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FACTORS AFFECTING PERFORMANCE IN THE EGYPTIAN CONSTRUCTION PROJECTS

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ملخص البحث :

يعتبر الهدف الرئيسي لمقاولى التشيد والبناء هو تنفيذ المشروع المطلوب ضمن التكلفة المقدرة والمدة الزمنية المستهدفة. حيث يهدف هذا البحث الي تحسين اداء وممارسات العاملين في مشروعات التشييد في مصر وبناء علي ذلك تم تحديد قائمة بالعوامل الرئيسية التي تؤثر على الأداء في مشاريع البناء في مصر وذلك للمشروعات متوسطة الحجم في القطاعين العام والخاص. ومن بين هذه العوامل: طريقة تقديم العطاءات ونوع العقد و تنظيم العمالة ، وتخطيط الموقع، والتعاقد من الباطن، ودرجة التفاعل بين المصمم والمقاول. لقد تم استخدام اسلوب الاستبيان في هذا البحث لجمع البيانات المطلوبة حيث تم توزيع عدد 100 استبيان على النحو التالي: 24 مالك و44 مقاول و32 استشاري وكانت أهم العوامل التي اتفق عليها الخبراء من الجهات الثلاثة هي: عدم توافر الموارد على النحو المخطط له خلال مدة المشروع؛ نقص المهارات القيادية لمدير المشروع؛ وتصاعد أسعار المواد، ونوعية التجهيزات والمواد الأولية في المشروع. ثم تم تجميع وتحليل البيانات وعمل تقدير كيفي لتأثير هذة المخاطر وذلك بالطرق الإحصائية ثم تحديد مؤشرات الأداء الرئيسية (KPIs) لأداء المشروع وذلك من خلال التطبيق لعدد 30 حالة دراسية و خلصت الدراسة الي أن تقييم الأداء فى المشروعات بلغ 60% والناتج عن تأثير العوامل الداخلية والخارجية والمتعلقة بإدارة المشروع. مما أدى إلى التاثير السلبى فى تأخير البرامج الزمنية فى المشروعات بقيمة 25%. و التأثير السلبى على التكاليف حيث أنة من دراسة تأثير الزمن على التكلفة فمن المتوقع ان تحسين أداء التكاليف يؤددي الي تحقق وفرا بنسبة 3 % فى مشروعات التشييد.

1. ABSTRACT

The main objective of any construction contractor is to execute his work within the estimated cost and time target. This research aims to improve the performance and practices of workers in construction projects in Egypt. Accordingly, a list of the main factors affecting performance in construction projects in Egypt was identified for medium-sized projects in the public and private sectors. Two performance indicators namely: cost and schedule growth. Cost growth can be defined as the increase in the final project cost measured as a percentage of original estimated cost. On the other side, schedule growth is the difference between schedule and actual project time expressed as a percentage of the original scheduled time. Such two performance indicators can be generally affected by many important factors. The current research primarily employed questionnaire surveys to collect the required data. Following a thorough literature review and structured interviews with professionals. Hundred questionnaires were distributed as follows: twenty-four to owners, forty-four to consultants and thirty two to contractors. The most important factors agreed by the owners, consultants and contractors were: average delay because of closures and materials shortage; availability of resources as planned through project duration; leadership skills for project manager; escalation of material prices; availability of personals with high experience and qualification; and quality of equipment's and raw materials in project. The practices concerning with the Key Performance Indicators (KPIs) such as time, cost, project owner satisfaction and safety checklists were analyzed in order to know. The main practical problems of projects performance in Egypt and then to formulate recommendations to improve performance of construction projects in Egypt. The

analysis of previous evaluations in 30 case studies shows that the performance evaluation in the projects under study reached 60% due to the impact of internal and external factors related to project management. The negative impact on the delay of time schedules in the projects under study by 25%. Negative impact of time on the cost is expected when improving performance to reach the performance evaluation achieves an improvement in cost performance, achieving a savings of 3% for construction projects.

2. INTRODUCTION

The traditional approach to success in the construction industry, both in academia and in industry, places great emphasis on the ability to plan and execute projects. In the past, companies completing projects in a timely manner within an established budget and meeting required quality considerations have been considered successful companies. Minimizing an emphasis on management practices and organizational stability, companies with a track record of successful project completion have been considered the construction industries' top-performers. Measuring and assessing construction project performance on an ongoing basis is an important part of management and control of a project. This research is mainly concerning with project performance in medium size projects for the public & private sectors of the building construction Industry in Egypt Figure. 1.1.

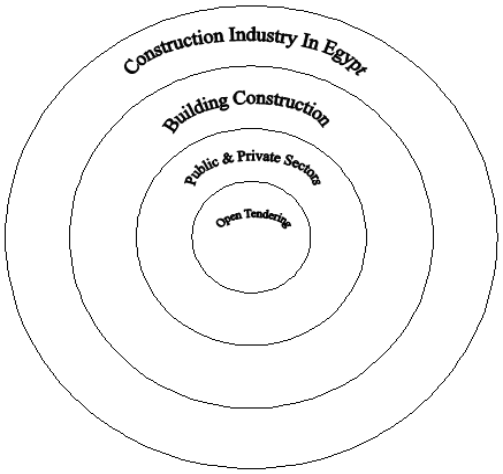

Figure1: Research scope

3. RESEARCH METHODOLOGY

To achieve the study objectives, the following steps are being proposed:

1. Review the literature to study previous researchers` related work and collect the critical factors that might affect the project performance.
2. Conduct semi-structured interviews using Delphi technique with construction experts to discuss these factors, choose or mix, and determine the final factors and KPIs that will be used in the questionnaire of the study, ensuring its suitability for the Egyptian construction industry.
3. Conducting questionnaire survey among different parties: clients, consultants and contractors, each category for both public and private sectors to guarantee good representation of the industry.
4. Analyze questionnaire results to determine factors and KPIs weights and relative importance.
5. Apply case studies.

