

THE CONTRIBUTION OF EARNED VALUE ANALYSIS FOR COST
CONTROLLING OF CONSTRUCTION PROJECTS

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ABSTRACT

Earned Value Analysis (EVA) is a project performance measurement technique. Managers can manage the performance of project by comparing the planned value to actual results. It allows the calculation of cost variance, performance indices and forecast the project cost performance. Therefore, EVA is very important to monitor and control the performance of the construction project. This research is using descriptive study. The purpose of this study is conducted to study the relationship between the EVA and the cost performance of the construction project. Furthermore, the aim of this study also needs to determine the effect of the EVA in the construction project. In this study, survey research will be chosen to collect the data. In order to do the survey research, questionnaire will be chosen as a quantitative method approach. There are 100 companies located in Negeri Sembilan and the sample needed is 80 companies. The results of respondent rates are 38 out of 80 companies. The results have shown that there is a positive correlation between the EVA and the cost performance of the construction project. The result of average mean also indicate that the EVA has successfully to assist the project cost within the budget is the highest mean value among the seven effects of the EVA.

ABSTRAK

Analisis Nilai diperolehi (EVA) adalah teknik projek pengukuran prestasi. Pengurus boleh menguruskan prestasi projek dengan membandingkan nilai merancang dan nilai yang sebenar. Ia membolehkan pengiraan kos varians, indeks prestasi dan ramalan prestasi kos projek. Oleh itu, EVA adalah sangat penting untuk memantau dan mengawal pelaksanaan projek pembinaan. Kajian ini menggunakan kajian deskriptif. Tujuan kajian ini dijalankan untuk mengkaji hubungan antara EVA dan prestasi kos projek pembinaan. Tambahan pula, tujuan kajian ini juga perlu menentukan kesan EVA dalam projek pembinaan. Dalam kajian ini, penyelidikan kajian akan dipilih untuk mengumpul data. Soal selidik akan digunakan untuk bagi kepada responden. Terdapat 100 syarikat yang terletak di Negeri Sembilan dan sampel yang diperlukan adalah 80 syarikat. Hasil daripada kadar responden adalah 38 daripada 80 syarikat. Keputusan telah menunjukkan bahawa terdapat hubungan yang positif antara EVA dan prestasi kos projek pembinaan. Hasil purata min juga menunjukkan bahawa EVA telah berjaya untuk membantu kos projek dalam bajet adalah nilai min yang paling tinggi di antara tujuh kesan EVA.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In an increasingly demanding world, the market that full of competitiveness between the competitor will make the focus of customer satisfaction is increasingly important for the company that wants to be successful. Nowadays, the satisfaction of the quality and performance of the project not enough to fulfill customer requirement, but the time or value relationship in its project can increase the satisfaction of the customer (Pedro et al., 2011). Thus, good allocation of resources is very important to minimize the waste.

In order to make a project successful, it is very important for the project completed within schedule, complete within budget and the good quality. In addition, to ensure the project can complete within time and minimize the cost and others, it is important to implement a control system. By implementing the control system, the manager will have the latest information about the project. Then, if there is any problem occurs in the project, the control system can act as an alert signal to the manager and implement the corrective measures that are relevant to the project. Earned Value Analysis (EVA) is one of the methods believe is effective control tool (Carayannis et al., 2005)

According to Mahadik and Bhangale (2013) stated that EVA is a method of performance measurement. Managers can manage the performance of project by comparing the planned value to actual results. It allows the calculation of cost and schedule variances and performance indices and forecasts of the project cost and schedule duration. Therefore, EVA is very important to monitor and control the performance of the construction project.

1.2 PROBLEM BACKGROUND

Nowadays, Malaysia is undergoing significance changes from the mining and agriculture based to industrialized country. There are many foreign investors come to Malaysia to do investment and plays an important role in increasing the economics of Malaysia. Malaysia is one of the 20 largest exporting nation's worldwide (Commerce, 2010)

In 2007 Malaysia's gross domestic product (GDP) was RM504.9 billion and increase to RM 528.3 billion in 2008 (CBM, 2009). The economy downturn has caused the result in a decline in Malaysia's exports and industrial production. However, in 2011, there was a steady growth of 5.1% with GDP of RM588.3 billion (CBM, 2011).

