
EARNED VALUE IN THE UAE CONSTRUCTION INDUSTRY: AWARENESS EFFICIENCY AND AREAS OF IMPROVEMENT

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ABSTRACT

In today's critical construction industry standing traumatized by an economic downfall, fundamental project management initiatives are sought. Earned Value represents one of the best techniques to measure projects' performance. Yet, despite the numerous circumstances where Earned Value had proven success, the industry showed a slow reaction and the relevant level of awareness among the industry players have remained uncertain. This ambiguity drove the urge to acquire a better understanding of the awareness in the UAE construction management circle vis-à-vis Earned Value. The efficiency of Earned Value application, drawbacks and room for improvement are the main areas of interest in this paper. An extensive study of the existing literature helped drawing a hypothesis for a field study materialized through a survey conducted in the UAE. Professional opinion and experience was captured to scrutinize awareness levels, assess the intelligibility of the Earned Value users and their satisfaction. Findings indicated that a very shy percentage of practitioners are embracing Earned Value, and there is a great level of understanding, satisfaction and good will for better performance among users. Willingness to improve management practices through learning is an encouraging finding from the survey, for the future of the practice in the industry.

Keywords: Earned value, Project management tool, Cost control, Schedule monitoring, Project performance monitoring.

1. INTRODUCTION

Earned Value Analysis also referred to as Earned Value Management is a tool used to measure projects' performance and progress, by integrating scope, schedule and cost. Its principles are applicable to all projects from various industries.

"Earned Value" has been in use since the 1960's when the US Department of Defense (DoD) realized the necessity of a powerful project management system that would predict and ultimately control the cost of their projects. The system was first imposed on their contractors under the title PERT/cost. In 1967, principles of EVM were established through Cost/Schedule Control Systems Criteria (C/SCSC) by the US DoD to which government contractors had to strictly adhere to for contracts with high risk of cost overruns to the government. Despite the implementation difficulties of the C/SCSC, the EVM concepts continued to evolve and expand to other countries that chose to apply the EVM system to the construction industry.

Nowadays, in a climate of domination of highly sophisticated and complex projects to be delivered in a limited time and with a tight budget, it has become of paramount importance to apply such project management tools and techniques for project control.

To Fleming and Koppelman (1998), EVA enables early perceptibility of the results, from as early as the 15 per cent completion of a project. One can thus conclude a tendency of final costs and completion

date of the project at a certain phase, when it is still possible to take corrective measures. It is unanimously agreed that the EVM is stronger in cost management than it is in schedule management.

This research aims to investigate the use of Earned Value Analysis as a project management tool in the UAE construction industry. It is conducted according to two approaches: an extensive reading with critical appraising of the literature review related to the area of research, where experiences and case studies from around the world are discussed. Experience from the UAE will be captured using a Web-based survey questionnaire sent by e-mail to practitioners working in the UAE Construction industry.

2. HOW DOES EARNED VALUE WORK?

At the onset, the project needs to be EVA oriented, and a well-defined and priced Work Breakdown Structure (WBS) and a baseline schedule need thus to be put in place. All work must be planned and budgeted. The technique will provide cost variance and schedule variance at any point of time of the project life cycle. In order to calculate variances three key parameters of the Earned Value Analysis must be available. These are as follows:

1. **Planned Value (PV):** the planned cost of the total amount of work scheduled to be performed by the milestone date.
2. **Earned Value (EV):** the planned cost of completed work up to the milestone date.
3. **Actual Cost (AC):** the cost incurred to accomplish the work that has been done to date. AC can be easily provided by the accountants on the project.

The manager can only judge the project's health by comparing those parameters, see Figure 1.