4. LITECRATURE REVIEW

Project management plays an important role in turning uncertain events and efforts into certain outcomes and promises. Buildings provide a fundamental human need, serving as environmental separators. We construct buildings to provide shelter, keeping outside out, and inside in. Over time buildings have moved beyond their original scope of providing a basic human need. Today, we spend 90% of our lives in buildings (U.S. EPA, 2018). Project delivery systems are very important in achieving the desired outcomes of projects (Leicht, Molennar, Messner, Franz, & Esmaeili, 2016) and in mitigating the factors affecting performance in the construction projects associated with projects (McGraw-Hill Construction, 2014).

Larsen et al. (2015) studied the factors affecting schedule delay, cost overrun, and quality level in public construction projects by analyzing the factors that project manager's experience as having the greatest effect on time, cost, and quality, and to discover whether the effects of these factors are significantly different from each other. A questionnaire with 26 factors identified from interviews was sent to the full population of publicly employed project managers. Factors were ranked using the relative importance index and tested for significant differences using Friedman's test. Wilcoxon's test was used in a post-hoc analysis. From the findings it was determined that the most influential factor for time is unsettled or lack of project funding; for cost, errors or omissions in consultant material; and for quality, errors or omissions in construction work. The main conclusion of this research is that project schedule, budget, and quality level are affected in significantly different ways. Therefore, a project manager cannot handle such critical issues by focusing only on schedule or budget complications; nor can he or she assume that time, cost, and quality are equally affected.

Durdyev et al. (2017) presented a study to fill an important knowledge gap that causes of delay in residential construction projects in Cambodia by identifying the various attributes for construction project delay, using the residential building projects as a starting point. Feedback from a survey administered to the contractors and consultants was analyzed using Relative Importance Index (RII). Results showed that shortage of materials on site; unrealistic project scheduling; late delivery of material; shortage of skilled labor; complexity of project; labor absenteeism; late payment by the owner for the completed work; poor site management; delay by subcontractor; accidents due to poor site safety are ranked by the contractors and consultants as the main causes of project delays in Cambodia. Construction frontline players are recommended to put their efforts on the identified key factors in relation to their magnitudes of influence. By doing so, the causes of project delays in the Cambodia's construction and real estate sector could be significantly reduced or controlled, which will ultimately lead to the on time project completion.

Saldanha (2018) studied the effects of improved morale on team productivity and whether morale does have a bearing on team performance. Techniques to track the performance of teams with their perception of project morale will be investigated. Various approaches to study and track the impact of morale on team performance are investigated in this research. The study of how morale influences team performance has steadily received increased attention (with organizations seeking to implement systems and procedures to positively impact morale and subsequently, team performance. The results of the survey conducted in this paper showed positive results between project

performance and morale. The results obtained through the survey that formed a part of this research undoubtedly shows that morale and productivity are interconnected with a greater sense of positive morale positively impacting productivity. This information may seem obvious but the fact that morale is often overlooked as a factor when considering productivity underscores the importance of continuing research into morale and how people are affected by it. Another important consideration when reviewing the interaction between morale and productivity is necessity to Adopt a balanced approach.

Khoso et al. (2019) studied and identified the factors causes the change order in two different phases i.e. preconstruction and construction stage. Views were taken from relevant experts over included factors after in-depth literature review from past researches. A questionnaire was made and floated with different construction players from clients, consultants and contractors side. The data was analyzed by SPSS using average index technique. The analysis of data showed that, Mistakes in specifications, Mistakes in design and Lack of experience in selecting construction team by client are the most critical factors during preconstruction phase. Whereas, Design modification by owner, change in scope at later stage and Delays in payment by client are most critical factors of construction phase, responsible for change order. The extensive discussion of these factors revealed various parameters related to Pakistan construction. This study will enable the clients, consultants and contractors to be aware of factors which causes changes in orders and their consequences on project completion. By the identification of possible reasons, the right decisions can be made to mark the project successful.

4.1 Factors Affecting Performance of Managers

Navon (2005) stated that data are collected and used for construction managers as a basis to evaluate the project performance indicator's (PPI) actual value to compare it with the planned value and forecast its future value based on past performance. Pheng and Chuan (2006) identified the importance of the working environment variables for the performance of a project manager in the private and public sectors according to three main groups which are job condition, project characteristic and organizational related categories. The result revealed that working hours, physical condition of project site, complexity of project, material and supplies, project size, duration of project and time availability were viewed differently in terms of importance by the contractors and consultants groups. Team relationship was ranked as the most important variable affecting the performance of a project manager. It is obtained that project manager's experiences do not have much effect on how they perceive their working environment.

4.2 Factors Affecting Cost and Time Performance

Iyer and Jha (2005) remarked that the factors affecting cost performance are: project manager's competence; top management support; project manager's coordinating and leadership skill; monitoring and feedback by the participants; decision making; coordination among project participants; owners' competence; social condition, economical condition and climatic condition. Coordination among project participants was as the most significant of all the factors having maximum influence on cost performance of projects.

4.3 Key Performance Indicators

Cheung et al. (2011) remarked seven main key indicators for performance which are: time, cost, quality, client satisfaction, client changes, business performance, and safety and health. Navon (2005) stated that a number of research efforts to fully automate project performance control of various project performance indicators have been carried out in recent years. These are also briefly described together with the concept of measuring indirect parameters and converting them into the sought indicators. These are (1) labor and earthmoving productivity based on measuring the location of workers or earthmoving equipment at regular time intervals; (2) progress based on the above data; (3) a comprehensive control of construction materials starting by monitoring orders and purchasing up to the movement of the materials on site. Ugwu and Haupt (2007) developed and validated key performance indicators (KPI) for sustainability appraisal using South Africa as a case study. It is used four main levels in a questionnaire to identify the relative importance of KPI. The main indicators were: economy, environment, society, resource utilization, health and safety and project management and administration. Chen et al (2011) provided nine key performance indicators (KPIs) which can be applied to measure project management performance PMP and evaluate potential contractors as well as their capacity by requesting these indices.

