

Research Article

Investigation Cost Deviation of Highway Project

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Abstract: Cost management of highway projects just as important as the other elements. This research involves an investigation of the cost management status of the highway construction projects in Iraq. The survey includes investigation and evaluation of the reality of cost planning and control and determination of the causes of construction cost deviation. Causes of cost deviation have been investigated and collected by conducting personal interviews and questionnaires with site engineers and by reviewing the previous literature. The questionnaire form was designed by following a simple method, because the questionnaire is an important source of acquiring field information and data. The Iraqi Road and Bridge Directorate was selected as a sample study. It is worth mentioning that the statistical analysis has been conducted by using the SPSS program (version 20). Cost deviation reasons have been classified into three groups by the researchers, which are planning reasons, designing reasons, and execution reasons. Planning reasons classification had a relative importance equal to 2.7, designing reasons classification had a relative importance equal to 3, and execution reasons classification had a relative importance equal to 2.45 according to this study.

Keywords: Cost control, cost estimation, cost overrun, cost planning

INTRODUCTION

It is no secret that the major role played by the cost is an important element in construction projects, so it is supposed to get the attention and focus by the management team. In construction projects, the implementing agency for a construction project may be exposed to significant financial losses or a decrease in profit expected during the implementation, which could be due to poor planning of the work cost, weak cost control, and inability to provide data and information which give clear images of the distribution of labor cost during implementation. This speech does not apply to the contractor only, but it also includes the business owner. In fact, the cost management and planning process begins precisely with the beginning of the emergence of the idea of the project. Also, it is important to mention that the feasibility studies proved their importance for the purpose of controlling the cost during implementation (Al-Tae and Saco, 2009). Cost Management is the process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs (Project Management Institute, 2013). One of the benefits of cost management in the pre-contract stage, especially in multi-contract projects, is that it helps the project team to better establish the appropriate project contract

strategy. Cost management can also help in identifying possible programming restraints both in contract preparation and execution (Potts, 2008). The cost estimate is the process of determining an approximation of the cash resources which are needed to achieve the project activities.

The key purpose of this process is that it calculates the cost amount required to accomplish the project work (Project Management Institute, 2013). In the cost estimation process, it is necessary to take some factors into consideration, such as project scope, resource availability, project constraints, and required productivity of labor and plants (Dunn *et al.*, 2015). The cost estimating methodology might be conducted by taking two steps, each one has a specified responsibility which they prepare and review, those two steps are the responsibility of the cost engineering office (Dalton *et al.*, 2011).

RESEARCH IMPORTANCE

The importance of the research can be summarized as follows:

- This study highlights on the highway projects cost (such as the cost estimating method used in this type of the projects). Since this type of the projects

have a great importance among other types of the construction projects.

- The motivation of this study is the limited number of research in the area of cost controlling and estimating with regard to construction highway projects, the management of the highway projects cost and the need for a better cost estimating and controlling methodology and tools.
- The study results could have important implications in the improvement of methods and tools of the cost monitoring and estimation.

RESEARCH OBJECTIVES

The objectives of the research are to evaluate and to investigate the following:

- The reality of the planning and control of the highway projects cost.
- The reasons that stand behind the cost deviation of the construction projects.

RESEARCH METHODOLOGY

A four-step study methodology is conducted, in order to obtain the objective of the study:

- Literature review
- Personal interviews with engineers of exact specialization in highway Engineering or at least of past experience in highway projects
- Questionnaire form designing
- The statistical analysis.

LITERATURE REVIEW

Extensive Literature review was conducted by the researchers which include the past studies which are closely related to the cost controlling, estimation methods, cost monitoring, studies closely related to highway projects in papers published in local and international journals, local and global theses and dissertations, conference proceedings. Finally, the international information network (the internet). The purpose of this step is to be the researchers capable to

get a better understood about the current status and to design a proper question list in order to cover all the details needed to accomplish the objective of the study.

Personal interviews: Semi-planned interviews have been conducted by the researchers with engineers who have a past experience in the highway projects, these interviews dealt with engineers who was working in different establishments, with different academic qualifications, in order to get a comprehensive coverage to all needed information. A total of seven face to face interviews were done with them. A set of questions was presented to each engineer by a sheet before the interview to ensure a better understanding and communication during the interview session. Some general and demographic information for Engineers who have been interviewed are summarized in Table 1.

As indicated in Table 1, it is apparent that all of the engineers possesses an academic qualification such as Ph.D., M.Sc. and B.Sc. and have a good number of working experience years in construction sector. This may be considered a good indicator to attain perfect information.

Questionnaire form design: For this research the questionnaire is an important tool for collecting the field information needed to accomplish the aims behind it, to stand on the main causes that make the estimated cost to deviate from the expected bound. This step has done two split forms:

Open questionnaire: By taking advantages of the literature review the researcher has been out with a list of reasons that lead to delinquency the estimated cost. But To find out additional reasons and to get the best formulation for the questionnaire the personal interviews has been conducting, as indicated in advance.