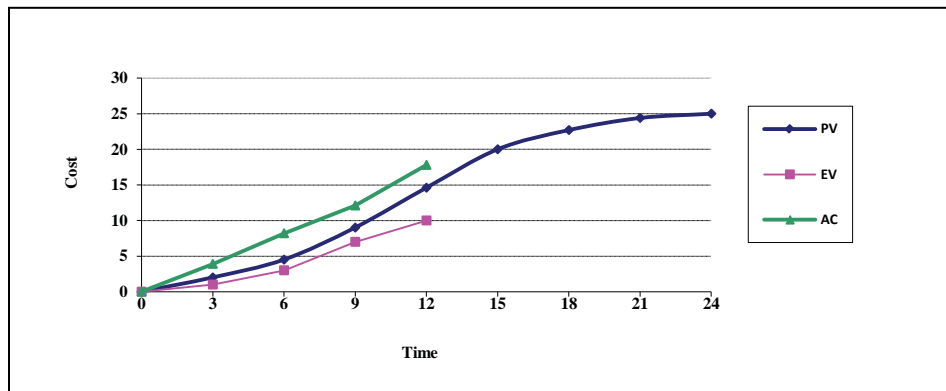


Figure 1: Typical Curve Showing (EV), (PV) and Actual Cost (AC)

Schedule Variance (SV=EV-PV): Indicates conformance of the actual progress to the schedule, and represents the difference between EV and PV at a certain date

Cost Variance (CV=EV-AC): Compares budgeted cost of work performed with the actual cost of the same work at a certain date.

It is worthwhile noting, that both Schedule and Cost variances are measured in units of “money”. It is criticized for being cause of confusion that EV measures progress in units of money, which is not a tangible value to the customer (Stratton 2005). A negative variance, in one or in both of the above, is an indication of poor performance of the project.

Cost Performance Index (CPI): It is a measure of cost efficiency on a project. It is the ratio of value earned EV to the amount spent at a point of time AC ($CPI = EV / AC$).

Schedule Performance Index (SPI): It is a measure of schedule efficiency on a project. It is the ratio of value earned EV to the value planned at a point of time PV ($SPI = EV/PV$).

A value equal to or greater than one indicates a favourable project condition, i.e. a performance better than planned, and a value less than one indicates an unfavourable project condition.

Budget at Completion (BAC) It is the total budget baseline for the project, and the highest planned value.

Estimate Cost at Completion (EAC) It is the estimated final cost of the project. EAC is based on the simple concept that the estimate at completion is equal to the amount of money already spent on the contract plus the amount of money it will take to complete the contract. EAC is calculated using the following formula: $EAC = AC + (BAC - EV) / CPI$. This formula is algebraically simplified in some texts to: $EAC = BAC / CPI$.

Time Estimate at Completion (TEAC) While EV does not provide accurate means to estimate the total time at completion based on actual performance, it is however indicative if one uses similar assumptions and logic to the EAC calculation. Anbari (2003) revealed that TEAC for a project can be calculated based on the baseline schedule at completion (SAC) and actual performance. Similarly to the above, $TEAC = SAC / SPI$.

Variance at Completion (VAC) It is the difference between Budget at Completion and Estimate at Completion. ($VAC = BAC - EAC$). A negative value is unfavorable and is a forecast of a contract overrun while a positive variance is a sign of good health.

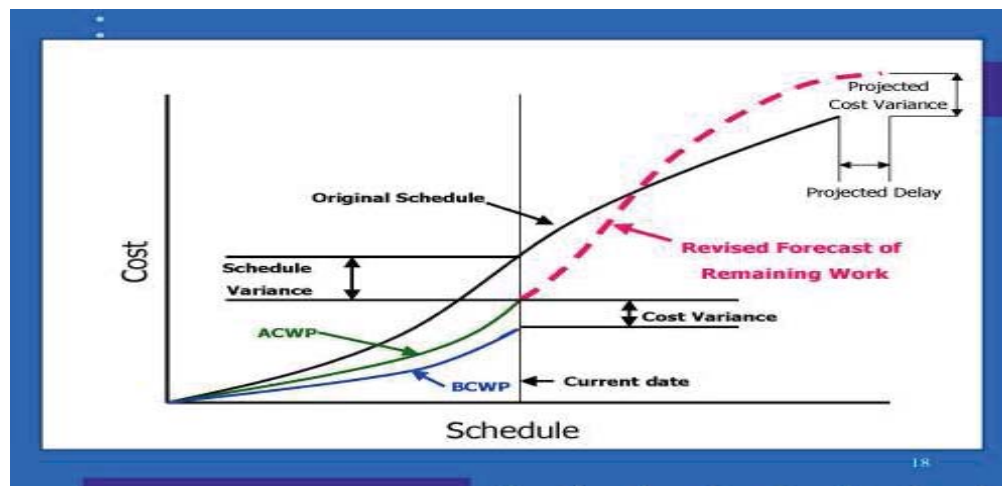


Figure 2: Typical Curve Showing Variances (Manley 2001)

Management Reserve (MR) It is a designated amount of time and/or budget which is not specified for the accomplishment of a task. It is more for management control purposes, meant to cover any additional work within the authorized work scope of the contract. It cannot be used to compensate or reduce cost variances.

