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Accelerated construction for a bridge in rural Texas

- Accelerated bridge construction proved appropriate for a bridge in the Texas Panhandle due to a lack of alternate routes for the heavy truck traffic in the area.
- This bridge serves as a case study illustrating the use of the analytical hierarchy decision tool presented elsewhere in this issue of *PCI Journal*.

Looking at a map of the Texas Panhandle, you would not think such empty country would require accelerated bridge construction (ABC), but Gageby Creek runs through an oil patch where heavy truck traffic related to oil and gas exploration imposes significant demands on roads and bridges. The original bridge on County Route EE over Gageby Creek was built in 1967. County officials estimated that the current traffic on CR EE is 400 vehicles per day, with trucks accounting for as much as 50% of the total. Demolition and replacement were completed in a total of seven working days.

The most feasible detour route was 10 mi (16 km) long and comprised county roads too narrow to carry this traffic safely. The estimated cost of traffic delays to users exceeded $5000 per day, according to Kit Black, PE, Texas Department of Transportation (TxDOT) Amarillo District design engineer. Black indicated that local officials were concerned about the effects of a lengthy road closure on the energy industry, which is vital to the local economy. "ABC provided TxDOT much-needed positive press in the local community," he says.

Analytical hierarchy decision tool

As developed by Saeedi et al.,[1] the analytical hierarchy decision tool uses pairwise comparisons of various alternatives for a quantitative evaluation of advantages and disadvantages. Although the tool was not used in the decision in favor of ABC for this

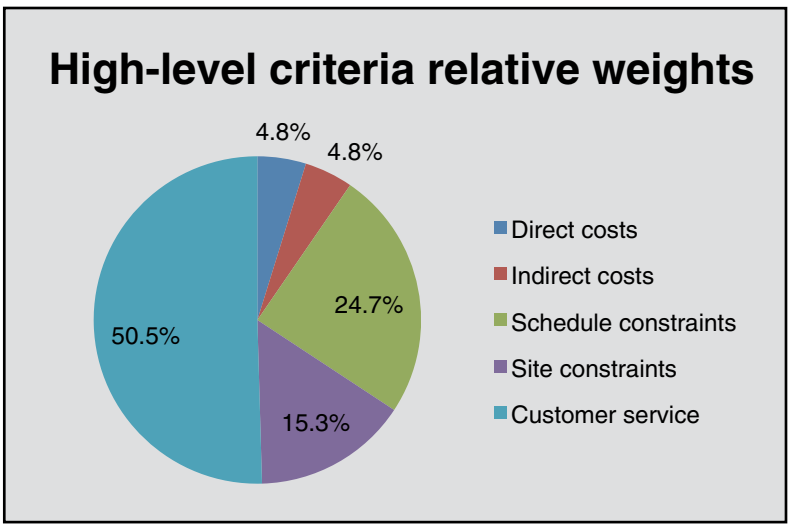
The two-lane bridge, constructed in October 2012, carries County Route EE over Gageby Creek in the Texas Panhandle.

particular bridge, it does illustrate how even a simple bridge in an out-of-the-way location may be a strong candidate for ABC.

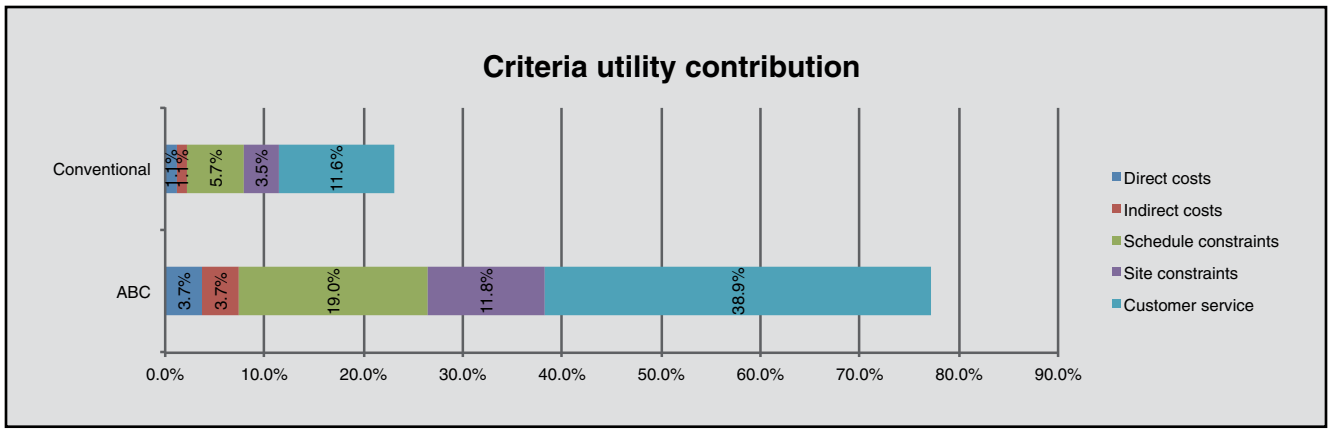
The user defines the alternatives to be considered, with the default alternatives being ABC and conventional construction.[2]

The user then rates the five high-level criteria—direct costs, indirect costs, schedule constraints, site constraints, and customer service—on their relative importance for the project by a series of pairwise comparisons. Ten unique pairs—direct costs with each of the other four criteria, indirect costs with each of the remaining three criteria (other than direct costs), and so on—are each rated numerically. If both elements of the pair contribute equally to the objective, the rating is 1. If one element is favored over the other to the highest possible degree, the rating is 9.

