Investigation of Key Factors to measure on-site Performance of a Construction firm

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Abstract

The performance of projects has always been an area of interest in the construction industry. Roles of all construction supply chain partners are necessary; however the role of a contractor firm in the construction project is pivotal. So, this research intended to explore a Construction Firm's performance criteria which could measure the level of performance of that firm in an ongoing project. Data was collected from construction professionals working in three principal project participant organizations, namely Owner, Consultant and Contractor. A total of 113 nos. of performance measuring items were sorted from literature review and used to collect data. Statistical tools processed by SPSS program was employed to analyze the data. Out of total 113 items, only 65 nos. of variables were found to be acceptable to every population group of this study. Factor analysis revealed 12 key performance predicting factors (KPPF) with 53 predictive indicators. 12 KPPFs with index weight are: work progress and smoothening (9.3%), change order management and work accuracy (9.1%), business relationship building (8.1%), adequacy of construction work procedure (8.6%), quality performance (8.0%), health and site safety adequacy (8.8%), Innovative contractor (8.0%), adequacy of construction site information (6.8%), compliance with contract plan/specification requirements (8.9%), creditworthiness and financial capability (8.3%), intra-agency relationship and responsiveness (7.0%) and resource management (9.2%). These results could be useful to project management body to evaluate performance of its contractor firm on site as well as the contractor itself to assess own performance and its subcontractors on-site.

Key Words : Performance evaluation, Key performance factors, Project success, Construction projects, Construction firm, Project management body.

1. Introduction

The performance of projects has always been an area of interest in the construction industry. One aspect involves the analysis of completed projects, which provides an insight into issues of 'what went right', and 'what went wrong' (Lim and Ling, 2002). The interactions and interrelationships between project participants are dependent and largely determine the overall performance of a construction project. Harmonious working relationships are essential if projects are to be successful. There is a need therefore for key participants to assess each other's performance on a mutually agreeable and regular basis. That way they can monitor and seek to continuously improve their own performance for the benefit of the overall project (Soetanto and Proverbs, 2002).

Roles of all construction supply chain partners are necessary; however the role of a contractor firm in the construction project is pivotal. In this regard, the performance of contractor needs to be high quality and

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selecting the right and highly performing contractor for the right project is the most crucial challenge for any construction owner. Construction companies must undertake regular evaluation of their performance in order to ensure the adoption of timely and appropriate strategies to survive in business.

There are numerous studies about criteria towards prequalification and contractor selection (Hatush and Skitmore 1998; Ng and Skitmore 1999; Lim and Ling 2002; Wong 2004; Singh and Tiong 2006 etc.). These criteria mostly evaluate contractors only for a new project. But whether contractor is going in right direction or not in an undertaking project, it is necessary to evaluate their on-site performance. Again, there are also heavy focuses given to the investigation of the performance determinants at the project level rather than individual contractor firm by Chua et al. 1999, Shenhar et al. 2001; Phua 2004, Chan et al. 2004, PASS (Hong Kong), Construction best practice program (CBPP, UK), an excellence model presented by European foundation for quality management (EFQM) etc. To the best of our knowledge, scant empirical attention has been devoted to investigating the performance determinants at the firm level at globally as well as Korean domestic context. Some researchers and institutes (Kagioglou et al. 2001, Shen et al. 2003, Dikmen et al.2005, Cheah et al 2004, Yu et al. 2006; Jung and Kim 2004) working in construction field have discussed and tried to develop performance indicators for construction firm, but they are not enough as well as based on manufacturing or business field performance criteria such as balanced score card (BSC), benchmarking etc. In this context, on-site performance based measurement tool to measure the performance of a construction firm was sought.

So, the main purpose of this work was to explore such performance or quality of service criteria, which could measure the level of performance of contractor firm on-site. This paper argues that identifying the factors that drive construction firm performance is critical because these bear a direct relevance to what companies in responding to betterment in terms of prioritizing, organizing, structuring and procuring their resources to generate economic advantages and achieve sustainable competitive advantage. Three research questions were postulated to conduct this work: (1) What factors are given emphasis by construction professionals as key elements to construction firm performance measurement? (2) In what way the contractor's performance measures can be classified? and (3) What are the relative importance of the key performance measuring factors? The focus of this research is on overall construction contractors, as a proof of concept. Future generalizations/revisions of the framework can be conducted for different size and scope of organizations and nature of projects.

2. Performance measurement

According to Neely et al. (2002) performance measurement is the process of quantifying the efficiency and effectiveness of past action and a performance measure as a parameter used to quantify the efficiency and/or effectiveness of past action (cited in Lin and Shen 2007). However, in the context of this research definition of performance measurement is modified and defined as the process of quantifying the efficiency and effectiveness of undergoing activities of a firm. It is not only measuring past actions, but measuring current performance in periodical basis. In other words, performance measurement is the process of determining how successful organizations or individuals have been in attaining their objectives. Good performance is a synonym of success and critical success factors (CSF) include issues vital to an organization's current operating activities and its future success. In construction terms, CSFs are those factors which predict success on projects. Xerox has developed ten questions regarding the achievement of quality product; these could be a good point of departure towards assessing any business company's own performance level (cf. El-Mashaleh et al 2007).

Broadly, two types of indicators are employed during performance measurement, namely leading indicators and lagging indicators (Unahabhokha et al. 2007). A leading

Table 1. Previous researches

S.N.	Performance Indicators
1	Health & safety performance (1), (2), (3), (6), (7), (8), (9)
2	Financial strength (1), (3), (5), (6)
3	Business relationship and satisfaction (2), (3), (4), (6), (8)
4	Timely Completion (2), (6), (7), (8)
5	Business performance/reputation (2)
6	Management capability (1), (4), (9)
7	Technical ability (1), (5), (9)
8	Quality performance (2), (6), (7)
9	Cost performance (2), (7), (8)
10	Marketing ability/Profit (5), (8)
11	Information flow/analysis (4), (5), (9)
12	Plants and equipment management (3), (6)
13	Past experience (5)
14	Site management (6), (9)

References: 1. Hatush et al. 1997; 2. CBPP 2000; 3. Ponpeng et al. 2003; 4. Bassioni et al. 2005; 5. Dikmen et al. 2005; 6. Acharya et al. 2006; 7. Shen et al. 2006; 8. El-Mashaleh et al. 2007; 9. Kashiwagi (2004)

indicator measures the drivers of future performance, for example: a product quality; it is a leading indicator of the customer satisfaction. A lagging indicator measures the output or success of past activity, for example manufacturing cost; it is a lagging indicator of the efficiency of production. It is also important that the relationship between these different measures must be viewed from a holistic viewpoint and suggestion be the collective improvements.