It is intended to cover unknown unknowns, not to be confused with Contingency Reserve (CR), which is intended to cover known unknowns, identified risks.

A successful EVM application involves a set of requirements considered by many as too complicated and costly to implement.

3. EV IMPLEMENTATION REQUIREMENTS AND BENEFITS

Establishing and undertaking EVM system within an organization requires a substantial cultural change. Fleming and Koppelman (1998) identified some of the essential requirements for proper implementation of EV on all projects. The most important requirement is to have a clearly defined Work Scope at the onset through establishment of a detailed and priced Work Breakdown Structure (WBS); then establish an Integrated Bottom-up Plan with scheduled *Work Packages* that have estimated costs and resources, and estimated completion duration; and Project Control through Measurements against Schedule: Project's schedule performance, project's cost efficiency, and forecasting the final cost periodically. The accuracy

of estimated data and actual data and the time intervals for measuring are of paramount importance to its successful application (Smith 2008).

EV can be used every time a product is to be delivered within a certain schedule and budget and in line with certain standard of quality (Anbari 2003). Fleming and Koppelman (2002) point out that in the construction industry, practitioners use EV but rarely refer to the term "Earned Value".

Christensen (1998) listed ten main benefits of Earned Value. EV provides a single management control system providing reliable data, and an integration of work, schedule, and cost using a Work Breakdown Structure. The system also provides a database useful for comparative analysis. Most important of all, it is an early warning signal for cost and time performances with projections of final cost and time. It can help identify, address, and resolve problems timely (Schulte, 2001). In addition, contractors are encouraged to implement EV because it improves their cash flow when applied appropriately. A regular monitoring by the parties will make the assessment of the Contractor's claim for payment more efficient and judicious. Moreover, the application of EV is useful not only at the project level, but also at the whole business level. EVM leads to successful portfolio management: failing projects may stop and resources may be shifted to a more successful project. Besides, EVM offers the choice to integrate the Risk Management (RM) within the Earned Value Management, insights of one can be used to inform the other (Hillson 2004). Finally, and in line with the EVM benefits, Software can now do Earned Value saving time more efficiently. Available software: EV Manager that works inside MS Project 2007 or higher, the Project Team Builder (PTB), Pro Track's assistant, and Deltek Cobra.

4. PROBLEMS ASSOCIATED WITH EARNED VALUE

4.1 Costly and Time Consuming Implementation

Coopers & Lybrand/TASC (1994) and Lampkin (1992) among others, as cited by Christensen (1998) had concluded that, the marginal cost of EVMS criteria ranged between 0.4% and 1.63% of the contract cost. Nowadays, such costs are further reduced due to technology innovations and high speed of information transfer in addition to new software, which would save users time and cost.

4.2 Unreliable Schedule Indicators

Divergent are opinions when it comes to EV aptitude to measure the schedule performance through reliable schedule indicators. Fleming and Koppelman (2005), Henderson (2004), Lipke (2003), and Vanhoucke and Vandevoorde (2006), argue that EVM is not the best tool to predict project's duration, and that EVM schedule indices can only be used as a warning tool rather than an analysis tool for the project's time performance.

In fact, Lipke's research was triggered by the aberrant behaviour of EVA's schedule indicators at the end of the project: EV and PV curves converge to the same point. Consequently, using the formulas developed earlier in this study, Schedule Variance (SV) and SPI, at the completion of the project, will equal respectively zero and 1, no matter how late the Actual Completion is, compared to the planned.