Closed questionnaire: It is a regular survey of the views of elected sample of experienced engineers in the field of highway projects by implementing the questionnaire prepared using data obtained from the theoretical side and open questionnaire for the purpose identified in detail the degree of effect for each reason

Table 1: The general information of the interviewed engineers

Interviewee	Functional position	Academic qualification	Specialization	Years of experience	Work place
Mr. a	Project manager	M.Sc	geotechnical	10	The Ministry of Construction and Housing /Arbil
Mr. b	Site engineer	B.Sc	Civil eng.	6	Ministry of transportation/ Baghdad
Mr. c	Department manager	B.Sc	Highway and bridges eng.	17	Ministry of higher education/ Baghdad
Mr. d	Tests engineer	B.Sc	Civil eng.	10	Ibn-rishid company/ Baghdad
Mr. e	Site engineer	B.Sc	Civil eng.	12	AKG company
Mr. f	Department manager	B.Sc	Civil eng.	28	Ministry of higher education/ Baghdad
Mr. g	consultant	Ph.D	Highway & bridges eng.	14	Ministry of higher education/ Baghdad

Table 2: The general information of the arbitrators

Arbitrator	Academic qualification	Years of experience	Work place
Hamza faisal moshrif	Ph.d	18	Teeba university/Sudia Arabia
Haitham qais abbas	B.Sc	28	Higher education ministry/Iraq
Faisal Ahmed	Ph.D	25	Higher education ministry/Iraq
Zaid Talal	Ph.D	13	Higher education ministry/Iraq
Yassir Khalid	M.Sc	12	Higher education ministry/Iraq
Haider hamed	M.Sc	14	Ministry of construction and housing/Iraq

Table 3: The distributed and received questionnaire forms number

Name of the firm	Distributed	Received
Ministry of higher education	16	14
Ministry of housing and construction/General Authority of Roads and Bridges/maintenance division	11	7
Ministry of housing and construction/General Authority of Roads and Bridges/supervision division	29	26
Ministry of housing and construction/General Authority of Roads and Bridges/planning division	15	11
Total	65	58

on the final result. Closed questionnaire details will be addressed in subsequent items. The questionnaire form was arranged by using clear managerial expressions so that, all the individuals of the elected sample can be able to answer all the items easily. The scientific method was used in preparing the questionnaire according to (Al-Zwainy and Neran, 2015; Al-Zwainy *et al.*, 2013, 2015, 2016; Al-Zwainy, 2009, Alzwainy *et al.*, 2012; Al-Zwainy and Al-Marsomi, 2016). Questionnaire form version distributed among the sample individuals was in Arabic language, but since the language adopted by the researcher is the English, so it is distributed in English language, which consists of three parts, each part divided into many items, this will be explained below:

Part one: This part included public or demographic information, which describes the characteristics of the elected members of the sample, such as the name of the work place, academic certificate, engineering specialization, the current job position, functional grade and finally sector type.

Part two: The purpose of this part is to evaluate the reality of the planning and control of the highway projects cost. It includes items such as the cost importance degree, The extent of adoption of each manner of cost estimation for highway projects, The extent of adoption of each manner of contracting, The extent of adoption of each manner for the execution in highway projects, the extent of adoption the historical data in cost estimation, the reality of the actual cost compared with the estimated cost, finally the extent of cooperation between the project parties.

Part three: This part addressed as (the reasons behind deviation the actual cost on estimated cost of the construction project as general). Also it divided into three sections so that, each section divided into many items. Section one addressed as planning reasons, section two addressed as designing reasons, finally section three addressed as execution reasons.

Before distributing questionnaires to an elected community sample it is necessary to refer the questionnaire form to a number of arbitrators working in the field of research in civil engineering also working in the field of implementation of construction projects. In fact, the purpose of this step is to measure the apparent honesty, to give their notes to be the questionnaire at its best and to know the Agreement of the paragraphs of the questionnaire with the targets that put for it. The researcher has selected arbitrators groups who meet the scientific, academic and professional characteristics. Some of them agreed to be arbitrators but other did not agree to be arbitrators for their own reasons. The researcher annexed the general information of the arbitrators who interacts positive and in the Table 2.

After the questionnaire has been arbitrated by the Arbitration Commission, some items have been changed according to their notes and approved by them, the final questionnaire form has been distributed to the selected engineers sample. The distribution step has included the following actions:

- The presence of the researcher with questioned engineer for the purpose of answering questions and clarify the phrases if they were mysterious.
- A suitable period of time was given to each questioned engineer to finish the questionnaire form in order to get a better result.
- The List questionnaire answered by the elected engineer checked by the researcher at the same moment to ensure that the list totally completed.
- The collected answers have been packaged into SPSS program to prepare them for statistical analysis and converted into a graphics which easily understood.

Table 3 is displays the distributed and received questionnaire forms number:

As it is clear from Table 3 the total number of the distributed forms to the named firms was 65 while the received forms number from the same firms was 58. In

Table 4: Reliability statistics

Cronbach's Alpha	No. of items
0.717	89

fact, five of the 58 were incomplete and with illogical answers so they neglected. Consequently, the net number forms which analyzed were 53.