In the late 1970s and 1980s, most of the performance measurements were based on costing and accounting systems. These systems were criticized by the researchers by identifying their shortcomings and argued for change. Consequently, in the late 1980s and early 1990s 'balanced' or 'multidimensional' performance measurement frameworks were developed by Keegan et al. in 1989 year,

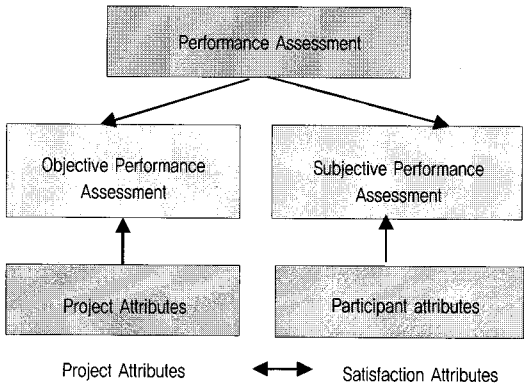

Fig 1. Conceptual performance model
Source : Soetanto and Proverbs(2002)

Cross and Lynch in 1988-89 year, Kaplan and Norton in 1992 year etc. Camp in 1989 year, Spendolini in 1992 year and Hudson in 1997 has dealt about the performance metrics by benchmarking. These new frameworks placed emphasis on non-financial, external and future looking performance measures. McGeorge and Palmer in 1997 year have identified the key issues for the construction industry, which involved many of above questions (cf. El-Mashaleh et al. 2007).

2.1 Model of performance assessment

Conceptually, the outcomes of performance assessment (in terms of levels of satisfaction) can be influenced by two major attributes, those of the performer as performance attributes and those of the assessor as satisfaction attributes as shown in fourth level of model in fig. 1 (Soetanto and Proverbs 2002). Satisfaction attributes are differentiable from performance attributes mainly because of their unique nature, they being inherent within an individual (i.e. assessor). That is performance attributes may reflect on both participant and projects and will influence both participant and project performance. In contrast satisfaction attributes reflect on the assessor and influence his/her performance assessment and such are beyond the control of the performance.

Performance attributes also consist of participant attributes and project attributes. Participant attributes represent the characteristics or nature of a particular participant or their organization, such as company age, turn over etc. Project attributes represent the characteristics/nature of a project, comprising attributes which may be outside the control of the participants. Controllable attributes are for example: forms of contract, procurement system; extent of design finished prior to work on site etc. Satisfaction attributes include the personal characteristics of the individual assessor (e.g. experience, background etc.) and of their employer, which may influence their assessment (e.g. company age, turnover, no. of employees etc.). Fig.1 demonstrates the relationships between the different attributes in

Table 2: Perceived contractor performance measuring variables

Perceived performance measuring items			
1	Knowledge of and compliance with owner standard	58	Availability and adequacy of owned construction plant/ equip.
2	Knowledgeable and well known about the work to be performed to the finest detail	59	Adherence to project schedule and project completion timeframe
3	Cooperative, superior working relationship and open communication with project owner	60	Responding all directives immediately
4	Cooperative, accommodating and open communication with consultant	61	Timely submissions of project progress etc.
5	Relationship with regulating authorities	62	Construction materials ordered, purchased and received in time
6	Relationship with subcontractors	63	Early notification of possible delay claims
7	Regular attending the project meetings by qualified…	64	Responding and addressing immediately to all corrective work
8	Familiarity and compliance with regulating authorities	65	Minimizes magnitude of claims and disputes
9	Familiarity with local working culture	66	Well designed safety program
10	Established organizational structure	67	Strict compliance with owner's safety regulations
11	Litigation tendency	68	Proposed health and safety program
12	Degree of trust in other project team members	69	Health and safety records on previous projects
13	Depth of experience on similar types of projects	70	Maintains an adequate program to monitor compliance with contract
14	Qualification and experience of technical and managerial staff	71	Minimizes job site accidents
15	Manpower resources (technicians, experts etc.)	72	Timely and adequately corrects safety deficiencies
16	Present workload and capability to support the project	73	Quality of site safety maintenance
17	Quality control and assurance program	74	Accuracy and timeliness of regulatory documentation
18	Specialized knowledge of particular const. method	75	Provides valid and appropriate supporting documentation for change orders
19	Capability to working within limits of operation	76	Timely submission of change order proposals
20	Understanding of environmental requirements	77	Timely performs change order works
21	Compliance with labor standards	78	Practices claim and change order avoidance
22	Availability of testing equipment	79	Ability to complete the project within the allotted cost
23	Contractor's time and project cost saving attitude	80	Ability to produce no errors and accurate representation
24	Risk sharing level or attitude with other participants	81	Works to mitigate the number of changes and control the cost
25	Trend of employing reputed subcontractors	82	Change order quotations are reasonable and timely
26	Types of performance bond submitted	83	Willing to resolve the issues quickly
27	Cash out/payment schedule in the project	84	Creditworthiness of company
28	Tendency to performing quality work and materials	85	Current working and fixed assets
29	Tendency to finish work in scheduled time	86	Current liabilities and commitments
30	Responsibility in setting down project objectives	87	Profit generating ability
31	Setting down project priorities seriously	88	Capital structure and liquidity status of the company
32	Attitude to solve project complexity	89	Financial arrangement for the project work
33	Type of control and monitoring procedures	90	Contractor reputation and image in the industry
34	Ability to deal with unanticipated problems	91	Origin of the company
35	Coordination of work with client operations	92	Number of years in the construction business
36	Management of subcontractors and suppliers	93	Rank of listing on the stock market
37	Responsiveness to owner's project staff request	94	Adequacy of staffing, materials and equipment
38	Timely subcontractor approval and work order	95	Timely submissions of shop drawings and samples
39	Timely and accurate submissions of clear project records and as-built drawings and documents	96	Timeliness in obtaining regulatory inspections and permits
40	Timely and accurate submissions of all other docs.	97	Providing timely notice of conditions impacting schedule
41	Adjusting worker wages and facilities	98	Timely creation, submission and approval of project schedule
42	Compliance with owner affirmative action	99	Timely notice of schedule tie-inns, cut-over, shutdowns etc.
43	Timely payment to staffs, subcontractors etc.	100	Accurately and timely notice that work in place is ready
44	Maintains an adequate daily log for all activities	101	Quality achievement of subcontractor work
45	Employment of skilled and knowledgeable staff	102	Subcontractor attendance at scheduled meetings
46	IT knowledge (electronic document management)	103	Subcontractor responsiveness and compliance with owner
47	Compliance with required testing and inspections	104	Familiarity with local weather/geographic condition
48	Strict compliance with contract plans	105	Familiarity with local labor market and material supplies
49	Quality of as-built drawings	106	Relationship with local authority
50	Superior quality of finished work	107	Home office location from job site area
51	Creating minimal problems	108	Communication and transport method from office to job site
52	Highly qualified workforce	109	Experience with specific type of facilities
53	Employing knowledgeable subcontractors	110	Promptly performs punch list (defective) works
54	Quality of housekeeping and project cleanliness	111	Provides clear and complete operating/maintenance manuals
55	Conditions and procedures of plant and equipment	112	Promptly, and completely clears thework site after finishing the job without hindering other parties movement
56	Use of modern and suitable plants and equipment	113	Supports task inspection, commissioning and project delivery
57	Equipment is always well maintained and available		

assessment of performance.

