

# An Assessment of Earned Value Reliability to Control Project Construction

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## Abstract

The objective of this research is to assess the reliability of earned value measures implemented in the construction control process. These measures are related directly to the main project's objectives - time, cost and quality. The reliability of earned value measures (EVMS) was conducted through a survey done on a sample of constructing companies using judgmental sampling methodology. Questionnaire forms and direct interviews were implemented with experts from the construction industry. The questionnaire design reflects to which extent the reliability of EVMS. These surveys were based on the non-probability judgmental sampling and analyze the results to identify the effect of earned value measures on the reality. The analysis of questionnaire survey and structured interviews illustrated that there are a great impact of EVMS on the reliability of construction control process.

**Keywords:** Reliability, Earned value measures (EVMS), Construction control, Judge mental sampling, and Questionnaire model.

## 1. Introduction

The objectives of construction project are mainly including time, cost and quality. Earned value measures (EVMS) are considered effective tools that can be implemented for achieving these objectives.

Earned value measures (EVMS) make a comparison between planned and actual time schedule and can expect if we are ahead or behind schedule. In addition, earned value measures (EVMS) distinguish the variance between actual and planned cost and predict if the project will be over or under budget. Earned value measures (EVMS) provide organizations with methodology needed to integrate the management of project scope, schedule and cost. EVMS can play a crucial role in answering management questions that are critical to the success of every project such as:

- Are we ahead or behind schedule?
- How efficiently are we using our time?
- When is the project likely to be completed?
- Are we currently under or over budget?
- How efficiently are we using our resources?
- What is the remaining work likely to cost?
- What is the entire project likely to cost?
- How much will we be under or over budget at the end?

If the application of EV to a project reveals that the project is behind schedule or over budget, then the project manager can identify:-

- Where problems are occurring?
- Whether the problems are critical or not?
- What it will take to get the project back on track?

The three project objectives which are called in some cases iron triangle including: cost, time and quality.

The current construction control process and their measures including:

1.1. Cost control process:-

During the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process.

These tools serve the dual purpose of recording the financial transactions that occur as well as giving managers an indication of the progress and problems associated with a project.

1.1.1. Forecasting for activity cost control:-

It isn't sufficient to consider only the past record of costs and revenues incurred in a project. Good managers should focus upon future revenues, future costs & technical problems. Various cost accounts associated with each category:- budgeted cost, estimated cost, cost committed, cost exposure and cost to date.

1.2. Time control process (schedule control):-

In addition to cost control, project managers must also give considerable attention to monitoring schedules.

$DF = Wht$

(DF) is the forecast duration.

(W) Is the amount of work.

(ht) is the observed productivity to time (t).

1.3. Total quality control:-

A quality control in constructions typically involves insuring compliance with minimum standards of material and workmanship in order to insure the performance of the facility according to the design.

To make a good knowledge of earned value measures we should first define the essential features of any earned value measures implementation:-

1.3.1. A valuation of planned work, called planned value (PV) or budget cost of work scheduled (BCWS).

1.3.2. Pre-defined "earned rules" (also called metrics) to quantify the accomplishment of work, called earned value (EV) or budget cost of work performed (BCWP).

1.3.3. Scheduled variance (SV) = EV-PV.

1.3.4. Scheduled performance index (SPI) = EV/PV ( $\geq 1$  preferable) (ahead of schedule).

1.3.5. Cost variance (CV) = EV-AC, where (AC) is the actual cost.

1.3.6. Cost performance index (CPI) = (EV/AC) ( $\geq 1$  preferable) (under budget).

1.3.7. Estimate at completion (EAC) = AC + ((BAC - EV)/CPI) = (BAC/CPI).

1.3.8. Estimate to complete the remaining work of the project (ETC)

$ETC = EAC - AC$ .

1.3.9. To- complete performance index (TCPI).

1.3.10.  $(TCPI)BAC = (BAC - EV) / (BAC - AC)$ .

1.3.11.  $(TCPI)EAC = (BAC - EV) / (EAC - AC)$ .

1.3.12. Independent estimate at completion (IEAC).  
 $IEAC = \sum AC + ((BAC - \sum EV) / CPI)$ .

## 2. Problem Statement

In construction projects, the main indicators of project success are directly related to time, cost and quality. The major factors that could affect these indicators are:-

2.1. Watching and controlling the project time schedule.

2.2. Watching and controlling the project budget.

2.3. Availability of factors helping to control of both time and cost.

2.4. Project barriers (time, finance and labors).

2.5. Work performance indicators.

So, in our research we conduct a survey to measure the assessment of these factors (EVMs) and their reliability in construction projects based on direct and in direct interviews with experts in construction field.