The statistical analysis: Several statistical tests were conducted using SPSS (version 20) program (which is an acronym for the phrase the Statistical Package for Social Sciences) by the researcher in order to obtain a more comprehensive view of the results. Some of these statistical tests could be listed as below:

- Measures of central tendency for each item such as mean
- The frequency and the percentage for each item.
- Measures of dispersion for each item such as the standard deviation.
- Test of reliability (alpha-chronpach) and validity.
- Test of normality by examine some statistical criteria such as skeweness and kurtosis

The intended questionnaire reliability is that the questionnaire will give the same results if it is distributed again (or many times) on the same sample. In other words, the reliability means the stability of the results with no dramatically change If what has been re-distributed to the members of the sample during certain (or discrete) periods. While the intended of the validity test is a tool used to investigate whether the questionnaire is measure what it putting for it. Mathematically the validity is the square root of the reliability coefficient (Majeed, 2013). In fact, getting the validity is more important than the reliability since the scale may be characterized by reliability but it is not honest. Directly the output of the reliability test obtained from SPSS program (version 20) is displayed in the Table 4.

As indicated in the Table 4 the reliability coefficient of the scale is (0.717) while the validity coefficient can be known by taking the square root of the reliability coefficient. So, the validity coefficient obtained is (0.8467). As seen the squaring root result is close to one, which meaning this is a good indicator of the questionnaire validity.

The form of the questionnaire has been divided into several parts as past referred. The aim of this step was for the simplification and the facilitation, so each part will be analyzed separately as will be seen later:

Part one: personal data: This part described previously, it contains many questions. Each question will be analyzed separately as will be displayed:

From Fig. 1 the reader can notice that nearly One-third (30.19%) of the sample individuals were from the

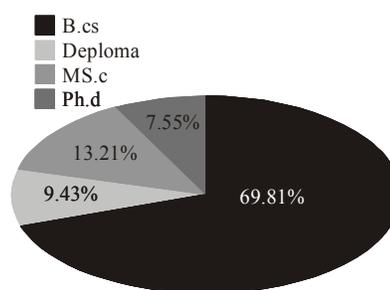


Fig. 1: The academic qualification

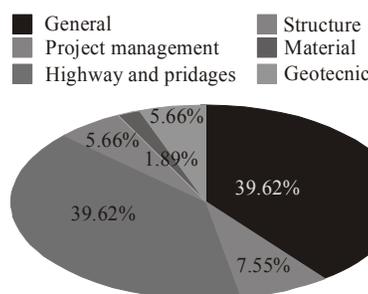


Fig. 2: Specialization in civil engineering

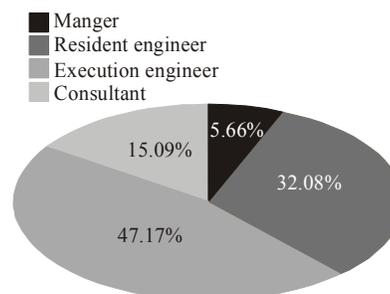


Fig. 3: The current job position

holders of advanced qualification degrees, this give a good indicator about the sample individuals. And the other (69.81%) were holding the BC.s academic qualification.

As evidenced in Fig. 2 the percentage of the individuals who specialized in bridges and highway branch form a good percentage (39.62%) also it equal to the percentage of the general division (39.62%). While the remaining percentages form the other branches.

As explained in Fig. 3, the mostly percentage of the execution engineer class can be noticed where its value is 47.17%, while the resident engineer class ranked second (32.075%). And the remaining values are for manger and consultant individuals which are 5.66% and 15.094% respectively.

Figure 4 shown that the older engineer class took the large percentage (35.85%), the engineer class took the second rank (22.64%) and 18.87% for the engineer leader class. As evidenced in the same figure, the

Table 5: Cost importance degree item analysis

Mean	St.d.	skewness	kurtosis
3.49	0.639	-0.882	-0.225
Little importance	Intermediate importance	Important	v. important
0	4	19	30

Table 6: Unit price estimation method statistical analysis

Mean	St.d.	skewness	kurtosis
3.17	1.051	-0.972	-0.364
Don't use	Rarely	Mostly	Always
6	7	12	28

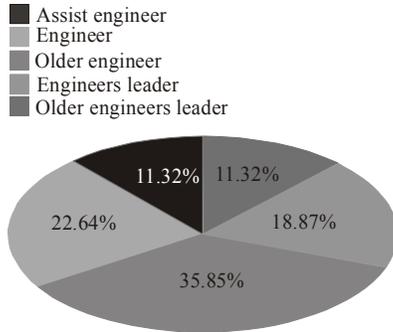


Fig. 4: The current job degree

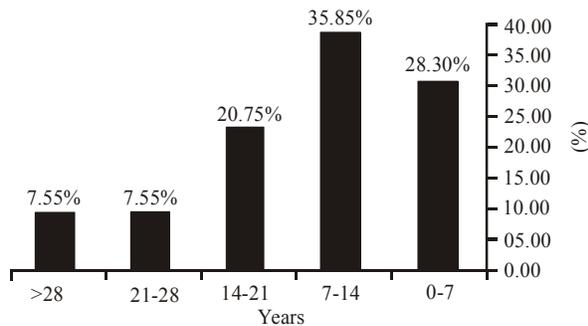


Fig. 5: The total experience year

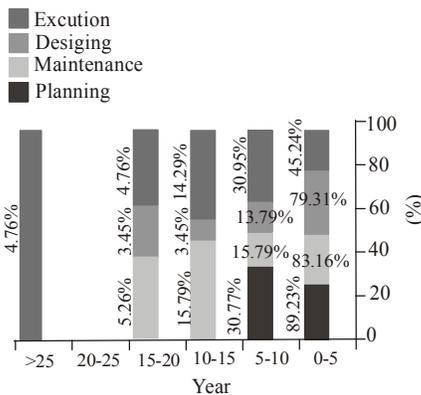


Fig.6: The division of the total years of experience

percentage for the assist engineer and older engineers leader classes are the same (11.32%).