2.2 Previous studies on performance indicators

Some major performance indicators developed or recommended by some of previous researches are depicted in table 1. Some researchers have used competitiveness or effectiveness as success criteria of construction firm. Those terms have been considered as synonyms of performance factors and have been included

in table 1. A matrix was prepared to compare and cluster the findings of previous researches. However, it was been tedious to cluster them as the researchers have given different names for almost same results. For example, stakeholders focus, owner/consultant relationship, customer satisfaction, public relations etc. So, all of these indicators are grouped in business relationship and satisfaction section (S.N. 3 in Table 1).

According to Table 1, 14 numbers of performance indicators have been reported by two or more researches. Based on these 14 numbers of previous researches, performance indicators such as health and safety performance (ii) financial strength, (iii) business relationship and their satisfaction (iv) timely completion (v) business performance and reputation and (vi) management capability are the top listed indicators in the Table 1.

3. Research method

A comprehensive literature study was performed to answer the research questions. This study has adopted quantitative research method, in which measurement and observation are used to prove theories and obtaining results. A total of 113 numbers of performance measuring constructs (shown in table 2) were determined referring literatures like Lim and Ling (2000), Ling (2004), Wong (2004), Singh and Tiong (2006) as well as author's self experience. Five-point Likert scale (1= strongly disagree and 5 = strongly agree) field survey questionnaire was employed to get the responses from professionals regarding perceived performance measures. Mean scale rating, ANOVA and factor analysis, correlation tools were used to analyze the data.

The mean scale rating more than 3.5 was used as a cutoff value for significant performance measuring factors. Later, ANOVA at 5% significant level was employed to check the consistency of all parties regarding the acceptance of the performance measures. Practical significance test (denoted as 'd') was used to look further whether significant mean difference variables rejected by ANOVA at 5% were practical or not. Because, some times ANOVA test rejects by chance the hypothesis that means of population groups are equal. Post hoc test (Tukey's and Dunnett C's) was employed to identify significant mean differences between two particular subgroups.

Practical difference (d) can be calculated by dividing the mean difference of two particular parties' in a group by their pooled SD. A cutoff value of 0.5 (= d) was used to accept or reject the practical difference hypothesis (Cohen 1988, cited in Coetzee, 2005). Factor analysis was employed to reduce the large numbers of performance measures into a smaller set of manageable performance indicators. Correlation strength was used to determine the weight of each performance-measuring factor. Statistical computer program SPSS 13 was employed to analyze the data.

4. Data analysis and results

Questionnaire survey method was used to collect the research information. 'The more the better' concept was adopted in collecting the data. Hence, questionnaire instruments were distributed by all means, that is hand-

Table 3. Respondents' information

Organization affiliation	Field Experience	Management Position	Construction field	Project owner category	Project amount	Construction time
Owner= 17.5%	〈5 years= 19.1%	Senior level= 22.5%	Building/Apartment = 18.8%	Government= 34.5%	〈 100 billion KRW= 7.7%	〈 1 year= 1.9%
Consultant= 24.3%	6-10 years= 19.1%	Middle level= 41.5%	Road Const.= 33.8%	Public= 40.6%	101-500 billion KRW= 16.9%	1-3 years= 28.6%
Contractor= 58.2%	11-15 years= 30.7%	Junior level= 36.0%	Rail/Subway= 13.2%	Private= 24.9%	501-1000 billion KRW =35.7%	3-5 years= 28.9%
Total N = 325	〉15 years= 31.1%		Others= 34.2%		〉 1000 billion KRW= 39.7%	〉 5 years= 40.6%

