Modeling of Estimate at Completion in Earned Value

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Abstract. This paper will explain the concept of Earned value management and definition of the influenced factor, earned worth management (EVM) is an associate trade commonplace for observance the performance of in progress comes. The performance baseline is about up within the designing section to live any time and price deviations throughout project execution. supported this progress, associate estimate at completion (EAC) is forecasted, investigate a wide range of factors impact on earned value in different countries, especially in Iraq and the region to reduce cost project in estimate to complete and estimate at complete, which helps decision-makers to make the right decision to reduce costs, achieve planned duration and taking into account other aspects.

Keywords: Earned value management; Estimate at completion; Project risk; factors affecting, Cost and schedule.

1. Introduction
Earned value management (EVM) is one of the potential measurement method of performance and evaluating the success of a construction project [1]. It addresses the 3 performance key areas: scope, schedule and budget [2], additionally earned price management (EVM) addresses several project management areas together with project organizing, planning, scheduling, budgeting, accounting, analyzing, coverage and variance watching, and so, it's doable to forecast value or schedule overruns and other important factors such as quality, risk, safety and social factors) in an early stage of the construction project [3].

Many applications could be used in different projects to demonstrate the advantages of Earned value management (EVM) in extracting additional information from data about the status, trend, and future project schedule performance and associated cost. Earned Value Management (EVM) can be defined as a management technique for project performance monitoring [4]. EVM integrates scope, price, and schedule management underneath an equivalent framework and it provides performance variances and indexes which permit managers to discover over-costs and delays. Moreover, underneath this technique, new real knowledge generated throughout the project run time is employed to explain trends for the longer-term project total price and finishing date. The potential benefit of using it is to estimate and address the delay factors in the construction projects [5] so its application to the Iraqi projects may have a significant impact in the case of conducting adaptive and adjustments commensurate with the local scope of Iraqi projects.

2. Methods of Analysis

2.1. The Use of EVM on Iraqi Delaying Project
Many Iraqi construction projects have not been completed within the duration and cost planned and this affects the objectives of the project significantly in terms of cost, time, and quality. The using EVM will have a positive impact to mitigate that risk because the EVM will indicate the Deviation in the early stages of the project, and will explain the basic equation of EVM.

2.2. Earned Value Management (EVM)
It is a project management technique for objectively measuring project performance and progress as shown in Eq. (1):
EV = Budget at Completion (BAC) * Actual Complete % 

(1)

2.3. Cost Performance Index (CPI)
It is a life of the money effectiveness and potency of a project. It represents the number of completed work for each unit of value pay.

CPI = (EV/AC) 

(2)

Where CPI greater than one is favorable (under budget):
- < 1 means the price of finishing the work is above planned (bad);
- = 1 means the price of finishing the work is true on set up (good);
- > 1 implies that the value of finishing the work is a smaller amount than planned (good or typically bad).

Having a high CPI (in some cases, terribly high is simply one.2) could mean that the arrange was too conservative, and therefore a high range could not be smart, because the CPI is being measured against a poor baseline

2.3.1. Schedule Performance Index (SPI)
It is a measure of schedule efficiency, expressed as the ratio of earned value to planned value (PV).

SPI = (EV/PV) 

(3)

It can be concluded the following with the above formula: SPI > 1 More work has been completed than the planned (ahead of schedule); SPI < 1 Less work has been completed than the planned (behind schedule), and SPI = 1 Work is being completed at about the same rate as planned (on time).

2.3.2. Estimate to Complete (ETC)
ETC is that the estimate to finish the remaining works of the project. ETC should be supported objective measures of the outstanding work remaining, generally supported the measures or estimates accustomed to produce the first planned price (PV) profile, together with any changes to predict performance supported historical performance, actions being taken to boost performance, or acknowledgment of degraded performance. While algebraically, ETC ought to ne'er be computed mistreatment either EAC or AC. within the following equation,

ETC = ((BAC-EV)/CPI) 

(4)

ETC is that the variable, EAC is that the variable and AC are fastened supported expenditures thus far. ETC should be reportable in truth to replicate the project team estimate to complete the outstanding work. If ETC pushes EAC to exceed BAC, then project management skills are used to either suggest performance enhancements or scope modification, however, ne'er force ETC to convey the "correct" answer so EAC = BAC. Managing project activities to stay the project among budget may be the activity of a human factor, not a function

2.4. Budget at Completion (BAC)
The entire planned worth (PV or BCWS) at the tip of the project. If a project incorporates a management reserve (MR), it’s usually not enclosed within the BAC, and severally, within the performance mensuration baseline.

