# Analysis of Time and Cost overruns in Educational Building projects in Egypt

**Walid kholif, Hossam Hosny and Abdelmonem Sanad**

*Abstract*— **Educational building projects are considered as one of the most important construction projects in Egypt. It is well known that most construction projects in Egypt exposed to time and cost overrun or both. This phenomenon may affect the progress of educational building projects in Egypt. The aim of this research is to find out the main causes of time and cost overruns in educational buildings in Egypt, ranking these causes according to their relative importance and level of severity and investigate the expected effects of these factors on both cost and time overruns of a selected sample of the educational building projects in Egypt. Finally a multiple regression model was developed for both time and cost overruns using SPSS version 16.**

*Index Terms*— **Educational building projects in Egypt, the main causes of time and cost overruns, ranking, statistical model.**

## I. Introduction

Time and cost overruns in education building projects in Egypt are critical issues that badly affect project delivery. This may lose the goal of building larger number of educational projects to reduce the concentration of the people in the class that can improve the overall education system in Egypt. Time and cost overrun generally result from different factors that occur at various phases of the project life cycle. These factors include increase in project scope, design error, mistakes in soil investigation, difficulty in getting work permit from government, bureaucracy in bidding/tendering method. Through this research statistical regression models for time and cost overruns were developed using SPSS version 16. To achieve this goal, first a review of the past literature is presented. A questionnaire survey was conducted to identify the most important time and cost overrun factors. Finally the paper provided two regression models that can be used to assess the expected time and cost overruns in educational building projects in Egypt. The development of the two models was discussed and the validity of them was also investigated.

**Manuscript received November 21, 2013.**

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## II- Literature Review

Based on several previous researches, it is readily known that time and cost overruns are inherent characteristics for the construction industry in most countries. The most important time and cost overrun factors according to contractors were preparation and approval of shop drawings, delays and cost overrun in contractors' progress, payment by owners and design changes by owner, (Assaf, *et al.* 1995). 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 indicated by Chan and Kumaraswamy (1997) as the main causes of time and cost overruns in Hong Kong. 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. 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. 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. Jahren and Ashe (1990) 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). Chang (2002) also categorized the reasons for cost and time increases in engineering design projects 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. 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. 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. 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 take off and labor cost increase due to environment restriction. 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. 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.

## III- Objective

The objectives of this research paper are:

1- To find out the main causes of time and cost overruns in educational buildings in Egypt.
2- To rank these causes according to their relative importance and level of severity.
3- To investigate the expected effects of these factors on the cost and time overruns of a selected sample of the educational building projects in Egypt.
4- To develop a statistical regression model that can be used to assess the expected time and cost overruns in the future educational buildings projects in Egypt.

## IV- Methodology

The study will be conducted through the following sequential steps:

1- A literature review will be carried out to cover the previous studies regarding the construction project cost and time overruns. Based on this review, the different causes that are expected to affect the cost and time overruns will be clearly identified.
2- Based on the previously identified factors, a questionnaire survey targeted at contractors and consultant will be conducted to identify the most important causes of time and cost overruns in the educational buildings projects in Egypt.
3- The identified causes will be also categorized according to their relative importance. Such relative importance mainly includes frequency index, severity index and important index.
4- To address the study objectives, data will be collected for a selected sample of educational projects that were executed through the time period from 2007 to 2011 by the Egyptian authority of educational building.
5- Finally the collected data and the questionnaire survey will be deeply investigated to:
   (a) Identify the main causes influencing the cost and time overruns in the educational building projects, Ranking these factors according to their relative importance and identifying the most important factors.
   (b) Investigate the simultaneous relationship between these factors and the cost and time overrun by developing two regression models using SPSS version 16 program.

## II. UNITS

Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). **This applies to papers in data storage.** For example, write "15 Gb/cm$^2$ (100 Gb/in$^2$)." An exception is when English units are used as identifiers in trade, such as "3½ in disk drive." Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength $H$ is A/m. However, if you wish to use units of T, either refer to magnetic flux density $B$ or magnetic field strength symbolized as $\mu_0 H$. Use the center dot to separate compound units, e.g., "A·m$^2$."