5. IDENTIFYING FACTORS AFFECTING PERFORMANCE OF CONSTRUCTION PROJECTS

5.1 Design of Questionnaire

As discussed previously, criteria that mostly influence the assessment and prequalification of project performance in the Egyptian industry in order to determine the weight and relative importance of each criteria, a questionnaire survey is designed and distributed among the different construction parties, namely: owners, consultants, and contractors.

5.2 Population and Sample Size

The size of the sample required from the population was determined based on statistical principles for this type of exploratory investigation to reflect a confidence level of 99%. The sample size was determined using the following formula: (Dutta 2006):

$$N = \frac{(Z_{1-\frac{\alpha}{2}})^2 \times \sigma^2}{e^2} \quad \text{..... .... } Eq.(1)$$

Where: N is the sample size, $Z_{1-\frac{\alpha}{2}}$ is the desired level of confidence (1-α), which determines the critical Z value, σ is the standard deviation, and e is the acceptable sampling error.

For this research, the 99% degree confidence level corresponds to $\alpha = 0.01$. Each of the shaded tails has an area of $\alpha/2 = 0.005$. The region is 0.5 – 0.005 = 0.495. Then, from the table of the standard normal distribution (z), an area of 0.495 corresponds to a z value of 2.58. The critical value is therefore $z_{\alpha/2} = 2.58$, the margin of error was assumed as $e = 0.25$, and from the 20 samples was retakes from

population, the standard deviation was calculated σ = 0.88. Accordingly, the sampling size is calculated by using the Eq. (1) as follows:

$$N = \frac{2.58^2 \times 0.88^2}{0.25^2} = 82.48$$

5.3 Analysis of the Questionnaire Results

The distribution of the 73 survey respondents among the three main parties is shown in Table (1).

Table 1: Collected questionnaires from different parties

Party	Public	Private	Total
Owner	27	13	40
Consultant	10	10	20
Contractor	16	24	40
Total	43	47	100

5.4 Classification of the Surveyed Experts Based on Their Experience

A questionnaire survey was conducted among construction experts to identify the most important factors affecting performance of construction projects. The respondents to the questionnaire were classified according to their experience Figure (2). A closer inspection to Figure (2) clearly Shows that about 58.5% of the respondents have experience greater than 15 years, around 25% Have experience greater than or equals to 10 years and less than 15 years, around 12.5% of Respondents have experience between 10 and 5 years and finally 4 % have experience from 1 Year and less than 5 years.

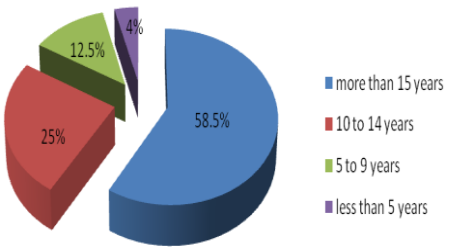

Figure 2: Classification of participated respondents based on their experience

5.5 Classification of the Surveyed Experts Based on the Construction Party

The respondents to the questionnaire were classified according to construction party they work. A closer inspection to Figure (3) clearly shows that about 40% of the respondent's works for owner, around 20% have work for consultant and finally 40 % work for contractor.

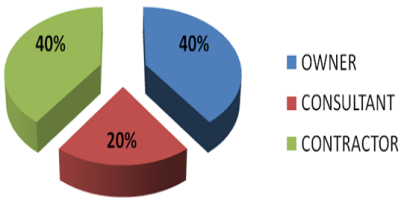

Figure 3: Classification of participated respondents based on the construction party

5.6 Classification of the Surveyed Experts Based on the Company

The respondents to the questionnaire were classified according to construction party they work. A closer inspection to Figure (4) clearly shows that about 53% of the respondents work for governmental party and about 47% have work for private party.

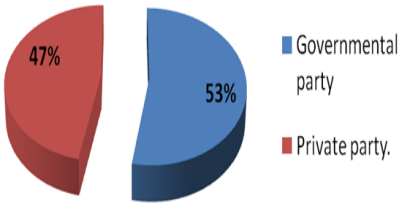

Figure 4: Classification of participated respondents based on the company

5.7 Classification of the Surveyed Experts Based on the Annual Average of the Total Projects Cost

The respondents to the questionnaire were classified based on the annual average of the total. A closer inspection to Figure (5) clearly shows that about 29% of the respondents annual average of the total projects cost greater than 100 million , around 12.5% have annual average of the total projects cost greater than or equals to 50 million and less than 100 million, around 17% of respondents have annual average of the total projects cost greater than20 millions and less than 50 million , around 29% of respondents have annual average of the total projects cost greater than5 millions and less than 20 million and finally around 12.5% of respondents have annual average of the total projects cost greater than1 million and less than 5 million.

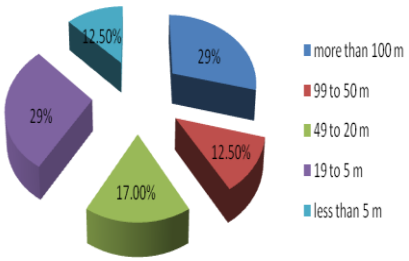

Figure 5: Classification of the surveyed experts based on the annual average of the total projects cost

5.8 Questionnaire Contents

The data included in the questionnaire is divided into six parts. These six parts are:

- **Part –1** contains personal information (name, address, tel., organization, fax no., and E-mail) to ease contact with each respondent.
- **Part –2** contains organizational information (organization type, category, previous experience, work size, grade of the Egyptian Federation for construction contractors in case of contractors).
- **Part –3** is defining the degree of the factors affected on project performance represents main areas:
    - Internal factor.
    - External factor.
    - Factors related to project managers.