2.5. Estimate at completion (EAC)
Projects throughout their execution part might deviate from their original planned cost; so, the project team forecasts the EAC that differs from the budget at completion (BAC) and relies entirely on the present performance of the project [6]. Though a variety of studies supported customary formulae and alternative models are offered to forecast EAC, that one offers the most effective answer is that the practitioner’s quandary. Within the face of no specific guideline concerning the most effective model for many correct results, the selection is left with analysts and project managers to determine the EAC formula to be used for foretelling [7].

The sole attainable intuitive recommendation is obtainable by the project conditions and level of experience possessed by the project management team [8]. EAC formulae have supported the mix of many information components, that embody the budgeted price of labor schedule (BCWS), budgeted price of labor performed (BCWP), and the actual price of labor performed (ACWP). In line with PMI (2013), 3 of the foremost common
EAC forcasting techniques for the estimate to complete (ETC) are mentioned within the following. The first methodology uses the particular price till the information date and predicts that the remainder of the project is going to be dead at the planned rate. The mathematical illustration of this methodology is given in Eq. 5.

\[
EAC = AC + ETC
\]  
(5)

\[
EAC = AC + (BAC - EV)
\]  
(6)

The second methodology considers the present price-performance index (CPI) of the project and assumes that the remainder of the project is going to be completed at the present rate, as mathematically expressed in Eq. 7.

\[
EAC = \frac{BAC}{CPI}
\]  
(7)

The third statement equation considers each SPI Associate in Nursing CPI of the project and is usually helpful once the schedule of the project is an impacting issue. This methodology will be varied by distributing a complimentary weight to every index as per the project manager’s call. However, the total of those weights sometimes equates to one [9]. The mathematical illustration of this methodology is given in atomic weight.

\[
EAC = ETC + AC
\]  
(8)

2.6. Variance at completion (VAC)

The vacation may be a forecast of what the variance, specifically the price Variance (CV), is going to be upon the completion of the project. it's the dimensions of the expected cost or underrun. In several things, the project manager should request further funding as early as potential, or a minimum of report the potential for associate overrun. The vacation represents the dimensions of this request.

\[
VAC = BAC - EAC
\]  
(9)

3. Types of Regression

3.1. Linear Regression
Linear regression assumed that there's a linear relationship between variables. There are unit 2 kinds of statistical regression; easy linear regression and multilinear regressions. When there's quite one variable quantity the multi statistical regression is employed (MLR).

3.2. Nonlinear Regression
One of the foremost blessings in exploitation nonlinear regression is that the broad varies of functions that maybe work. Several scientific or physical processes area unit inherently nonlinear; so, to aim a linear work of such a model would essentially cause poor results [10]. Nonlinear regression conjointly shares the characteristic with statistical regression of getting economical use of knowledge. That's nonlinear regression (NLR) will provide smart estimates of the unknown parameters within the model exploitation comparatively little knowledge sets [11]

4. Methodology

4.1. Developing Six Equations Index by Using NLR
The Leven Berg-Marquardt technique is used to develop the NLR equations. This technique is based on inserting variables in a nonlinear equation built according to some values of equation parameters and checked by the "coefficient of determination" test. Based on the checklist results, the independent variables for the cost index that have the most significant impact on the estimate at a complete model of projects are treated to fit the analysis mechanism so they become as shown in Table 1.

On the other hand, the first equation for the cost index as shown in Eq. (10), Table 2 shows the best values of the parameters of the equation in this research

\[
COI = C_1 I_1 + C_2 I_2^{C1} + C_3 I_3 + C_4 I_4 + C_5 I_5^{C7} + C_6 I_6 + C_7 I_7^{C10} + C_8 I_8^{C12} + C_9 I_9
\]  
(10)

Where COI is the cost index.
Table 1. Input Variable for Cost Index (COI).

| Items                                                                 | Symbol |
|----------------------------------------------------------------------|--------|
| Policy and requirements of the client                                | I₁     |
| Policy and experience of the company                                 | I₂     |
| Price changes (marital, labor, equipment)                           | I₃     |
| Errors in estimated quantities.                                     | I₄     |
| Funding and factors affecting it: provide financial liquidity to contractor | I₅   |
| Funding and factors affecting it: The Company has access to banking facilities | I₆   |
| Funding: grants or loans                                            | I₇     |
| Funding: governments financing                                       | I₈     |
| Funding: private financing (private banks)                          | I₉     |