The questionnaire had asked the sample individuals about the total experience years in the highway projects execution then the division of this experience years, in

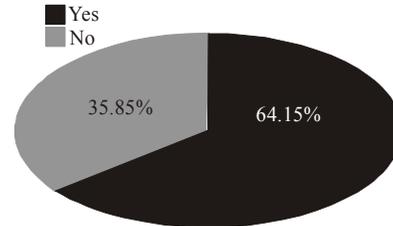


Fig. 7: Using the historical data

the designing, planning and scheduling, maintenance and the execution in the highway projects types. Figure 5 displays the total experience year of the targeted sample and Fig. 6 display the division of these years:

Part two: Evaluation the reality of the planning and control the cost of highway projects:

Cost importance degree: The statistical analysis of this item is displayed in the Table 5.

The displayed statistical results in Table 5 could be interpreted, where the small standard deviation (St. d.) value (0.639) refers to the homogeneity of the sample views about the item, also the values of skewness and the kurtosis (-0.882,-.225 respectively) refer to normal distribution of the results. In Fig. 7 the reader can notice that most of the sample agreed on the importance of the cost and no one expects that the cost has no importance.

The extent of using each cost estimation method:

There are many cost estimation methods so the purpose of this item is to investigate the using each method:

Unit price estimation method: The statistical analysis of this item is displayed in the Table 6.

The standard deviation (St.d.) given by SPSS program was 1.05 for this item it is a small value this indicates the homogeneity of the sample views about item. From Fig. 8 the reader can notice that the unit price estimation method is used more than the others method in this type of projects.

Lump sum estimation method: The statistical analysis of this item is displayed in the Table 7.

The small value of the st.d. deviation (0.889) indicates the homogeneity of the sample opinions also

Table 7: Lump sum estimation method statistical analysis

Mean	St.d.	skewness	kurtosis
2.45	0.889	-0.023	-0.676
Don't use	Rarely	Mostly	Always
8	19	20	6

Table 8: Roughly estimation method statistical analysis

Mean	St. d.	skewness	kurtosis
1.81	0.709	0.288	-0.936
Don't use	Rarely	Mostly	Always
19	25	9	0

Table 9: Unit price contract statistical analysis

Mean	St. d.	skewness	kurtosis
3.08	0.917	-0.776	-0.139
Don't use	Rarely	Mostly	Always
4	8	21	20

Table 10: Lump sum contract statistical analysis

Mean	St. d.	skewness	kurtosis
2.79	1.026	-0.564	-0.735
Don't use	Rarely	Mostly	Always
9	7	23	14

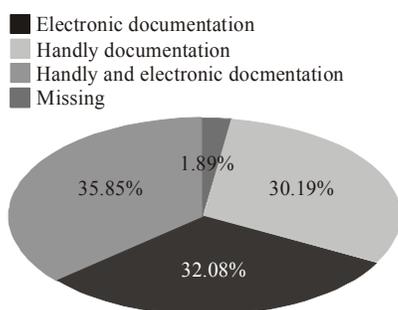


Fig. 8: The manner of documenting the historical data

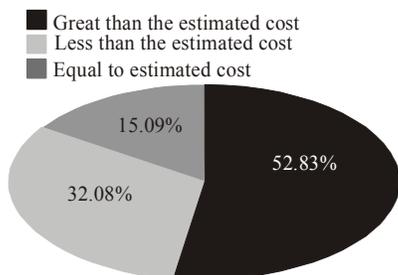


Fig. 9: The final cost status

the values of the skewness and kurtosis refer to the normal distribution. As explained in Fig. 9, the reader can notice the fluctuation in using the lump sum estimation method.

Rough estimation method: The statistical analysis of this item is displayed as in the Table 8.

From Table 8 the small value of the std. deviation (0.709) indicates the homogeneity of the sample opinions also the values of the sekewness and kurtosis

refer to the normal distribution. As explained, the reader can notice that the using of roughly estimation method is little.

The extent of using each contracting method:

Unit price contract: The statistical analysis of this item is displayed in the Table 9.

As indicated in Table 9, the st.d value refers to homogeneity of sample views. As indicated, the reader can take impression that this type of contracting is used extensively in highway projects. In fact, this is expected since the activities of highway project are related to a specified unit such as cubic meter, square meter and meter length. So unit price contract will be the suitable choice compared with other types.

Lump sum contract: The statistical analysis of this item is displayed in the following Table 10.

As indicted in Table 10 by mean value (2.79) and indicated, the reader can notice that the lump sum contract is mostly used after the unit price contract.