The construction industry is a highly dynamic sector and plays an important role in the developing country. In Malaysia, construction industry plays an important part in Malaysia economy. Economically, it contributes in significant improvement in the overall GDP of a country. By using advance of construction skill, it improves the quality of life by providing the infrastructure that can bring convenience to the citizen such as roads, hospitals, schools and other facilities. The aim of government for the Malaysian construction industry to be a world class, can compete with others and innovative CIDB (2006). In order to manage well the project, the knowledge and skill of the project managers are very important. Government and Construction Industry Development Board (CIDB) have put effort to increase the skill and knowledge among the contractor, consultant, and others.

However, according to many researchers (Abdul-Aziz and Jaafar (2007); Ibrahim and Roy (2010); Kamal and Flanagan (2012)) mentioned that there are many problems such as low quality, cost overrun, project delay, many foreign workers, unskilled workers in construction site that cause the construction project cannot success. The most challenge problems happen in construction projects are poor time management and cost overrun. Sambasivan and Soon (2007) stated that construction sector suffered a temporary crisis between 1997 and 2000 (ASEAN crisis) and now it has started to do some improvement. However, delays still occur in construction industry with the project cannot achieve the goal because of poor risk management. Therefore, cost control and time management are very crucial in order to manage well the projects.

In the construction industry, in order to manage complexity of the project, resource usage for the projects, project management techniques are used to plan, manage, monitor and forecast the future performance of the projects (Keil et al., 2003). It is important to control on cost performance of projects to ensure the project cost performance is within the budget. Thus, project cost management is needed to keep the project within the budget.

The performance of a construction project can measure through traditional approach such as monitoring day by day, performance review, and others. By using the traditional approaches can compare the plan value and the actual cost. These traditional approaches are unable to determine about what actually has been performed. Khamidi et al., (2011) showed that the traditional approaches does not related to the real cost performance of the construction project.

As stated by Alvarado et al. (2004) traditional approaches that analyze the cost performance may be misleading the decision of the project manager. By using the traditional approach that will not show the earned value may affect the project manager believe that the project is in the right track. Conversely, it can mislead the actual flow of the project, which is behind schedule because not much work or money has been spent or accomplished. Hence, when managers add the earned value can determine the cost performance effectively and without ambiguity (Alvarado et al., 2004). Shatanand et al.

(2012) mentioned that traditional management does not allow for analysis against the physical amount of work performed. Based on these traditional performance measurement tools, one of the effective method believes can measure the performance is Earned Value Analysis (Carayannis et al., 2005).

Earned Value Analysis (EVA) is a technique can effectively monitor and control the construction projects. Naderpour and Mofid (2011) have mentioned that Earned Value Management (EVM) is integrated the cost, time and technical performance and act as project control method. It allows the calculation of cost and schedule variances and performance indices and forecasts of the project cost and schedule duration.

EVM has become most commonly used methods of project performance measurement (PMI, 2008). EVM is a tool that can use by the project manager to measure the project performance of the project. Naeni et al., (2011) stated the earned value technique is an important technique to analyze and control the project performance that can measure the accuracy of the performance and the progress of the projects.

EVM can provide an early warning about the performance problem when applied it properly. Earned Value (EV) is integrated three crucial elements which are cost, scope and schedule to measure and monitor the progress of the projects. Planned value and actual costs of the activity will compare to EV is to calculate the cost and time performance and measure the project performance (Naeni et al., 2011). Earned Value is very important to know the current progress of the project.

EVM can consider successful when get the support from the top management, organizational support and effective training (Chou et al., 2010). It has provided a platform for the organization to improve the cost and schedule control, identify the risks and impacts of the project to manage well the project.

In conclusion, the project manager can manage well the project by using EVA to analyze the cost and schedule variance. By using EVA, the project manager can forecast the trend of the project performance. At the same time, it allows project managed to

minimize the risk of the project to the minimum level. The EVA is a useful technique for guiding the project manager enable to be a good decision maker(Patil et al., 2012).

1.3 PROBLEM STATEMENT

Ali and Kamaruzzaman (2010) stated that construction industry is an important element to increase the economy of Malaysia. Construction industry contributes significantly to the growth of socioeconomic development shows that the important to manage well the project. However, there is a cost overrun problem that considered the significance in construction projects. There are multiplicity of factors that cause the construction projects suffer from the cost and time overrun. The factors of cost overrun and time overrun are inaccurate or poor estimates of original cost, improper planning, poor project management, insufficient fund, mistake in design and others.