## V- Questionnaire Survey

### *A. Identify the main factors affecting time and cost overrun*

A direct interview survey was used through a carefully prepared detailed questionnaire to identify the most important time and cost overruns factors. Questionnaire was sent to the selected respondent from contractors and consultants. The questionnaire also offers some level of confidentiality and

allows respondents to give true opinions on issues asked. Because the mother tongue of most people working in construction in Egypt is Arabic it was necessary to provide an Arabic questionnaire format. Data were gathered indirect interview because of the difficulty in gathering questionnaires by post. A total of 80 questionnaires were sent to construction professionals involved in educational building project in Egypt. The chosen projects locate in 12 different cities, Cairo, Alexandria, Giza, Qalubia, Daqahlia, Behera, Gharbia, Asyood, Sohag, Eloqsor, Elminia and Qna. Uncompleted questionnaires were eliminated. Fifty two full responses were obtained showing a response rate of 65%. The response rate from contractors and consultants is 78.85%, 21.15%, respectively. Regarding number of years involved in construction, 3.85% of respondents have less than or equal to 5 years, 25% of them have between 5 and 10 years. 13.55% of them have years of experiences between 10 and 15 years and finally 57.6% of them have 15 years of experiences or more.
The percentage of respondents whose experiences are 15 years or more is the highest this gives a great confidence regarding questionnaires results. The classification of the respondents according to the Egyptian Contractors Union are shown in Table I.

| **Contractors categories** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Not Ranked | Total |
|---|---|---|---|---|---|---|---|---|---|
| **No of contractors** | 3 | 4 | 8 | 8 | 7 | 6 | 2 | 3 | 41 |

Table I: The categories of the respondent contractors

*B. Questionnaire Design*

This research has adopted field survey methodology to uncover factors influencing on time and cost overruns arising during all stages of the projects.
To identify the time and cost overruns factors in educational building projects in Egypt, literature reviews, case analysis and discussion with practitioners of all parties involved in educational building projects were carried out. After that a pilot questionnaire was prepared.
The designed questionnaire was randomly distributed to two principal construction parties (consultant and contractor). For each factor the respondents were requested to answer both frequency of occurrence and severity. A five-point scale of 1 to 5 is adopted for evaluating the effect of each factor. These numerical values are assigned to the respondents rating, 1 = very low, 2 = low, 3 = medium, 4 = high, 5 = very high for frequency a similar scale was also considered for severity. In order to fit into conditions in educational building projects in Egypt a pilot test was performed for preliminary questionnaire. Twelve experts were involved in this pilot test. They are three consultants in educational building projects, one public owner, five contractors and three professional project manager in educational building projects. Both of them have more than 15 years of experience in Educational building projects in Egypt. They were asked to critically review the design and structure of the questionnaire. Their valuable comments were used to revise the research questionnaire. After revising the questionnaire the second pilot questionnaire was resent to these twelve experts.
At this time the comments received were positive and no change was necessary. The questionnaire was ready to survey; Fifty three causes (based on literature survey) are listed in six respective groups:
*A-Owner-related group consists of*, financial difficulties of owner, slow payment of completed works, low speed of decision making and delay to furnish and deliver the site to the contractor by the owner.
*B-Contractor-related group consists of*, poor site management and supervision, financial difficulties of contractor, mistakes during construction, ineffective planning and scheduling by contractors, inexperienced contractor, poor financial control on site, inaccurate cost estimation, poor relationship between management and labor, rework due to poor work / wrong materials by the contractor, poor monitoring and control, Lack of database in estimating activity duration and resources and lack of administrative employee and incompetent subcontractors.
*C-Consultants-related group consists of*, slow inspection of completed works, mistakes in design, practice of assigning contract to lowest bidder, inaccurate bill of quantities, long period between design and time of bidding/ tendering, waiting for approval of shop drawings and material samples, mistakes in soil investigation, weakness of qualified supervisor, inflexibility (rigidity) of consultant and original contract duration is too short.
*D-Project-related group consists of*, environmental restrictions, design changes, additional works, lack of communication between parties, occurrence of site accidents during construction and personality clash between contractor agent and engineering supervisor.
*E-Material and labor group consists of*, escalation of material prices (inflation), inadequate production of raw materials in the country, shortages of materials, shortages of skilled workers / technical personnel, high cost of skilled labor, poor labor productivity, high equipment maintenance costs and poor equipment productivity.
*F- External factors-related group consists of*, unforeseen site (ground) conditions, difficulties in getting work permit from government, bureaucracy in bidding/ tendering method, unavailability of utilities in site (such as, water, electricity, telephone, etc.), high insurance and high interest rates, political insecurity instability, project location, stealing and waste on site, litigation, high transportation costs, bad weather and uncontrollable external factors.