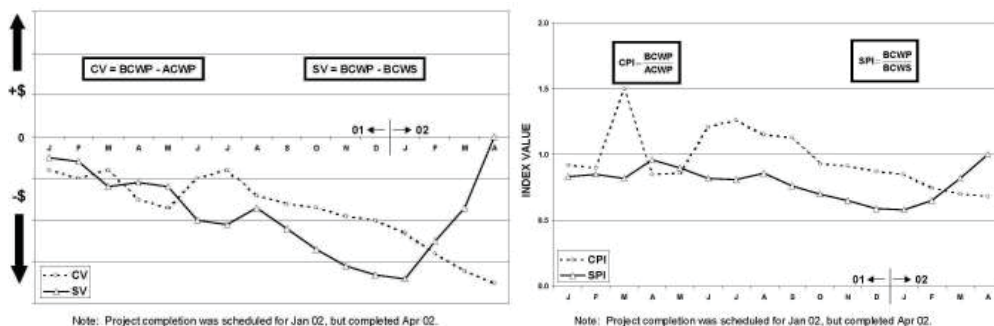


Figure 3: Cost and Schedule variances and performance indices behaviours. (Lipke 2003)

Thorough studies concluded that the best method to predict the total duration of a project is Lipke's (2003) Earned Schedule (ES) (Vanhoucke and Vandevorde 2008). ES offers schedule indicators that behave normally over the total duration of the project. It is derived from Earned Value and is an extension of it. The same data/figures collected for EVA are used for ES which unlike EVA, uses time to measure schedule performance and not cost. The Earned Schedule technique adds to EVM's EV (Earned Value), PV (Planned Value) and AC (Actual Cost) it adds the ES (Earned Schedule) and AT (Actual time) metrics. Small letter indices have been added to refer to "time".

AT is the time elapsed from the project/activity's start until the given time of the analysis.

ES is the projection of the EV (BCWP) at the same given time of the analysis, horizontally onto the PV (BCWS) curve as per the following graph. It is calculated as follows:

- ES (cum) is the Number of completed PV time increments EV exceeds + the fraction of the incomplete PV increment

- $ES(cum) = C + I$ where: C = number of whole time increments of the PMB for which $EV \geq PV$

$I = (EV - PV(c)) / (PV(c+1) - PV(c))$

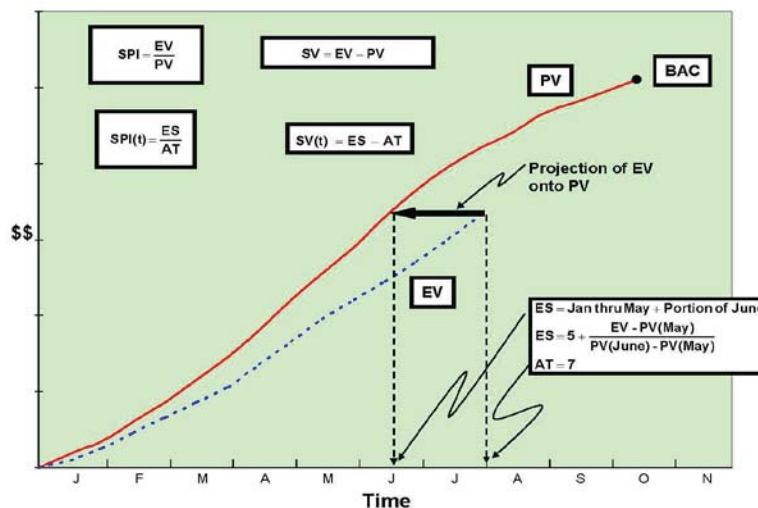


Figure 4: Earned Schedule Concept (ES Website)

The Earned schedule technique features an SV (t) and SPI (t) calculated similarly to the one calculated for EVA, as per the following formulas:

$SV(t) = ES - AT$ ("t" is to refer to the ES Schedule Variance (SV))

$SV(\$) = EV - PV$ (\$ is to refer to the EVA Schedule Variance (SV))

$SPI(t) = ES / AT$ ("t" is to refer to the ES Schedule Performance Indicator (SPI))

$SPI(\$) = EV / PV$ (\$ is to refer to the EVA Schedule Performance Indicator (SPI)).

SV (t) and SPI (t) are to behave more suitably throughout the project's cycle and allow more accurate results related to time.

