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Perception of Thai Professionals on Key Performance Indicators (KPIs) for Mega Construction Projects

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Abstract
Performance measurement criteria of mega projects vary from project to project. Though there is no general agreement among the researchers on key performance factors on mega projects, this research targets to investigate such factors in context of Thailand construction industry. The study explores the significance of key performance indicators in perspective of various construction stakeholders. Findings indicate that traditional triangle of 'on time, under budget and according to specification', is no more a standard of performance measurement on mega projects. Other factors such as safety, efficient use of resources, and other qualitative measures are increasingly becoming important. This implies that Thai construction industry is slowly departing from traditional measures of performance to a rather mix of qualitative and quantitative performance measures.

Keywords
Project performance management, key performane indicators (KPIs), Thai construction industry

1. Introduction

Project success means different to different stakeholders. A project that may seem successful to client may be a completely unsuccessful venture for contractors or otherwise. Invariably, stakeholders have distinct interests in a particular project and therefore perception of success may also vary depending on this perception (Bryde and Brown, 2005). In case of large projects, where number of stakeholders is large, it is important to assimilate the viewpoint of all interest groups about project success. Cox *et al.* (2003) note findings show that perception of project success may even vary according to management's perspective.

To clarify some ambiguities on scale of project success, Lim and Mohammed (1999) argue that there are two possible viewpoints of project success: macro and micro. The macro viewpoint takes care of the question "does the original concept tick?" The users and stakeholders are usually the ones looking at project success from the macro viewpoint. The micro viewpoint usually concerns the construction parties. The developer and contractor looks at project success from the micro viewpoint. Therefore, it is likely that various stakeholders perceive the project success and hence success factors differently. Further,

micro success is pertains to traditional triangle of whether the project is on time, within budget and according to specifications. In other words, micro success is more concerned about profitability or short-term gains. However, macro success is more concerned about eventual functions or long-term gains of the project.

Cooke-Davies (2002) also notes a distinction between project success which is measured against the overall objectives of project and project management success which is measured against the widespread and traditional measures of performance against cost, time and quality. Despite extensive research, there is no general agreement of a set of key performance indicators (KPIs) for construction projects to-date (Chan *et al*., 2004). Considering these future implications of research on KPIs, the present study particularly focuses on the Second Bangkok International Airport (SBIA), a mega construction project in Thai construction industry. The SBIA is a unique project in Thailand due to the volume of construction, available budget, diversity of stakeholders, involvement of several local and international construction firms, and keen interest of the government due to future business and strategic implications of the project. The paper captures the perception of various stakeholders about KPIs of the project. It also highlights some practical as well as research implications for future work.

2. Performance Measurement in Construction

Performance measurement in construction project has been dominated by the conventional measures of what Atkinson (1999) calls 'iron triangle'. Despite the simplistic nature of performance measurement through traditional iron triangle of time, cost, and quality, several researchers have started to depart from this approach and new direct and indirect measures are being employed for project performance measurement. Low and Chuan (2006) argue that the measure of project success can no longer be restricted to the traditional indicators which include time, cost and quality. They advocate the expansion of success measurement towards project management success or product success or both. This differentiation of success criteria is also suggested by various researchers who believe that project success is different from project management success (see Shenhar et al., 1997; Cookie-Davies, 2002). Several other researchers suggest that in addition to the measures of iron triangle, customer satisfaction (see Pinto and Slevin, 1988) and overall satisfaction of stakeholders (see Bryde and Brown, 2003) should also be considered in performance evaluation criteria. Some researchers have also given the notion of project risks and the capacity to resolve problems encountered by the project team which is another major element in evaluation of project success (see Belout and Gauvreau, 2004).

In study of professionals at different managerial levels, Cox et al. (2003) differentiates between quantitative and qualitative measures of success. Their quantitative performance indicators include Unit/MH, $/unit, cost, on time, resource management, quality control, % complete, earned man-hour, lost time accounting, and punch list. Most of these measures also appear in the estimating/costing systems utilized by the majority of construction firms. Qualitative performance indicators of Cox et al. (2003) include safety, turn-over, absenteeism, and motivation. However, acknowledge that qualitative indicators are considered as reliable performance and productivity evaluation tools due to their perceived difficulty and/or inability to be measured.

In their research, Turner (1997) note the following criteria to measure the success of projects: the facility is produced to specification within budget and on time; the project provides a satisfactory benefit to the owner; the project achieves its stated business purpose; the project meets pre-stated objectives to produce the facility; the project satisfies the needs of project team and supporters; the project satisfies the needs of users; the project satisfies the needs of stakeholders. Briefly, review the studies cited in the literature shows that performance measurement of construction projects is slowly moving away from employing the traditional measures towards rather a mix of quantitative and qualitative measures. In the current study, the authors also make an attempt to capture the perception of construction project leaders about a mix of different quantitative and qualitative key performance indicators.