Turnkey contract: The statistical analysis of this item is displayed in the Table 11.

The results showed that there is no embarking upon this type of contracts in highway projects at least, as illustrated in Table 11.

Cost plus contract: The statistical analysis of this item is displayed in the Table 12.

As turnkey contract, there is no embarking upon the cost plus contract as the results showed the sample individuals opinions.

Build-design contract: The statistical analysis of this item is displayed in the following Table 13.

Table 11: Turnkey contract statistical analysis

Mean	St. d.	skewness	kurtosis
1.45	0.541	0.416	-1.065
Don't use	Rarely	Mostly	Always
28	24	1	0

Table 12: Cost plus contract statistical analysis

Mean	St. d.	skewness	kurtosis
1.77	0.724	0.376	-0.99
Don't use	Rarely	Mostly	Always
21	23	9	0

Table 13: Build-design contract statistical analysis

Mean	St. d.	skewness	kurtosis
1.6	0.566	0.234	-0.801
Don't use	Rarely	Mostly	Always
23	28	2	0

Table 14: Construction management contract

Mean	St. d.	skewness	kurtosis
1.32	0.471	0.791	-1.43
Don't use	Rarely	Mostly	Always
36	17	0	0

Table 15: General contractor manner statistical analysis

Mean	St. d.	skewness	kurtosis
3.15	0.949	-0.875	-0.192
Don't use	Rarely	Mostly	Always
4	8	17	24

Table 16: Direct execution manner statistical analysis

Mean	St. d.	skewness	kurtosis
2.62	0.765	-0.565	0.077
Don't use	Rarely	Mostly	Always
5	14	30	4

Table 17: On-trust execution manner statistical analysis

Mean	St. d.	skewness	kurtosis
1.68	0.644	0.411	-0.645
Don't use	Rarely	Mostly	Always
22	26	5	0

The results showed that also there is no embarking on this type of contracts as indicated in Table 13.

Construction management contract: The statistical analysis of this item is displayed in the Table 14.

This type of contract is new in contracting area in Iraq, but the purpose of item is to know if the governmental firms are using it. But the sample results showed that for this type of contracting there is no embarking about it.

The extent of using each execution manner: There are many manners of execution used in highway projects. So the purpose of this item is to investigate the using of each manner:

General contractor manner: The statistical analysis of this item is displayed in the Table 15.

As the results showed this type is the most popular execution manner used compared with others types.

Direct execution manner: The statistical analysis of this item is displayed in the Table 16.

The statistical analysis showed that there is a fluctuation in using this type. In other words it either used sometimes but in other times is not used. The results are shown in Table 16.

On-trust execution manner: The statistical analysis of this item is displayed in the Table 17.

Among other types of execution manners, the analysis results showed that there is no embarking in using on-trust execution manner compared with other types.

Construction management manner: The statistical analysis of this item is displayed in the Table 18.

Table 18: Construction management manner statistical analysis

Mean	St. d.	skewness	kurtosis
1.38	0.527	0.926	-0.296
Don't use	Rarely	Mostly	Always
34	18	1	0

Table 19: Attaining additional allocation statistical analysis

Mean	St. d.	skewness	kurtosis
2.06	0.602	0.531	1.646
Always	Some times	Mostly	Never occur
7	37	8	1

Table 20: Returning the surplus of the budget statistical analysis

Mean	St. d.	skewness	kurtosis
2.19	0.735	0.59	0.59
Always	Sometimes	Mostly	Never occur
7	32	11	3

The statistical analysis results showed that using of this type is excluded as enhanced by Table 18.

The depending on the historical data: The aim of this item is to know if the historical data are utilized in estimation the cost of the current project. Figure 7 describe the sample answers:

As it is clarified, the historical data are utilized in a percentage of 64.15% according to the sample opinions.

The manner of documenting the historical data: After asking if the historical data are using or not, the sample engineers are asked about the manner of documenting if they answer the previous question in yes. Figure 8 describe the sample answers:

35.85 is the percentage of the answers which addressed in No in the previous question. 32.08% of persons who answer Yes, said that the manner of documenting is electronic and manually together, 30.19% of the sample individuals who answer Yes said that the manner of documenting is manually only and the only electronic documenting manner took the little percentage which is equal to 1.89.

The final actual cost status: This item aimed the status of the final actual cost in compared with the estimated cost. Figure 9 describes the sample answers for this item:

Mostly of the sample opinions shown that the final actual cost is greater than the estimated in a percentage equal to 52.83 and the little percentage of the sample views said that the actual cost and the estimated are equally (15.09%). But the other said that the actual cost is less than the estimated in a percentage equal to 32.08.

- The difficulty of attaining additional allocation for additional works (change orders): as indicated by the title, the aim of this item is clarified. The statistical analysis of this item is displayed in the Table 19.

Most of the sample opinions said that the difficulties occur either sometimes or mostly (69.81%, 15.09% respectively). But a percentage of 13.21% said that it may occur always. And the smaller percentage of the sample views says it never occurs (1.887%).

- Returning the surplus of the budget to the firm: the aim of this item is to know if there is a surplus from the budget allocation are returned to the firm. the statistical analysis of this item is displayed in the Table 20.

