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The Use of Contingency Reserves to Analyze Risk Response Actions in Project Management

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Abstract

Risks are part of the nature of projects and risk management is an important component of project management. Risks may appear in any moment and aspect of a project, producing schedule delays, cost overruns and even poor quality if they are not effectively managed. Risk management process includes the identification and analysis of risks in order to decide risk responses. Risk considerations allows the project manager to make decisions related to scope, time or cost baseline during the planning phase and to establish plans to be used during the constructing phase of the project.

Risk response consists of identifying, evaluating, selecting, and implementing actions in order to reduce the probability of occurrence of the risk or reducing its impact if occurs. While risk analysis through qualitative and quantitative methods is frequently studied, the decision making process related to selecting risk responses is not so studied. There are two main approaches in this topic: the identification of risk responses and the selection of actions to accelerate the project.

The proposal is based on four steps: identification of potential risks, identification of critical risks, evaluation of risk impacts and evaluation of risks responses. Potential risks are identified through literature review, expert judgment and field research on site. Critical risks are identified through a Failure Mode Effect Analysis (FMEA) which uses occurrence and impact risk dimensions to build a risk score (RS) and the detection dimension to build a risk priority number (RPN). Subsequently, there is evaluated the probability and impact of critical risks over the project and simulated trough Monte Carlo Simulation (MCS). Finally, response actions are evaluated considering changes in logic network, risk probability and impact, secondary risks and contingency required trough MCS.

The proposed method was applied in a highway construction project. A preliminary list of 1,471 risks was reduced to 303 risks by identifying duplicated and some included in others. The FMEA allowed to identify 8 critical risks for the project. A literature review allowed to identify 227 potential response actions corresponding to the four generic strategies applied in construction industry: avoid, accept, transfer and mitigate. Specific project responses were identified and evaluated according to restrictions such as traffic management, neighborhood relationship, potential safety-casualties, construction method and site space. Three responses were identified by the experts: re-design based on additional studies; enhancing project management and working in two work fronts. The simulation was conducted for every response and impacts over the schedule were identified.

The application of the method showed advantages over main approaches in selecting risk responses. Detailed risk and response analysis allowed to understand their impact over project schedules. A decision process guided by risk

management methodology offer the chance of making risk-related decisions instead of jumping to accelerate the project.

Keywords
Risk response strategy selection, secondary risks, contingency reserve, Monte Carlo Simulation, FMEA.

Biographies
Alvaro Cuadros is currently a PhD. candidate 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. His research interests include risk management, earned value management, project scheduling, and project management maturity models.

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.

Armando Orobio is Civil Engineer and Master in Road Infrastructure from Universidad del Cauca (Colombia), He earned a PhD in Civil Engineering from West Virginia University (EE.UU.). He is currently professor at the School of Civil Engineering and Geomatics at Universidad del Valle (Colombia) and director of the Construction Research Group. Prof. Orobio has authored several international scientific articles and an international research book. His research topics are Highway construction, construction planning, construction management, and pavements construction.