-Part –4 is classifying each group of the seven groups into second level criteria (sub criteria) to give their degree of importance from (0-10) where 0 means totally unimportant and 10 means extremely important.

- **Part –5** evaluating technical criteria into seven criteria to give their importance degree from (0-10) where 0 means totally unimportant and 10 means extremely important.
- **Part –6** is developed to give opportunity to the respondents to mention any recommendations, suggestions or remarks.

For part – 4 of the questionnaire, technical ability had the highest mean value while health and safety had the lowest mean value. This reflect the behavior of the developing countries towards health and safety requirements (that should be of highest importance) as shown in Table 2.

Table 2 :Mean value of the questionnaire results

Factors		Owner				Consultant				Contractor				Mean
		Public	private	Tot.	Mean	Public	private	Tot.	Mean	Public	private	Tot.	Mean	
INTERNAL FACTOR	ORGANIZATIONAL STRUCTURE	185	99	284	7.83	88	88	176	8.80	192	196	388	8.88	8.49
	PROJECT LAND SCAPE	157	87	244	6.76	68	64	132	6.60	188	160	348	8.03	7.29
	RESOURCES AVILABILITYRES	223	113	336	9.19	84	92	176	8.80	196	232	428	9.73	9.35
	CASH FLOW	227	129	356	9.90	84	96	180	9.00	180	216	396	9.00	9.32
	MATERIAL QUALITY	200	104	304	8.35	80	88	168	8.40	188	188	376	8.62	8.48
INTERNAL FACTOR		992	532	1524	8.41	404	428	832	8.32	944	992	1936	8.85	8.59
EXTERNAL FACTOR	TENDER METHOD	169	71	240	6.40	68	68	136	6.80	140	180	320	7.25	6.86
	CORACT TYPENT	192	80	272	7.25	76	80	156	7.80	152	188	340	7.72	7.57
	CLEARITY OF BUDGET / TIME AND PROJECT SCOPE	203	105	308	8.45	88	92	180	9.00	160	216	376	8.50	8.58
	ECONOMICAL CONDITIONS	187	109	296	8.26	82	78	160	8.00	168	204	372	8.45	8.29
EXTERNAL FACTOR		751	365	1116	7.59	314	318	632	7.90	620	788	1408	7.98	7.82
FOCORS RELATED TO PROJECT MANAGEMENT	APPLYING PROJECT MANAGEMENT UNDAMENTAL	203	89	292	7.84	74	82	156	7.80	176	208	384	8.73	8.22
	COST AND TIME MANAGEMENT	204	100	304	8.28	78	86	164	8.20	184	200	384	8.77	8.48
	RISK MANAGEMENT	200	72	272	7.12	62	70	132	6.60	164	188	352	8.02	7.41
	GOOD COORDINATION (DESIGNER / CONTRACTOR / PROJECT TEEM)	219	109	328	8.95	92	96	188	9.40	192	236	428	9.72	9.38
FOCORS RELATED TO PROJECT MANAGEMENT		826	370	1196	8.05	306	334	640	8.00	716	832	1548	8.81	8.37

5.9 Importance Factor

In this method, each factors affecting in Performance is having an importance factor according to respondent answers. The value of each factors can be calculated as follows:

$$\text{Importance Factor} = \frac{\text{Sum of (actual score of each factors)}}{\text{Total no. of Questionnaires}*100} \qquad \text{Eq.(2)}$$

Having six groups (Owner public & private, Consultant public & private and Contractor public & private) each set contain 13 criteria weights. In order to define the most effective criteria(criteria with the highest weight), each group is rearranged in descending order as shown in tables (3.a, 3.b and 3.c) for the owner, consultant, and

contractor, respectively. Having six sets representing the six categories of the construction parties, and they are arranged in descending order from the highest affecting criterion to the lowest one, we use the simple average method to select the criteria with weights greater than the average of each set.

Table 3.a: Importance factors according to consultant

Rank	Factors	Importance Factor	Number	%
1	Good coordination (designer / contractor / project team)	94.00%	12	60.00%
2	Resources availabilities	88.00%	12	60.00%
3	Cash flow	90.00%	12	60.00%
4	Clarity of budget / time and project scope	90.00%	12	60.00%
5	Cost and time management	82.00%	8	40.00%
6	Organizational structure	88.00%	8	40.00%
7	Material quality	84.00%	8	40.00%
8	Applying project management fundamental	78.00%	12	60.00%
9	Economic conditions	80.00%	12	60.00%
10	Risk management	66.00%	12	60.00%
11	Contract type	78.00%	12	60.00%
12	Site layout	66.00%	12	60.00%
13	Tender method	68.00%	12	60.00%

Table 3.b : Importance factors according to contractor

Rank	Factors	Importance Factor	Number	%
1	Good coordination (designer / contractor / project team)	97.27%	32	72.73%
2	Resources availabilities	97.27%	36	81.82%
3	Cash flow	90.00%	28	63.64%
4	Clarity of budget / time and project scope	85.45%	24	54.55%
5	Cost and time management	87.27%	32	72.73%
6	Organizational structure	88.18%	24	54.55%
7	Material quality	85.45%	24	54.55%
8	Applying project management fundamental	87.27%	28	63.64%
9	Economic conditions	84.55%	20	45.45%
10	Risk management	80.00%	24	54.55%
11	Contract type	77.27%	28	63.64%
12	Site layout	79.09%	28	63.64%
13	Tender method	72.73%	16	36.36%

