UNIVERSITI PUTRA MALAYSIA

DEVELOPMENT OF VISUALIZED EARNED VALUE MANAGEMENT TOOL FOR PROJECT MANAGEMENT

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DEVELOPMENT OF VISUALIZED EARNED VALUE MANAGEMENT TOOL FOR PROJECT MANAGEMENT

By

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This research presents an application framework named, Visualized Earned Value Management System (VEVM) for assessing project performance along initiation, planning, execution and closure phases by deploying earned value (EV) analysis and possible integration with existing project management database system. The existing system is named as Electronic Project Status Report (ePSR) which developed by Continental Ag. First part of this study was to evaluate the acceptance among project management practisioner on earned value management method thru conducted survey. This study also attempts to solve problem and promote EV to project manager and project stake holder in handling complicated, dynamic and massive project information especially when changes to the project baseline which is unavoidable. Thus, it is crucial for a project manager to have a comprehensive yet simple system to use in order to assist project manager in managing these deviations to ensure project are kept in the plan path and complying to the triple constraints in project management which are time, cost and scope. This research contributed on development of VEVM in order to provide graphical information about the project status which also serves as a control technique to monitor the project status on cost control, schedule performance and to provide early alert for corrective action on highlighted deviation from the project baseline. Through feasibility study, it has been shown that the visualized system provide an objective measures of the work that project manager can access project achievement by converting the project data into manageable information clusters and in parallel promoting the earned value management method as an effective tool to monitor and control project constraints which are cost, timeline and scope. Analysis based on project actual data used , showed that the developed visualized EVM tool is able to provide project actual and forecast trend status in term of execution as early as G30 phase on the development PLC. The problem faced claimed by project management practioner such as EVM is a complicated tool to understand and taking too much time to manage are overcome with usage of the developed

visualized earned value management system. The graphical information and triggering features in the sdeveloped tool provides quick and easy understanding of the project health at various stages of the project-life-cycle.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Kejuruteraan

PEMBANGUNAN PERALATAN PENGURUSAN NILAI MENGURUS VISUALISASI UNTUK PENGURUSAN PROJEK

Oleh

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Kajian ini mengutarakan satu applikasi yang di namakan sebagai Sistem Pengurusan Nilai Perolehan Secara Gambaran VEVM untuk menilai kemajuan sesuatu projek semasa perlaksanaan. Sistem yang diguna pakai adalah "Electronic Project Status Report" yang di bangunkan oleh syarikat Continental Ag, Germany. Tujuan kajian dibuat adalah untuk menyelesaikan masalah yang dihadapi oleh pengurus projek dan pihak berkepentingan dalam projek untuk mengendalikan maklumat projek yang rumit dan dinamik terutamanya apabila perubahan kepada garis dasar projek yang tidak dapat dielakkan. Oleh itu, pengurus projek memerlukan sistem yang komprehensif dan mudah digunakan untuk membantu proses menguruskan masalah yang dihadapi disamping memastikan projek disimpan dalam laluan rancangan dan mematuhi segala kekangan. Kajian ini menyumbang kepada pembangunan VEVM untuk menyediakan maklumat grafik tentang status projek dan juga berfungsi sebagai teknik kawalan untuk memantau status projek kawalan kos, prestasi jadual dan memberi amaran awal untuk tindakan pembetulan. Melalui kajian yang telah di lakukan, dengan menukar data projek kepada maklumat gambaran yang lebih mudah diuruskan dapat menyediakan langkah-langkah objektif dimana pengurus projek boleh menilai pencapaian kemajuan projek. Di masa yang sama, sistem ini juga menggalakkan dan mempromosi penggunaan kaedah pengurusan perolehan ini sebagai peralatan yang effektif dan mudah untuk memantau dan mengawal kekangan projek iaitu kos, jadual dan juga skop. Analisa menggunakan data sebenar projek menunjukan, sistem gambaran visual EVM mampu menyatakan maklumat mengenai status keadaan sebenar project and juga unjuran status projek se awal fasa G30 di dalam PLC pembangunan. Masaalah yang di hadapi of pengamal pengurusan projek di dalam penggunaan EVM seperti kerumitan penggunaan peralatan dan kesukaran memahami taksiran dari EVM dapat diatasi dengan menggunakan sistem gambaran EVM ini. Gambaran visual dan juga ciri-ciri lain yang dibangunkan di dalam peralatan ini dapat

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This thesis was submitted to the Senate of University Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Engineering. The members of the Supervisory Committee were as follows:

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CHAPTER 1

INTRODUCTION

1.1 Background

Automotive industry in Malaysia has seen rapid growth and changes since the last 15 years. Contributing to some MYR 30 billion to the country gross domestic product in year 2014 (Raupach et al., 2014) (Le Quéré et al., 2015), the automotive is still a key economic engine in the nation. Local automotive vendors and original equipment manufacturer (OEM) have a massive pressure to develop to a level of international competitiveness. Holistic approach will have to be considered by vendors and OEMs to improve their product and services to sustain and grow in this industry. As such, intensive and effective strategy need to be deployed starts from the beginning which is product development stage.

