

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Project control plays an important role in supporting the successful implementation of construction projects at Company, particularly in ensuring the achievement of schedule and cost targets through the monitoring of schedules, Budget Plans (RAB), actual costs, and WBS-based physical progress. However, the monitoring process, which remains manual and not yet fully integrated, often causes inconsistencies in PV, EV, and AC information, delays in deviation identification, and corrective responses that tend to be reactive. Consequently, these conditions may lead to project delays and cost overruns in subsequent periods.

Therefore, this study designed a weekly project control Business Intelligence (BI) framework integrating EVM, XGBoost prediction as a $t + 1$ early warning mechanism, and Lean Construction-based corrective action recommendations. Based on the research findings and discussion, the following conclusions were obtained:

- 1) The weekly project control Business Intelligence (BI) framework at PT Royal Project Management was designed by integrating schedule data, Budget Plans (RAB), actual costs, and WBS-based physical progress into weekly PV, EV, and AC components to ensure consistent performance information. PV was derived from scheduled planned costs or weekly RAB data, EV was derived from WBS-based physical progress converted into

earned values, and AC originated from actual project costs. These data were processed to generate EVM indicators and S-Curve analysis, which were then visualized within a dashboard as measurable and easily interpretable weekly monitoring information.

- 2) The XGBoost model was successfully utilized to predict next-period performance deviations as an EVM-based early warning mechanism by predicting EV and AC for the subsequent week and then deriving projected indicators such as SPI and CPI. Walk-forward evaluation results showed that XGBoost outperformed the baseline model, with EV prediction results achieving a MAPE of 3.81% and MAE of 9,041,938, compared to the baseline MAPE of 4.89% and MAE of 11,604,457. Meanwhile, AC prediction achieved a MAPE of 1.16% and MAE of 2,763,343, compared to the baseline WMAPE of 7.06% and MAE of 16,825,022. These results indicate that the model is capable of providing look-ahead signals, particularly for cost-related risks.
- 3) The predicted deviation results were integrated with Lean Construction principles to generate corrective action recommendations through a rule engine that converts actual indicators (t) and predictions ($t + 1$) into operational risk statuses (Normal, Alert, Critical). These risk statuses were mapped into Lean-based SOPs and action logs, enabling the system not only to detect risks but also to recommend corrective actions such as: constraint elimination (look-ahead/ready work), work sequence rescheduling, material

waste and rework control, and measured resource additions for critical activities to prevent deviations from becoming more severe.

5.2 Recommendations

Based on the research results, several recommendations can be proposed to improve the implementation of weekly project control at PT Royal Project Management and for future studies:

- 1) PT Royal Project Management is recommended to implement the Lean Construction-based corrective action SOPs developed in this study as part of routine operational processes through weekly monitoring, assignment of PICs and follow-up deadlines, as well as verification of implementation evidence within the action log. Thus, the project control system will function not only as a reporting tool but also as a closed-loop control mechanism to prevent project deviations from escalating further.

- 2) The company is advised to implement the Business Intelligence (BI) system in an integrated manner within weekly project monitoring and control processes. BI implementation can assist the company in monitoring project indicators in real-time, detecting potential deviations earlier, and supporting faster and more targeted decision-making.

- 3) The company is also advised to calibrate the risk-status thresholds within the rule engine. This calibration should be adjusted based on evaluations from multiple projects and the company's management policies regarding risk appetite. With appropriate calibration, the early warning system can

produce alarms that are more proportional and neither overly sensitive nor excessively lenient.

- 4) For future BI system development, automatic data input integration is recommended to reduce human error and accelerate dashboard updates. In addition, the implementation of role-based access control is also recommended so that each role receives information according to its needs and responsibilities.
- 5) Future studies are recommended to utilize larger training datasets, either by combining data from multiple similar projects or by extending project historical records. The addition of more data is expected to improve prediction model reliability and reduce the risk of overfitting.
- 6) Future research is also recommended to incorporate supporting variables such as: field constraint logs, material or vendor delays, weather conditions, design changes, and rework or quality inspection activities, so that corrective action recommendations can become more accurate and targeted.
- 7) To obtain stronger findings, future studies are recommended to test the BI system across more projects with different characteristics in terms of scale, type of work, and complexity level. This is important to evaluate the consistency of system performance and assess the extent to which the developed model can be implemented more broadly.