Table 3.c : Importance factors according to owner

Rank	Factors	Importance Factor	Number	%
1	Good coordination (designer / contractor / project team)	91.11%	20	55.56%
2	Resources availabilities	93.33%	20	55.56%
3	Cash flow	98.89%	32	88.89%
4	Clarity of budget / time and project scope	85.56%	20	55.56%
5	Cost and time management	84.44%	16	44.44%
6	Organizational structure	78.89%	20	55.56%
7	Material quality	84.44%	12	33.33%
8	Applying project management fundamental	81.11%	16	44.44%

9	Economic conditions	82.22%	12	33.33%
10	Risk management	75.56%	20	55.56%
11	Contract type	75.56%	24	66.67%
12	Site layout	67.78%	20	55.56%
13	Tender method	66.67%	20	55.56%

The parties involved in construction process, namely: owner, consultant, and contractor together selected the most important criteria in contractor selection through questionnaire survey. After using statistical and weighting process, 4 criteria were selected and will be (under their 3 main groups). These criteria are

1. planned cost
2. time planned
3. safety
4. Client satisfaction (time/ cost/ quality).

6. Key Performance Indicator and Earned Value Analysis

A Key Performance Indicator (KPI) is a measurable value that demonstrates how effectively a company is achieving key business objectives. Organizations use KPIs at multiple levels to evaluate their success at reaching targets. High-level KPIs may focus on the overall performance of the business, while low-level KPIs may focus on processes in departments such as sales, marketing, HR, support and others. KPIs assist an organization to define and measure progress toward organizational goals and objectives. Once an organization has analyzed its mission and defined its goals, it needs to measure progress towards those goals. KPIs provide a measurement tool. KPIs assist an organization to measure that it is 'on track' – most often, that it is working towards and attaining a beneficial outcome or improvement. In many cases, KPIs are used in projects and to measure service delivery. KPIs almost always require qualitative analysis to support their interpretation. At the investment stage (if being monitored), the trigger for a qualitative analysis will be a variation from plan. At the adoption stage, the trigger for a qualitative analysis will be a trend contrary to expectations. A case study of 30 project applied to performance and time , cost , safety ,client satisfaction kpi ,the result depend on the assessment of the performance factors in each case study Finally the result produced the impact of cost, time, safety, client satisfaction overall the 30 projects by analysis these cases by regression as shown in Table (4).

Table 4: Case Studies Assessment

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	GOOD COORDINATION (DESIGNER / CONTRACTOR / PROJECT TEEM)																															
	EXCELLENT	(ACTUAL PROBLEMS/SOLVED PROBLEMS)=1	0.90	1.00	0.85			0.83	0.87				0.80		0.80	0.93	0.89	0.91						0.89	0.90		0.87	0.81	0.81	0.80		0.80
	V.GOOD	(ACTUAL PROBLEMS/SOLVED PROBLEMS)=1.1				0.70	0.75			0.71	0.78	0.79		0.76					0.76	0.70	0.74	0.73	0.75									
	GOOD	(ACTUAL PROBLEMS/SOLVED PROBLEMS)=1.2																													0.68	
	FAIR	(ACTUAL PROBLEMS/SOLVED PROBLEMS)=1.3																								0.64						
	POOR	(ACTUAL PROBLEMS/SOLVED PROBLEMS)>1.3																														
2	RESOURCES AVILABILITYRES																															
	EXCELLENT	AVAILABE RESOURCES /REQUIRED RESOURCE=1					0.90		0.89				0.89		0.87			0.80	0.81	0.89				0.89	0.99				0.90	1.00		
	V.GOOD	AVAILABE RESOURCES/REQUIRED RESOURCE=.9	0.70	0.79		0.79				0.79	0.73	0.76		0.78							0.76	0.75	0.78				0.78			0.79	0.78
	GOOD	AVAILABE RESOURCES/REQUIRED RESOURCE=.8			0.68			0.69								0.67	0.69									0.67		0.68				
	FAIR	AVAILABE RESOURCES/REQUIRED RESOURCE<.8																														
	POOR	AVAILABE RESOURCES/REQUIRED RESOURCE<.7																														
3	LIQUIDATED MONEY																															
	EXCELLENT	• HAS ADVANCED PAYMENT& PAYMENT ACCORDING TO CONTRACT ALONG P.L.C		0.80					0.81	0.83					0.90			0.85	0.98		0.89									0.80	0.84	
	V.GOOD	• ACCORDING TO CONTRACT (NO. ADV. PAY.) ALONG P.L.C	0.70		0.79	0.76	0.75	0.71			0.75	0.72	0.74	0.79		0.70				0.79		0.75	0.72	0.74	0.71	0.75	0.77	0.77				0.70
	GOOD	• LATE ONE MONTH ALONG PROJECT LIFE CYCLE																											0.69			
	FAIR	• LATE TWO MONTHS ALONG PROJECT LIFE CYCLE															0.60															
	POOR	• LATE MORE THANTWO MONTHS ALONG PROJECT LIFE CYCLE																														
4	CLEARITY OF BUDGET / TIME AND PROJECT SCOPE																															
	EXCELLENT	CLEARITY OF BUDGET / TIME AND PROJECT SCOPE WITH TRADITIONADL INTERAC				0.87											0.90	0.81														
	V.GOOD	CLEARITY OF BUDGET / TIME AND PROJECT SCOPE WITH PHASED CONSTRUCTIO	0.77		0.75			0.71	0.74		0.70				0.70				0.76		0.74	0.73	0.71				0.70	0.75	0.73	0.79	0.78	
	GOOD	CLEARITY OF BUDGET / TIME AND PROJECT SCOPE WITH FAST TRACK		0.67						0.68		0.69	0.65	0.68						0.65				0.69	0.69	0.67						
	FAIR	CLEARITY OF SCOPE ONLY					0.63									0.62																0.60
	POOR	CLEARITY OF BUDGET / TIME ONLY																														
5	COST AND TIME MANAGEMENT																															
	EXCELLENT	THE PROJECT IN AHEED SCHEDULE &UNDER BUDGET										0.81	0.90	0.87																		
	V.GOOD	THE PROJECT IN ON SCHEDULE &ON BUDGET	0.76	0.75		0.79	0.75	0.73	0.71	0.79							0.78		0.70	0.71	0.73	0.71	0.70	0.78	0.79		0.70	0.70				
	GOOD	THE PROJECT IN BEHIND SCHEDULE &UNDER BUDGET									0.67				0.65			0.69												0.66	0.68	0.69
	FAIR	THE PROJECT IN AHEAD SCHEDULE &OVER BUDGET			0.60											0.62										0.64						
	POOR	THE PROJECT IN BEHIND SCHEDULE & OVER BUDGET																											0.48			
6	ORGANIZATIONAL STRUCTURE																															
	EXCELLENT	STRONG MATRIX																												0.89		
	V.GOOD	BALANCED		0.76	0.78	0.79			0.71	0.70	0.79										0.75	0.73	0.71	0.70	0.70	0.79	0.70	0.71				
	GOOD	WEAK MATRIX					0.65					0.66	0.67		0.65	0.66	0.68	0.67	0.69	0.65									0.65			
	FAIR	PROJACTIZE MATRIX	0.60					0.62						0.64																		
	POOR	FUNCTIONAL MATRIX																													0.45	0.48