## VI- Questionnaire data analysis

*A. Index Analysis*

The data are processed through three types of indices as follows:
• *Frequency index* (F.I.):
This index expresses occurrence frequency of factor responsible for delay and cost overruns. It is computed as per following formula: F.I = Σa*n / Total score. Where: a = constant expressing the weight assigned to each responses (ranges from 1 for very low to 5 for very high), n = frequency of each response.
• *Severity index* (S.I.):
This index expresses severity of factor that caused delay and cost overruns. It is computed as per following formula: S.I = Σa*n / Total score.

Where: a = constant expressing the weight assigned to each responses (ranges from 1 for very low to 5 for very high), n = frequency of each response.

• *Importance index* (Imp. I.):

This index expresses the overview of factor based on both their frequency and severity. It is computed as per following formula: Imp. I. = F.I. × S.I.

Table II: Importance Index and Ranking of cost and time overrun factors

| Code | Causes | Overall | | contractors | | consultants | | GROUP | symbol |
|---|---|---|---|---|---|---|---|---|---|
| | | Imp. I | Rank | Imp. I | Rank | Imp. I | Rank | | |
| F6 | political insecurity instability | 0.56 | 1 | 0.63 | 1 | 0.49 | 1 | External | X1 |
| E1 | Escalation of material prices (Inflation) | 0.48 | 2 | 0.59 | 3 | 0.38 | 3 | Material, labor & Equipment | X2 |
| F2 | Difficulties in getting work permit from government | 0.48 | 3 | 0.60 | 2 | 0.37 | 5 | External | X3 |
| B3 | Practice of assigning contract to lowest bidder | 0.44 | 4 | 0.56 | 4 | 0.32 | 13 | Consultant | X4 |
| E5 | High cost of skilled labor | 0.42 | 5 | 0.46 | 9 | 0.38 | 4 | Material, labor & Equipment | X5 |
| C2 | Financial difficulties of contractor | 0.41 | 6 | 0.40 | 11 | 0.43 | 2 | Contractor | X6 |
| A2 | Slow payment of completed works | 0.39 | 7 | 0.46 | 8 | 0.33 | 11 | Owner | X7 |
| F5 | High insurance and high interest rates | 0.38 | 8 | 0.48 | 7 | 0.30 | 19 | External | X8 |
| F3 | Bureaucracy in bidding/ tendering method | 0.38 | 9 | 0.51 | 5 | 0.27 | 25 | External | X9 |
| A1 | Financial difficulties of owner | 0.38 | 10 | 0.49 | 6 | 0.28 | 22 | Owner | X10 |
| B4 | Inaccurate bill of quantities. | 0.36 | 11 | 0.38 | 15 | 0.34 | 9 | Consultant | X11 |
| F10 | High transportation costs | 0.34 | 12 | 0.39 | 13 | 0.29 | 21 | External | X12 |
| C7 | Inaccurate cost estimation | 0.28 | 13 | 0.25 | 41 | 0.30 | 16 | Contractor | X13 |
| B7 | Mistakes in soil investigation | 0.27 | 14 | 0.31 | 29 | 0.23 | 39 | Consultant | X14 |

Table II shows the importance indices and rankings of causes consistent with various parties. As importance index is calculated from multiplying frequency index by severity index, rankings of causes based upon Imp. I. all parties have met an agreement that these are the highest 14 important causes of time and cost overruns in educational projects in Egypt, we are going to eliminate the cause political insecurity instability because all the project have finished before the Egypt revolution (all the projects between 2007 to 2011).