3. Methodology

Through literature review and preliminary interviews with industry experts, a list of 9 key performance indicators was prepared in form of a questionnaire that was distributed among project managers, deputy project managers, and line managers on project site of Suvarnabhumi Airport. Respondents were asked to rate each performance indicator based on their professional judgment on a given 5-point Likert scale. The 5-point Likert scale was adopted for the ranking exercise and to facilitate the analysis of the responses, numerical values were assigned to the respondents' ratings i.e., 1 to 5 for "extremely important" to "not important at all" respectively. A total of 80 questionnaires were delivered to the respondents personally, together with a covering letter explaining the purpose of the study and assuring them of anonymity. Respondents were also sent an e-mail from the client to cooperate with the research team and respond to the questionnaire. This endorsement of the client resulted in a high response rate and out of total 80 questionnaires, 76 were collected back. This yielded a response rate of 95%.

Tables 1-4 provide demographic details of subjects who participated in this study. Most of the respondents (over 75%) were working in joint ventures of project organizations. Few were working in consortiums (12 %) and even fewer were working in their parent organizations (11.5 percent). Almost half of the respondents were project managers, deputy project managers, and construction managers. Others were holding the designation of line managers (quality control manager, contracts manager, design manager, designer coordinator, site manager etc). As all the respondents were professionally positioned at management level or higher, a certain level of accuracy in the data collected was assured. Moreover, more than eighty percent of the respondents had educational background of civil engineering. Others held professional degrees in mechanical engineering, electrical engineering, commerce, computer sciences, and social sciences. Respondents belonged to over ten nationalities and spoke more than five different native tongues. Majority of the respondents spoke English as their second language.

Table 1: Type of Organization

Type of organization	Frequency
Independent	9
Joint Venture	57
Consortium	10

Table 2: Experience of Respondents in Project Management

Experience	In Project Management	As Project Manager
<5 years	13	27
6-10 Years	18	21
11-15 Years	13	11
16-20 Years	18	8
21-25 Years	8	7
26-30 Years	4	1
>30 Years	2	1

Table 3: Educational Background of Respondents

Background	Civil	Mechanical/ Electrical	Commerce/ Economics	Computer	Social Sciences
Frequency	61	9	4	1	1
Percent	80.5	11.7	5.2	1.3	1.3

Table 4: Profile of the Respondents

Group	Project Manager	Deputy Project Manager	Project Engineer	Line Manager	Total Responses
CR	1	1	2	3	7
PMC	1	1	-	8	10
CSC	7	7	4	20	36
DC	2	-	-	3	5
CC	3	2	1	10	16
Total	14	11	7	44	76

(Note: CR= Client Representative, PMC= Project Management Consultants, CSC=Construction Supervision Consultants, DC= Design Consultants, CC=Construction Contractors)

Further, respondents had considerable experience both in the field of project management as well as project manager. Participants in this study were divided into five groups: CR (Client/Developer Representatives), PMC (Project Management Consultants), CSC (Construction Supervision Consultants), DC (Design Consultants), and CC (Construction Contractors).

4. Analysis of Variance (ANOVA)

Analysis of variance (ANOVA) was performed to ascertain if various respondent groups had a general agreement in opinion or not. This comparison of means was carried out by dividing the respondents into different groups based on the following categories:

- Type of organization
- Structure of organization
- Overall experience in project management
- Experience as project manager
- Educational background

Sub-classes of each of the above categories are shown in Table 4. Results of ANOVA in Table 5 reveal that respondents have no difference in opinion on rating perceptions of KPIs when they were tested for different sub-classes of overall experience in project management, experience as project manager, and educational background. However, clear difference in rating perceptions are observed when type and structure of the organization is controlled. Particularly, under these two categories, substantial difference in rating perception can be observed for ‘one time’, ‘under budget’, ‘right the first time’. Difference in rating perception is also notable for ‘meets the specifications’ when type of organization is controlled.

This illustrates that various construction-related stakeholders (client, contractors, consultants, and designers) have substantially different perception for traditional KPIs. However they tend to agree on most qualitative measure of project performance. Moreover, perception of ‘on time’ and ‘under budget’ also tends to differ between respondents belonging to independent organizations (that are doing the project as independent entity) and those who work in JVs or consortiums.