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
7	MATERIAL QUALITY																															
	EXCELLENT	HAS NO DEFECT& ACCORDING TO SPESIFICATION ALONG P.L.C																					0.91									
	V.GOOD	HAS 3% DEFECT& ACCORDING TO SPESIFICATION ALONG P.L.C		0.78									0.76	0.78							0.70				0.78	0.76						
	GOOD	HAS 5% DEFECT& ACCORDING TO SPESIFICATION ALONG P.L.C	0.69		0.69	0.65	0.65	0.65				0.67			0.67	0.69	0.65			0.67							0.67	0.67	0.65		0.65	
	FAIR	HAS 7% DEFECT& ACCORDING TO SPESIFICATION ALONG P.L.C							0.61	0.64	0.62							0.64	0.61											0.63		0.63
	POOR	HAS MORE THAN 7|% DEFECT& ACCORDING TO SPESIFICATION ALONG P.L.C																				0.50		0.56								
8	APPLYING PROJECT MANAGEMENT UNDAMENTAL																															
	EXCELLENT	APPLYING PROJECT MANAGEMENT FUNDAMENTALMAKE FULL PLANING &CONTROLLING &LESON LE																														
	V.GOOD	APPLYING PROJECT MANAGEMENT FUNDAMENTALMAKE FULL PLANING &CONTROLLING						0.71	0.74	0.75			0.78						0.78	0.76	0.75											
	GOOD	MAKE ONLY PLANING &CONTROLLING		0.67	0.69	0.68					0.66			0.67								0.66		0.66	0.65			0.66				0.67
	FAIR	MAKE PLANING ONLY	0.61				0.64					0.62					0.60									0.61	0.60		0.63	0.61	0.62	0.60	
	POOR	N0 (PLANINC &CONTROL&LESON LEARNED)													0.46	0.50						0.56										
9	ECONOMICAL CONDITIONS																															
	EXCELLENT	CONTRACT PRICE IN EGP																														
	V.GOOD	CONTRACT PRICE IN EGP&$.+ TERM OF CHANGE IN PRICE		0.71						0.70					0.78					0.70					0.70						
	GOOD	CONTRACT PRICE IN $. +TERM OF CHANGE IN PRICE	0.67					0.65				0.66		0.69			0.67	0.69					0.65		0.67		0.65		0.67	0.66	0.65
	FAIR	CONTRACT PRICE IN EGP-NO			0.64	0.62	0.61		0.63		0.60		0.60							0.60		0.61	0.64		0.60			0.62				
	POOR	CONTRACT PRICE IN $.														0.34													0.59			
10	RISK MANAGEMENT																															
	EXCELLENT	THE PROJECT FOLLOW RISK MANAGEMENT																0.84														
	V.GOOD	MAKE RISK PLAN				0.78	0.71	0.70	0.76																		0.70					
	GOOD	THE PROJECT HAS CONTENGENCY +MANAGEMENT RESERVE	0.69							0.67	0.69	0.65				0.67	0.68					0.69							0.67			
	FAIR	THE PROJECT HAS CONTENGENCY ONLY		0.60									0.63	0.64	0.61								0.60	0.62	0.61	0.60		0.61		0.64	0.63	0.60
	POOR	THE PROJECT HAS NO RISK MANAGEMENT OR CONTENGENCY ONLY			0.56														0.56	0.45	0.37											
11	CONRACT TYPE																															
	EXCELLENT	Cost-Plus Contracts								0.89																						
	V.GOOD	DAILY RATE					0.76				0.70		0.71		0.70										0.70	0.73	0.70			0.79		
	GOOD	Unit Price Contracts				0.65		0.69				0.65							0.66	0.67												
	FAIR	Unit Price Contracts		0.60	0.64									0.60				0.61			0.63	0.64	0.62	0.60				0.60	0.60			
	POOR	Lump Sum Contracts	0.59						0.59							0.50	0.47														0.56	0.39
12	PROJECT LAND SCAPE																															
	EXCELLENT	HAS NO OBSTACLES																														
	V.GOOD	HAS ONE OBSTACLES															0.78															
	GOOD	HAS TWO OBSTACLES		0.65		0.67		0.68	0.67				0.69					0.67			0.66	0.67					0.69		0.67	0.65	0.65	
	FAIR	HAS TREE OBSTACLES	0.61		0.63					0.64				0.60	0.63								0.61	0.64	0.62	0.60		0.62				
	POOR	HAS MORE THAN THREE OBSTACLES					0.59				0.50	0.54				0.57			0.50	0.35												0.36
13	TENDER METHOD																															
	EXCELLENT	DIRECT CONTRACT																														
	V.GOOD	Professional Construction Management																														
	GOOD	Design-Construct Method																														
	FAIR	General contract method	0.63	0.63	0.61	0.63	0.62	0.61	0.35	0.64	0.62		0.62	0.63		0.63	0.63	0.62	0.64	0.64	0.63	0.63	0.62	0.63	0.63	0.62	0.61	0.60		0.63	0.64	0.63
	POOR	Separate Contracts Method										0.54			0.26														0.50			