### *B. Projects Data*

Data were collected on 102 educational building projects in Egypt comprising small, medium and large projects. Methods involved are traditional design, construction management and management contracting and project management. Two tendering methods were considered (open tender and selective). All projects were completed between years 2007 to 2011. The collected projects locate in 12 different cities in Egypt. The distribution of these projects is shown in Table III.

Table III: Project location

| No | City | No of projects |
|---|---|---|
| 1 | Cairo | 6 |
| 2 | Alexandria | 8 |
| 3 | Giza | 3 |
| 4 | Qalubia | 5 |
| 5 | Daqahlia | 28 |
| 6 | Behera | 14 |
| 7 | Gharbia | 1 |
| 8 | Asyoud | 7 |
| 9 | Sohag | 23 |
| 10 | Eloqsor | 1 |
| 11 | Elminia | 2 |
| 12 | Qna | 4 |
| **Total No of Projects** | | **102** |

Thirty three projects out of 102 projects having cost overruns with a percentage of 32.35%. Moreover, about 87.88% of these projects have no time overruns, while 29 projects only having time overrun with a percentage of 28.43% of total projects, as shown in Table IV. Fifteen projects have fallen in liquidated damages with a percentage of 14.7%.

Table IV: Distribution of project according to time and cost overruns

| | | ***Ratio of actual project construction duration to planned project duration*** | | |
|---|---|---|---|---|
| | | **≤ 1** | **> 1** | **Total** |
| ***Ratio of actual as built cost to estimated cost*** | **≤ 1** | 69 | 0 | 69 |
| | **> 1** | 4 | 29 | 33 |
| ***Total*** | | 73 | 29 | **102** |

The projects size and duration are classified into three groups as shown in Tables (V, VI).

Table V: Classification of Project according to project size

| Projects size | No of projects | Cost overrun | % of projects | % of Average value of cost overrun |
|---|---|---|---|---|
| **Less than 1 million** | 17 | 3 | 17.65 | 14.13 |
| **Between 1 to 5 million** | 69 | 19 | 27.54 | 7.51 |
| **More than 5 million** | 16 | 11 | 68.75 | 5.91 |
| **Total** | 102 | 33 | **32.35** | |

The collected projects were classified into three groups according to their tender price. The first group includes projects with a tender price less than 1 million EGP. The tender prices of the other two groups are smaller and greater than 5 million EGP respectively. A closer inspection to Table V, clearly show that the percentage of projects that have cost overrun 17.65%, 27.54% and 68.75% for the three groups respectively. Such result clearly indicates that the probability of occurrence of the cost overrun increase as the project size increase. Moreover, the average percentage of cost overruns was found to be 14.13%, 7.51% and 5.91% for the three groups respectively. This clearly indicates that the severity of cost overrun is inversely proportional to the project size.

Table VI: classification of Project according to project time

| Projects durations | No of projects | Time overrun | % of projects | % of Average value of time overrun |
|---|---|---|---|---|
| **Less than 8 months** | 9 | 0 | 0 | 0 |
| **Between 8 to 12 months** | 65 | 18 | 27.69 | 19.18 |
| **More than 12 months** | 28 | 11 | 39.29 | 9.67 |
| **Total** | 102 | 29 | **28.43** | |

The collected projects were classified into three groups according to their project scheduled time. The first group includes projects with scheduled time less than 8 months. The project scheduled time of the other two groups is smaller and greater than 12 months respectively.

A closer inspection to Table VI, clearly show that the percentage of projects that have time overrun 0%, 27.69% and 39.29% for the three groups respectively. Such result clearly indicates that the probability of occurrence that the time overrun increase as project scheduled time increase. Moreover, the average percentage of time overruns was found to be 0%, 19.18% and 9.67% for the three groups respectively.

## VII- Regression Model

The development of two multiple regression models for estimating cost and time overruns is a major objective for this research. These two multiple regression models were developed based on the most importance factors that were previously identified. Both backward and forward regression models (BRM and FRM) were employed using SPSS version 16 for the development of the two regression model for cost and time overruns. The final results of the comparison between BRM and FRM indicated that the backward regression model is more valid and applicable than the forward regression model. This may be due attributed to the fact that the backward regression model has the advantage of looking at all the available variables in the early stages of the model development process (Attalla and Hegazy 2003).

