Analysis of Time delay and Cost overruns due to change order in Youth Sports center construction projects in Egypt

Salaheldin Mohamed, Prof. Adel M. Belal, Hesham Bassioni, Ahmed Elhakeem

Abstract— **The Ministry of Youth and Sports is one of the Egyptian organizations which develop many projects that can be considered as infrastructure projects. This research will focus on sport and youth facilities. The research addresses cost and time overrun due to change orders and how to avoid/ reduce it in future projects. The objective of this study is to find out the main factors of cost overruns and delay in sports facilities project in Egypt , ranking them according to their relative importance and level of severity, investigating the expected effects of the previously identified factors on the cost and time overruns of a selected sample of the sports facilities projects in Egypt and developing a statistical regression models that can be taken as an approach in expecting cost and time overruns of any projects in the future.**

Index Terms— **Analysis, Change order, Youth sports center projects in Egypt, Time delay and cost overruns.**

I. INTRODUCTION

Changes in construction are events that result in any modification of the original or current scope. This include, modifications in time of execution, change in cost of work, specifications etc. Construction change orders are one of the most widely experienced change orders. However, many projects are plagued by severe construction disputes triggered by such changes. For a project to run its entire life without a single change order, would mean that the design, execution, coordination, and communication on the project have to be perfect. This is simply impossible. Different factors that occur at various phases of the project life cycle generally lead to time and cost overrun. Increase in project scope, design error, mistakes in soil investigation, difficulty in getting work permit from government and bureaucracy in bidding/tendering method are some of these factors. Through this research statistical regression models for time and cost overruns were developed using Excel Adds – on tool. To achieve this goal, first a review of the past literature is presented. The most important time and cost overrun factors were identified. Finally, the paper provided two regression models that can be used to assess the expected time and cost overruns in sports facilities construction projects in Egypt.

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The development of the two models was discussed and the verification of them was also investigated.

II. LITERATURE REVIEW

Time and cost overruns are inherent characteristics for the construction industry in most countries based on several previous researches. Jahren and Ashe (1990) found that a cost overrun rate of 1 to 11% is more likely to occur on larger projects compared to overruns on smaller projects but mentioned that managers on large projects typically make special efforts to keep cost-overrun rates low. They also determined that the risk of high cost overrun rates is greater when the winning bid amount is less than the engineer’s estimate and further identified some cost-overrun factors such as the contract document quality, nature of interpersonal relations on the project and contractor policies. In other studies, the reasons for cost overruns have been found to include rising costs of labor and materials, inadequate analysis, poor costing methods, poor control and scheduling, and inadequate information, Akpan and Igwe (2001). The reasons for cost and time increases in engineering design projects were also categorized as those within the owner’s control for which the owner is responsible, those within the consultant’s control for which the consultant is responsible and those beyond the control of the owner or the consultant, such as increased work scope, changes in legislation or changes in standards and archeological discoveries, Chang (2002). Mansfield et al. (1994) investigated the important factors responsible for delays and cost overruns in highway construction projects in Nigeria such as poor contract management, material shortages, inaccurate estimating and overall price fluctuations. Preparation and approval of shop drawings, delays and cost overrun in contractor’s progress, payment by owners and design changes by owner are the most important time and cost overrun factors according to contractors, (Assaf, et al. 1995). Chan and Kumaraswamy (1997) indicated poor site management and supervision, unforeseen ground conditions, low speed of decision making involving all project teams, Client initiated variations and necessary variations of works as the main causes of time and cost overruns in Hong Kong. Trigunarsyah (2004) pointed to the fact that contractor involvement in pre-construction phases could reduce time and cost problems during site operation. Refer to Aibinu and Odeyinka (2006) delay is a situation when the contractor and the project owner jointly or severally contribute to the non-completion of the project within the agreed contract period. Delays in construction projects are frequently expensive since there is usually a construction loan involved which charges interest, Management staff dedicated to the project whose costs are time dependent and ongoing inflation in wage and material prices. Creedy (2004) is of the view that identification of the existence and influence of cost overrun risk factors in a project can lead to a better control on project cost overrun and also can help in proposing solutions to avoid future overruns.

Recently Gkritza and Labi (2008) determined that larger projects and longer duration projects were more likely to incur cost overruns and provided mathematical relationships between project size and overrun likelihood. Flyvbjerg et al. (2003) admitted that cost escalation is a pervasive phenomenon in transport infrastructure projects irrespective of project type, geographical location and historical period. Flyvbjerg et al. (2004) found that cost escalation is strongly influenced by the implementation phase length and project type, and suggested that decision makers and planners should be duly concerned about long implementation phases. Other studies from Hong Kong include the work of Lo et al. (2006) who examined the distribution of construction delays. Six of the most significant causes of construction delay were found, these are: unforeseen ground conditions, Poor site management and supervision, client variations, inexperienced contractor, slow coordination and seeking of approval from concerned authorities and inadequate contractor resources. This indicated that these construction delay problems still exist and that further action for improvement is required. Sambasivan and Soon (2007) established poor planning, poor site management, inadequate supervisory skills of the contractor, delayed payments, material shortage, labor supply, equipment availability and failure, poor communication and rework were the most important causes of delays in the Malaysian construction industry. Abdel-Razek et al. (2008) found that delayed payments, coordination difficulty, and poor communication were important causes of delay in Egypt. Le-Hoai et al. (2008) ranked the three top causes of cost overruns in Vietnam as material cost increase due to inflation, inaccurate quantity takes off and labor cost increase due to environment restriction. Kaliba et al. (2009) concluded from their study that the major causes of delay in road construction projects in Zambia were delayed payments, financial deficiencies on the part of the client or contractor, contract modification, economic problems, Material procurement, changes in design drawings, staffing problems, equipment unavailability, poor supervision, construction mistakes, poor coordination on site, changes in specifications, labor disputes and strikes. Agaba (2009) attributes delays in construction projects to poor designs and specifications, and problems associated with management and supervision. M.E. Kaliba, et al. (2009) concluded that cost escalation of construction projects in Zambia are caused by factors such as inclement weather, scope changes, environment protection and mitigation costs, schedule delay, strikes, technical challenges and inflation.

III. OBJECTIVE

The objectives of this research paper are:

1- Determine the main factors which lead to cost overrun and time extension due to change orders in construction projects (will focus on sport facilities).
2- Conduct detailed analysis of change order factors to assess the impact on cost and time of the construction projects.
3- Develop a database upon which recommendations are made in order to reduce time delay and cost overruns due to change order.

IV. METHODOLOGY

The study will be conducted through the following sequential steps:

1) Conduct extensive literature review on the previous literature in order to determine the causes of cost overrun and time extension.
2) Develop an initial list of factors that affect cost and time overrun in construction projects generally.
3) Divide these factors into groups due to responsibility Conduct meetings with experts to improve this list of causes.
4) Extend the study to include the Additive change order categories:
a) Work disciplines (civil work, electrical work, structural work, architectural work)
b) Project parties (Owner, consultant, Contractors, Local Authorities)
5) Exclude the factors that are not lead to change order in the construction projects.
6) To address the study objectives, data were collected from 39 Sports facilities projects. This section describes these items, how they were selected and measured, and how to interpret them in the context of the modeling results.
7) Investigate the relationship between the selected factors and time and cost overruns.
8) Develop two statistical regression models for time and cost overruns.
9) Develop a recommendation in order to avoid / reduce cost overruns and time extension due to change order.

V. DATA COLLECTION TICHNIQUE

A. Identify the main factors affecting time and cost overrun

From the previous literature review, the factors that cause cost and time overrun from the four Egyptian literature were gathered in the table (4) as shown below, which concluded 126 factors that cause time and cost overruns in Sports facilities buildings projects in Egypt. After that, the identified (126) factors that lead the sports facilities building projects in Egypt to time and cost overruns were grouped into seven groups due to factors responsibility (Owner related factors, consultant related factors, contractor related factors, Local authorities related factors, Site conditions related factor, Force majeure related factors and Factors not leading to change order). Then from the previous factors, the factors will not lead to change order such as factors related to contractor and other will be excluded to be (66) factors. After that in this step, the most important factors from the previous (66) factors will be determined due to what really happened in the project and gathered to be just (7) factors as follow:
1) Additional work during construction.
2) Suspension of work by owner.
3) Design errors and revisions.
4) Foundation conditions encountered in the field.
5) Local Authorities Utility Relocation.
6) Changes in site conditions.
7) Political situation.

B. Back Ground Information on the Youth Sport Center Construction Project

The sample of this study will be a Youth Sports Center which is a club for the purpose of playing one or more sports. YSC range from organizations whose members play together, unpaid, watched mostly by family and friends, to large commercial organizations with professional players which have teams which regularly compete against those of other clubs and attract sometimes very large crowds of paying spectators. YSC may be dedicated to a single sport, or to several (multi-sport Center).

VI. MODEL DEVELOPMENT AND ANALYSIS

Once the highest important 7 factors (quantitative and qualitative) that could impact time and cost overruns in Sports facilities building projects in Egypt were identified, The Input Data to be examined using regression analysis was the severity of these factors on the 39 Sports facilities building projects sites. The Output is to develop the two regression models to be used for future consideration to assess in expected cost and time overruns of any future Sport facilities building projects. Using this software, a regression equation is fitted to the significant independent variables.

A. Cost overrun regression model.

- *Correlation test:*

Figure 1 Correlation test for cost overrun

	Original cost(E.P.)	Original Duration (Days)	Additional work during construction	Suspension of work by owner	Design errors and revisions	Foundation conditions encountered in the field	Different site condition	Local Authorities Utility Relocation	Political situation	cost increase
Original cost (E.P.)	1									
Original Duration (Days)	0.946582438	1								
Additional work during construction	-0.173576659	-0.202201266	1							
Suspension of work by owner	-0.071862278	-0.07093009	-0.053743077	1						
Design errors and revisions	-0.169630543	-0.207170107	-0.10402415	-0.050936377	1					
Foundation conditions encountered in the field	0.306138164	0.207115341	-0.260385927	-0.127500352	-0.246787425	1				
Different site condition	-0.134248363	-0.198256115	-0.068523339	-0.03355308	-0.064944748	-0.162565121	1			
Local Authorities Utility Relocation	-0.122674411	-0.121083095	-0.091743548	-0.044923068	-0.086952295	-0.217652863	-0.057277677	1		
Political situation	-0.085712791	0.054420913	-0.119371062	-0.058451133	-0.113136978	-0.283196518	-0.07452619	-0.099780559	1	
cost increase	0.759001292	0.640450219	-0.162214508	0.012365545	0.176314186	0.47309132	-0.113173041	-0.180674097	-0.106356622	1

So we can figure out that there is a **very strong uphill** (positive) linear relationship between cost increase and original cost of the project which make sense, the greater the original cost the greater the cost increase.
Also, we can figure out that there is a **strong uphill** (positive) linear relationship between cost increase and original duration of the project which means that when the original duration increase, the cost overrun will increase strongly.
Also, we can figure out that there is a **moderate uphill** (positive) linear relationship between cost increase and foundation condition of the project which means that when the foundation condition encountered in the field happens, the cost overrun will increase moderately.
Also, we can figure out that the linear relationship between cost increase and the rest of variables vary between a **weak uphill** (positive) and **weak downhill** (negative) so we can neglect the relationship between them.

- *Regression Analysis:*

Figure 2 Regression test for cost overrun

Multiple R	0.93485112
R Square	0.873946616
Adjusted R Square	0.8348266
Standard Error	298708.2033
Observations	39

ANOVA

	df	SS	MS	F	Significance F	
Regression	9	1.794E+13	1.99333E+12	22.34013962	9.62323E-11	<0.05
Residual	29	2.58757E+12	89226590713			
Total	38	2.05276E+13				

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-509652.0324	280544.507	-1.816653043	0.079619962	-1083429.974	64125.90921	-1083429.974	64125.90921
Original cost (E.P.)	0.606451801	0.151913834	3.992077508	0.000408762	0.295753124	0.917150478	0.295753124	0.917150478
Original Duration (Days)	-1811.045292	2208.775391	-0.81993185	0.418943333	-6328.498196	2706.407611	-6328.498196	2706.407611
Additional work during construction	254707.5594	87415.27738	2.913764813	0.006811284	75923.24291	433491.8759	75923.24291	433491.8759
Suspension of work by owner	243162.0031	81194.35443	2.994814169	0.00557079	77100.90262	409223.1035	77100.90262	409223.1035
Design errors and revisions	340303.42	52944.19115	6.427587477	4.96345E-07	232020.3909	448586.4491	232020.3909	448586.4491
Foundation conditions encountered in the field	290976.53	50618.68507	5.748401596	3.18303E-06	187449.6949	394503.3651	187449.6949	394503.3651
Different site condition	236071.2934	114449.4018	2.062669527	0.048201193	1995.984377	470146.6024	1995.984377	470146.6024
Local Authorities Utility Relocation	246671.1179	122191.0983	2.018732308	0.052846355	-3237.738341	496579.9742	-3237.738341	496579.9742
Political situation	262458.7378	75614.11365	3.471028425	0.001644915	107810.5112	417106.9644	107810.5112	417106.9644

From the above regression analysis, we can figure out the following:

1- Multiple R (coefficient of correlation) = 0.935 … Which means the correlation between the variables in this model is excellent.
2- The robustness or the strength of the regression model can be determined by examining the model coefficient of determination (R2). The coefficient of determination R2 represents the total variability in time and cost overrun in Sport facilities building projects in Egypt.
3- R2 = 0.873946616 … which means that 87.4% of the total variation in time overrun can be explained by the model.
4- The p-value for each term tests the null hypothesis that the coefficient is equal to zero (no effect). A low p-value (< 0.05) indicates that you can reject the null hypothesis. In other words, a predictor that has a low p-value is likely to be a meaningful addition to your model because changes in the predictor's value are related to changes in the response variable. Conversely, a larger (insignificant) p-value suggests that changes in the predictor are not associated with changes in the response.
5- P-value (original duration) = 0.418943333 > 0.05…which means the significance of this variable is very low (insignificant), thus we can exclude it and start a new regression analysis without it.

- *Regression Analysis after exclusion the insignificant variables:*

Figure 3 Regression Analysis after exclusion the insignificant variables

Regression Statistics	
Multiple R	0.933286881
R Square	0.871024402
Adjusted R Square	0.836630909
Standard Error	297072.2201
Observations	39

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*	
Regression	8	1.788E+13	2.235E+12	25.32526731	2.52054E-11	< 0.05
Residual	30	2.64756E+12	88251903938			
Total	38	2.05276E+13				

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-710181.8185	136692.8554	-5.195456754	1.34138E-05	-989345.872	-431017.7651	-989345.872	-431017.7651
Original cost (E.P.)	0.487254073	0.043847918	11.11236516	3.71185E-12	0.397704678	0.576803467	0.397704678	0.576803467
Additional work during construction	276291.4687	82900.9831	3.332788809	0.00229436	106985.0743	445597.8631	106985.0743	445597.8631
Suspension of work by owner	252080.5423	80021.79602	3.150148521	0.003681261	88654.23243	415506.8523	88654.23243	415506.8523
Design errors and revisions	354184.999	49889.55709	7.099381508	6.78105E-08	252296.9308	456073.0673	252296.9308	456073.0673
Foundation conditions encountered in the field	307136.8833	46368.58292	6.623814315	2.47405E-07	212439.6036	401834.163	212439.6036	401834.163
Different site condition	270171.7669	106041.481	2.547793226	0.016202695	53606.17105	486737.3627	53606.17105	486737.3627
Local Authorities Utility Relocation	266490.0941	119120.4739	2.237147698	0.032858054	23213.6312	509766.557	23213.6312	509766.557
Political situation	252613.7949	74245.83514	3.40239684	0.001911503	100983.5708	404244.019	100983.5708	404244.019

1- Multiple R (coefficient of correlation) = 0.933 … (Almost the same) Which means the correlation between the variables in this model is excellent.

2- R2 = 0.871 … which means that 87.1% of the total variation in cost overrun can be explained by the model.

3- Cost overrun = -710181.8185 + 0.4873 × original cost + 276291.4687 × Additional work during construction + 252080.5423 × Suspension of work by owner + 354184.999 × design errors and revision + 307136.8833 × Foundation condition encountered in the field + 270171.7669 × different site condition + 266490.0941 × Local authorities' utility relocation + 252613.7949 × Political situation.

B. Time Delay regression model.

- Correlation test:

Figure 4 Correlation test for Time delay

	Original cost (E.P.)	*Original Duration (Days)*	*Additional work during construction*	*Suspension of work by owner*	*Design errors and revisions*	*Foundation conditions encountered in the field*	*Different site condition*	*Local Authorities Utility Relocation*	*Political situation*	*time extension*
Original cost (E.P.)	1									
Original Duration (Days)	0.946582438	1								
Additional work during construction	-0.173576659	-0.202201266	1							
Suspension of work by owner	-0.071862278	-0.07093009	-0.053743077	1						
Design errors and revisions	-0.169630543	-0.207170107	-0.10402415	-0.050936377	1					
Foundation conditions encountered in the field	0.306138164	0.207115341	-0.260385927	-0.127500352	-0.246787425	1				
Different site condition	-0.134248363	-0.198256115	-0.068523339	-0.03355308	-0.064944748	-0.162565121	1			
Local Authorities Utility Relocation	-0.122674411	-0.121083095	-0.091743548	-0.044923068	-0.086952295	-0.217652863	-0.057277677	1		
Political situation	-0.085712791	0.054420913	-0.119371062	-0.058451133	-0.113136978	-0.283196518	-0.07452619	-0.099780559	1	
time extension	0.339845145	0.36443676	-0.29389645	0.20438152	-0.026637729	0.117457199	-0.144788445	0.003371344	0.387048933	1

From the above chart, we can figure out that the linear relationship between time extension and the whole variables vary between a **weak uphill** (positive) and **weak downhill** (negative) so we can neglect the relationship between them.

- *Regression Analysis:*

Figure 5 Regression Analysis for Time delay

Regression Statistics	
Multiple R	0.668677103
R Square	0.447129068
Adjusted R Square	0.275548434
Standard Error	31.23684439
Observations	39

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	9	22884.50138	2542.722376	2.605941347	0.024357363
Residual	29	28296.47298	975.7404474		
Total	38	51180.97436			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.068182477	29.33741026	0.036410251	0.97120472	-58.93355862	61.06992357	-58.93355862	61.06992357
Original cost (E.P.)	1.00718E-05	1.58861E-05	0.633998305	0.531051404	-2.2419E-05	4.25625E-05	-2.2419E-05	4.25625E-05
Original Duration (Days)	0.023511578	0.230978502	0.101791197	0.919622981	-0.4488925	0.495915656	-0.4488925	0.495915656
Additional work during construction	-0.894902686	9.141287005	-0.097896793	0.922687756	-19.59093384	17.80112846	-19.59093384	17.80112846
Suspension of work by owner	18.59519565	8.490745774	2.19005446	0.036711189	1.229670712	35.96072059	1.229670712	35.96072059
Design errors and revisions	6.816907226	5.536538475	1.231257989	0.228118558	-4.506585378	18.14039983	-4.506585378	18.14039983
Foundation conditions encountered in the field	7.720299092	5.293353082	1.458489349	0.155452196	-3.105823538	18.54642172	-3.105823538	18.54642172
Different site condition	2.748447118	11.96832934	0.22964334	0.819980971	-21.72953481	27.22642905	-21.72953481	27.22642905
Local Authorities Utility Relocation	16.21154589	12.77790259	1.268717286	0.214631545	-9.922199245	42.34529103	-9.922199245	42.34529103
Political situation	26.0917009	7.907202667	3.299738478	0.002568647	9.919655616	42.26374618	9.919655616	42.26374618

From the above regression analysis, we can figure out the following:

1- Multiple R (coefficient of correlation) = 0.669 … Which means the correlation between the variables in this model is good.

2- The robustness or the strength of the regression model can be determined by examining the model coefficient of determination (R2). The coefficient of determination R2 represents the total variability in time and time extension in Sport facilities building projects in Egypt.

3- R2 = 0.4471(< 0.7) … which means that 44.71% of the total variation in time extension can be explained by the model, and it's too low…which means that the model is so weak.

4- P-value (original cost, original duration, additional work during construction, Design errors and revisions, Foundation conditions encountered in the field, Different site condition and Local Authorities Utility relocation) > 0.05… which means the significance of these variables is very low (insignificant), thus we can't count on this regression analysis.

5- From the previous data we can figure out the model for time extension is not working properly, and we cannot account on it to validate another projects with the same criteria. May be because at this model the main factors that lead to time extension don't affect the project duration due to floating of the project items, or because it's not comply with the amount of additional work in the project due to these factors.

VII. MODEL DEVIATION

The data collected was examined by comparing the actual cost overrun for the 39 Sport facilities building projects to the estimated cost overrun by substituting the data for 39 projects in the estimated cost overrun regression model, then we are going to calculate the percentage of error of the cost overrun according to the following equation:

$$\boldsymbol{Estimating\ Error}\ (\%) = \frac{(\boldsymbol{Regression\ OUTPUT} - \boldsymbol{Actual\ Output})}{\boldsymbol{Actual\ Output}} \times \mathbf{100}$$

$$\boldsymbol{Average\ ERROR} = \frac{\sum_{i=1}^{n} \boldsymbol{Estimating\ Error}}{\boldsymbol{n}}$$

Where n is number of experiments.

No.	Original cost (E.P.)	Actual cost increase (E.P.)	Estimated cost increase (E.P.)	Error (%)
1	588000	105840	-116540	10.11
2	588000	41160	-153505	272.95
3	672000	2096640	1388178	33
4	672000	188160	169836	9.74
5	672000	376320	538664	43.14
6	672000	329280	231527	29.69
7	672000	362880	427768	17.88
8	672000	1545600	1152937	25.41
9	672000	342720	538664	57.17
10	672000	430080	446127	3.73
11	672000	725760	1152937	58.86
12	672000	792960	1388178	75.06
13	896000	277760	278981	0.44
14	896000	250880	434768	73.3
15	896000	188160	33535	82.18
16	896000	152320	-7112	95.33
17	896000	250880	259378	3.39
18	896000	188160	259378	37.85
19	896000	734720	734720	0
20	896000	89600	33535	62.57
21	1022933	450091	546088	21.33
22	1022933	603531	709657	17.58
23	1022933	347797	340829	2
24	1022933	102293	95383	6.75
25	1022933	225045	95383	57.62
26	1022933	51147	40860	20.11
27	1206666	543000	382999	29.47
28	1206666	603334	635612	5.35
29	1206666	410267	382999	6.65
30	1206666	820534	799182	2.6
31	1206666	120667	231956	92.23
32	1206666	144800	231956	60.19
33	2795668	643003	959156	49.17
34	2918022	1225569	1325910	8.19
35	4382712	2147528	2039586	5.03
36	4382712	3024071	2346723	22.4
37	4382712	2016047	2039586	1.17
38	4090430	2362470	2204308	6.69
39	4090430	1186224	1897171	59.93
Average Cost Overrun Error percentage			37.59641026 %	

Table 1 Validation of the model

VIII. CONCOLUSION

1- The probability of occurrence of cost overrun increase as the original cost increase.

2- The concluded seven significant factors from the regression models affecting time and cost overruns in sports facilities projects in Egypt are:

A. Additional work during construction
B. Suspension of work by owner.
C. Design errors and revisions.
D. Foundation conditions encountered in the field.
E. Different site condition.
F. Local Authorities Utility Relocation.
G. Political situation.

3- A design with errors practically means wrong or insufficient representation of project deliverables. This will lead to wrong application of techniques in achieving result, such that as the actual execution phase of the project unfolds these design errors, attempt to correct it will lead to delay and cost overrun. Another way design errors could lead to cost overrun and delay could be seen in the fact that project estimations are done base on the produced designs, as such, having errors in design in a form of omission or misrepresentation will mean that the estimation for the project cost will also include these omissions, thereby leading to extra works, change order etc., thus resulting in delay and cost overrun. Similarly, designs that are done without extensive investigation of site could contain potential errors. This is because such designs could lead to additional work, revision of scope of work, and contract revision as the actual site conditions begins to float up at the construction phase of the project. These will no doubt affect the overall project delivery time and cost.

4- Any additional work in the project during execution will mean that the entire initial project plan will have to be reviewed such that a reviewed budget, schedule and quality will have to be developed. This means more time and resources will be needed as against the initial baseline. "With each additional work, precious project resources are diverted to activities that were not identified in the original project scope, leading to pressure on the project schedule and budget". Additional work could be as a result of wrong initial scope definition, inherent risk and uncertainties, sudden change of interest, project funding change, etc. this could lead to change request which in turn could lead to change in project deliverables, budget and/or even the entire project team. Poor scope change management could lead to dispute that may require spending time and money on arbitration and litigation for what the contractor or the client believes he is entitle to. This will no doubt lead to delay and cost overrun of the project.

5- Testing the validity of the developed cost overruns regression model clearly shows that the developed models can be taken as a new approach in expected cost and time overruns of any projects at level of confidence 63%.

6- Cost overrun = -710181.8185 + 0.4873 × original cost + 276291.4687 × Additional work during construction + 252080.5423 × Suspension of work by owner + 354184.999 × design errors and revision + 307136.8833 × Foundation condition encountered in the field + 270171.7669 × different site condition + 266490.0941 × Local authorities' utility relocation + 252613.7949 × Political situation.

7- The time extension regression model is not working properly and can't be trusted, because the nature of the sample project. The significant factors affecting the time of the project lead to additional work can be done at the original duration of the project because the contractor can float the time of the project items during the construction phase, more over that the original project duration was more than enough to finish the desired work.

IX. RECOMMENDATIONS FOR THE PARTICIPATORS

1- The new participators in such projects (Youth Sports Center) can use the cost overrun model to predict the cost overrun of the project during the planning phase which will enable him/them to increase the budget of the project from the bedding phase.
2- Good communication with the entire design team and integrating a design process that is properly planned,
3- Giving enough time for corrections, extensive investigation and reviews.
4- An effective project planning, controlling and monitoring should be established to enhance project performance throughout the project life cycle.
5- Application of value management could be used to obtain the best Cost effective design options.
6- Proper site investigation should be done to ensure that all site conditions are noted in the design.
7- identify the fact that change is inevitable in project and could equally be beneficial to the entire project success.
8- Integrate a proper change management plan such that a proactive approach could be adopted involving the project stakeholders and incorporating their needs throughout the project lifecycle.
9- During the planning phase of the project, identify the key success factor in conjunction with the client and establish KPI in the form of milestone that will measure the success for of attaining the project scope.
10- Seek approval for changes from sponsor and communicate changes in a timely way.
11- The scope could be frozen so as to concentrate on the expected deliverable for highly evolving change in project.
12- The government should work to establish utility map covering the whole areas in Egypt and make it available when required

RECOMMENDATIONS FOR FUTURE WORK

1- Using another way to evaluate the impact of each factor on the project, for example dividing the additional work into two or three factors due to the percentage of the cost increase in each project.
2- Choose another analysis way to establish a model, such as Neural network.
3- Choose another sample project which can be analyzed easily without interference between variables and its effect on cost and time.
4- Enlarge the number of projects within the sample.
5- Take the suitability of the Project duration factor into consideration as a new factor affecting the cost overrun and time delay.

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