7. Performances of case studies and Measurement of Project Performance

Navon (2005) defined performance measurement as a comparison between the desired and the actual performances. For example, when a deviation is detected, the construction management analyzes the reasons for it. The reasons for deviation can be schematically divided into two groups: (a) unrealistic target setting (i.e., planning) or (b) causes originating from the actual construction (in many cases the causes for deviation originate from both sources). Navon (2005) stated that performance measurement is needed not only to control current projects but also to update the historic database. Such updates enable better planning of future projects in terms of costs, schedules, labor allocation, etc. Pheng and Chuan (2006) stated that the measurement of project performance can no longer be restricted to the traditional criteria, which consist of time, cost and quality. There are other measurement criteria such as project management and products.

Samson and Lema (2002) proposed performance measurement system. The system comprises of construction business perspective including innovation and learning, processes, project, stakeholders, and financial perspective. The indicators developed from perspectives are categorized into three main groups which are drivers' indicators, process indicators and results indicators. The key to the success or failure of the measurement system are leadership commitment; employees' involvement and empowerment; and information coordination and management. Shen et al (2005) presented a method for measuring the environmental performance of construction activities committed by a contractor through calculating the contractor. Environmental performance score (EPS). The level of EPS serves as a simple indicator for measuring and communicating the level of a contractor's environmental performance.

The Result analysis of assessment of case study use regression method to make kpi's factors according to improve the assessment of most importance factors, Table (5) shows the results of KPIs for 30 case study, the results aims to help the stakeholders to improve their practice and performance of construction projects in Egypt.

Table 5: KPIs Results

Project no.	PLNNED COST	ACTUAL CSOT	PLNNED TIME(day)	ACTUAL TIME(day)	Estimated Cost /day =Planned Cost / Planned	Volume Of Work / time =Planned Cost /Actual time	Actual Cost / time = Actual Cost /Actual time	Schedule Performance index	Comment	Cost Performance index	Comment	Cost Schedule index	EV	cv	sv	%cv	%sv
1	1380000.00	963438.00	120	135	11500.00	10222.22	7136.58	0.89	Behinde schedule	1.43	under Budget	1.27	1226666.67	263228.67	-153333.33	0.08%	-0.05%
2	2352000.00	1643736.00	150	150	15680.00	15680.00	10958.24	1.00	on schedule	1.43	under Budget	1.43	2352000.00	708264.00	0.00	0.21%	0.00%
3	212528.00	172148.00	120	120	1771.07	1771.07	1434.57	1.00	on schedule	1.23	under Budget	1.23	212528.00	40380.00	0.00	0.01%	0.00%
4	88000.00	65350.00	90	120	977.78	733.33	544.58	0.75	Behinde schedule	1.35	under Budget	1.01	66000.00	650.00	-22000.00	0.00%	-0.01%
5	639200.00	508852.00	30	45	21306.67	14204.44	11307.82	0.67	Behinde schedule	1.26	Over Budget	0.84	426133.33	-82718.67	-213066.67	-0.03%	-0.07%
6	1400000.00	1060882.00	90	114	15555.56	12280.70	9305.98	0.79	Behinde schedule	1.32	under Budget	1.04	1105263.16	44381.16	-294736.84	0.01%	-0.09%
7	1044575.00	1154778.00	90	114	11606.39	9162.94	10129.63	0.79	Behinde schedule	0.90	Over Budget	0.71	824664.47	-330113.53	-219910.53	-0.10%	-0.07%
8	308500.00	264986.00	45	90	6855.56	3427.78	2944.29	0.50	Behinde schedule	1.16	under Budget	0.58	154250.00	-110736.00	-154250.00	-0.03%	-0.05%
9	3377728.00	2545860.00	150	180	22518.19	18765.16	14143.67	0.83	Behinde schedule	1.33	under Budget	1.11	2814773.33	268913.33	-562954.67	0.08%	-0.17%
10	1587000.00	1390767.00	105	150	15114.29	10580.00	9271.78	0.70	Behinde schedule	1.14	under Budget	0.80	1110900.00	-279867.00	-476100.00	-0.08%	-0.15%
11	2350000.00	1791771.00	180	165	13055.56	14242.42	10859.22	1.09	Ahead schedule	1.31	under Budget	1.43	2563636.36	771865.36	213636.36	0.23%	0.07%
12	165000.00	148836.00	120	135	1375.00	1222.22	1102.49	0.89	Behinde schedule	1.11	under Budget	0.99	146666.67	-2169.33	-18333.33	0.00%	-0.01%
13	212000.00	191660.00	120	120	1766.67	1766.67	1597.17	1.00	on schedule	1.11	under Budget	1.11	212000.00	20340.00	0.00	0.01%	0.00%
14	57000.00	52950.00	30	45	1900.00	1266.67	1176.67	0.67	over schedule	1.08	Over Budget	0.72	38000.00	-14950.00	-19000.00	0.00%	-0.01%
15	1550000.00	977368.00	90	150	17222.22	10333.33	6515.79	0.60	over schedule	1.59	under Budget	0.95	930000.00	-47368.00	-620000.00	-0.01%	-0.19%
16	4460000.00	3069466.00	180	150	24777.78	29733.33	20463.11	1.20	Ahead schedule	1.45	under Budget	1.74	5352000.00	2282534.00	892000.00	0.69%	0.28%