Table 4. Statistical and practical significance test result

S.N.	Item No.	Perceived performance items	Overall Mean (N=325)	ANOVA and 'd' Result			
				Org.	Pro. type	Position	Ownership
1	2	Knowledgeable and well known about the work to be performed to the finest detail	4.23	0.27	0.963	0.041* (d=0)	0.062
2	3	Cooperative, superior working relation with owner	4.21	0.412	0.227	0.06	0.378
3	4	Cooperative, accommodating and open communication with design/supervision..	4.14	0.486	0.345	0.108	0.029* (d=0)
4	73	Quality of site safety maintenance	4.09	0.237	0.589	0.059	0.147
5	34	Ability to deal with unanticipated problems (e.g. risk management)	4.06	0.013* (d=0)	0.11	0.239	0.039* (d=.36)
6	80	Ability to produce no errors, accurate representation of work completed	4.05	0.171	0.009* (d=0)	0.117	0.003* (d=.48)
7	63	Early notification of possible delay claims	4.03	0.475	0.115	0.064	0.16
8	10	Established organizational structure ···	4	0.063	0.13	0.128	0.154
9	39	Timely and accurate submissions of clear project records and as-built drawings···	3.98	0.264	0.089	0.062	0.025* (d=.41)
10	48	Strict compliance with contract plans and specifications	3.95	0.773	0.609	0.009* (d=.40)	0.032* (d=0)
11	13	Depth of experience on similar types of projects	3.94	0.2	0.237	0.336	0.034* (d=0)
12	23	Contractor's time and project cost saving attitude or approach	3.93	0.012* (d=.49)	0.222	0.761	0.015* (d=.47)
13	35	Coordination of work with client···	3.92	0.154	0.147	0.854	0.762
14	45	Employment of trained/ skilled and knowledgeable staff ···	3.92	0.547	0.509	0.036* (d=.37)	0.107
15	20	Understanding of environmental (noise, dust, water pollution etc.) requirements	3.88	0.044* (d=.44)	0.092	0.026* (d=.45)	0.039* (d=0)
16	77	Timely performs change order works	3.88	0.030* (d=0)	0.035* (d=0)	0.533	0.104
17	98	Timely creation, submission and approval	3.88	0.622	0.127	0.482	0.106
18	76	Timely submission of change order···	3.86	0.153	0.29	0.244	0.249
19	29	Tendency to finish work in scheduled time	3.85	0.242	0.025* (d=0)	0.578	0.374
20	50	Superior quality of finished work even exceeding contract requirements	3.85	0.886	0.987	0.010* (d=.44)	0.444
21	84	Creditworthiness of company	3.84	0.085	0.308	0.744	0.063
22	40	Timely and accurate submissions of all···	3.83	0.598	0.638	0.504	0.159
23	110	Promptly performs punch list	3.83	0.14	0.566	0.077	0.105
24	16	Present workload and capability to support the current project	3.82	0.281	0.8	0.234	0.011* (d<.5)
25	30	Responsibility in setting down project objectives	3.82	0.473	0.019* (d=0)	0.057	0.032* (d=.43)
26	43	Timely payment to staffs, subcontractors and suppliers	3.82	0.073	0.089	0.043* (d=.41)	0.129
27	74	Accuracy and timeliness of regulatory···	3.82	0.319	0.061	0.664	0.174
28	82	Change order quotations are reasonable and timely	3.8	0.189	0.176	0.013* (d=.41)	0.245
29	92	Number of years in the construction···	3.8	0.219	0.147	0.71	0.666
30	18	Specialized knowledge of particular construction method	3.78	0.14	0.912	0.278	0.004* (d<.5)
31	60	Responding all directives immediately	3.78	0.165	0.092	0.064	0.538
32	89	Financial arrangement for the project···	3.78	0.188	0.412	0.197	0.812
33	99	Timely notice of schedule tie-inns, cut-over, shutdowns and/or interruptions	3.78	0.064	0.215	0.030* (d=0)	0.17
34	17	Quality control and assurance program	3.77	0.663	0.66	0.029* (d=.37)	0.102
35	53	Employing highly qualified and knowledgeable subcontractors	3.77	0.031* (d=0)	0.407	0.14	0.618
36	57	Equipment is always well maintained ···	3.76	0.2	0.089	0.143	0.098
37	97	Providing timely notice of conditions impacting schedule	3.76	0.158	.011* (d=0)	0.3	0.398
38	52	Highly qualified workforce (technicians, workers etc.) employment	3.75	0.081	.036* (d=0)	0.237	0.76
39	95	Timely submissions of shop drawings	3.75	0.379	0.18	0.544	0.151
40	61	Timely submissions of project progress, progress photos, shop drawings etc.	3.74	0.031* (d=.41)	0.385	0.083	0.128
41	113	Supports building commissioning and project delivery program	3.74	0.017* (d=.47)	0.303	0.012* (d=.38)	0.087
42	67	Strict compliance with owner's security, health and safety regulations	3.73	0.235	0.503	0.028* (d=.37)	0.302
43	111	Provides clear and complete operating···	3.72	0.169	0.593	0.15	0.244
44	47	Compliance with required testing···	3.71	0.085	0.19	0.106	0.117
45	68	Proposed health and safety program	3.71	0.401	0.076	0.004* (d=.48)	0.218
46	58	Availability and adequacy of owned construction plant and equipment.	3.7	0.112	0.048* (d=0)	0.132	0.518
47	70	Maintains an adequate program to monitor compl ···	3.7	0.379	0.059	0.115	0.531
48	78	Practices claim and change avoid	3.7	0.301	0.062	0.099	0.284
49	19	Capability to working within limits ···	3.69	0.461	0.229	0.113	0.09
50	24	Risk sharing level or attitude with other···	3.67	0.542	0.163	0.195	0.572
51	112	Promptly and completely clears the work site without hindering third parties movement	3.67	.045* (d=.40)	0.561	0.163	0.181
52	41	Adjusting worker wages and facilities···	3.64	0.368	0.062	0.903	0.579
53	5	Relationship with regulating authorities	3.61	0.362	0.595	0.589	0.325
54	7	Regular attending the project meetings ···	3.6	0.111	0.18	0.232	0.193
55	109	Experience with specific type of facilities	3.57	0.163	0.692	0.308	0.375
56	22	Availability of testing equipment ···	3.56	0.249	0.308	0.086	0.054
57	21	Compliance with labor standards	3.55	0.41	0.057	0.492	0.051
58	27	Cash out/payment schedule in the project	3.55	0.033* (d=.46)	0.182	0.32	0.719
59	37	Responsiveness to owner's project staff···	3.54	0.276	0.147	0.962	0.351
60	46	IT knowledge, e.g. electronic document···	3.54	0.304	0.374	0.218	0.282
61	104	Familiarity with local weather/geographic	3.54	0.059	0.213	0.71	0.077
62	105	Familiarity with local labor market···	3.54	0.098	0.433	0.817	0.477
63	69	Health and safety records ···	3.53	0.459	0.304	0.145	0.647
64	86	Current liabilities and commitments	3.51	0.296	0.546	0.673	0.629
65	106	Relationship with local authority	3.5	0.033* (d=0)	0.187	0.744	0.666

Notes: d=0 indicates mean differences could not be detected as statistically significant by post hoc test

Table 5. Performance evaluation factor matrix

S.N.	Item no.	Factorial elements	Factor	Factor loading	Eigen value	Variance (%)	h^2
1	112	Promptly and completely clears the work site···	F1	0.678	25.27	8.02	0.7
2	110	Promptly performs punch list		0.633			0.65
3	111	Provides clear and complete operating···		0.603			0.67
4	113	Supports job inspection and project delivery program		0.575			0.68
5	95	Timely submissions of shop drawings		0.522			0.56
6	60	Responding all directives immediately		0.446			0.6
7	99	Timely notice of schedule tie-inns, cut-over, shutdowns···		0.436			0.58
8	61	Timely submissions of project progress, progress photos...		0.416			0.66
9	77	Timely performs change order works	F2	0.662	2.54	7.44	0.69
10	76	Timely submission of change order proposals		0.61			0.69
11	34	Ability to deal with unanticipated problems		0.479			0.63
12	74	Accuracy and timeliness of regulatory···		0.468			0.56
13	2	Knowledgeable and well known about the work to be performed ···		0.449			0.52
14	80	Ability to produce no errors, accurate representation of work		0.46			0.63
15	3	Cooperative, superior working relation with owner	F3	0.764	1.81	7.16	0.66
16	4	Cooperative, accommodating and open communication with design/supervision consultant		0.737			0.63
17	7	Regular attending the project meetings ···		0.512			0.56
18	10	Established organizational structure ···		0.491			0.55
19	24	Risk sharing level or attitude with other···		0.436			0.55
20	27	Cash out/payment schedule in the project	F4	0.635	1.76	5.52	0.55
21	21	Compliance with labor standards		0.551			0.57
22	29	Tendency to finish work in scheduled time		0.512			0.59
23	30	Responsibility in setting down project objectives		0.449			0.54
24	52	Highly qualified workforce (technicians, workers etc.)	F5	0.7	1.52	5.48	0.7
25	53	Employing highly qualified and knowledgeable subcontractors		0.68			0.66
26	50	Superior quality of finished work even exceeding contract ···		0.422			0.52
27	68	Proposed health and safety program	F6	0.758	1.44	5.05	0.8
28	69	Health and safety records ···		0.673			0.75
29	67	Strict compliance with owner's security, health and safety ···		0.666			0.74
30	70	Maintains an adequate program to monitor compliance with contract···		0.579			0.67
31	73	Quality of site safety maintenance		0.449			0.6
32	18	Specialized knowledge of particular construction method	F7	0.771	1.35	5.02	0.64
33	17	Quality control and assurance program		0.61			0.6
34	16	Present workload and capability to support···		0.537			0.59
35	19	Capability to working within limits ···		0.463			0.61
36	105	Familiarity with local labor market···	F8	0.718	1.27	4.55	0.64
37	104	Familiarity with local weather/geographic		0.696			0.64
38	48	Strict compliance with contract plans and specifications	F9	0.57	1.16	4.02	0.63
39	47	Compliance with required testing···		0.562			0.63
40	46	IT knowledge, e.g. electronic document···		0.451			0.64
41	39	Timely and accurate submissions of clear project records ···		0.434			0.66
42	84	Creditworthiness of company	F10	0.627	1.12	3.98	0.62
43	86	Current liabilities and commitments		0.523			0.54
44	89	Financial arrangement for the project···		0.506			0.54
45	92	Number of years in the construction···		0.429			0.53
46	5	Relationship with regulating authorities	F11	0.666	1.05	3.75	0.63
47	106	Relationship with local authority		0.635			0.7
48	37	Responsiveness to owner's project staff···		0.576			0.62
49	58	Availability and adequacy of owned construction plant/equip	F12	0.628	1	3.53	0.7
50	57	Equipment is always well maintained ···		0.593			0.71
51	43	Timely payment to staffs, subcontractors and suppliers		0.438			0.6
52	45	Employment of trained/ skilled and knowledgeable staff ···		0.429			0.63
53	41	Adjusting worker wages and facilities···		0.419			0.57

Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalization., Rotation converged in 17 iterations

to-hand, faxes, emails and ordinary post mails. 360 numbers of responses were collected. Out of these numbers, 35 questionnaires could not be utilized as they were either partially filled or outliers. Detailed information related to respondents with regard to organization affiliation, field experience, management position, project ownership, project amount etc. is provided in table 3.

Reliability test was employed to check the suitability of data for further statistical test. Reliability test resulted a high Cronbach's alpha value 0.984 (nearly one) for 113 items and 325 responses. This indicates that the data is highly reliable (Keytone 2001). Furthermore, one sample test at 95% confidence level of each individual 113 items yielded significance value less than 0.05 (all p-value =0). This test also has indicated that all items can be used as performance evaluation measures.

4.1 Mean value and ANOVA test

Mean of agreement towards perceived performance measuring variable was adopted in the beginning to sort out the variables. Mean rate scale result of performance measuring variables indicated that 15 numbers of variables (item nos. 71,2,3,1,14,4,73,83,34,59,72,80,63, 15,10) in descending order have mean value more than 4.0 in five-point scale, 10 variables (item nos. 85, 11, 9, 91, 108, 8, 25, 26, 107 and 93) have mean value less than 3.5 (hence declined for further test as criteria set in section 3) and rest of 88 variables have mean value between 3.5 and 4.0. Further test of consistency in acceptance with respect to four population domains namely (i) organizational attachment (ii) management position (iii) ownership and (iv) construction field; over these 103 variables was conducted through ANOVA test at 5% level. These four population groups were selected because these domains happen to be the principal influence factor in any types of construction projects. ANOVA test result depicted significant statistical differences ($p<0.05$) with respect to different variables and selected population groups (can be seen in Table 4). However, 34 numbers of items (3, 5, 7, 8, 9, 10, 19, 21, 22, 24, 35, 37, 40, 41, 46, 47, 57, 60, 63, 69, 70, 73, 74, 76, 78, 84, 86, 89, 92, 95, 98, 104, 105, 109, 110, and 111) have no significant mean differences at all (all $p > 0.05$) with respect to all four population category. Hence, these have been accepted as possible performance evaluation measures.

Multiple comparisons HSD post-hoc test was employed to detect the differences in mean of two particular subgroups. With the result of these differences and pooled standard deviation (SD), whether the ANOVA differences were practical or not were determined by practical significance test (d). Table 4 illustrates the final result of accepted performance evaluation measures. The statistical ($p<0.05$) and practical significant ($d>0.5$) variables in any one of four population categories have been deleted from the list. These two tests criteria are the basis of acceptance of the variables as a performance evaluation measure. With these criteria, 38 numbers of variables were been rejected from original 103 numbers of items.

According to table 4, mean difference with respect to 31 variables are statistically significant as shown by asterisk symbol (*), however post hoc test either could not detect the differences or these differences were not practically significant ($d<0.50$). So, all together this study has investigated 65 parameters (34 no statistical + 31 no practical) statistically to evaluate the performance of a contractor firm in an ongoing project. However, 65 numbers of parameters are large to manage independently. Therefore further condensation of these 65 measures was considered as an appropriate step. So, another statistical tool, namely factor analysis has been employed to reduce the measurable elements into a smaller set and a manageable form. The next section will thus describe about the factor analysis process.

4.2 Factor analysis

65 numbers of perceived performance measuring items were correlated before factor analysis. Correlation result shows that there is no any correlation greater than 0.666,

hence there is no problem of multi-collinearity (Field, 2005; Chap. 15). The 65 items were inter-correlated with principal factor component method and rotated to form a simple structure by means of Varimax rotation. Variables found to be having factor loadings less than 0.4 and cross-loadings less than 0.10 were eliminated from the final factor result list. The Kaiser-Meyer-Olkin (KMO) value 0.958 is found to be greater than 0.7, which means the data set is likely to factor well. Bartlett's test ($p = 0.000$) rejects the hypothesis (at $p<0.001$) that the correlation matrix is an identity matrix without significant correlations between variables. Both diagnostic tests confirm that the data were suitable for factor analysis. Based on Kaiser's criterion (eigenvalue more than 1), 12 numbers of factors were postulated as provided in Table 5. These twelve factors represent 63.535 percent of total variance.

The variables comprised in one factor component with factor loadings, communalities (h^2), eigenvalue and variance are also shown in Table 5. Out of original 65 variables used to factorize, 12 items did not qualify in final factor loading matrix (table 6) due to either less than 0.4 factor loading or cross loading less than 0.10 value. According to this table, communalities of all elements greater than 0.50 and the items loaded on a single factor with little cross loading provide evidence of good convergent and distinguished validity. 12 factors are termed as performance measuring instrument and have been defined as the Key Performance Predictive Factors (KPPF). Each of these twelve KPPFs will be interpreted and discussed in the next section.

KPPF-1: This factor refers to the activities of contractor that ensures healthy project progress and smooth closure of every job in the project. Therefore, it is labeled as "Work Progress and Smoothening Factor." Categorically no any previous researches have mentioned about this indicator. So, this is a sole finding of this research.

KPPF-2: This factor refers to the activities of contractor that effectively manages the changes in construction work and finishes the work to the required accuracy. Therefore this factor is labeled as "Change Management and Work Accuracy." This finding is in line with the performance indicator developed by CBPP in UK construction industry.

KPPF-3: This factor refers to the contractor's required relationship with the other main project participants such as owner, consultants etc. and its own strong organizational structure to cope with them efficiently. So, this factor is labeled as "Business Relationship Development." A good relationship with project owner and consultants should always be a prime concern for construction firm. This positive relationship would certainly help the contractor to remain in the business. This indicator is common findings of previous researches such as CBPP, Ponpeng et al (2003), Bassioni et al (2005), Acharya et al. (2006) and El-Mashaleh et al. (2007) as shown in Table 1.

KPPF-4: This factor refers to the tendency of contractors to achieve the objectives of project and finish the work in time by applying necessary management steps. This factor is labeled as "Adequacy of Construction Work Procedure Performance." Construction companies should also be accountable to achieving project ultimate goal. They should make every endeavor to assist the Owner in identifying and developing other crucial objectives and requirements for the project. This finding is in line with the findings of Bassioni et al. (2005). These authors have discussed about work process, function and program management in construction projects.