Table 2. Parameters Estimates for Cost Index (COI).

| Parameter | C₁ | C₂ | C₃ | C₄ | C₅ | C₆ | C₇ | C₈ | C₉ | C₁₀ | C₁₁ | C₁₂ | C₁₃ |
|-----------|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
| Estimate  | -0.185 | 0.414 | 1.508 | 0.326 | 0.338 | 0.336 | -0.072 | -0.035 | 0.164 | 0.023 | 1.233 | 0.048 |

Furthermore, based on the checklist results, the independent variables for the time index that have the most significant impact on the estimate at a complete model of projects are treated to fit the analysis mechanism so they become as shown in Table 3.

Table 3. Input Variable for Time Index (TII).

| Items                                                                 | Symbol |
|----------------------------------------------------------------------|--------|
| Rise production capacity through: Increasing labor force              | I₁     |
| Rise production capacity through: Increase machines and equipment     | I₂     |
| Rise production capacity through: Increase the number of working hours | I₃     |
| Rise production capacity through: Raising the skill of the workforce  | I₄     |
| Quick completion of work                                             | I₅     |
| Effect of the management method on the delay of completion of the project | I₆     |
| The effect of the (economic situation) factor on the delayed completion of the project | I₇     |
| Availability of money liquidity and exchange rate                     | I₈     |

Moreover, the second equation for the time index as shown in Eq. (11), Table 4 shows the best values of the parameters of the equation in this research.

\[
TII = T₁I₁ + T₂I₂ + T₃I₃ + T₄I₄ + T₅I₅ + T₆I₆ + T₇I₇ + T₈I₈ + T₉I₉ + T₁₀I₁₀ + T₁₁I₁₁ + I₁₂
\]

Where TII is the time index.

Table 4. Parameters Estimates for Time Index (TII).

| Parameter | T₁  | T₂  | T₃  | T₄  | T₅  | T₆  | T₇  | T₈  | T₉  | T₁₀ | T₁₁ | T₁₂ |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Estimate  | -0.059 | -20.177 | 0.006 | 1.753 | 0.061 | 0.468 | 0.474 | 0.12 | 5.264 | -0.03 | 18.472 | 0.00022 |

Otherwise, based on the checklist results, the independent variables for the quality index that have the most significant impact on the estimate at a complete model of projects are treated to fit the analysis mechanism so they become as shown in Table 5.

Table 5. Input Variable for Quality Index (QUI).

| Items                                                                 | Symbol |
|----------------------------------------------------------------------|--------|
| Reduce the cost of acquisition and use the raw materials.           | I₁     |
| Contribute to strengthening the competitiveness of the institution  | I₂     |
| Matching materials to specifications                                | I₃     |
| matching work to quality specifications                            | I₄     |
| Does the organization conduct internal audits periodically to determine the conformity of the quality management system to ISO 9001 – 2015 | I₅     |
| Does the employer take the necessary procedures to remove the causes of nonconformity and prevent its recurrence? | I₆     |
The third equation for the quality index as shown in Eq. (12):

\[
QUI = Q_1I_1 + Q_2I_2 + Q_3I_3 + Q_4I_4 + Q_5I_5 + Q_6I_6
\] 

(12)

Where QUI is the Quality index and the best values of the parameters of the equation in this research are:

\[
Q_1 = 0.275; \quad Q_2 = 0.179; \quad Q_3 = 0.906; \quad Q_4 = 0.067; \quad Q_5 = 0.87; \quad Q_6 = 0.295; \quad Q_7 = 0.972; \quad Q_8 = 0.153; \quad Q_9 = 0.116.
\]

Based on the checklist results, the independent variables for the risk index that have the most significant impact on the estimate at the complete model of projects are treated to fit the analysis mechanism so they become as shown in Table 6.

