency in risk management	**	**	
	9. improve in progress management	**	***	**
Manufacturing /Defense	1. reduction in processing time		***	*
	2. improve in work accuracy		***	**
	3. improve in overall project control		***	
	4. improve in budget & cost control		***	
	5. communication within PM team			
	6. communication with stakeholders			
	7. prompt in decision making		***	
	8. efficiency in risk management		**	
	9. improve in progress management		*	
Information & Communication Technology (ICT)	1. reduction in processing time			
	2. improve in work accuracy			
	3. improve in overall project control			
	4. improve in budget & cost control			
	5. communication within PM team			
	6. communication with stakeholders			
	7. prompt in decision making		**	
	8. efficiency in risk management		*	
	9. improve in progress management			
Research & Development (R&D)	1. reduction in processing time			
	2. improve in work accuracy			
	3. improve in overall project control			
	4. improve in budget & cost control			
	5. communication within PM team	*		
	6. communication with stakeholders	*		
	7. prompt in decision making	*		*
	8. efficiency in risk management		*	
	9. improve in progress management			

*: $\alpha \leq 0.10$, **: $\alpha \leq 0.05$, ***: $\alpha \leq 0.01$

From the results in Table 4, it is very obvious that the impact of PMIS quality on the PM performance is different depending on the industry where PMIS is used. Overall, the two dimensions of PMIS quality, system quality and information qualty, seem to have more impact on the PM performance than service quality. Notable is that the two industries of construction and manufacturing show very different pattern. System quality seems to be more important for improving the PM performance for construction industry while information quality seems more important for manufacturing industry. As for the ICT and R&D industries, PMIS seems to have relatively lesser impact compared to construction and manufacturing industries. A possible explanation is that many different types of information systems are already in use in ICT industry, and therefore there is relatively little value PMIS can add additionally to the project management. Also, for R&D industry, projects are relatively small in size in terms of project budget and the number of participants, and there is little need for a systematic control in a large scale which PMIS can provide. PMIS can have greater impact as the project size becomes bigger since it serves as a nerve system of a project. When a project is small in scale, the management control can take a more informal format.

Test of Hypothesis 3

H3. PM performance will have positive impacts on user satisfaction.

The impacts of PM performance on user satisfaction are tested and the results are presented in Tables 5 and 6. Table 5 shows the impact of overall PM performance on user satisfaction and Table 6 shows the impacts by individual PM performance measures. The overall PM performance has a positive and significant impact on user satisfaction at $\alpha \leq 0.01$ level. Examining the impact of PM performance in detail, only two PM performance measures seem to have significant impacts on user satisfaction, and they are 'processing time reduction' and 'communication within PM team'. This result seems to be rather disappointing for the purpose of proving the PMIS usefulness. However, this analysis is done for the entire sample that contains all the industry types. There might be different picture coming out if the analysis is conducted for each individual industry.

Table 5. Regression results for H3 tests (overall PM performance -> User satisfaction)

Model	Unstandardized coefficients		Standardized coefficients	t	p-value	Multicollinearity Statistics	
	B	S.E	Beta			tolerance	VIF
(Constant)	-.088	.235		-.374	.709		
PM performance	.945	.068	.768	13.952	.000	1.000	1.000

F = 194.653 (p = 0.000) adjusted R square = 0.587

Table 6. Regression results for H3 tests by individual performance variables (individual PM performance measures -> User satisfaction)

Model	Unstandardized coefficients B	S.E	Standardized coefficients Beta	t	p-value
(Constant)	-.018	.233		-.078	.938
reduction in processing time	.399	.108	.389	3.693	.000
improve in work accuracy	.019	.123	.018	.157	.876
improve in overall project control	.025	.091	.024	.277	.783
improve in budget & cost control	.113	.083	.115	1.371	.173
communication within PM team	.179	.095	.182	1.882	.062
communication with stakeholders	.082	.086	.086	.960	.339
prompt in decision making	.117	.096	.115	1.217	.226
efficiency in risk management	.141	.097	.137	1.449	.150
improve in progress management	-.136	.094	-.133	-1.449	.150

F = 24.191 (p = 0.000) adjusted R square = 0.605

Test of Hypothesis 4

H4. PM performance will have positive impacts on reuse intention.

The impacts of PM performance on reuse intention are tested and the results are presented in Table 7. Here, the value for the dependent variable of reuse intention is an averaged score of two measures, that is the reuse intention and the intention to recommend to others. The PM performance is found to have a very strong and positive impact on the reuse intention by PMIS users. Intuitively, this result seems to confirm the common sense that users become more satisfied and also wants to recommend its adoption to other people when a PMIS helps to improve the project management performance.

Further analyses are necessary to find out which individual measures of PM performance are considered important for the users in terms of affecting reuse and/or recommendation intention.

Table 7. Regression results for H4 tests (PM performance -> Reuse intention)

Model	Unstandardized coefficients B	S.E	Standardized coefficients Beta	t	p-value	Multicollinearity Statistics tolerance	VIF
(Constant)	1.079	.243		4.440	.000		
PM performance	.800	.070	.701	11.426	.000	1.000	1.000

F = 130.564 (p = 0.000) adjusted R square = 0.488

Test of Hypothesis 5

H5. User satisfaction will be positively related with reuse intention.

In many research on service quality, user satisfaction is considered to be related and/or to affect the reuse intention by the customers. User satisfaction and reuse intention is assumed

to be positively related in this study and the relationship is tested. As shown in Table 8, the two variables are found to be positively and significantly related with each other at $\alpha \leq 0.01$ level. Also, it is thought that higher user satisfaction leads to higher reuse intention rather than the other way around.

Table 8. Regression results for H5 tests (User satisfaction -> Reuse intention)

Model	Unstandardized coefficients		Standardized coefficients	t	p-value	Multicollinearity Statistics	
	B	S.E	Beta			tolerance	VIF
(Constant)	2.062	.209		9.880	.000		
User satisfaction	.554	.064	.597	8.646	.000	1.000	1.000

F = 74.757 (p = 0.000) adjusted R square = 0.352

Conclusion

This study initially investigated the impact of PMIS quality on the PM performance, and extended its investigation into the further effects on user satisfaction and reuse intention. The hypotheses presented in the research model are mostly found to be statistically significant although some of the variables different pictures depending on the industry types. Among the three dimensions of PMIS quality, the two dimensions of system quality and information quality seem to be more important to the users than the remaining service quality dimension. On the whole, the overall PM performance is found to have positive and significant impacts on both user satisfaction and reuse intention. However, examining the details reveals that only a few individual PM performance measures seem to affect user satisfaction and reuse intention. Further investigation will be necessary to find out whether this phenomenon is general for all the industries, or whether it will be different depending on the industries. User satisfaction is found to have a positive and significant influence on reuse intention although it does not play a mediating role between PM performance and reuse intention.

The contribution of this research is that it helps to clarify the logical relationship from PMIS quality to the PM performance, and to user satisfaction and reuse intention, and helps us to understand what aspects of PMIS are considered beneficial and important to the users. These findings can help the PMIS developers to design a better information system by reinforcing the important quality factors which PMIS users regard highly.

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(to be continued)