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Performance Monitoring Model for Time and Cost Efficiency in Building Construction Projects: An Empirical Study

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ABSTRACT

Objective: *This study aims to develop and evaluate an integrated performance monitoring model based on Earned Value Management (EVM) and Building Information Modeling (BIM) to improve time, cost, and quality efficiency in building construction projects.* ***Method***: *A quantitative case study approach was applied using data from 204 building construction projects in Indonesia. The analysis employed Earned Value Analysis (EVA), correlation analysis, and multiple linear regression, supported by SPSS and BIM-based simulation tools.* ***Results***: *The findings show that 50% of projects achieved a Cost Performance Index (CPI) between 1.0 and 1.1, while 60% recorded Schedule Performance Index (SPI) between 0.9 and 1.1. In addition, 75% of projects met quality standards based on the Quality Performance Index (QPI). The integrated model significantly improves early detection of project deviations and enhances corrective action efficiency.* ***Novelty***: *The novelty of this study lies in the integration of Earned Value Management (EVM) and Building Information Modeling (BIM) into a unified performance monitoring framework that enables real-time, data-driven decision-making for cost, time, and quality control in construction projects under external uncertainty conditions.*

INTRODUCTION

Building construction projects are an important sector that supports infrastructure development worldwide, especially in developing countries such as Indonesia. In recent decades, the demand for commercial, residential, and public facilities has continued to increase along with population growth and urbanization. However, despite the increasing need for infrastructure, building construction projects often face significant challenges related to implementation time and costs. Inaccuracy in project planning and execution often causes delays in completion and budget overruns. This phenomenon, in addition to impacting the company's productivity and reputation, also reduces the overall efficiency of the project (Memon et al., 2011).

Many construction projects experience delays due to inaccurate planning, design changes during the construction process, and lack of effective coordination between project stakeholders. These conditions result in significant cost increases, especially during critical phases of construction. In addition, external factors such as macroeconomic changes, government regulations, and construction material market conditions also contribute to uncertainty in the implementation of building construction projects (Aziz, 2013). Therefore, a comprehensive monitoring approach is needed to monitor project progress in real-time, so that deviations from the initial plan can be identified early on and corrective actions can be taken immediately.

Earned Value Management (EVM) is one of the most widely used methods to monitor the performance of construction projects, especially in terms of time and cost management. EVM provides important indicators, such as the Cost Performance Index (CPI) and Schedule Performance Index (SPI), which help project managers in evaluating project performance