

**STRATEGIES TO MEASURE PROGRESS
AND PRODUCTIVITY IN MODEL-BASED
CONSTRUCTION PROJECTS**

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Pada alaf ini, banyak projek-projek pembinaan yang semakin berkembang dan untuk memastikan kecekapan dan kelancaran projek-projek ini, pengukuran kemajuan pembinaan yang tepat sangat diperlukan. Kemajuan dan pengesanan produktiviti yang dilakukan secara manual semasa ini adalah sangat memakan masa dan mempunyai kemungkinan yang tinggi untuk berlakunya kesalahan. Serentak dengan kemajuan kita ke arah projek-projek pembinaan moden, kita memerlukan alat dan teknik yang betul bagi memastikan ukuran kemajuan yang tepat. Pada masa kini, kita mempunyai teknologi berasaskan model untuk membantu mengukur kemajuan tersebut. Walau bagaimanapun, kesusasteraan semasa tidak menyediakan strategi yang tepat mengenai bagaimana untuk memanfaatkan model dalam mengukur kemajuan atau produktiviti. Kajian ini meneroka strategi semasa dan potensi untuk mengukur kemajuan menggunakan teknologi berasaskan model. Data kualitatif dari wawancara individu dengan pengamal industri yang telah berpengalaman dengan projek pembinaan berasaskan model dianalisis. Penemuan kajian akan menambah kesusasteraan semasa dengan menyediakan strategi pengukuran kemajuan dalam pembinaan berasaskan model.

ABSTRACT

These days more construction projects arise and to ensure the efficiency of these projects, precise construction progress measurement is needed. Current manual progress and productivity tracking are very time consuming and have a high possibility for error to occur. As we are advancing towards modern construction projects, we require tools and techniques in ensuring accurate progress measurement. Nowadays we have model-based technologies to assist in measuring those progress. However, current literature does not provide with proper strategies on how to benefit the model in measuring progress nor productivity. This study explores the current and potential strategies to measure progress using model-based technology. Qualitative data from individual interviews with industry practitioners that have experienced with model-based construction projects were analysed. It can be said most of the companies in construction industry prefer the real-time construction simulation. The findings of the study will add to the current literature by providing the strategy of progress measurement in model-based construction.

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LIST OF SYMBOLS

LIST OF ABBREVIATIONS

ADC	Automated data collection
APM	UK Association of Project Management
BIM	Building Information Modelling
BoK	UK Body of Knowledge
CIDB	Construction Industry Development Board
CPM	Construction Project Management
CREAM	Construction Research Institute of Malaysia
ICT	Information and Communication Technology
IT	Information Technology
VDC	Virtual design and construction

CHAPTER 1

INTRODUCTION

1.1 Introduction

Construction project management (CPM) is the process of controlling the overall progress of a project to ensure the success of its objective. It is the party that is responsible for handling the planning, execution and coordination of a construction project. CPM tasks will not stick to just one field area, but it will cover all fields involved in the construction project. Hence, it is crucial to acquire sophisticated knowledge such as finance, law, building process, mediation, business and also the ability to solving problems in CPM. A construction project manager is the one who is responsible in ensuring that a project is executed according to plan and the primary purpose is to manage the project so that it will finish on schedule and within the budget given, but still obey the plan, code and specification of the project. As developed by Project Management Institute, there are five phases of construction project management which is, Initiation, Planning, Execution, Performance and Monitoring and Closure. In this case, we will be looking at the Performance and Monitoring phase. This phase happens concurrently with the execution phase as it is necessary to track the performance to ensure that the process is in line with the overall plan (Golparvar-Fard et al., 2009).

Model-Based Construction Projects or known as Virtual Design and Construction (VDC) is the use of an integrated multi-disciplinary performance model in design and construction projects to help with the project's goals as stated by Cerovsek (2011). It is mainly a virtual concept where they describe the project in term of computer-based. These models are logically integrated, where every parties that involve (user) with the project have access to the data and information shared, and if somebody makes any changes to the data, everyone will be able to see the changes made. Model-based has three different phases and each phase has its value proposition, strategy for producing

value and also cost. The first phase is Metric and Visualization, where they perform a 3D model of the overall project including the design, construction, operation and management (Meža et al., 2014). The second phase is Integration. In this phase, the computer-based automated method is produced in order for the user to exchange data. The last phase is the automation phase, where automated methods helps perform routine design task. Nowadays, VDC has been implemented in many countries including Malaysia although it is still not widely use as it is new to Malaysia (Latiffi et al., 2013).

1.2 Problem Statement

Current CPM progress measurement may not track the project progress accurately as mostly the project manager did not collect data through objective method or criteria. Since the process is time consuming, the project manager usually will collect the data mainly based on their own individual experience or subjective judgement. This may lead to the limit of consistency, accuracy and objectiveness of the data. The manual data collection and extensive data extraction from different construction documents, will distract manager from the important task of decision making. Furthermore, the formats of reporting used in industry nowadays may not able to completely and quickly communicate project progress. This leads us to the weakness of current CPM progress measurement which is, it is time consuming and require tedious work as we need to collect data from construction drawings, schedules and budget information too. The quality of progress control depends on the quality of the inspector's field reports, which may sometimes contain entry mistakes and usually it is very low (Zhang and Arditi, 2013).

VDC has become known and established in the construction industry in Malaysia. Most of the owners or clients require using this technology in their project and will pick the construction manager, engineers, architect or companies that implement this method in their proposal. As stated by (Aryani Ahmad Latiffi et al., 2013), this method can enhance and improve planning process, design and construction of projects. There is a lot of other benefits of VDC in Construction Project Management such as, time and cost effective, the data is more frequent, increase accuracy of the data collection and also it improves communication and collaboration between parties involved in the projects. We can see that, dozens of benefits can be obtained from implementing this method in CPM

but how the benefit can be obtained is still indistinct. From the literature review that I have done, it is still unknown on the strategy or method on how to measure progress and productivity in construction using this method. Hence further research is required in order for me to be able to understand the most feasible strategy in using VDC for construction project management

1.3 Research Objective

The main purpose of this research is to explore the feasible strategies for measuring progress in model-based construction project. In order to achieve this, several objectives are identified as follows:

1. To determine the common strategies that currently be used to measure construction progress.
2. To investigate the challenges in implementing these strategies.

1.4 Research Scope

For this research, I have decided to interview Construction Manager, Project Manager and BIM Manager of G7 companies under CIDB. This is because, mostly, only big companies are the one who involve with bigger and complex projects and usually this complex projects will require the usage of VDC in their project especially in the performance and monitoring phase.

This interview will not only cover certain part of area, as the targeted candidates are open to whole Malaysia and also from Singapore. As we all know, model-based construction projects are still new in Malaysia, so I was hoping as my target is not limited to certain area only, I am able to collect as many as relevant data as possible.

1.5 Significance of Research

Although it is proven that there is a lot of benefit of VDC in construction project management but how we can obtain the benefit is still unknown as the method to measure progress in model-based construction projects is still unclear to the construction industry in Malaysia. By conducting this research, it can improve the understanding to the current industry on the method to measure progress and productivity in model-based construction

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