Table 5: ANOVA for Different Sub-classifications of Respondents

KPI	Type of Org.		Structure of Org.		Overall Exp.		Exp. as PM		Educational Background	
	F	Sig.	F	Sig.	F	Sig.	F	Sig.	F	Sig.
On time	3.80	.007	7.79	.007	1.13	.349	.22	.949	2.58	.033
Under budget	4.06	.005	9.11	.003	1.27	.286	.38	.855	.82	.534
Meets specifications	2.75	.034	2.47	.120	3.26	.010	1.20	.318	.91	.474
Efficiently	.46	.762	1.30	.257	1.23	.301	1.30	.271	2.23	.060
Right first time	3.80	.007	5.85	.018	1.58	.176	1.16	.334	1.26	.291
Safely	2.27	.070	3.34	.071	.98	.433	1.21	.314	2.23	.060
Free from defects and high quality of workmanship	.22	.923	.11	.737	1.29	.276	1.53	.189	3.68	.005
Conforms to expectations	.75	.558	.22	.638	1.09	.371	1.33	.258	1.08	.377
Minimized construction aggravation, disputes, and conflicts	.67	.611	.55	.461	1.30	.272	1.27	.284	1.66	.154

5. Rating Perception of KPIs

To further explore the perception of KPIs of respondents belonging to different types of construction organizations, ranking was carried out based on mean scores obtained by each KPI. Table 6 shows these ranks of KPIs given by different groups of respondents.

Table 6: Key Performance Indicators

KPI	Overall (76)**		CR (7)		PMC (10)		CSC (38)		DC (5)		CC (16)	
	M*	R*	M	R	M	R	M	R	M	R	M	R
On time	4.61	1	4.00	3	4.60	1	4.55	1	5.00	1	4.88	1
Under budget	4.38	2	3.57	7	4.40	2	4.42	2	4.20	4	4.69	2
Efficiently (use of resources)	4.25	3	4.43	1	4.30	3	4.24	5	4.00	6	4.25	4
Safely	4.24	4	3.57	6	3.90	6	4.37	4	4.60	2	4.31	3
Meets the specifications	4.21	5	3.57	8	4.10	4	4.39	3	4.20	5	4.13	6
Free from defects and high quality of workmanship	4.03	6	4.00	4	3.90	7	4.05	8	3.80	7	4.13	7
Conforms to stakeholders expectations	4.00	7	4.14	2	3.90	8	4.11	7	3.60	9	3.88	9
Right first time	3.99	8	3.14	9	3.90	5	4.16	6	4.40	3	3.88	8
Minimized construction aggravation, disputes, and conflicts	3.95	9	3.71	5	3.90	9	3.92	9	3.80	8	4.19	5

Table 6 reveals some insightful results. It is evident that all respondent groups have given almost similar ranks to various KPIs except for ‘Client’ whose ranking drastically differs from that of other groups.

Pearson and Spearnman correlations in table 7 also illustrate that 'Client' has significantly different perception of KPIs as compared other groups whose means scores and rank order significantly correlate to each other (see Table 7). It is also evident that there are weak or even negative correlations between rating perceptions of client and other construction stakeholders. It may also be an indicative of misalignment of client needs with comprehension of project goals by other stakeholders, particularly design consultants who have highest negative correlation with client in their rating perceptions of KPIs. It can also be seen that rating perception of designers is not significantly correlated with project management consultants and contractors which may be a possible indicator of lack of understanding of project requirements on part of designers.

Table 7: Person's Correlations (based on means scores of KPIs)

	CR	PMC	CSC	DC	CC
CR	1.000				
PMC	.293	1.000			
CSC	-.076	.749(*)	1.000		
DC	-.325	.547	.793(*)	1.000	
CC	.133	.855(**)	.708(*)	.634	1.000

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 8: Spearman's Correlations (based on rank orders of KPIs)

	CR	PMC	CSC	DC	CC
CR	1.000				
PMC	-.050	1.000			
CSC	-.167	.900(**)	1.000		
DC	-.383	.700(*)	.767(*)	1.000	
CC	.083	.667(*)	.700(*)	.633	1.000

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Overall ranking of KPIs shows that respondents are conscious about time, budget and efficient use of resources along with safety and compliance of specifications. During some personal interviews with professionals working onsite, it was found that 'time' was the most critical factor which they were struggling with. Since the project is a high profile symbol in the Thai construction industry and has often made headlines in the news, it is understandable that the respondents cared so much about time and budget. Although higher rating of safety over compliance with specification is surprising but it is notable that there is a minute different between mean scores of 'efficiently', 'safely', and 'meets the specifications'. Nonetheless, this higher rating perception of safety and efficient use of resources shows a sign of concern of respondents about these factors. Although it may not mean a total paradigmatic change but it reveals that professionals have started to think in dimensions other than time, cost, and quality for measuring the construction project performance.

6. Conclusions

This research suggests that the conventional 'iron triangle' is no more a standard of measuring construction project performance in Thailand. Rather other factors such as safety, efficient use of resources, and other qualitative measures are increasingly becoming important. There also seems an important need for aligning client's understanding of KPIs with perception of other stakeholders, particularly design consultants. This misalignment of interests indicate two future directions of improvement: first, the project management consultants should try to educate the client on various aspects

of construction; and second, other stakeholders, especially designers and contractors should also assimilate and comprehend client's needs. Findings in this study indicate that a common understanding of KPIs, despite distinctive of different stakeholders, is vital for the success of project. It will not only help to reduce the probability of potential conflicts but will also help to achieve project objectives with collective effort of all stakeholders.

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