**Table 6. Input Variable for Risk Index (RSI).**

| Items                                                                 | Symbol |
|-----------------------------------------------------------------------|--------|
| The quality of the land is not appropriate in terms of its ability to  | I₁     |
| withstand construction or because of its other characteristics.       |        |
| Lack of infrastructure connected to the place of execution such as    | I₂     |
| roads or inadequate place of implementation.                          |        |
| Delay payments to local companies from the employer                   | I₃     |
| Financing cut off unexpectedly by local companies                      | I₄     |
| The high prices of materials necessary to carry out civil works in    | I₅     |
| construction sites due to economic conditions                         |        |
| Difficulty accessing project sites due to security situation          | I₆     |

The fourth equation for the risk index as shown in Eq. (13):

\[
RSI = R_1I_1 + R_2 + R_3I_2 + R_4I_3 + R_5I_5 + R_6I_6
\] 

(13)

Where RSI is Risk index and the best values of the parameters of the equation in this research are:

\[
R_1 = 0.231; \quad R_2 = 1.007; \quad R_3 = 0.194; \quad R_4 = 0.075; \quad R_5 = 1.243; \quad R_6 = 0.187; \quad R_7 = 0.257; \quad R_8 = 1.033; \quad R_9 = 0.138.
\]

Based on the checklist results, the independent variables for the safety index that have the most significant impact on the estimate at a complete model of projects are treated to fit the analysis mechanism so they become as shown in Table 7.

**Table 7. Input Variable for Safety Index (SAI).**

| Items                                                                 | Symbol |
|-----------------------------------------------------------------------|--------|
| Provide adequate personal safety equipment (gloves, glasses, helmets,) | I₁     |
| on-site                                                               |        |
| Does the use of new machines affect the provision of appropriate      | I₂     |
| training.                                                             |        |
| Do accidents occur due to lack of safety standards in construction     | I₃     |
| companies.                                                            |        |
| The safety officer, if any, or the implementing contractor shall be    | I₄     |
| responsible for the laying down of guiding plates by the approved      |        |
| design of the Civil Defense, indicating to the site's employees or     |        |
| non-employees the risk of the site according to the nature of the     |        |
| executed works.                                                       |        |
| Are buildings adjacent to the drilling work supported if there is a    | I₅     |
| potential for impact on these works?                                  |        |

The fifth equation for the safety index as shown in Eq. (14):

\[
SAI = S_1I_1 + S_2I_2 + S_3I_3 + S_4I_4 + S_5I_5 + S_6I_6 + S_7I_7 + S_8I_8 + S_9I_9
\] 

(14)

Where SAI is Safety Index and the best values of the parameters of the equation in this research are:

\[
S_1 = 0.383; \quad S_2 = 1.600; \quad S_3 = 0.102; \quad S_4 = 1.266; \quad S_5 = 5.344; \quad S_6 = 10.450; \quad S_7 = 0.173; \quad S_8 = 0.501; \quad S_9 = 1.438.
\]

Based on the checklist results, the independent variables for the social index that have the most significant impact on the estimate at a complete model of projects are treated to fit the analysis mechanism, so they become as shown in Table 8.

**Table 8. Input variable for Social Index (SOI).**

| Items                                                                 | Symbol |
|-----------------------------------------------------------------------|--------|
| Project size                                                          | I₁     |
| Reliance on local labor                                               | I₂     |
| The impact of social customs and traditions on the region             | I₃     |

The sixth equation for the social index as shown in Eq. (15):

\[
SOI = A_1I_1 + A_2I_2 + A_3I_3
\] 

(15)
Where SOI is Social Index and the best values of the parameters of the equation in this research are $A_1=0.302$; $A_2=0.191$; $A_3=1.000$; $A_4=0.455$; $A_5=1.180$.

4.2. Developing Model Estimate at Completion

After the six equations have been developed, the effect of each factor was taken for (14) case study by invited selected professional site engineers and experienced engineers to assess the importance of each factor in the project to calculate the value of six equations index.

\[
ETC^* = \frac{(BAC-EV)}{(CPI + SPI + CI + TI + QI + RSI + SI + SOI)} \tag{16}
\]

\[
EAC^* = ETC^* + AC \tag{17}
\]

\[
VAC^* = BAC - EAC^* \tag{18}
\]

Where:
- $ETC^*$: Improvement Estimate to Complete,
- $EAC^*$: Improvement Estimate at Complete,
- $VAC^*$: Improvement Variance at Completion.

Table 9 shows the calculation of estimate at completion for (15) case studies before improvement the results illustrate high deviation in estimate at completion of projects through cost project index and schedule project index by using the Eqs. (1) to (6), assuming the project scenario when it is over budget and behind schedule will remain until the project complete as well for another project status. It’s noted that most of Iraq projects suffer from lagging and high deviations in cost and time from what is planned in the contract and we in this research strive to address and reduce these deviations by measuring the performance of the project at all stages and improve the calculations of the final costs and taking into account all things that affect cost deviations through improved performance of final cost calculations. As well as Table 10 shows the calculation of estimate at complete for (15) case studies.

