

Development of a Framework to Determine the Relative Weights of the Contextual Factors for Complex Highway Projects Using Analytic Hierarchy Process

Akanksha Sinha, MSc. and Mehmet E. Ozbek, Ph.D. and Kelly C. Strong, Ph.D.

Colorado State University
Fort Collins, Colorado

Traditional project management strategies for highway projects originated with the advent of new construction during the 1950s and 1960s focusing on three dimensions of complexity i.e. cost, schedule and technical (scope). But recently with the major focus shifting towards reconstruction/ rehabilitation projects, the project management strategies also need to shift to include other dimensions rather than perceiving them as risks. A paper by Winter and Smith (2006), "Rethinking Project Management", introduced five new directions to consider while preparing a risk management strategy for complex projects. The five new directions include 1) theories of the complexity of project and project management; 2) project as social process; 3) value creation as prime focus; 4) broader conceptualization of projects and; 5) practitioners as reflective practitioners. Following this, another research was conducted by the Second Strategic Highway Research Program, R-10, to study the factors that impact the construction of complex reconstruction/rehabilitation projects. The primary outcome of the R-10 study was a five-dimensional approach to project management planning (5 DPM) that adds context and financial planning to the traditional project management dimensions of technical, cost and schedule. Experience during the pilot testing of the 5DPM implementation suggested that the most complicated dimension to assess during the project management planning phase for a complex project is the context dimension which refers to the external factors that have an impact on the project and are difficult to predict and plan before the start of the project. Currently there is no process for evaluating these factors and they are mostly perceived as risks. The R-10 research team identified 8 factor categories which are stakeholders, project-specific factors, resource availability, environmental factors, legal and legislative requirements, global and national events, unusual conditions and localized issues and 26 factors under these categories which can cause complexity.

The objective of this research is to create a framework using Analytic Hierarchy Process (AHP) to determine the relative weights of these contextual factors. Two complex projects, U.S. 34 Rebuild and I-25 North Expansion project, was chosen to test the efficacy of the AHP method. The research methodology was a three step process. In the first step, a comprehensive literature review was conducted to identify the 8 factor categories and 26 factors. In the second step, meeting was conducted with the U.S. 34 Rebuild team and I-25 North expansion team to vet the contextual factors identified in the previous step. A Likert scale of 0-2 was used to rank all the factors and the factors that scored below 0.5 were automatically eliminated and the ones that scored 1.5 and above were automatically included. The factors that scored between 0.5-1.5 were discussed upon. After the discussion, the U.S. 34 rebuild team identified 17 factors whereas the I-25 team identified 19 factors and added one more factor which they considered relevant to their project. The third and final step was the formulation of the AHP survey in which all these factors were compared pairwise. The primary reason for selecting AHP method was the requirement of pairwise comparison of intangibles derived through the literature and judgement of the experts in a structured mathematical method. The Group AHP performed further, helps the project management teams to come up with the relative weights of each of the factors as a group.

The major finding of this study was that as a group, the US 34 Rebuild team had put more value on factors under 'Localized issues' and the I-25 North Team had put more value on factors under 'Environmental Category'. It was also found that both the teams placed the lowest value to the factors under 'Global and National Events'. This framework will enable the project management team of complex highway projects to determine the relevant weights of the factors during the project management planning phase which can help them in making important decisions at the early stages of the project. Through this, the study contributes in aiding the DOTs with the framework to identify the contextual factors and prioritize them right from the start rather than perceiving them as risks. This framework completely relies on the experience and judgements of the project management teams and so lends valuable thoughts making it an interactive process and creating a valuable project. One of the ways in which the results can be used is to formulate a risk management strategy to optimally allocate the resources and form a realistic schedule.

Keywords: Complex Highway Projects, Rehabilitation, Analytic Hierarchy Process