Backward and forward regression models were employed using SPSS version 16. ***Forward regression*** begins with no variables in the equation, enters the most significant variable at the first step, and continues adding and deleting variables until none can significantly improve the fit. On the other hand, ***backward regression model*** begins with all candidate variables, then removes the least significant variable at the first step and continues until no insignificant variables remain (Attalla and Hegazy 2003).

### *A. Time Overrun Model*

Table VII indicated the final results of backward regression equation and its ANOVA statistics. BRM explained over 94.6% of the variation in time overrun in educational building projects in Egypt by explanatory variables. This means that the backward regression model is an adequate and a whole significant. The derived equation for the backward regression model is illustrated as follows:

***Time overrun =0.453+0.123× X3 + 8.592 × 10^-7 × X4 – 2.293 × 10^-7 × X5 – 0.123 × X6 + 0.064 × X7 – 1.444 × 10^-6 × X8 + 0.061 × X9 – 1.799 × 10^-6 × X11 + 2.533 ×10^-7 × X13 + 0.197 × X14 + 1.369 × 10^-6 × X12.***

A careful inspection to tables clearly indicated that the eleven of the fourteen factors were being considered in the developed model. The regression model has strong correlation coefficient R equal to 0.973 and the coefficient of determination R square equal 0.946

which is a best fit which means that 94.6% of the total variation in time overrun can be explained by the model. Also it has average percentage error of 8.07%.

Table VII: Coefficients of Variables, T-Test Statistic and ANOVA Statistic of Final Run Using Backward Stepwise Regression for Time Overrun

Coefficients

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | **B** | **Std. Error** | **Beta** | | |
| 4 | (Constant) | 0.45 | 0.04 | | 12.5 | 2.7E-21 |
| | Difficulties in getting work permit from government | 0.12 | 0.02 | 0.24 | 8.05 | 3.2E-12 |
| | Practice of assigning contract to lowest bidder | 8.6E-07 | 4.02E-07 | 1.35 | 2.14 | 0.04 |
| | High cost of skilled labor | -2.3E-07 | 1.2E-07 | -0.19 | -1.88 | 0.06 |
| | Financial difficulties of contractor | -0.123 | 0.014 | -0.35 | -8.95 | 4.5E-14 |
| | Slow payment of completed works | 0.064 | 0.02 | 0.14 | 3.67 | 0.0004 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | High insurance and high interest rates | -1.4E-06 | 8.4E-07 | -0.92 | -1.72 | 0.09 |
| | Bureaucracy in bidding/ tendering method | 0.06 | 0.02 | 0.14 | 2.99 | 0.004 |
| | Inaccurate bill of quantities | -1.8E-06 | 2.1E-07 | -1.40 | -8.73 | 1.3E-13 |
| | Inaccurate cost estimate | 2.5E-07 | 5.5E-08 | 0.20 | 4.60 | 1.4E-05 |
| | Mistakes in soil investigation | 0.20 | 0.03 | 0.39 | 6.99 | 4.7E-10 |
| | High transportation costs | 1.4E-06 | 1.5E-07 | 1.27 | 9.42 | 4.6E-15 |

ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 4 | **Regression** | 10.203 | 11 | 0.928 | 144.74 | 0.000[d] |
| | **Residual** | 0.577 | 90 | 0.006 | | |
| | **Total** | 10.780 | 101 | | | |

Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 4 | 0.973[d] | 0.946 | 0.940 | 0.0801 |

*B. Cost Overrun Model*

Table VIII indicated the final results of backward regression equation for project cost overrun and its ANOVA statistics. BRM explained over 89.2% of the variation in cost overrun in educational building projects in Egypt explained by explanatory variables. This means that the backward regression model is an adequate and a whole significant. The derived equation for the backward regression model is expressed as follows:

***Cost overrun = 0.873+0.016× X3 + 5.306 × 10^-8 × X5 + 0.032 × X6– 9.214 × 10^-8 × X8- 0.043 × X9 + 9.48 ×10^-8 × X13+ 0.076 × X14.***

The regression model has a strong correlation coefficient R equal 0.901 and the coefficient of determination R square equal 0.812 which is a best fit which means that 81.2% of the total variation in cost overrun can be explained by the model. Also it has 2.42% as an average percentage error. It has to be noted that seven of the previously identified fourteen input factors were only considered by the developed model. This clearly indicates that the other seven factors were found to have no significant effect on the project cost overrun.

Table VIII: Coefficients of Variables, T-Test Statistic and ANOVA Statistic of Final Run Using Backward Stepwise Regression for Cost Overrun

Coefficients

| Model | | Un standardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 8 | (Constant) | 0.873 | 0.014 | | 64.67 | 0.00 |
| | Difficulties in getting work permit from government | .016 | .006 | 0.137 | 2.82 | 0.006 |
| | High cost of skilled labor | 5.31E-8 | .000 | 0.190 | 1.90 | 0.06 |
| | Financial difficulties of contractor | .032 | .005 | 0.387 | 6.12 | 0.00 |
| | High insurance and high interest rates | -9.21E-8 | .000 | -0.250 | -2.35 | 0.02 |
| | Bureaucracy in bidding/ tendering method | -.043 | .009 | -0.430 | -5.06 | 0.00 |
| | Inaccurate cost estimate | 9.48E-8 | .000 | 0.314 | 4.39 | 0.00 |
| | Mistakes in soil investigation | .076 | .012 | 0.638 | 6.29 | 0.00 |

ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 8 | **Regression** | 0.484 | 7 | 0.069 | 58.109 | 0.000[h] |
| | **Residual** | 0.112 | 94 | 0.001 | | |
| | **Total** | 0.596 | 101 | | | |

Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 8 | 0.901[h] | 0.812 | 0.798 | 0.03450 |

## VIII-Testing the validity of the developed regression model

The validity of the developed regression model was tested for a selected sample of projects in Egypt. Data were collected for 30 additional educational building projects in Egypt. All these projects were completed in the years 2011 – 2012. The collected projects were located in 5 different cities in Egypt. Eight projects out of 30 projects having time and cost overruns with percentage 26.67%. Eight projects have fallen in liquidated damages with percentage 26.67%. As shown in Table IX.

Table IX: Results of the validation process

| No | Project Name | Actual % | | Estimated% | | Abs. Variance% | |
|---|---|---|---|---|---|---|---|
| | | Time Over run | Cost Over run | Time Over run | Cost Over run | Time | Cost |
| 1 | صلاح الدين الابتدائية الصباحية | 1.27 | 1.1 | 1.22 | 1.03 | 3.9 | 6.3 |
| 2 | الخلفاء الراشدين ب المشتركة | 1.02 | 1.03 | 1.13 | 1.07 | 10.6 | 4.03 |
| 3 | اسماعيل القباني اعدادى بنين | 1 | 0.92 | 1.11 | 1.01 | 10.7 | 9.85 |
| 4 | بغداد الابتدائية | 1.15 | 1.07 | 1.18 | 1.07 | 2.65 | 0.63 |
| 5 | سند ( 2 ) الابتدائي | 1.36 | 1.1 | 1.41 | 1.16 | 3.63 | 5.28 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6 | اسكان العبور | 1 | 0.97 | 1.09 | 1.00 | 8.81 | 3.34 |
| 7 | العمراوى ابتدائية المشتركة | 1 | 0.98 | 0.98 | 1.00 | 1.98 | 3.02 |
| 8 | ناصر الابتدائية المشتركة | 1 | 0.99 | 1.01 | 1.01 | 1.34 | 1.37 |
| 9 | حسن صبحي الإعدادية | 1.32 | 1.1 | 1.45 | 1.16 | 10.0 | 5.62 |
| 10 | شباب المستقبل | 1.27 | 1.1 | 1.27 | 1.09 | 0.31 | 0.60 |
| 11 | أمير الشعراء للتعليم الأساسي | 1.18 | 1.08 | 1.19 | 1.08 | 0.32 | 0.006 |
| 12 | محمد فريد الإعدادية | 0.89 | 0.97 | 0.87 | 0.96 | 1.95 | 1.21 |
| 13 | الحوائكة الابتدائية المشتركة | 0.92 | 0.99 | 0.88 | 0.91 | 4.38 | 8.23 |
| 14 | بني هلال الابتدائية المشتركة | 0.87 | 0.93 | 0.76 | 0.88 | 12.1 | 5.99 |
| 15 | بني شقير ابتدائية المشتركة | 0.86 | 0.99 | 0.85 | 1.04 | 1.04 | 3.81 |
| 16 | رزق محمد صالحين اساسي | 1 | 0.93 | 1.10 | 0.97 | 9.89 | 4.32 |
| 17 | الخوالد الابتدائية الجديدة | 1 | 0.90 | 0.92 | 0.89 | 7.80 | 0.23 |
| 18 | الدوير للتعليم الاساسي | 1 | 0.92 | 0.88 | 0.93 | 12.0 | 1.39 |
| 19 | نجع الكوم الابتدائية المشتركة | 0.91 | 0.98 | 0.98 | 1.01 | 7.56 | 3.393 |
| 20 | نجع حامد رمضان اساسي | 0.96 | 0.93 | 1.07 | 0.98 | 11.4 | 5.215 |
| 21 | قصر بخالس ثانوى | 1.05 | 1.02 | 1.03 | 1.01 | 1.29 | 1.197 |
| 22 | السمطا بحري الإعدادية | 0.96 | 0.93 | 0.96 | 0.95 | 0.06 | 2.528 |
| 23 | ابو بكر الصديق اعدادى | 1 | 0.95 | 1.03 | 1.01 | 2.77 | 6.154 |
| 24 | الحرس الوطني الابتدائية | 0.84 | 0.91 | 0.85 | 0.94 | 0.93 | 3.199 |
| 25 | اساسي بعزبة الكبل | 1 | 0.99 | 0.94 | 1.01 | 5.56 | 1.796 |
| 26 | أم السعود اساسي | 1 | 0.94 | 0.98 | 0.89 | 2.11 | 5.25 |
| 27 | ميت غراب الابتدائية | 0.95 | 0.99 | 0.96 | 0.96 | 1.34 | 3.44 |
| 28 | كفر بدواي اساسي | 0.92 | 0.96 | 0.94 | 0.94 | 1.67 | 1.43 |
| 29 | د مو الإعدادية | 0.96 | 0.95 | 0.92 | 0.94 | 4.35 | 0.44 |
| 30 | الحرية اساسي | 1 | 0.89 | 1.11 | 0.9 | 11.2 | 0.62 |
| **Average Time and Cost Overrun variance** | | | | | | 5.12 | 3.33 |

*A –Time overruns validation*

The collected data was examined by calculating the actual time overrun for the 30 educational building projects as shown in Table 9. Then the estimated time overrun was calculated using the developed time overrun regression model. The percentage error of the time overrun was calculated according to the following equation:

$$\%of\ Error = ABS\left(\frac{Actual\ time\ overrun - Estimated\ time\ overrun}{Actual\ time\ overrun}\right)$$

According to Table 9 the average percentage error of the time overrun estimate was found to be 5.12%.

*B –Cost overruns validation*

The collected data was examined by calculating the actual cost overrun for the 30 educational building projects as shown in Table 9. Then we are going to calculate the estimated cost overrun by substituting the data for 30 projects in the estimated cost overrun regression model and then we are going to calculate the percentage of error of the cost overrun according to the equation:

$$\%of\ Error = ABS\left(\frac{Actual\ cost\ overrun - Estimated\ cost\ overrun}{Actual\ cost\ overrun}\right)$$

By substituting in the above equation the average percentage error is very low, equal to 3.33%.
which means that the validity of the cost overrun regression model is excellent.
However, the results of the validation process clearly show that the developed regression models have an average percentage error of 5.12% and 3.33% for the time and cost overrun respectively. Such results provide a good indication regarding the ability of the developed model to assess the expected percentage of time and cost overrun for any future educational projects.

## IX- Conclusion

The analysis of time and cost overruns of a selected sample of 102 educational projects show some interesting findings:

- Thirty three of the selected projects about 32.35% have exposed to cost overrun. On the other side, time overrun was only noticed on 29 projects about 28.43%.
- The average percentage of the actual cost overrun was found to be inversely proportional to the project size.
- Testing the validity of the developed cost and time overruns regression models clearly show that the developed model can accurately assess in expected cost and time overruns of any future projects at level of confidence 96.67% and 94.88% respectively.

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