### Table 9. Estimate at complete for (15) case studies.

| Project | Contract Value | Actual Cost (AC) | Contract Duration | Actual Duration | % of Completed | Planned Value (PV) |
|---------|----------------|------------------|-------------------|-----------------|----------------|--------------------|
| P.1     | 2,863,770,000  | 2,870,346,030    | 540               | 472             | 86.50          | 2,503,147,111     |
| P.2     | 6,500,000,000  | 6,529,791,000    | 330               | 290             | 92.00          | 5,712,121,212     |
| P.3     | 3,472,344,810  | 3,480,170,810    | 420               | 380             | 77.50          | 3,141,645,304     |
| P.4     | 25,114,681,760 | 19,589,451,773   | 1003              | 990             | 71.00          | 24,789,167,440    |
| P.5     | 27,477,372,000 | 7,040,055,388    | 910               | 841             | 20.90          | 25,393,922,914    |
| P.6     | 4,510,987,000  | 3,600,145,282    | 360               | 343             | 55.50%         | 4,297,968,169     |
| P.7     | 4,899,000,000  | 4,899,000,000    | 540               | 495             | 82.50%         | 4,490,750,000     |
| P.8     | 8,435,529,200  | 6,832,778,652    | 240               | 202             | 78.30%         | 7,099,903,743     |
| P.9     | 1,736,360,000  | 980,125,830      | 420               | 360             | 49.00%         | 1,488,308,571     |
| P.10    | 14,958,000,000 | 13,620,754,800   | 720               | 668             | 77.00%         | 13,877,700,000    |
| P.11    | 572,368,411    | 681,118,409      | 240               | 280             | 85.23%         | 667,763,146       |
| P.12    | 663,496,920    | 390,145,280      | 240               | 197             | 50.40%         | 544,620,389       |
| P.13    | 590,191,920    | 301,258,362      | 240               | 200             | 33.90%         | 491,826,600       |
| P.14    | 29,600,000,000 | 19,964,715,698   | 540               | 400             | 61.00%         | 21,925,925,926    |
| P.15    | 125,699,508,800| 90,780,940,500   | 900               | 436             | 48.00%         | 88,458,215,001    |

### Table 9. Continued.

| Project | Earned Value (EV) | CPI | SPI | ETC | EAC | VAC |
|---------|-------------------|-----|-----|-----|-----|-----|
| P.1     | 2,477,161,050     | 0.86| 0.99| 447,973,080 | 3,318,319,110 | -454,549,110 |
| P.2     | 5,980,000,000     | 0.92| 1.05| 567,807,913 | 7,097,598,913 | -597,598,913 |
| P.3     | 2,691,067,228     | 0.77| 0.86| 1,010,372,171| 4,490,542,981 | -1,018,198,171|
| P.4     | 17,831,424,050    | 0.91| 0.72| 8,001,325,372| 27,590,777,145| -2,476,095,385|
| P.5     | 5,742,770,748     | 0.82| 0.23| 26,644,420,153| 33,684,475,541| -6,207,103,541|
| P.6     | 2,503,597,785     | 0.70| 0.58| 2,886,602,974 | 6,486,748,256 | -1,975,761,256 |
| P.7     | 4,041,675,000     | 0.83| 0.90| 1,039,181,818| 5,938,181,818 | -1,039,181,818 |
| P.8     | 6,605,019,364     | 0.97| 0.93| 1,893,630,865 | 8,726,409,517 | -290,880,317    |
### Table 10. Improvement estimate at complete for (15) case studies.

