

## **Selection of Project Duration Forecast Method Using Earned Value Metrics**

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### **Abstract**

Earned value management (EVM) is a project control system that considers technical performance, schedule and budget. It offers an early warning method to know the need for corrective actions in the project. It was created to control project costs so it has not widely been used to control the project duration.

There are some EVM-based proposed methods, focusing on time control, that measure time performance to support the making decision process. Those systems, offer the possibility of forecasting final project duration in addition to performance measurement. This paper shows the result of a research project that evaluated the application of EVM, and other EVM-based systems, such as Earned schedule (ESM) and Earned duration (EDM) management, to forecast project duration.

In first place it was identified the metrics and schedule forecast procedure of each method, to later conduct the field research in construction site to build the data set of metrics. the project was monitored for reviewing control information. Performance information uncompleted or not clear were consulted with project manager. Every week was calculated earned value metrics and forecast according to each method and some scenarios. First scenario supposed that previous project performance would not affect future performance; the second scenario supposed that previous time performance would affect it; and the third scenario supposed that previous time and cost performance would affect future performance.

Finally, it was evaluated the performance of methods under every scenario. The mean and standard deviation were calculated to establish the difference to the real project duration and a complementary analysis was conducted to measure the forecasts reliability through accuracy and precision measurement. It was used the Mean Absolute Percentage Error (MAPE) to measure accuracy, and the Standard Deviation of the MAPE to evaluate precision. Both measurements were applied on every monthly forecast that every method offered during the construction phase of the projects.

The comparison among methods was made through a case study from the construction industry. A project scheduled for 19 weeks, which actually took 23 weeks. The monitoring and control meetings had a weekly base due to the duration of the project. Considering this, forecasts were calculated every week after every control was done. Information used to estimate final duration was extracted from weekly status reports and occasionally meetings with the project manager were held to understand problems and decisions.

With a forecast average of 24 weeks, the closest forecast to the real project duration was ESM, even considering that previous performance problems would affect future performance. Considering general results by scenario, it could be seen that the forecast increased as the scenario changed from scenario 1 to 3. Consequently, not considering previous performance produced more optimistic forecast in the case study. The research found that earned value methods are good proxies to forecast final project duration during the construction phase. The ESM, an EVM-extension, uses time units instead of cost units, was the best method to forecast final project duration.

### **Keywords**

Forecasting, earned value management, earned schedule management, earned duration management

### **Biographies**

**Juan Pablo Ibarguen** holds a B.Sc. in Industrial Engineering from Universidad del Valle, Cali, Colombia.

**Leonardo Rivera** holds a B.Sc. in Industrial Engineering from Universidad del Valle, Cali, Colombia; an M.S.I.E. from Georgia Tech and a Ph.D. in Industrial and Systems Engineering from Virginia Tech. He worked at a private university for 17 years, and currently works at the School of Industrial Engineering at Universidad del Valle as the Coordinator of Graduate Programs. His research interests include Lean Manufacturing, Logistics and Supply Chain, the Layout of Facilities and Distribution Centers, applied Mathematical Modeling and Programming for Industrial Engineering. He has published 18 papers in domestic and international journals and five chapters in research books.

**Alvaro Cuadros** is currently a PhD. student in Engineering Doctoral program at Universidad del Valle. Mr. Cuadros holds a B.Sc. in Industrial Engineering and MBA degrees from Universidad del Valle, Cali, Colombia. Member of PMI and PMI Pacífico chapter, and of the Iberoamerican network of Project Engineering. Full time professor since 2010. His research interests include risk management, earned value management, project scheduling, and project management maturity models.