4.3 Does not distinguish between critical and non-critical activities

Earned Value does not highlight the critical tasks when it points out a schedule delay. Minor delays in critical activities along with major progress on non-critical ones, may indicate a misleading value of SPI, which in this case will be >1 , and when used to forecast the Estimate at Completion, it leads to bright forecast results; while in fact, in this case, the project is more likely to be behind schedule. This leads to poor prioritization of tasks execution.

4.4 High resistance to the use of EVM

In general, Earned Value is evaluated as a non-popular project management tool. There is some prejudice about it among Project Managers that McKinlay (2006) from her field experience was able to report. Some of the quoted reasons were related to the fact that EVM was too bureaucratic or too expensive or that a baseline can't be established early.

4.5 Humble Commercial Awareness of the EV technique

It is true that in leading countries in terms of EVM like the USA, Canada, and Australia where the tool originated, or in others like Sweden, UK, Japan, or Germany, they do not lack awareness and research about the technique and its usage. However, it is believed that in the rest of the world, the awareness about the EV tool and its uses remains shy.

4.6 Inadequate Application of EVM, Poor Management

In most of the cases where it is pledged among practitioners that the application of Earned Value was unsuccessful, it was mostly due to the wrong application of the tool. Lukas's (2008) and Cleland and Ireland's (2007) in their studies summarised mistakes and weaknesses that would preclude a successful EV application. These include: lack of encouragement from senior management; incomplete or undocumented project; WBS not complete or stopped at a summary level, or even not used or accepted; tasks not integrated with WBS-Schedule-Budget; and inadequate data collection system, on progress and actual costs.

5. PROJECT MANAGEMENT IN THE UAE CONSTRUCTION INDUSTRY

During the construction prosperity years of the UAE, mainly during the 2000 credit boom, the focus was on finalizing projects, no matter how and at which cost. This period witnessed a slowdown in the awareness spread and educational and training programs related to construction project management. Later in 2008, during the recession period where the opportunities decreased and the competitiveness among companies increased, project management has become a compulsory key element in corporate success.

In a country where the construction sector plays a major role in the economy, it is captivatingly observed that construction delays and cost overruns are tremendously adversely affecting the construction industry as well as the overall economy: The need for investigating a proper project management is seriously emerging.

6. SURVEY DATA COLLECTION AND ANALYSIS

In order to build a full understanding of the EV tool, its applicability, use and limitations, and to look at the level of awareness through project managers in the UAE construction field and explore the prospect of developing an efficient framework for the application of EV, it was important to conduct a double phased study, including, at the first stage, extensive review of the existing literature related to the subject, and at the second stage, a UAE market field related data collection through questionnaire.

A questionnaire was sent to 151 professionals from different construction contracting companies operating in the UAE. A total of eighty two professionals completed the survey, at a return rate of 54%. State the purpose of the questionnaire.

6.1 Awareness and Current Use of Earned Value Management:

38% of the respondents have never heard about the term Earned Value. Among the 62% who are familiar with the term, 53% do not use EV at all. One of the limitations that should be highlighted is related to the

level of education and the extent of familiarity of those non users of EV and its characteristics. This has not been assessed through this survey.

The proportion of professional practitioners in the UAE who never heard about Earned Value is alarming. Especially when the data from the survey reveals that out of those who did never hear about EV, 74% work in international companies. This reflects a poor professional training to UAE practitioners. When asked about the reason for not implementing EV on their projects, the majority of responses fell around the reason *It has never been required by a Client and we are doing well without it*, evidencing that the questioned UAE contractors care mostly about the client's requirements rather than caring about their proper performance evaluation. This represents a weak point in the industry....*we are doing well without it* is another proof of weakness and lack of awareness. The reality diagnosed in the UAE today's status says that the Construction industry *is not doing well*.

6.2 Satisfaction among Users of EV and Perceived Limitations

75% of the respondents believe that EV would be a useful tool to use and it is necessary to project controls. Such a high rate of satisfaction among users of the tool in the UAE represents a strong incentive for further research on the tool and further spreading of knowledge through trainings and conferences.

In the UAE, 58% of the users of EV disagree or strongly disagree to the hypothesis that EV is a time consuming activity. The majority's view is clearly different to Lampkin's (1992) two decades ago. This may be contributed to the advancement of technology and available software that can help saving EVM users' time and money.