Endut et al. (2009) mentioned in their study, there are 308 public and 51 private construction projects found that only 46.8% of the public projects and 37.2% of the private projects completed within the budget. Time and cost overrun become a global problem in the construction project. In the construction industry, it is very important to have project control technique to the cost performance of the project to minimize the probability occur the cost overrun.

Khamidi et al., (2011) stated that the traditional approaches such as day to day monitoring, monthly or weekly management reports, performance reviews, key performance indicators and others to measure the performance of the construction projects. According to Bhosekar and Gayatri (2012), the traditional method focuses on plan expenditures and the actual expenditures. By using these approaches cannot determine about what has actually done or amount of money spent to the activities. These limitations of traditional approach cannot effectively determine the proper cost performance of the project. Consequently, the project manager needs effective technique to meet the challenges of cost overrun that can improve the cost performance of the project. Earned Value Analysis (EVA) is an effective project control tool (Carayannis et al., 2005).

Khamidi et al., (2011) stated that EVA is a worldwide technique that adopted by many developed country such as United State, United Kingdom, Australia and South Korea. However, it is not very common in Malaysia as a project control technique (Khamidi et al., 2011). When implement EVA in the construction industry, the problem such as cost too high, too much paperwork and time consuming affect the EVA unable to fully adopt in the construction companies.

Moreover, Kim et al. (2003) stated that the factor causing the EVA cannot fully adopt because lack of understanding of EVA and the lack of people participates in implementing the EVA. In addition, the different organizational-culture-related problem such as culture of distrust and some pressures to report only good news can cause the less application of EVA. Therefore, this study attempt to highlight the contribution of EVA in improving the cost performance in the construction industry.

1.4 RESEARCH OBJECTIVE

The objectives of this study are:

- I. To study the relationship between the Earned Value Analysis and cost performance in construction project.
- II. To determine the effect of Earned Value Analysis in construction project.

1.5 RESEARCH QUESTIONS

The specific research questions are:

- I. How is the relationship between the Earned Value Analysis and cost performance in construction project.
- II. What are the effects of Earned Value Analysis in construction project.

1.6 THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

1.6.1 THEORETICAL FRAMEWORK

Based on this research framework is related to independent variable which is Earned Value Analysis and dependent variable is cost performance in construction project. The relationship between Earned Value Analysis and cost performance in construction project is shown in Figure 1.1.

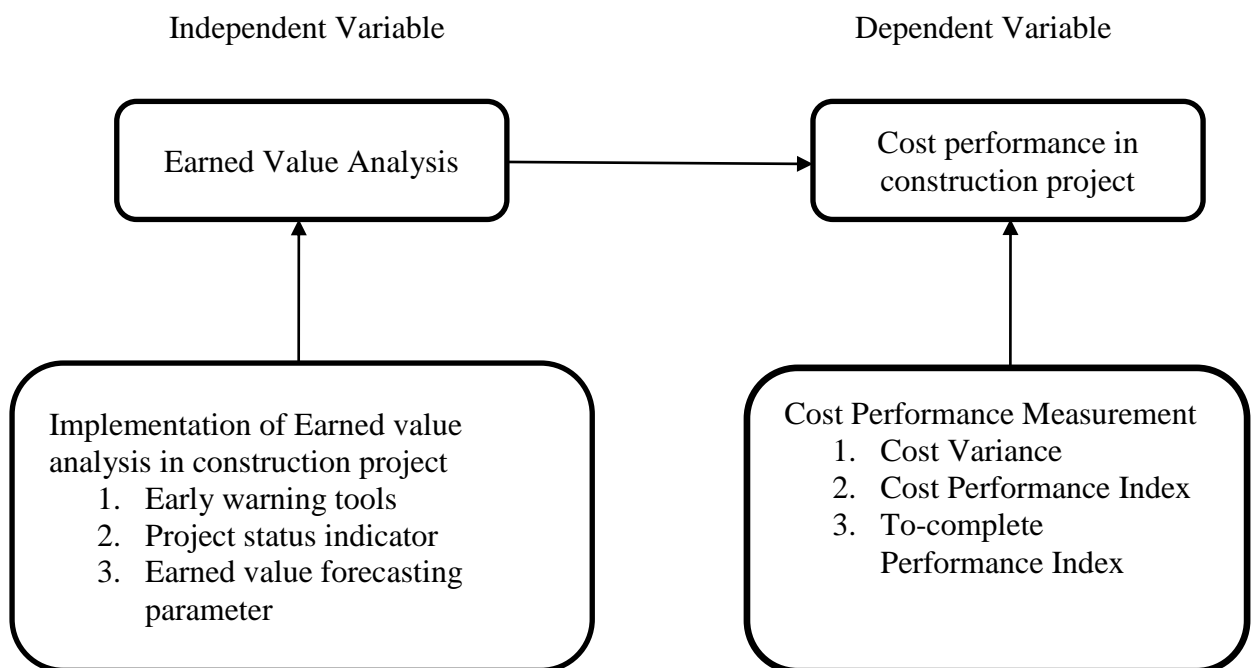


Figure 1.1: Framework Shows That Relationship Between Earned Value Analysis and Cost Performance

1.6.2 HYPOTHESIS DEVELOPMENT

H1: There is a positive relationship between the Earned Value Analysis and cost performance in construction project.

H2: There will be a positive effect of the Earned Value Analysis in the construction project.

The implementing of Earned Value Analysis is very important to manage or monitor the whole progress of the project to ensure the project performance to be measured and sustain the organizational growth. Therefore, it is important to let the project manager know about the contribution of the Earned Value Analysis toward the cost performance of the project so that can increase the usability of the Earned Value Analysis in Malaysia. They also can know more about the effect of implementing the Earned Value Analysis in the construction project. This relationship provides the theoretical support for hypothesis H1 and the effect of Earned Value Analysis is supported by hypothesis H2.

1.7 SCOPE

The scope of this research is focus on the relationship between Earned Value Analysis and cost performance in the construction project. After determining the relationship between Earned Value Analysis and cost performance need to determine the effect of the Earned Value Analysis in construction project. Therefore, the scope of this study focuses on Construction Company located in Negeri Sembilan.

In addition, the scope of this study will focus on the construction companies that are categorized in Grade 7 (G7) which were registered in the Construction Industry Development Board (CIDB) Malaysia. The Grade 7 means the company is considered big company and unlimited of capital to implement the new technique in construction project. Construction Company in this category is having unlimited of projects that need to manage so they might have the opportunity and experiences in using the EVA as a tool to monitor the cost performance of the project. Thus, the result from the perspective of the contractor or consultant in this category may more accurately.

1.8 SIGNIFICANCE OF STUDY

This study is important to discover the contribution of the EVA in order to increase the usability of Earned Value Analysis in Malaysia. Besides that, this study gives construction sector a guideline how to measure the cost performance by using Earned Value Analysis.

Then, the finding of this study can conclude that there is a relationship between the Earned Value Analysis and the cost performance. The construction manager will realize that implementing the Earned Value Analysis in a construction project is very important as a guidance to improve the cost performance and increase the productivity. The construction manager will realize that the importance of the Earned Value Analysis can widely adopt in Malaysia.

This information can provide for the future researcher a source of reference and further studies can be conducted in the near future.

1.9 EXPECTED RESULT

After completing this study, it is expected to reach the objectives that have been stated. Besides that, it can give a better view about the relationship between the earned value analysis and cost performance which are the construction company that involved in this study. Throughout this study, it is expected to find out the contribution of the EVA to increase the usability of the EVA in the construction industry.

In addition, these studies also need to find out the effect of using EVA leads the improvement of construction project. Furthermore, this study can provide a guideline to the construction manager to measure the project performance. Therefore, when the company has applied this EVA technique can measure the project performance effectively.

1.10 SUMMARY

This chapter mainly described the necessary procedures to conduct a research. The main purpose of this research is to study on the relationship between the EVA and the cost performance. In addition, this study also will determine the effect of the EVA in the construction project. The objective of the research will be the elementary of the whole research.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter consists of the review on past literatures that related to the research objectives, which includes the relationship of Earned Value Analysis (EVA) and the cost performance of construction project and the effect of the EVA in the construction project.

2.2 INTRODUCTION OF EARNED VALUE CONCEPT

In Malaysia, the construction industry is one of major industry contributing significantly in the growth of socioeconomic development. There is nearly 3.3 percent of the Gross Domestic Product (GDP) that contribute by the construction industry and many foreign workers come to Malaysia work on the construction industry. Thus, the growth of the construction industry is very important that can affect the economy of the country. The increasing of the GDP as a promoter also will affect the improvement of the other industries.

In the construction industry, cost is a major consideration in the project and is an important parameter of a project. The proper cost management is the major force that can make the project successful (Azhar et al., 2008). In the project life cycle include initiation, planning, execution, monitoring and controlling and closing. Throughout the project life cycle, cost will incur at all the stage of the life cycle. In order to manage well the cost in project, the project control tool is a basic requirement for tracking cost, time, and quality in a construction project.

In construction industry, there are many companies search for tools and technique that can improve the project performance. EVA is a useful technique to monitor and measure the accuracy of the cost performance to provide the better understanding about the progress of the projects. Earned Value is an enhancement over traditional accounting progress measures such as day to day monitoring, monthly or weekly management reports and others. Traditional accounting method is focused on planned accomplishment and actual cost. On the other hand, Earned Value is focused on the actual accomplishment of the projects. This gives managers greater insight into potential risk areas. Consequently, managers can create the risk management plan based on the actual cost, schedule and technical progress of the work. Lukas (2008) stated that EVA is comparison between the progress and budget of the work packages to plan work and actual costs. Furthermore, EVA is a quantitative technique to measure the performance of the project and predict the final result of the project.

Earned Value Management (EVM) is very important in order to implement the EVA to monitoring the progress of the project. Marshall (2007) mentions EVM is a project management methodology for controlling a project. The methodology addresses many project management areas, including project organization, planning, scheduling and budgeting, analysis, reporting and others. EVM is integrated the cost and time to measure the performance of the project and includes the work breakdown structure and S-curve. The work package of WBS will consist of estimation of cost, time and rolled up to another level of WBS element. In S-curve consist of baseline which is use planned value to draw it. Actual Cost (AC) and Earned Value (EV) are calculated to form another unique curve to compare with the baseline. The S-curve can provide the latest information to the stakeholder and monitor the project as well.

Bhosekar and Gayatri (2012) stated that Earned Value Management System (EVMS) is a guideline, procedure, process, tools as a company's management control system. EVMS is a guideline to help the managers to implement the EVA in order to monitor the project status. If there is cost overrun occurs, project management team may reduce the scope and quality in some sections of project or providing additional budget to cover the cost overrun. Therefore, organization needs to have EVMS to ensure the

project manager can follow the guideline of EVMS in order to guide the management team in a right direction.

2.3 BACKGROUND OF EARNED VALUE MANAGEMENT

Earned Value Management (EVM) is a project management methodology for measuring financial and project performance. According to Naderpour and Mofid (2011) stated that EV concept was discovered by the industrial engineers over a century ago. The industrial engineers discover planned factory standard and actual factory hours do not provide an accurate measurement of the true cost. However, when the industrial engineers convert the planned factory to the earned standard and relate the earned standard to the actual hours cause they start to focus the real cost performance.

In 1967, EVM was introduced by the U.S. federal government as an integral part of the Cost/Schedule Control System Criteria (C/SCSC) to understand the aspect of financial and as a methodology to measure the true cost performance. During the 1980s the methodology emerged as a project management tool and available to other industries. However, Earned Value concept unable to adopt by the industry until the 1990s that the industry adopted the concept, renamed it as EVMS, and established a formal Earned Value process (Workman, 2006). Industry recognized the previous Department of Defense (DoD) criteria and categorized 32 criteria into following five sections:

- I. **Organization:** Activities that assign the task and the scope of the work.
- II. **Planning and Budgeting:** Planning the activities, estimation, budgeting and authorizing the work.
- III. **Accounting:** Calculate all the cost of material and work needed to complete the work.
- IV. **Analysis:** Activities to compare budgeted, performed, and actual costs; analyze variances; and develop estimates of final costs.
- V. **Revisions and Data Maintenance:** Activities to incorporate internal and external changes to the scheduled, budgeted, and authorized work.

These five categories are very useful for the complex project because effectively manage the project with a common sense approach. Initially, U.S government managed the project by using EVM as a government contractual mandate. Since 1996, EVM will implement for the government contractual requirement has transferred into private sector of manager that also will use it as a project management tool when the emerging of EVMS (Fleming and Koppelman, 2010). In USA, the EVMS as a set of guideline, practices, and procedures were defined by the Department of Energy to help the manager make decision making and help in managing the risk. In 1998, the EVMS criteria were adopted by the American National Standards Institute/Electronic Industries Alliance Standard 748, Earned Value Management Systems (ANSI/EIA-748). Thus, in almost 50 years, EVM has developed from a concept used primarily in the military to an industry standard. The project manager can use EVMS as a guideline to manage the project and Earned Value Analysis technique to measure the project performance.

Table 2.1: EVM Progress Timeline

Year	Event
1967	Cost / Schedule Control System Criteria (C / SCSC) introduced by the U.S. Department of Defence (DOD)
1972	First C / SCSC Joint Implementation Guide issued to ensure consistency among military departments
1991	DOD Instruction 5000.2 – Defence Acquisition Management Policies and Procedures issued reaffirming the use of earned value management
1996	DODR 5000.2 R – Mandatory Procedures for Major Defence Acquisition Program and Major Automated Information System Acquisition Programs issued. Draft industry guidelines accepted by Under Secretary of Defence and C / SCSC revised from 35 to 32 criteria
1998	American National Standard Institute / Electronic Industries Alliance published industry guidelines for earned value management Systems (EVMS; ANSI / EIA – 748-98 for)
1999	Under Secretary of Defence adopts ANSI / EIA – 748-98 for DOD acquisition
2000	Simplified earned value management Terminology, published by Project Management Institute
2005	<i>Practice Standard for Earned Value Management</i> published by the Project Management Institute

Source: (Young and Anbari, 2010)

2.4 CURRENT STATUS OF EARNED VALUE MANAGEMENT (EVM)

Nowadays, the EVM is an effective performance monitoring tool and valuable in any type of projects. The EVM becomes the great need for current project management environment because of cross-industry collaboration. EV practice has adopted widely in defense, energy, product, and software development projects.

According to Kim et al., (2003) stated that 82% of project managers that has used the EVM is accepted or strongly accepted the methodology. There are many EVM users either fully or partially implemented and computerized to help the EVM processes (Kim et al., 2003).The EVM was strongly accepted by the project manager is a proof that the EVM can effectively manage well the project performance.

In recent years, Chen and Zhang (2012) stated that there are many EVM software such Microsoft Project and Project Server, wInsight, Cobra and Open Plan have used to do the analysis. EVM is developed into a web-based visualized implementation of the system by converting the project data into manageable information that can assist the managers to monitor the project performance. The advancement of the technology has attracted more users to adopt the EVA because it can easily monitor the progress by using software. Moreover, there are many companies starting to provide the EVM service package such as web-based EVM training and tools implementation and training. An effective web based EVM can increase the mutual trust, knowledge sharing and relational consensus between the contractors and stakeholders. Furthermore, web based EVM training can increase the worker's knowledge and get support from the top management.

According to Bower (2007), in 1995 International Performance Management Council was created by the defense departments of Australia, Canada, and the USA to facilitate mutual development in the EVM field. Today, Australia and Canada have adopted this technique by establishing the US similar EV criteria and industry standards in government and private sectors. Furthermore, Japan joined the EVM community through its Ministry of Construction(Song, 2010). In European countries, the EVM techniques were widely adopted in UK and Sweden.

However, Narbaev and De Marco (2011) stated that the construction industry is still facing difficulties to adopt the EVM in the project that can help managers to effectively monitor the project and predicting the result of the project. In order to enhance the adoption of EVM in the construction industry, the choice of EVM form with an appropriate selection of its criteria is very important in order to monitoring and controlling the project well. There are many proper selection of EVM practice standards

such as (PMI 2011), ANSI/IEA-748 (the US National Defense Industrial Association), DoD's C/SCSC (the US DoD), and similar EVM guides for the UK, Australia, and Canada(Song, 2010).

2.5 EARLY WARNING TOOL

Time and cost overrun usually will occur in the beginning of the project but the project manager do not realize until they cannot achieve the objective of the project (Alvarado et al., 2004). In order to minimize the time and cost overrun, EVA as a project monitoring tool to monitor the progress of the projects. By using EVA, the project manager can examine the true performance of the project to know the latest progress of the project and identify the problem of the project. Earned Value provides an "Early warning" signal for do corrective action.

Early warning signal is given a notice to the project managers when the project is in a trouble situation. This can provide alerts to the company's management to avoid some crisis in the project. Project managers can manage the project by referring the objective cost and time estimated which can enhance the probability of the project success. According to the PMI (2005), EVM is one of the most effective performance measurement and feedback tools for managing projects and enable the manager to involve in the project management cycle which is plan-do-check-act. The earned value metrics are set up as a warning signal to detect in an easy and efficient way in the project.

Furthermore, early warning signal can help the project team to reduce the risk or uncertainty in the project. The project manager can have a clear picture about the current stage of the project and know the current risk may occur in the project. The warning signal can alert the project manager to do the contingency plan in order to mitigate the risk that happen in the project. This can support by Nagrecha (2002) as EVA act as an early warning project management tools to identify the problem before loss control.