| Project | CPI | SPI | COI | TII | QII | RSI | ETC* | EAC* | VAC* |
|---------|-----|-----|-----|-----|-----|-----|------|------|------|
| P.1     | 0.86| 0.99| 0.83| 0.79| 0.66| 0.64| 0.15 | 0.83| -76,471,084 |
| P.2     | 0.92| 1.05| 0.85| 0.94| 0.77| 1.00| 0.44 | 0.85| -110,675,348 |
| P.3     | 0.77| 0.86| 0.74| 0.25| 0.25| 0.24| 0.38 | 0.74| 3,686,555,999 |
| P.4     | 0.91| 0.72| 0.65| 0.16| 0.22| 0.20| 0.30 | 0.65| 215,365,208 |
| P.5     | 0.82| 0.23| 0.58| 0.28| 0.20| 0.23| 0.19 | 0.48| 7,818,581,904 |
| P.6     | 0.70| 0.58| 0.80| 0.32| 0.39| 0.30| 0.35 | 0.80| 1,422,867,335 |
| P.7     | 0.83| 0.90| 0.38| 0.84| 0.70| 0.64| 0.29 | 0.38| 170,775,490 |
| P.8     | 0.97| 0.93| 0.72| 0.94| 0.83| 1.00| 0.62 | 0.72| 7,098,197,727 |
| P.9     | 0.87| 0.57| 0.71| 0.82| 0.66| 0.20| 0.24 | 0.71| 1,337,331,473 |
| P.10    | 0.85| 0.83| 0.89| 0.79| 0.70| 0.77| 0.57 | 0.51| 5,069,775,490 |
| P.11    | 0.72| 0.73| 0.81| 0.94| 0.77| 0.74 | 0.99 | 0.81| 696,934,271 |
| P.12    | 0.86| 0.61| 0.60| 0.25| 0.16| 0.30 | 0.35 | 0.60| -124,565,860 |
| P.13    | 0.66| 0.41| 0.90| 0.10| 0.63| 0.93 | 0.40 | 0.90| 373,490,718 |
| P.14    | 0.90| 0.82| 0.46| 0.72| 0.94| 0.59 | 0.13 | 0.46| 212,882,240 |
| P.15    | 0.66| 0.68| 0.22| 0.17| 0.25| 0.19 | 0.13 | 0.22| 261,129,712 |

### Table 11. Comparison between EAC and EAC*.

| No. | Project                                      | EAC   | EAC*  | Residual Value  |
|-----|----------------------------------------------|-------|-------|-----------------|
| P.1 | Construction of gate in Basra Sports City    | 3,318,319,110 | 2,940,241,084 | -378,078,026 |
| P.2 | Construction of Olympic stadium in Najaf     | 7,097,598,913 | 6,610,675,348 | -486,923,565 |
| P.3 | Construction of a closed hall in Saydiya     | 4,490,542,981 | 3,686,555,999 | -803,986,982 |
| P.4 | Yarmouk Intersection/Mosul                   | 27,590,777,145 | 21,536,650,285 | -6,054,126,860 |
| P.5 | Muthanna Intersection                        | 33,684,475,541 | 14,858,637,292 | -18,825,838,248 |
| P.6 | Pavement the entrance of Rabia Nineveh       | 6,486,748,256 | 4,122,876,335 | -2,363,871,921 |
| P.7 | Construction of a closed sports hall in Kirkuk | 5,938,181,818 | 5,069,775,490 | -868,406,328 |
| P.8 | Construction of Schools 12 classes in Salah Al din | 8,726,409,517 | 7,098,197,727 | -1,628,211,790 |
| P.9 | Construction of the General commission Taxes/Karbala | 2,000,256,796 | 1,178,966,940 | -821,289,855 |
| P.10| Construction of a water purification unit for Basra Sports City | 17,689,291,948 | 14,341,244,310 | -3,348,047,638 |
| P.11| Adnan Ghazwan School 18 classes              | 799,153,360 | 696,934,271 | -102,219,090 |
| P.12| Zuhawr Al-Iraq School 18 classes             | 774,097,778 | 484,780,297 | -289,317,481 |
| P.13| Sibawayh Al-Obeidi School 18 classes         | 888,667,735 | 373,490,718 | -515,177,017 |
| P.14| Al Shaiba Intersection/Basra                | 32,729,042,128 | 22,146,739,737 | -10,582,302,391 |
| P.15| Basra Sport City Street 20 km length        | 189,126,959,375 | 116,910,652,662 | -72,216,306,713 |
5. Conclusions
The main conclusions are that:

- The Iraqi construction industry considered is delaying in developing modern methods that integrated relevant factor data with uncertainties for performance forecasting.
- Additional factors will greatly help project managers to better guess the EAC because it will be more comprehensive in the aspects affecting the project.
- Through the 15 projects studied in the fourth quarter, it is noticed the deviations in time and planned cost due to the neglect of many aspects of high impact on the projects.
- EVM found significant benefits in dealing with deviations, especially when considering other aspects such as (quality, health and safety, risk, and social) as well as key factors (cost and time).
- The original formula for the final cost calculations in EVM was developed by adding the effect of the factors, which led to the improvement of the value of the final cost calculations.
- The model developed in this study is practical and predicts reliable figures during the project construction period which helps stakeholders make better decisions.
- This research is an important addition in the world of knowledge, which aims to improve the appreciation of project objectives and increase confidence in expectations which can be verified statistically.

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