KPPF-5: This factor refers to quality workforce, knowledgeable subcontractors and accurate work output. Employment of qualified workforce and quality output are the fundamental performance constructs. So, this factor is labeled as "Quality Performance," Quality output is topmost requirement of any business. However, as a performance indicator in construction work as such is only categorically indicated by CBPP, Acharya et al. (2006) and Shen et al (2006).

KPPF-6: This factor refers to the site safety and health of workers, which is needed to be given a higher priority by the contractor. So, this factor has been labeled as "Health and Safety Performance." This indicator is

common finding of previous researches and also considered as prime concern in construction sites. According to table 1 previous researches CBPP (UK), Ponpeng et al. (2003), Acharya et al (2006), Shen et al. (2006) and El-Mashaleh (2007) have recommended this factor as a contractor performance indicator.

KPPF-7: This factor refers to the management capability, technical ability and vision of Construction Firm, which can cope with new and unknown situations in construction projects. For a better success of project, the contractor shall be innovative, capable of doing complex works and should have a clear vision. So, this factor is labeled as "Innovative Contractor." This finding is in line with previous researches of Bassioni et al. (2005), Diekman et al. (2005) and El-Mashaleh et al. (2007).

KPPF-8: Prior of construction work local information is very helpful to contractor to complete the project successfully. So, this factor rightly examines the contractor awareness about local condition. This factor has been labeled as "Adequacy of Construction Site Information." No any previous researches have been found categorically mentioned about this indicator. So, this indicator is also a sole finding of this research.

KPPF-9: This factor refers to whether contractor has followed the contract and specification as agreed before construction starts. Hence it is labeled as "Compliance with Contract Plans and Specification Requirements." Although to follow contract plans and specification is a fundamental process in construction works, no any previous studies have been found categorically indicating this factor as a performance indicator.

KPPF-10: This factor refers to financial arrangement, past experience and economic health of a construction firm. Financial capability is one of significant necessities of project success. A credible contractor could manage resources from outsource. This factor is named as "Creditworthiness and Financial Capability." This finding can be related with business performance/reputation and past experience indicators of previous studies listed in Table 1.

KPPF-11: The construction contractor should always maintain a reliable and cooperative relationship with different internal and external stakeholders. So, this factor has been named as "Intra-agency Relationship and Responsiveness." This indicator can be related with the business relationship and business performance/reputation in Table 1; however those previous studies have not been categorically mentioned about relationship with local authorities and regulating authorities.

KPPF-12: Availability and proper management of resources is a fundamental requirement of a construction contractor. As this factor refers to plant/equipment management and workforce management, it has been labeled as "Resource Management." This finding is also in line with previous researches of Ponpeng et al (2003) and Acharya et al. (2006).

5. Performance evaluation format

5.1 Weight of KPPF

Table 6 shows the correlation strength of 12 KPPFs (key factors). The table shows a strong and positive relationship (all 'r' value is more than 0.38, and significant at 1% level) between the 12 factors. This relationship indicates that these 12 KPPFs jointly can measure the performance of a construction firm on-site. Correlation strength has been adopted to calculate the individual weight of KPPFs. Rationale to employ correlation coefficient as a weighting criterion is that a more correlative power of a factor will have the highest effect in the overall performance measurement process. Weight of each KPPF is given at the bottom row of Table 6. Individual weight is calculated by dividing total 'R' by 'Rav'. A 12 prone performance measurement factor model with weight index is as follows:

Performance Index = 0.093F1+ 0.091F2 + 0.081F3 + 0.086F4 + 0.080F5 + 0.088F6 + 0.08F7 + 0.068F8 + 0.089F9 + 0.083F10 + 0.07F11 + 0.092F12

5.2 Evaluation scorecard

In the construction industry, measuring and improving

Table 6. Correlation coefficient of twelve performance evaluation factors

KPPFs	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
F1	1	0.76	0.62	0.71	0.59	0.73	0.64	0.53	0.72	0.67	0.52	0.71
F2	0.76	1	0.68	0.63	0.61	0.68	0.6	0.45	0.7	0.63	0.52	0.74
F3	0.62	0.68	1	0.57	0.5	0.56	0.54	0.41	0.62	0.5	0.5	0.62
F4	0.71	0.63	0.57	1	0.53	0.63	0.58	0.48	0.65	0.59	0.47	0.7
F5	0.59	0.61	0.5	0.53	1	0.55	0.55	0.41	0.63	0.58	0.41	0.66
F6	0.73	0.68	0.56	0.63	0.55	1	0.64	0.49	0.67	0.64	0.46	0.68
F7	0.64	0.6	0.54	0.58	0.55	0.64	1	0.38	0.61	0.52	0.42	0.58
F8	0.53	0.45	0.41	0.48	0.41	0.49	0.38	1	0.45	0.5	0.4	0.52
F9	0.72	0.7	0.62	0.65	0.63	0.67	0.61	0.45	1	0.59	0.47	0.72
F10	0.67	0.63	0.5	0.59	0.58	0.64	0.52	0.5	0.59	1	0.48	0.62
F11	0.52	0.52	0.5	0.47	0.41	0.46	0.42	0.4	0.47	0.48	1	0.52
F12	0.71	0.74	0.62	0.7	0.66	0.68	0.58	0.52	0.72	0.62	0.52	1
Total 'R'	8.2	8	7.12	7.54	7.02	7.73	7.06	6.02	7.83	7.32	6.17	8.07
Rav =	0.683	0.667	0.593	0.628	0.585	0.644	0.588	0.502	0.653	0.61	0.514	0.673
Weight	9.30%	9.10%	8.10%	8.60%	8.00%	8.80%	8.00%	6.80%	8.90%	8.30%	7.00%	9.20%

performance should always be an important endeavor among all parties involved in a project. The performance of any party in a project is susceptible to the surrounding environmental and conditions under which the work is performed, in addition to the characteristics of that particular party. The performance of the parties performing their work early on in the project, such as contractor party, can bring about a far-reaching impact on the performance of the project as a whole. Predicting engineering performance thus comes into play as a well-needed component of an efficient project management and control mechanism.

Various researchers for example Love and Holt (2000) have criticized the existing narrow focus in performance evaluation methods in construction industry. For acquiring an holistic perspective of business performance needs for examination beyond the narrow and reactive measures, requiring focus on the broad and longer term of considerations of the organizational corporate strategy, business processes and customers' needs. Observing the results of performance criteria of this study, it can be said that the lapses in current measurement method have been reasonable captured. It has included all the aspects of a Contractor Company's development requirement.

This study has revealed 12 significant performance measuring factors. All the 12 factors are self explanatory criteria of performance evaluation. 53 elements as shown in Table 5 define these 12 factors. These all 53 numbers of sub factors (elements) are completely agreed by the construction professionals based on organizational affiliation (owner, consultant, contractor), management position, field experience and types of project (building, road, rail etc.) domains. Therefore, the performance measuring results can be assured of the high level quality. An evaluator can apply these criteria to evaluate the performance level of Contractor Firm working in his /her project.