It is established that EV requires a particular attention to details of the activities in a project and of their progress. 46% of the respondents did not complain about details and agreed on the proposed response saying that any proper project management practice would require going through details. This large proportion understood project management principles and this supported the view of McCauley (2001) that EVMS fits naturally into the project management Cycle. 25% of the sample answered: I am using it, but not at a detailed level. This refers to those who manage the construction projects at high levels of the Work Breakdown Structure (WBS). They confirmed a sort of inappropriateness of the use of the tool. Jacob and Kane (2003) had proved through analysis that this way of operating EV deprives the tool of its ability to distinguish between activities criticality, which leads to erroneous results and forecasts.

6.3 Clients' Awareness and Type of Projects Applying EV

From responses to a series of questions, it appeared that a number of clients are indeed aware of the need to use EV. This can be explained by the local UAE clients employing in most of the cases foreign project management firms to manage their projects.

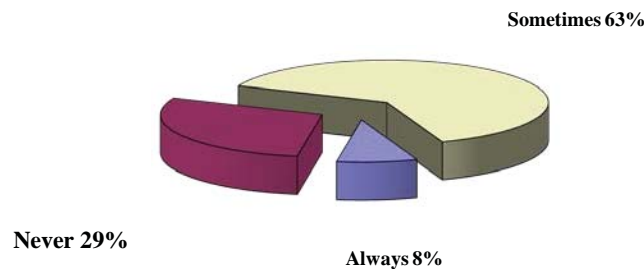


Figure 5: Level of Client Obligation for Company to use EVM

On the other hand, the fact that the bulk of the projects undertaken by the questioned users of EV in the UAE is Lump Sum projects, this fact negates the “rumors” that attribute EV to only Cost Reimbursable projects, and demonstrate that even projects based on lump sum pricing, which represents one of the most rigid forms of contract, are implementing EV and satisfied.

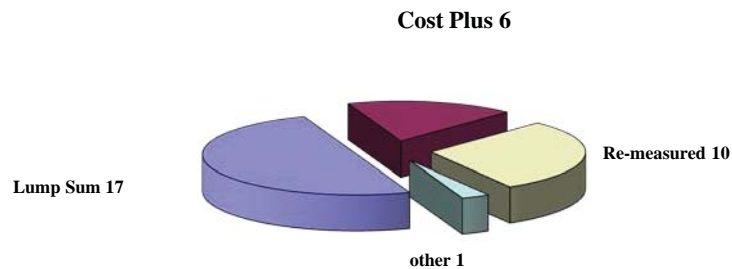


Figure 6: The type of Contract governing your projects applying EVM

Further, Anbari’s (2003) and Fleming and Koppelman (2002) views related to the types and sizes of projects being in their majority suitable for EVM implementation, have also been found appropriate and supported in the UAE, most of the respondents to this survey applying EV to all sizes of projects.

6.4 Current Management Practices in the UAE

For Fleming and Koppelman (2002) practitioners rarely use the term "Earned Value", they do use the tool without realizing it. To them, “*anytime the construction cost engineer puts a project baseline plan in place, this is Earned Value in its purest form*”. (Fleming and Koppelman 2002, p. 91). In order to evaluate how close the current management practice is to the characteristics of Earned Value, a sequence of questions to the non-users of EV revealed the following: The largest proportion of the practitioners who are not even familiar with the term Earned Value are performing a facet of EV, which in all cases is basic project management (78% use WBS, 79% have projects’ activities with a defined start and finish and duration in a baseline schedule, 91% confirmed that their project’s activities have a cost associated to each). But this is not all. In fact, the high popularity (78%) of the Bills of Quantities (BoQ) as a document illustrating and managing activities’ costs in a project in the UAE is alarming at the project management level. The BoQ as its name suggests, is mostly intended to deal with the quantities and is supposed to aid contractors in quoting lump Sum prices and not to conduct an effective cost control on the project’s activities during the construction phase. BoQs do not reflect real costs and are not manageable.

7. CONCLUSIONS AND RECOMMENDATIONS

1. A very limited proportion of companies are currently implementing Earned Value on their projects in the UAE, and the dependence on Information Technology and specialized software to achieve more effective results is widespread amongst those. Major limitations suggest that EV being too costly or time consuming have been disproved in the UAE through this field survey.
2. Incentives to further spreading of the Earned Value in the UAE are, in the first instance an atmosphere of general satisfaction among the users of the tool. A major agreement among both proponents and opponents of EV is that EV has limited abilities when it comes to schedule control.