Most of the sample opinions said that the budget funds are returned to treasury of the firm either sometimes or mostly (60.38%, 20.75% respectively). But a percentage of 13.21% said that it may occur always. And the smaller percentages of the views say it never occur (5.66%).

The cooperation among the project parties: The purpose is to investigate the extent of cooperation among the owner, the engineer and the contractor. The statistical analysis of this item is displayed in the Table 21.

The analysis showed that the always, sometimes and mostly results are nearly (33.96, 24.53, 32.08% respectively). As shown in Table 21.

Part three: The causes that stand behind exceeded of the actual construction cost on the estimated cost: In construction project in general there are many causes for actual cost overrun. These causes are classified by the researchers as planning reasons, designing reasons and execution reasons. The purpose of this part is to investigate the effect extent of each reason on actual cost and to know any classification which takes the greatest relative importance value. Before starting explaining the statistical analysis it is important to know something about the arithmetic mean. The codes

Table 21: The cooperation among the project parties statistical analysis

Mean	St. d.	skewness	kurtosis
2.17	1.014	0.22	-1.183
Always	Sometimes	Mostly	Never occur
18	13	17	5

Table 22: The unsuitability type of contracting statistical analysis

Mean	St. d.	skewness	kurtosis
2.68	1.07	-0.293	-1.13
Little effect	Intermediate effect	effective	v. effective
10	11	18	14

Table 23: The unsuitability of the execution manner statistical analysis

Mean	St. d.	skewness	Kurtosis
2.75	0.959	-0.432	-0.657
Little effect	Intermediate effect	effective	v. effective
7	11	23	12

Table 24: Unavailable of enough information about the project

Mean	St. d.	skewness	Kurtosis
3.26	0.82	-0.752	-0.37
Little effect	Intermediate effect	effective	v. effective
1	9	18	25

Table 25: Poor contractor selection statistical analysis

Mean	St. d.	skewness	Kurtosis
3.36	0.384	-0.976	-0.2
Little effect	Intermediate effect	effective	v. effective
1	9	13	30

Table 26: Lack of planning for inflation statistical analysis

Mean	St. d.	skewness	Kurtosis
1.98	0.843	0.436	-0.539
Little effect	Intermediate effect	effective	v. effective
17	22	12	2

are used by the researcher in SPSS program are 1 for little effective, 2 for intermediate effect, 3 for effective and 4 for high effective. So the arithmetic mean will be interpreted as following:

- If the value of mean is between zero and one, the interpretation will be little effective.
- If the value of mean is between one and two, the interpretation will be (intermediate effect).
- If the value of mean is between two and three, the interpretation will be (effective).
- If the value of mean is between three and four, the interpretation will be (very effective).

Planning reasons: The researchers thinks that there are many planning reasons which affect the cost overrun, each reason will be totally described as following:

The unsuitability of the contracting type with project type: The statistical analysis of this item is given in Table 22.

As indicated in Table 22, the mean value (2.68) is between two and three so the item could be interpreted as effective according to sample views.

The unsuitability of the execution manner: The statistical analysis of this item has been given in Table 23.

The statistical results explained that the execution manner is effective as indicated by the mean value (2.75) according to the sample opinions.

Unavailable of enough information about the project: The statistical analysis of this item is displayed in the Table 24.

The analysis appeared that this item is very effective as indicated by mean value (3.26) according to sample opinions.

Poor contractor selection: The statistical analysis of this item is displayed in the Table 25.

The statistical analysis of sample opinions shows that the bad selection of the contractor is very effective as indicated by the mean value (3.36) in Table 25.

Lack of planning for inflation or changing currency rates: The statistical analysis results of this item are given in Table 26.

Most of sample individuals said that this item has intermediate effect as indicated by the mean value (1.98) in Table 26.

Table 27: The clarity Lack of the owner requirements: Statistical analysis

Mean	St. d.	skewness	Kurtosis
2.91	0.883	-0.508	-0.33
Little effect	Intermediate effect	effective	v. effective
4	11	24	14

Table 28: Obscurity of specifications and conditions statistical analysis

Mean	St. d.	skewness	Kurtosis
2.89	0.824	-0.212	-0.627
Little effect	Intermediate effect	effective	v. effective
2	15	23	13

Table 29: Obscurity of plans and designs statistical analysis

Mean	St. d.	skewness	Kurtosis
3.11	0.689	-0.711	-0.605
Little effect	Intermediate effect	effective	v. effective
0	6	20	27

Table 30: Inaccurate bills of quantities statistical analysis

Mean	St. d.	skewness	Kurtosis
3.09	1.08	-0.862	-0.597
Little effect	Intermediate effect	effective	v. effective
7	7	13	26

Table 31: Change orders statistical analysis

Mean	St. d.	skewness	Kurtosis
3.49	0.669	-0.967	-0.183
Little effect	Intermediate effect	effective	v. effective
0	5	17	31

Designing reasons: From the point of view of the researchers, the designing reasons have impact on the construction cost overrun. So the impact of each reason on actual final cost is aimed by this item. These reasons with their statistical analysis will be totally described:

- The clarity lack of the owner requirements: the statistical analysis of this item is displayed in Table 27.