## 3. Research approach

As the objective of this research is to assess the reliability of EVMs implemented in the construction control process, so we should first define the factors which assess the EVMs:-

3.1. Reliability assessment of EVMs used in data collection.

3.2. Administrators of control process and their characteristics such as: training, awareness and aptitude.

3.3. System used in the construction projects.

3.4. EVMs' application time and its effect.

Based on these basic factors, a questionnaire model was conducted to define the major factors that assess EVMs. Direct and indirect interviews were conducted with experts in construction field whom choice based on judge mental sampling methodology. Structured interviews with experts and their answers on the questionnaire model helped us to collect all data needed to define the reliability assessment of EVMs.

From direct and indirect interviews with experts and their answers on the questionnaire model, data collection stage was successfully accomplished.

## 4. Analysis

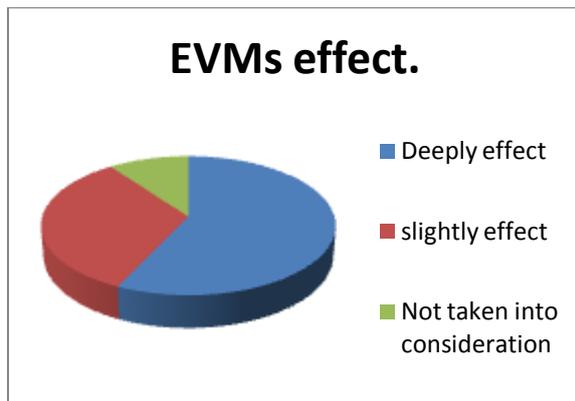
We used the non-probability sampling technique (judge mental sampling). Our sample cluster consists of 21 companies, many of them

replied on us by email and other by direct interviews. We will study the relations between the effect of EVMs and their reliable assessment. When we study the relation between EVMs and its reliability we will find that:-

-57% of the total sample cluster is deeply affected with EVMs.

-33% of the total sample cluster is slightly affected with EVMs.

-10% of the total sample cluster doesn't take EVMs effect into consideration.

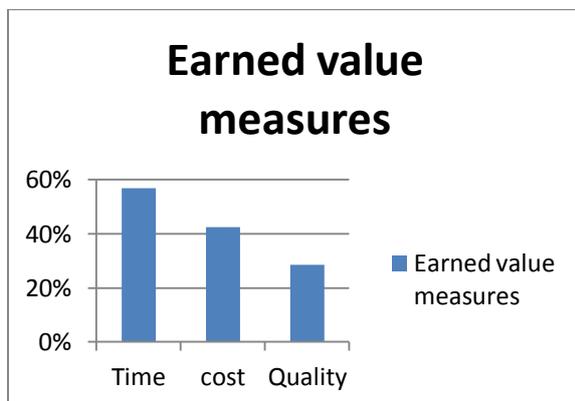


4.1. When we study the effect of EVMs we will find that:-

4.1.1. 57% of the total sample cluster affected with time as the most effective earned value measures.

4.1.2. 42.6% of the total sample cluster affected with cost as the most effective earned value measures.

4.1.3. 28.6% of the total sample cluster affected with quality as the most effective earned value measures.

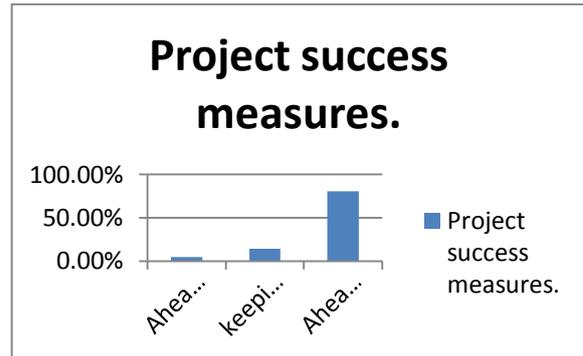


4.2. As our research concerned with assessment of earned value measures (EVMs) implemented in construction control process, so it's important to identify the success measures considered for earned value measures (EVMs).

4.2.1. 4.8% of the total sample cluster considered keeping ahead of time schedule is a measure for project success.

4.2.2. 14.3% of the total sample cluster considered keeping under budget is a measure for project success.

4.2.3. 80.95% of the total sample cluster considered keeping both under budget and ahead of schedule is a measure for the project success.

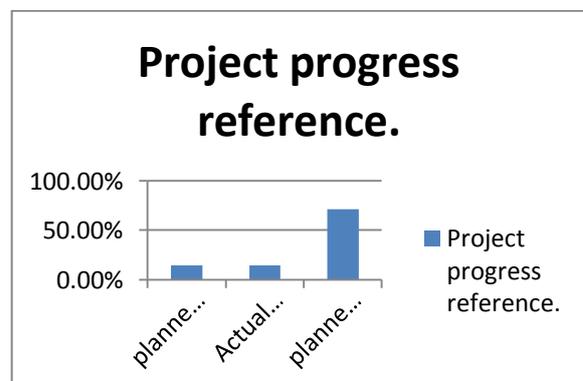


4.3. When we talk about construction control process, we should be aware with project progress evaluation strategy and our baseline reference for such evaluation.