3. The size and type of projects do not represent a criterion for the implementation of Earned Value in companies and on projects across the UAE.
4. The high resistance registered among today's project managers to the use of the tool was not reflected in this research work. A high level of satisfaction among the EV users in the UAE is evident. Non-users, however, provided a general impression of willingness to learning the tool's principles and subsequently implementing it.
5. The current situation in the UAE is alarming. It is not said that the progressive implementation of Earned Value on the projects to better measure their performance will be the only solution to the crisis; however, a gradual start, with adequate professional training to key people is a must.
6. One of the characteristics of EV being an adequate tool for portfolio management, it would be encouraged that government and UAE clients in general do mandate the use of EV by the contractor. In such a situation where major projects are being suspended and awaiting proper decision, data gathered through EVM systems would be a major support for decision making.

REFERENCES

- Anbari, F. T. (2003). The Earned Value Analysis Method: Extensions and Simplifications, presented at IPMA 17th World Congress on Project Management, Moscow, Russia, International Project Management Association (IPMA).
- Christensen, D. S. (1998) The Cost and Benefits of the Earned value Management Process. Acquisition Review Quarterly. Fall 1998
- Cleland, D.I. and Ireland, L.R. (2007) Project Management: Strategic Design and Implementation, Fifth Edition, The McGraw-Hill companies Inc. McGraw-Hill.
- Coopers & Lybrand and TASC. (1994). The DOD Regulatory Cost Premium: A Quantitative Assessment. December 1994 report.
- Fleming, Q. W. and Koppelman, J. M. (1998) Earned Value Project Management: a Powerful Tool for Software Projects. Crosstalk: The Journal of Defense Software Engineering.
- Fleming, Q. W. and Koppelman, J. M. (2002) Earned Value Management: Mitigating the Risks Associated to Construction Projects. Program Manager (2002), 31 (2), pp. 90-95.
- Fleming, Q. W. and Koppelman, J. M. (2005) Earned Value Project Management, Third Edition. Newtown Square, PA: Project Management Institute, 2005.
- Henderson, K. (2004) Further Developments in Earned Schedule. The Measurable News, Spring 2004, pp. 15-22.
- Hillson D. (2004) Earned Value Management and Risk Management: A Practical Synergy. Risk Doctor, Limited.
- Jacob D.S. and Kane M. (2004) Forecasting Schedule Completion Using Earned Value Metrics Revisited. The Measurable News, summer 1, pp. 11-17.
- Lampkin, E. D. (1992) The Marginal Cost and Practicality of Cost/Schedule Control Systems Criteria Implementation. Aeronautical Systems Center. Dayton, OH: Wright-Patterson Air Force Base.
- Lipke, W. H.,(2003) Schedule is Different, The Measurable News, Summer 2003, pp. 31-34.
- Lukas, J. A. (2008) Earned Value Analysis- Why it doesn't Work. 2008 AACE International Transactions. EVM. 01
- Manley, S. S. (2001). A Primer on Earned Value Analysis- How to tell if Your Project is On-Schedule and On-Budget. ACHMM Conference, Chicago Illinois, August 18-22, 2001.
- McCauley, M. (2001) The Value of Earned Value Management, PMI Pittsburgh Chapter Meeting (February 8, 2001)
- McKinlay, M. (2006) Why Not Implement EVM? International Cost Engineering Council, ICEC Cost Management Journal.
- Schulte, R. (2001). What is the Health of my Project? The Use and Benefits of Earned Value. White Paper Library, Welcom.

- Stratton, R. (2005) Not your Father's Earned Value. Projects at Work – 24 Feb 2005.
- Vanhoucke M. and Vandevoorde S. (2006) A Comparison of Different Project Duration Forecasting Methods Using Earned Value Metrics. International Journal of Project Management **24** (2006) pp. 289-302.
- Vanhoucke M. and Vandevoorde S. (2008) Earned Value Forecast Accuracy and Activity Criticality. The Measurable News Summer 2008 Issue 3, pp. 13-16.