The mean value obtained by the statistical analysis showed that obscurity of the owner requirements is effective where its value equal to 2.91 from the point of view of sample individuals.

Obscurity of specifications and conditions: The statistical analysis of this item is displayed in the Table 28.

The analysis of the sample answers gave a mean value equal to 2.89 which make the item interpreted as effective according to the sample individual answer.

Obscurity of plans and designs: The statistical analysis of this item is displayed in the Table 29.

Most of sample individuals said that the obscurity of the plans and designs has a big impact on the cost overrun as shown by the mean value (3.11).

Inaccurate bills of quantities: The statistical analysis of this item is displayed in the Table 30.

Most of the sample agreed that this item has a big impact on the cost overrun and the mean value (3.09) shows that:

Execution reasons: The researchers thinks that the execution reasons have impact (which could not be overlooked) on the actual final cost, so the effect extent is investigated for each reason as will be listed later.

Change orders: The statistical analysis of this item is displayed in the Table 31.

Any construction project is exposed to change orders because of a mistake in the original design and other reasons. Most of the sample agreed that this item is very effective as shown by the mean value (3.49):

- Poor efficiency of the administrative staff: the statistical analysis of this item is displayed in the Table 32.

After analyzing the opinions of the sample statically, the results showed that this item is effective from the point of view of the selected sample, as the mean value (2.98) referred.

Using poor execution manners: The statistical analysis of this item is displayed in the Table 33.

As the previous item the sample agreed that the poor execution manners item is effective as referred by the mean value (2.98).

Table 32: Poor efficiency of the administrative staff statistical analysis

Mean	St. d.	skewness	Kurtosis
2.98	0.82	-0.399	-0.41
Little effect	Intermediate effect	effective	v. effective
2	12	24	15

Table 33: Using poor execution manners

Mean	St. d.	skewness	Kurtosis
2.98	0.772	-0.228	-0.595
Little effect	Intermediate effect	effective	v. effective
1	13	25	14

Table 34: Productivity rate fluctuation of labor and equipments statistical analysis

Mean	St. d.	skewness	Kurtosis
1.94	0.989	0.737	-0.514
Little effect	Intermediate effect	effective	v. effective
22	17	9	5

Table 35: Accidents during the execution

Mean	St. d.	skewness	Kurtosis
1.81	0.856	0.762	-0.214
Little effect	Intermediate effect	effective	v. effective
23	19	9	2

Table 36: Fluctuation of materials prices

Mean	St. d.	skewness	Kurtosis
2.53	0.723	-0.261	-0.127
Little effect	Intermediate effect	effective	v. effective
4	20	26	3

Table 37: Labor wages fluctuation statistical analysis

Mean	St. d.	skewness	Kurtosis
2.23	0.776	0.091	-0.42
Little effect	Intermediate effect	Effective	v. effective
9	25	17	2

Productivity rate fluctuation of labor and equipments: The statistical analysis of this item is displayed in the Table 34.

The selected sample agreed that the productivity rate fluctuation has a medium effect on the cost overrun as indicated by the mean value (1.94):

- Accidents during the execution: the statistical analysis of this item is displayed in the Table 35.

Usually the accidents cost is represented by paying the compensation to employees or by repairing the failure. The sample engineers said that this item has a medium effect on the cost overrun as indicated by the mean value (1.81).

- Fluctuation of materials prices: the statistical analysis of this item is displayed in the Table 36.

Most of the sample individuals agreed that materials prices fluctuation is effective on cost overrun, as shown by the mean value (2.53):

- Labor wages fluctuation: the statistical analysis of this item is displayed in the Table 37.

- Renting and purchasing cost fluctuation of equipments: the statistical analysis of this item is displayed in the Table 38.

The sample individuals believe that this item has an intermediate effect on the cost overrun, as supported by the mean value of 1.96.

Inaccurate selection of machine and equipments: The statistical analysis of this item is displayed in the Table 39.

Poor attention oriented to the purpose and type of the used equipments may lead to cost overrun. The mean value (1.75) obtained by the SPSS program indicates that this item has an intermediate effect on the cost overrun from the point of view of the sample individuals.

Project duration reduction: The statistical analysis of this item is displayed in the Table 40.

The project duration reduction according to the owner requirements or other specification may lead to cost overrun. The sample answers showed that this item is effective if it happens, as indicated by the mean value of (2.98). The justification of them is that this item

Table 38: Renting and purchasing cost fluctuation of equipments statistical analysis

Mean	St. d.	skewness	Kurtosis
1.96	0.831	0.281	-0.969
Little effect	Intermediate effect	effective	v. effective
18	20	14	1

Table 39: Inaccurate selection of machine and equipments statistical analysis

Mean	St. d.	skewness	Kurtosis
1.75	0.83	0.914	0.256
Little effect	Intermediate effect	effective	v. effective
24	20	7	2

Table 40: Project duration reduction statistical analysis

Mean	St. d.	skewness	Kurtosis
2.98	0.772	-0.228	-0.595
Little effect	Intermediate effect	effective	v. effective
1	13	25	14

Table 41: Project duration exceeded on the specified scheduling

Mean	St. d.	skewness	Kurtosis
2.38	1.1	0.061	-1.361
Little effect	Intermediate effect	Effective	v. effective
16	11	16	10

Table 42: The relative importance of planning, designing, and execution reasons axes

Axis	No. of items (a) of each axis	Items Mean summation of each axis (b)	R.I = (b) / (a)	The interpretation
Planning reasons	5	13.52	2.7	According to this study, the planning reasons is effective as indicated by R.I which equal to 2.7
Designing reasons	4	12	3	According to this study, the designing reasons is very effective as indicated by R.I which equal to 3
Execution reasons	11	27.03	2.45	According to this study, the execution reasons is effective as indicated by R.I which equal to 2.45

requires double the team work and equipments to achieve the work rapidly.