In the case of the County Route EE bridge over Gageby Creek, direct costs and indirect costs were rated as equally important (1), while customer service was rated as having very strong importance (7) compared with either direct costs or indirect costs. By contrast, schedule constraints and site con-



Based on a pairwise comparison of the five high-level criteria when choosing a construction method for the Gageby Creek Bridge in the Texas Panhandle, customer service received the highest weight (50.5%), followed by schedule constraints (24.7%) and site constraints (15.3%). Download the software free from http://www.fhwa.dot.gov/bridge/abc/fast.cfm



Based on a pairwise comparison of the three subcriteria composing schedule constraints, calendar, utility, railroad, or navigational constraints outweigh the other two subcriteria combined. According to Kit Black, Texas Department of Transportation Amarillo District design engineer, the need to minimize traffic detours while constructing the Gageby Creek Bridge in the Texas Panhandle was paramount. At this location there were no marine- or wildlife-related schedule constraints. Availability of resources was of some concern, but the contractor had ample time to mobilize before beginning work.

The precast concrete abutment of the Gageby Creek Bridge in the Texas Panhandle is set in place on October 9, 2012.

straints were rated 5 (strong importance) compared with direct costs or indirect costs. Based on this pairwise comparison, customer service was weighted most heavily (50.5%) followed by schedule constraints (24.7%) and site constraints (15.3%).

Each high-level criterion comprises a number of subcriteria that must also be evaluated in the same fashion. For example, schedule constraints include calendar, utility, railroad, or navigational constraints, that is, constraints that affect the timing of construction due to climate, special events, or use of railroad and navigational channels. The marine and wildlife criterion includes constraints imposed by marine and wildlife regulation, for example to minimize interference with migratory wildlife or nesting of birds. The third subcriterion is resource availability, that is, schedule constraints associated with the availability of staff to design the bridge and oversee construction. In this example, constraints due to marine and wildlife regulations and resource availability were rated as equally important (1), while calendar, utility, railroad, or navigational constraints were rated 5 (strong importance) compared with either of the other subcriteria.

The first beam of the Gageby Creek Bridge in the Texas Panhandle is lifted into place. All four beams were set in the afternoon of October 10, 2012, in just over an hour.

Customizing the hierarchy

The software allows for customizing the hierarchy of criteria. The user may remove or deactivate criteria that have little or no relevance to the project or add criteria that are not listed.[2]

When cost criteria are extremely important, the user may elect to perform a cost-weighted analysis. All cost-related criteria must be removed from the hierarchy structure so that they are not counted twice. The analytical hierarchy process is conducted without them. The user then provides actual or closely estimated costs for each alternative. The software calculates a cost-weighted utility for each alternative comparable to a traditional cost-benefit analysis.[2]

Implementing the decision tool at TxDOT

TxDOT currently does not use the hierarchical decision tool in deciding when to use ABC. Instead, each project is evaluated on a case-by-case basis using such criteria as constructability, traffic control needs, and other project constraints. However, TxDOT is using the tool on a pilot basis in its Fort Worth district. TxDOT is also developing guidelines for using ABC. The guidelines may eventually include some form of analytical hierarchy decision making, along with examples and preferred ABC techniques.

References

1. Saeedi, A., S. Emami, T. L. Doolen, and B. Tang. 2013. "A Decision Tool for Accelerated Bridge Construction." *PCI Journal* 58 (2): 48–63.
2. Doolen, T., A. Saeedi, and S. Emami. 2011. "ABC Decision-Making Software Manual." Corvallis, OR: Oregon State University.

About the authors

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Abstract

This paper illustrates the use of a hierarchical decision tool to evaluate whether to use accelerated bridge construction (ABC) to replace a bridge in a rural area. County Route EE over Gageby Creek in the Texas Panhandle carries a great deal of truck traffic related to the oil and gas industry in the area. The lack of suitable alternate routes strongly influenced the decision to use ABC. Because customer service was heavily weighted compared with other high-level criteria, such as direct and indirect costs, ABC was the favored alternative. This example shows how ABC may prove appropriate even for a simple bridge in an isolated area.

Keywords

ABC, accelerated bridge construction, analytical hierarchy, bridge replacement, decision making.

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