4.3.1. 14.3% of the total sample cluster use planned time schedule as their baseline reference to evaluate their project progress.

4.3.2. 14.3% of the total sample cluster use actual cost compared with expected budget as their baseline reference to evaluate their project progress.

4.3.3. 71.43% of the total sample cluster use both planned time schedule and actual cost compared with expected budget as their baseline reference to evaluate their project progress.

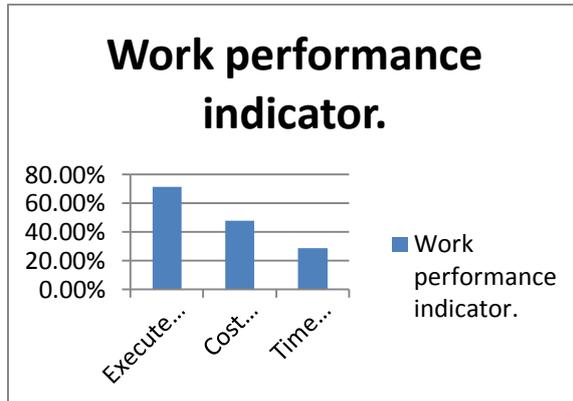


4.4. For clear studying of EVMs, it's important to identify our work performance indicators.

4.4.1. 71.43% of the total sample cluster considered executed work compared with planned work as their work performance indicator.

4.4.2. 47.62% of the total sample cluster considered cost spent compared with cost remaining as their work performance indicator.

4.4.3. 28.57% of the total sample cluster considered time spent compared with time remaining as their work performance indicator.



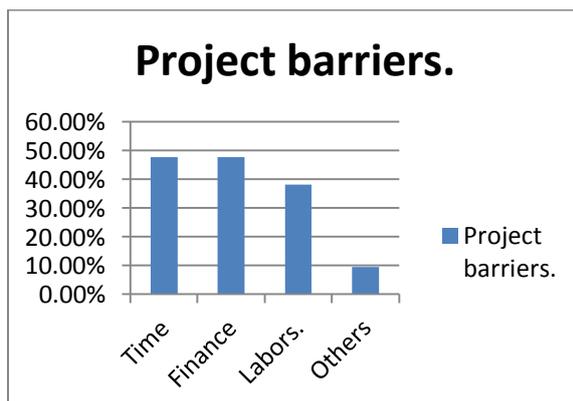
4.5. Finally, it's important to identify the barriers that can face any project and could affect EVMs implementation.

4.5.1. 47.62% of the total sample cluster considered time as their most effective barrier.

4.5.2. 47.62% of the total sample cluster considered finance as their most effective barrier.

4.5.3. 38.1% of the total sample cluster considered labors as their most effective barrier that could face them.

4.5.4. 9.52% of the total sample cluster considered other barriers that could face them.



## 5.Verification

Importance of EVMs implementation and its reliable assessment can appear in constructing a big factory "NAMAA feed factory" which I was the owner consultant in this project and "EL Gharably Engineering Company GECO." Was the main contractor. This project was planned to be

accomplished after 2 years from the beginning of construction works. But on real earth we had finished it after 3 years and 6 months exceeding the planned duration by one year and 6 months. This was due to several reasons, the most important reasons were:-

- 5.1. Non-accurate time schedule.
- 5.2. None clearly work performance indicators.
- 5.3. None qualified labors.
- 5.4. Conflict in project progress measures.

This was a verification for all previous what we had mentioned before about the reliability assessment of earned value measures implemented in the construction control process.

## 6. Conclusions

As our research objective is to assess the reliability of EVMs & define the factors that assess EVMs, we conducted a survey based on judge mental sampling and made direct and indirect interviews with experts in construction field and from analysis of data collected we found that:-

Most effective EVMs that assess in the sample cluster are time schedule. Cost and quality also have an effect in the sample cluster under surveying. Most of the sample cluster considers keeping under budget and ahead of time schedule are the measures for project success. The major part of the total cluster sample considers planned time schedule and actual cost compared with expected budget as their basic baseline references to evaluate their project progress. The major part of the sample cluster considers executed work compared with planned work as their work performance indicator, also cost spent compared with cost remaining can be taken into consideration as a work performance indicator. The major barriers that face the sample cluster under studying are finance and time as the major barriers; also labors can be taken into consideration.

From our studying we found that:-

Earned value measures (EVMs) are very important for construction control process as they manage the construction control process and measure the progress and the success of the project during, before and after the construction control process.

## 7. Recommendations

In order for accurate implementation of earned value measure (EVMs) for construction control process, future researches are recommended in the following:-

- 7.1. Accurate time schedule is recommended based on comparison between expected and planned time schedule.

7.2. Well managing of project budget using the comparison between actual and planned cost.

7.3. Clear definition of work performance indicators.

7.4. Clear definition of project progress reference.

7.5. Definition of all possible barriers (time, finance, labors,.....etc.) that could face the project.

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