Project duration exceeded on the specified scheduling: The statistical analysis of this item is displayed in the Table 41.

The sample individuals think that this item may lead to the cost overrun since this may lead to increase the indirect cost. The sample agreed that this item is rather effective as indicated by obtained mean value (2.38) from SPSS program.

Finally, the Relative Importance (R.I) (effect degree) of each axis (planning, designing and execution reasons) has been calculated, the Table 42 explains the procedures of this process.

CONCLUSION

The study found some important conclusions as follows:

- The questionnaire as an important source of acquiring field information about the cost deviation in highway construction project in Iraq.
- The estimation team gives the construction cost a big importance among the others management item (quality and time) as the questionnaire results showed.
- Among the other estimation methods, the unit price estimation method is the most popular method in

estimation the cost of highway project, among the other contracting methods, the unit price contract and then lump sum contract are popularly used in comparing with others and among the other execution methods the general contractor manner then the direct execution manner are popularly used in comparing with others as the questionnaire results showed.

- After investigate the status of the final cost, a little percentage (15.09%) of the sample said that it is equal to the estimated cost while the other agree that it is either greater or less than the estimated.
- There is a good cooperation among the project parties (owner, contractor and engineer) as the results appeared.
- Among the main variables that cause the cost deviation, the designing reasons take the big relative importance (which is equal to 3), while the planning reasons take a relative importance equal to 2.7 and the execution reasons take a relative importance equal to 2.45.
- More than half of the sample (64.15%) said that the historical data are stored or documented either manually or electronic documentation, to be used later in estimation the cost of the current project.
- Most of the sample opinions said that the difficulties in attaining additional allocation for additional works occur either sometimes or mostly (69.81%, 15.09% respectively, while the little remaining percentage said that it either occur always or never occur.

- Most of the sample opinions said that the budget surplus is occur and returned to treasury of the firm either sometimes or mostly (60.38%, 20.75% respectively). But the other little percentage said that it is either occur always or never occur.

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REFERENCES

- Al-Taee, M.R. and Z.M. Saco, 2009. Management and planning the cost in construction project. *Eng. J.*, 15(4): 785-799.
- Al-Zwainy, F.M., 2009. The use of artificial neural net work for estimate total cost of highway construction projects. Ph.D. Thesis, Civil Eng. Department, Baghdad University.
- Al-Zwainy, F.M.S. and M.S.K. Al-Marsomi, 2016. Investigation and evaluation the performance of the construction residential complexes projects. *Int. J. Appl. Eng. Res.*, 11(16): 8863-8877.
- Al-Zwainy, F.M.S. and T.H. Neran, 2015. Investigation and evaluation of the cost estimation methods of Iraqi communication projects. *Int. J. Eng. Manage. Res.*, 5(6): 41-48.
- Al-Zwainy, F.M.S., S.K. Abdulrahman and R.E.K. Zaki, 2013. Statistical evaluation of the affective factors on the process of preparing time schedules for Iraqi construction projects. *J. Eng. Dev.*, 17(1): 33-61.
- Al-Zwainy, F.M.S., R.H. Al-Suhaily and Z.M. Saco, 2015. Project Management and Artificial Neural Networks: Fundamental and Application. LAP LAMBERT Academic Publishing, German.
- Al-Zwainy, F.M.S., I.A. Mohammed and S.H. Raheem, 2016. Investigation and assessment of the project management methodology in Iraqi construction sector. *Int. J. Appl. Eng. Res.*, 11(4): 2494-2507.
- Alzwainy, F., H.F. Ibraheem and A.A. Hadi, 2012. Modern techniques and methods in engineering education. *J. Eng. Dev.*, 16(3): 1-16.
- Dalton, J.C., T.G. Edwards, J.E. Gott and M. McAndrew, 2011. Handbook: Construction Cost Estimating. 2nd Edn., Unified Facilities Criteria (UFC).
- Dunn, L., M. Vass and J. Mitchell, 2015. Project Cost Estimating Manual. 6th Edn., Department of Transport and Main Roads, State of Queensland.
- Majeed, A.O.A., 2013. Concepts of calendar, measurement and performance. Training Program Department, Training Collage, Saudi Arabia.
- Potts, K.F., 2008. Construction Cost Management: Learning from Case Studies. 1st Edn., Taylor & Francis, London, New York.
- Project Management Institute, 2013. A Guide to the Project Management Body of Knowledge (PMBOK® guide). 5th Edn., Project Management Institute Inc., Newtown Square, Pennsylvania.