Project no.	PLNNED COST	ACTUAL CSOT	PLNNED TIME(day)	ACTUAL TIME(day)	Estimated Cost /day =Planned Cost / Planned	Volume Of Work / time =Planned Cost /Actual time	Actual Cost / time = Actual Cost /Actual time	Schedule Performance index	Comment	Cost Performance index	Comment	Cost Schedule index	EV	cv	sv	%cv	%sv
17	4455525.00	3940380.00	240	270	18564.69	16501.94	14594.00	0.89	over schedule	1.13	under Budget	1.01	3960466.67	20086.67	-495058.33	0.01%	-0.15%
18	76660000.00	69698988.00	450	420	170355.56	182523.81	165949.97	1.07	Ahead schedule	1.10	under Budget	1.18	82135714.29	12436726.29	5475714.29	3.77%	1.69%
19	328000.00	326157.00	60	90	5466.67	3644.44	3623.97	0.67	over schedule	1.01	under Budget	0.67	218666.67	-107490.33	-109333.33	-0.03%	-0.03%
20	192000.00	169000.00	30	60	6400.00	3200.00	2816.67	0.50	over schedule	1.14	under Budget	0.57	96000.00	-73000.00	-96000.00	-0.02%	-0.03%
21	4316730.00	4386780.00	210	225	20555.86	19185.47	19496.80	0.93	over schedule	0.98	Over Budget	0.92	4028948.00	-357832.00	-287782.00	-0.11%	-0.09%
22	154000.00	135000.00	120	120	1283.33	1283.33	1125.00	1.00	over schedule	1.14	under Budget	1.14	154000.00	19000.00	0.00	0.01%	0.00%
23	90350.00	84000.00	15	15	6023.33	6023.33	5600.00	1.00	on schedule	1.08	under Budget	1.08	90350.00	6350.00	0.00	0.00%	0.00%
24	17820000.00	16260757.00	150	135	118800.00	132000.00	120450.05	1.11	Ahead schedule	1.10	under Budget	1.22	19800000.00	3539243.00	1980000.00	1.07%	0.61%
25	40000000.00	43769000.81	420	600	95238.10	66666.67	72948.33	0.70	over schedule	0.91	Over Budget	0.64	28000000.00	-15769000.81	-12000000.00	-4.78%	-3.71%
26	96000000.00	85543500.00	300	270	320000.00	355555.56	316827.78	1.11	Behind schedule	1.12	under Budget	1.25	106666666.67	21123166.67	10666666.67	6.40%	3.29%
27	247500.00	171250.00	30	45	8250.00	5500.00	3805.56	0.67	over schedule	1.45	under Budget	0.96	165000.00	-6250.00	-82500.00	0.00%	-0.03%
28	56000000.00	52089980.00	360	330	155555.56	169696.97	157848.42	1.09	Ahead schedule	1.08	under Budget	1.17	61090909.09	9000929.09	5090909.09	2.73%	1.57%
29	248993.00	198265.00	15	45	16599.53	5533.18	4405.89	0.33	behind schedule	1.26	under Budget	0.42	82997.67	-115267.33	-165995.33	-0.03%	-0.05%
30	6060777.00	6560777.00	180	270	33670.98	22447.32	24299.17	0.67	behind schedule	0.92	Over Budget	0.62	4040518.00	-2520259.00	-2020259.00	-0.76%	-0.62%
TOTAL	323757406.00	299336682.81	1641.00	2229.00	197292.75	148077.94	134291.92	0.75	behind schedule	1.10	under Budget	0.83	330065719.04	30729036.23	6308313.04		

8. CONCLUSION

A structured questionnaire survey approach was considered to study the impact of various attributes and factors affecting construction projects performance. The questionnaire assist to study the attitude of owners, consultants and contractors towards key performance indicators in the construction industry. Pilot study of the questionnaire was achieved by a scouting sample, which consisted of 100 questionnaires. These questionnaires were distributed to expert engineers such as projects managers, site engineers/office engineers and organizations managers. They have a strong practical experience in construction industries field. Their sufficient experiences are a suitable indication for pilot study. These groups give a comprehensive summary of the main key performance indicators. The indicators were summarized and collected according to previous studies and others are added as recommended by local experts.

The main groups considered in this research are time, quality, productivity, client satisfaction, regular and community satisfaction, people, health and safety, innovation and learning, and environment. Their sufficient experiences were a suitable indication to find out the perceptive of the relative importance of project performance indicators of the owner, consultant and contractor parties.

The most important factors agreed by the owners, consultants and contractors as the main factors affecting the performance of construction projects in Egypt were: escalation of material prices; availability of resources as planned through project duration; average delay because of closures and materials shortage; availability of personals with high experience and qualification; quality of equipment and raw materials in project; and leadership skills for project manager. However, there are some factors which can be considered as more important for one party than for others. This is because contractors are interested with operational and managerial factors. However, the owners and consultants considered the client and technical factors to be more important than operational ones. The formulate recommendations to improve performance of construction projects in the Egypt.

The practices concerning with the KPIs such as time, cost, project owner satisfaction and the safety checklists were analyzed in order to know the main practical problems in projects performance in Egypt and then to formulate recommendations to improve performance of construction projects in Egypt. The following is a summary and conclusion for the main practices concerning with the KPIs in the Egypt.

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