Statistical Project Control

Annelies Martens wins the best Master Thesis award by *PMI Belgium* for her study on statistical project control. In her study, she compares the accuracy of three statistical techniques to predict the duration of project activities using a multi variate analysis. The thesis is very quantitative, and very condense (only 41 pages) and is therefore not immediately written for non-academics. However, the results illustrate the high potential of the statistical techniques for future research and the award can be seen as a good investment in the future. It is therefore our aim to continue with this research in order to write academic papers in international journals as well as to translate this excellent research domain into practical guidelines for project managers. Annelies will join our young and dynamic research group at Ghent University as from October 2014.

Summary

Since the future progress of a project is uncertain, it is important for project managers to be able to estimate how a project will evolve. The objective of this thesis is predicting activity durations of a project in progress, based on the measurements of EVM parameters.

The first phase of the experiment consisted of building predictive models based on a large training set of simulated fictitious projects. In order to build these predictive models, both existing multivariate regression methods (Principal Component Regression (PCR), Partial Least Squares Regression (PLCA)) and a newly developed method known as Priority-based Linear Component Analysis (PLCA) were applied. Contrary to PCR and PLSR, PLCA determines only one linear component for each activity. Moreover, this method ranks the project activities according to their influence on the total project duration (using the Schedule Sensitivity Index obtained by simple Monte-Carlo simulations). Information used to estimate the activity duration of the most important activity is removed from the data before the duration of the second duration is estimated. This is different from PCR and PLSR predictions, where each activity is treated equally important.

Predictive models were built for projects behind schedule, on schedule and ahead of schedule. For each of these scenarios, 900 fictitious projects (with a different topological network structure as measured by the Serial/Parallel indicator) were used to build a predictive model. In the second phase, the predictive models were used to predict the activity durations of new fictitious project runs. In order to assess the performance of the predictive models, the accuracy of the forecasts was assessed by the Mean Absolute Percentage Error (MAPE) metric.

From left to right: Mario Vanhoucke, Jacques Neyns, Annelies Martens and Dirk Huyers

Results

The results of the study can be summarized along the following lines.

A first conclusion is that the performance of the PCR predictive models and the PLSR predictive models is similar in most cases. Both methods performed better in building accurate predictive models than PLCA. The latter however is computationally less intensive.

Another important conclusion is that the least accurate predictive models were those built for projects that were behind schedule. This observation can be explained by the fact that the applied methods are linear, while the relation between the activity durations and EVM parameters is hyperbolic. For small values, the linear approximation for this hyperbolic relation is the least accurate.

Finally, the accuracy of the predicted activity durations varied for the different project activities. While estimates for certain activities were highly accurate, estimates for other activities were less reliable.

These conclusions present several opportunities for further research. One suggestion is to examine the influence of the parameter used to rank the project activities on the performance of the PLCA models. Another suggestion is to look deeper into why some activity durations are more difficult to predict than others, in order to improve the prediction methods.

Acknowledgements

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In the near future, the student, Annelies Martens, will work further on this topic at the Operations Research & Scheduling (OR&S) group as a PhD student under the guidance of Mario Vanhoucke. Preliminary results as well as academic paper conclusions will be shared with PMI Belgium on our blogs, chapter events and more. Thank you, PMI Belgium, for investing in young potential and future research. We'll be back with more results soon. Stay tuned.