5.3 Performance predictive indicators (PPI)

To avoid assessors from coming up with their own interpretation for the KPPF criteria, 53 elements pertinent to the KPPF have been proposed. Predicting power (weight) of each element of factors, here it is defined as Performance Predictive Indicators (PPI) was determined according to the element's loading proportion in a particular factor. A detailed table with PPIs weightings and nature of measurement i.e., qualitative or quantitative is given in Table 7. As an example, performance evaluation of a Contractor firm is shown in Table 7. This performance evaluation format was applied in real construction field. The performance assessors from supervision consultant and owner representative had perceived this format comfortable and convenient

during evaluation process.

5.4 Performance rating classification (PRC)

Five level of performance rating has been proposed. They are (i) bad (0-20) (ii) poor (21-40) (iii) fair (41-60) (iv) good (61-80) and (v) excellent (81-100).

6. Conclusions

Periodical measurement of performance of a contractor firm is essential to guide the project in right direction. So, it was intended to identify what factors are useful to measure the performance. Three research questions were formulated to conduct the research. 113 numbers of performance measuring variables were sorted out from literature study. Field survey questionnaire method was adopted to collect the required data. Data were collected from construction professionals working in owner, consultant and contractor organizations. As many as 325 correct responses were received and analyzed with SPSS computer program. First research question revealed 65 numbers of items suitable for performance measurement. However, independent 65 numbers of criteria to measure performance happens to be a tedious work, so factor analysis was used to group the criteria and answer the second research question. 12 Key performance prediction factors (KPPF) with 53 pertinent performance indicators (PPI) with relative importance were sorted out to evaluate performance of a contractor firm on-site. Inter-correlation coefficient of 12 factors was used to evaluate the prediction power of KPPFs. As many as 53 numbers of PPIs pertinent to 12 KPPFs with index value has been recommended to help assessors to evaluate the performance.

Performance measurement is always a tedious job, especially in construction industry where various external factors influence the work proceedings. So, this study may not have covered all the character of construction projects. It is also not easy to suggest those all characters. It is the limitation of this study. However, from the nature of performance criteria developed, it can be said that the performance constructs reasonably could measure the contractor performance on site. This study represents the performance measuring criteria for a contractor in overall building and civil engineering construction perspective. Further study could be focused only within one set of construction projects. For example, it could be road construction or building construction or railway track construction. Because, the condition and performance requirement for a particular type of project may be differ than others. However, in broad sense, the performance criteria developed in this research could be useful to any type of construction projects. It is hoped that the results obtained in this work could be conducive to keen project management body to evaluate the performance of construction firm in his/her project. The contractor firm itself can use this format to evaluate its subcontractors and also itself to ascertain the right direction of ongoing work by self-assessment.

Acknowledgements

The authors would like to acknowledge the support of Pukyong National University (Busan) Research Fund #0012009 in 2006 for this work.

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논문제출일: 2007.05.11
심사완료일: 2007.09.05

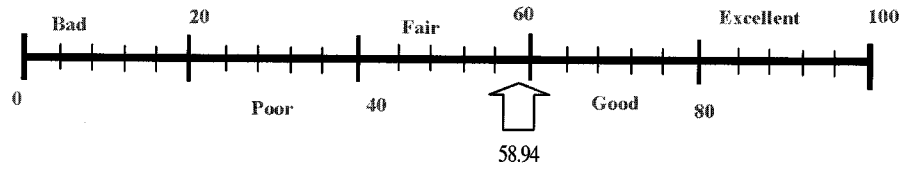
Table 7. Performance evaluation scorecard format with PPIs, weighting indexes and measuring criteria

Construction site name and address: Full name of Contractor/Subcontractor: Evaluation type: (i) Interim (ii) Final Reporting period: From……. To…….	Evaluation reporting officer: Name: Designation: Office name and address: Reporting date:	*Field evaluation criteria: Bad: 0-20 Poor: 21-40 Fair: 41-60 Good: 61-80 Excellent: 81-100

S.N.	KPPF and Performance Predictive Indicators(PPIs)	Weight	Field evaluation (0-100) *	Field Score (3x4)	Overall Performance score	Proposed evaluation criteria	Qualitative or Quantitative
1	2	3	4	5	6	7	8
	1.Work progress and smoothening						
1	Promptly and completely clear the work sit	0.157	60	9.42		Rarely (0-20%) - Absolutely Perfect (81-100%)	Qualitative
2	Promptly performs punch list	0.147	58	8.53		Rarely (0-20%) - Absolutely Prompt (81-100%)	Qualitative
3	Provides clear and ···complete operating	0.14	60	8.4		Rarely (0-20%) - Absolutely perfect (81-100%)	Qualitative
4	Supports job inspection and project delivery prog.	0.133	60	7.98		Rarely (0-20%) - Absolutely perfect (81-100%)	Qualitative
5	Timely submissions of shop drawings	0.121	40	4.84		<20% timely submission (0-20%) - All in time (81-100%)	Quantitative
6	Responding all directives immediately	0.104	40	4.16		<20% responses in time (0-20%) - All responses in time (81-100%)	Quantitative
7	Timely notice of schedule tie-inns, cut-over, shut..	0.101	60	6.06		<20% notice in time (0-20%) - All notices in time (81-100%)	Quantitative
8	Timely submissions of project progress, progress..	0.097	60	5.82		No progress report (0-20%) - All reports (81-100%)	Quantitative
	Overall (Factor level)	0.093		55.21	5.13		
	2. Change manage and work accuracy						
1	Timely performs change order works	0.212	60	12.72		Never in time (0-20%) - Absolutely in time (81-100%)	Qualitative
2	Timely submission of change order proposals	0.195	40	7.8		Never in time (0-20%) - Absolutely in time (81-100%)	Qualitative
3	Ability to deal with unanticipated problems	0.153	40	6.12		Absolutely unable (0-20%) - Absolutely capable (81-100%)	Qualitative
4	Accuracy and timeliness of regulatory···	0.15	60	9		Never (0-20%) -Absolutely accurate (81-100%)	Qualitative
5	Knowledgeable and well known about the work to	0.144	60	8.64		Scarce knowledge (0-20%) - Extremely knowledgeable (81-100%)	Qualitative
6	Ability to produce no errors, accurate representa···	0.147	60	8.82		More than 20% error (20-80%) - Zero error (81-100%)	Quantitative
	Overall (Factor level)	0.091		53.1	4.83		
	3. Business relationship development						
1	Cooperative, superior working relation with owner	0.26	40	10.4		Extremely less cooperative (0-20% - Extremely high cooperative (81-100%)	Qualitative
2	Cooperative, accommodating and open communi...	0.251	40	10.04		Extremely less (0-20%) - Extremely high (81-100%)	Qualitative
3	Regular attending the project meetings ···	0.174	60	10.44		Less than 20% attendance (0-20%) - All attendance (81-100%)	Quantitative
4	Established organizational structure ···	0.167	60	10.02		Less effective structure (0-20%) - Highly effective structure (81-100%)	Qualitative
5	Risk sharing level or attitude with other···	0.147	60	8.82		Low tendency (0-20%) - Absolutely high tendency (81-100%)	Qualitative
	Overall (Factor level)	0.081		49.72	4.03		
	4. Adequacy of const. work procedure						
1	Cash out/payment schedule in the project	0.296	80	23.68		Payment IN/OUT difference more than 100% (0-20%) - Payment IN/OUT difference less than 0% (81-100%)	Quantitative
2	Compliance with labor standards	0.257	60	15.42		More than 80% cases (0-20%) - Zero cases (81-100%)	Quantitative
3	Tendency to finish work in scheduled time	0.238	60	14.28		100% behind (0-20%) - Advance than schedule (81-100%)	Quantitative
4	Responsibility in setting down project objectives	0.209	60	12.54		Absolutely not showing (0-20%) - Absolutely responsible (81-100%)	Qualitative
	Overall (Factor level)	0.086		65.92	5.67		
	5. Quality performance						
1	Highly qualified workforce (technicians, workers..	0.388	60			No qualified workforce (0-20%) - All qualified workforce (81-100%)	Quantitative

