

## A Construction Management Tool: Determining a Project Schedule Typical Behaviors Using Cluster Analysis

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**Abstract :** Delays in the construction industry are a global phenomenon. Many construction projects experience extensive delays exceeding the initially estimated completion time. The main purpose of this study is to identify construction projects typical behaviors in order to develop a prognosis and management tool. Being able to know a construction projects schedule tendency will enable evidence-based decision-making to allow resolutions to be made before delays occur. This study presents an innovative approach that uses Cluster Analysis Method to support predictions during Earned Value Analyses. A clustering analysis was used to predict future scheduling, Earned Value Management (EVM), and Earned Schedule (ES) principal Indexes behaviors in construction projects. The analysis was made using a database with 90 different construction projects. It was validated with additional data extracted from literature and with another 15 contrasting projects. For all projects, planned and executed schedules were collected and the EVM and ES principal indexes were calculated. A complete linkage classification method was used. In this way, the cluster analysis made considers that the distance (or similarity) between two clusters must be measured by its most disparate elements, i.e. that the distance is given by the maximum span among its components. Finally, through the use of EVM and ES Indexes and Tukey and Fisher Pairwise Comparisons, the statistical dissimilarity was verified and four clusters were obtained. It can be said that construction projects show an average delay of 35% of its planned completion time. Furthermore, four typical behaviors were found and for each of the obtained clusters, the interim milestones and the necessary rhythms of construction were identified. In general, detected typical behaviors are: (1) Projects that perform a 5% of work advance in the first two tenths and maintain a constant rhythm until completion (greater than 10% for each remaining tenth), being able to finish on the initially estimated time. (2) Projects that start with an adequate construction rate but suffer minor delays culminating with a total delay of almost 27% of the planned time. (3) Projects which start with a performance below the planned rate and end up with an average delay of 64%, and (4) projects that begin with a poor performance, suffer great delays and end up with an average delay of a 120% of the planned completion time. The obtained clusters compose a tool to identify the behavior of new construction projects by comparing their current work performance to the validated database, thus allowing the correction of initial estimations towards more accurate completion schedules.

**Keywords :** cluster analysis, construction management, earned value, schedule

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