For a typical development of an automotive component, along the execution phase of the development, it is often happen that, changes to the project baseline is not avoidable and necessary. This will cause deviation to the project plan and budget thus the project goal accordingly. Therefore, it is critical for a project manager to have a triggering and monitoring system that will assist project manager and stake holders in managing project deviations.

Often, in some instances, the changes are so rapid that could be coming from the customer or even initiated by the project execution itself. The changes could be from any areas of the project involving change of specifications, shift of project timeline, changes in project budget or any other possible changes that deviated from the project initial plan. When this occurs, the project manager will have to evaluate the impact to the project triple constraint which is the cost, timeline and scope. These changes will introduce risks to the project and the identified risk will have to be managed to avoid failure in meeting project goals and target.

The performance of a project manager is usually appraised based on project key performance indicator (KPI) which mostly derived from the project triple constraint. In product development projects, the main KPI are normally the product profitability which are measured by the product return of sales (ROS) and the internal return rate (IRR) for the capital deployed to fund the development. There are three important awareness that a project manager need to observe in managing a project which are;

a) Knowing the project status on the schedule
b) Knowing the project status on the budget
c) Knowing what are the completed task and what need to be done more.

In assisting the project manager to manage the project, there are many method available and can be used depending on the type and complexity of the project. Among popular methods are Critical Path Method (CPM) (Kelley and Walker 1959) Program Evaluation Review Technique (PERT) (Cottrell 1999; Roman 1962), Monte Carlo Simulation (Kwak and Ingall 2007), S-Curve (Cioffi 2005), Time-Priority Allocation Scheduling Technique (TAPAS) (Kolisch 1996) and least explore method, Earned Value Analysis Method (EVM) (Hunter et al., 2014; Anbari 2003; Vandevoorde and Vanhoucke, 2006).

All methods available serve the same purpose which is to gauge the progress and report the project execution status against the project initial plan. Even they are quite similar and project manager can actually use either of them to access the project progress on a specific task. Some method and technique are focusing on project schedule thru project work breakdown structure, the financial impact on the project budget are noticeably neglected. Small and quick changes deviated from the project baseline were implemented with the assumption that it would not impact the project total budget. However, this, accumulated changes in the end can significantly damage the project profitability and easily caused project budget overrun.

Nonetheless, EVM method provide complete evaluation of the project status which covers financially, overview of the project progress and also reliable forecast of the project schedule and budget at very early of the project execution phase.

This study will focus on EVM method due to the ability of this method to provide comprehensive evaluation of the project progress in term of schedule as well as financial side of the project (Khamooshi and Golafshani 2014). The unique feature of this method is that its ability to provide reliable forecast of the project schedule and cost at the very early stage of project execution phase. Even though, this powerful yet reliable method is available, EVM is not widely used by project manager's community in managing their project especially in Malaysia.

1.2 Problem Statement

Project management system has become increasingly important to assist project manager in handling complicated, dynamic and massive project information especially when changes to the project baseline which is unavoidable. These changes will cause deviations to the project plan, budget and project goals where it will introduce risks to the project. The identified risks have to be mitigated to avoid failure or budget overrun. Therefore, it is crucial for a project manager to have a comprehensive yet simple system to use in order to assist project manager in managing these deviations to ensure project execution are kept in the planned path and complying to the triple constraints. Therefore, it is necessary to have visualized EVM in order to provide graphical information about the project progress status that could be easily interpretated by project manager and stake holders.

1.3 Objective

The objectives of this study are the following:

1) To validate the acceptance level of EVM usage as one of the project management tool.
2) To integrate extended EVM performance indices with classical EVM performance indices in a common project management tool for assisting project performance tracking and forecasting.
3) To develop a visualized EVM system that could overcome the associated problems as mentioned in the earlier part of this chapter. The purpose of visualized EVM system should be able to cover the user, implementation, culture and system issues.

1.4 Scope of study

This study will look into product development project generally in automotive industry and in specific, the development of automotive instrument cluster panel on how the propose visualized EVM system can be incorporated into the existing project management tools. Basically, for a development of a product the project can be further categories into project types depending on the project budget, technology complexity deployed and also the time lines of the project involve. Different project management topologies will be analyzed and compared and a topology is chosen to be implemented and tested. The thesis rounds off by discussing the results and starting the further work needed.

The focus will be on the middle size project type where the budget, time line and technology used are at a moderate level. Product development of meter cluster project involves four sub discipline work breakdown structure which are mechanical design, software development, electronic design and product verification and validation test. Each sub discipline activities are link in one project master schedule for planning and tracking of the project execution. The project master schedule is further organized into four stages of project phases which are the initiation phase, planning phase, execution and monitoring phase and closure phase. For the purpose of EVM analysis in this study, only the 1st level of the project work breakdown structure will be considered. To test the propose visualized EVM system, it is assume that other factor such as resources change, engineering change, and project organization change will remain constant from the project baseline.

1.5 Thesis outline

The thesis introduces the concepts the use of project management tool to assist project manager and project team in handling complicated, dynamic and massive project information and activities. Chapter 2 cover the literature review of the commom topologies used in project management. The topologies are compared and one is chosen to be analysed futher and implemented. The methodology describes the detail analysis of the EVM. The thesis rounds off by discussing the results and stating the further work needed. Abbreviations are listed in the nomenclature placed immediately after the table of contents.

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