S.N.	KPPF and Performance Predictive Indicators(PPIs)	Weight	Field evaluation (0-100) *	Field Score (3x4)	Overall Performance score	Proposed evaluation criteria	Qualitative or Quantitative
2	Employing highly qualified and knowledgeable sub	0.377	40			Non-performing subcontractor (0-20%) - highly competent subcontractor (81-100%)	Quantitative
3	Superior quality of finished work even exceeding	0.234	40			More than 80% cases (0-20%) - Zero cases (81-100%)]	Quantitative
	Overall (Factor level)	0.08		47.72	3.82		
	6. Health and site safety adequacy						
1	Proposed health and safety program	0.243	60	14.58		Not followed properly (0-20%) - Extremely good (81-100%)	Qualitative
2	Health and safety records ···	0.215	60	12.9		Fatal/ loss of organ cases (0-20%) - None injury (81-100%)	Quantitative
3	Strict compliance with owner's security, health and.	0.213	60	12.78		More than 80% complain in completed task (0-20%) - Zero complain (81-100%)	Quantitative
4	Maintains an adequate program to monitor compli..	0.185	60	11.1		Ineffective program (0-20%) - Perfect program (81-100%)	Qualitative
5	Quality of site safety maintenance	0.144	60	8.64		Extremely unsatisfactory (0-20%) - Extremely satisfactory (81-100%)	Qualitative
	Overall (Factor level)	0.088		60	5.28		
	7. Innovative contractor						
1	Specialized knowledge of particular construction ···	0.324	60	19.44		No specialization (0-20%) - Highly specialized (81-100%)	Qualitative
2	Quality control and assurance program	0.256	60	15.36		Highly unsatisfactory (0-20%) - Highly satisfactory (81-100%)	Qualitative
3	Present workload and capability to support···	0.226	60	13.56		Capability extremely not enough (0-20%) - Highly capable (81-100)	Qualitative
4	Capability to working within limits ···	0.194	60	11.64		Highly not capable (0-20%) - Highly capable (81-100%)	Qualitative
	Overall (Factor level)	0.08		60	4.8		
	8. Adequacy of construction site infor.						
1	Familiarity with local labor market···	0.508	80	40.64		Almost not familiar (0-20%) - Highly familiar (81-100%)	Qualitative
2	Familiarity with local weather/geographic	0.492	60	29.52		Almost not familiar (0-20%) - Highly familiar (81-100%)	Qualitative
	Overall (Factor level)	0.068		70.16	4.77		
	9. Compliance with contract and speci.						
1	Strict compliance with contract plans and specifica.	0.283	60	16.98		More than 80% non-compliance cases (0-20%) - Zero complain (81-100%)	Quantitative
2	Compliance with required testing···	0.279	60	16.74		More than 80% results fail and rework necessary (0-20%) - Zero failure (81-100%)]	Quantitative
3	IT knowledge, e.g. electronic document···	0.224	80	17.92		All manual function (0-20%)- all network based function (81-100%)]	Qualitative
4	Timely and accurate submissions of clear project···	0.215	40	8.6		More than 80% revisions or comments (0-20%) - No revision (81-100%)]	Qualitative
	Overall (Factor level)	0.089		60.24	5.36		
	10. Creditworthiness & financial capa.						
1	Creditworthiness of company	0.301	60	18.06		Market value < Share value (0-20%) - Market value double than Share value (81-100%)]	ualitative/ Quantitative
2	Current liabilities and commitments	0.251	80	20.08		More than 10% of project cost (0-20%) - No any commitments (81-100%)	Quantitative
3	Financial arrangement for the project···	0.243	65	15.8		Less than mobilization fund investment (0-20%) - More than mobilization (81-100%)	Quantitative
4	Number of years in the construction···	0.206	80	16.48		Less than 5 years (0-20%) - More than 30 years (81-100%)	Quantitative
	Overall (Factor level)	0.083		70.42	5.84		
	11. Intra-agency relation & responsive.						
1	Relationship with regulating authorities	0.355	60	21.3		Bad relationship (0-20%) - Extremely good relationship (81-100%)	Qualitative
2	Relationship with local authority	0.338	60	20.28		Bad relationship (0-20%) - Extremely good relationship (81-100%)	Qualitative
3	Responsiveness to owner's project staff···	0.307	60	18.42		Less than 20% responses (0-20%) - All prompt responses (81-100%)]	Quantitative
	Overall (Factor level)	0.07		60	4.2		
	12. Resource management						
1	Availability and adequacy of owned const. plant···	0.25	60	15		More than 50% delay due to plant/equipment (0-20%) - No any delay (81-100%)	Quantitative
2	Equipment is always well maintained ···	0.237	60	14.22		More than 80% cases of breakdown (0-20%] - No any breakdown cases (81-100%)	Quantitative

S.N.	KPPF and Performance Predictive Indicators(PPIs)	Weight	Field evaluation (0–100) *	Field Score (3x4)	Overall Performance score	Proposed evaluation criteria	Qualitative or Quantitative
3	Timely payment to staffs, subcontractors and supp	0.175	60	10.5		More than 6 months delay payment (0–20%) – Instant payment (81–100%)	Quantitative
4	Employment of trained/ skilled and knowledgeable..	0.171	40	6.84		More than 80% non-trained staff (0–20%) – All trained/skilled staffs (81–100%)	Quantitative
5	Adjusting worker wages and facilities···	0.167	60	10.02		Not adjusted for more than 3 years (0–20%) – Adjusts every year (81–100%)	Quantitative
	Overall (Factor level)	**0.092**		**56.58**	**5.21**		
	Grand total					**Comments on result:**	
	RESULT				**58.94 FAIR**	Technically contractor shows good performance; however some lapses have been found in some procedural works, such as timely submission of progress reports, shop drawings etc. If contractor focuses on those matters, it can improve from present fair performance standing.	



Reviewed by:
Name :
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Organization name:
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Comments: