



Value Engineering Fine-Tuned

Case Study of New Mexico's Success

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With a results-based approach to value engineering—the technique of providing a necessary function reliably at the lowest cost—the New Mexico State Highway and Transportation Department realized more than \$140 million in savings in 1999. According to Federal Highway Administration (FHWA) statistics, New Mexico ranked first among state transportation agencies in dollars saved through value engineering and third among states in return on investment.

In partnership with FHWA, the New Mexico State Highway and Transportation Department aggressively pursues value engineering through the direct and ongoing involvement of top management. Value engineering is a tool to improve performance—a tool that management should use, not just prescribe. The result is that each dollar New Mexico invested in value engineering in 1999 produced a savings of \$404. Overall, the Department's major investment program realized \$247 million in savings.

One of the ways New Mexico measures performance is the “return on investment for value engineering projects,” calculated by dividing the amount of money saved from a value engineering study by the cost of doing the study. Improvements to this index also are accompanied by positive, measurable results in other categories, such as “innovative ideas implemented,” “average day cost by contract,” and “Interstate construction cost per lane mile.” Value engineering has had a wide-ranging impact on the overall performance of the Department in delivering products and services to customers.

Changing the Approach

The results-based approach to value engineering is important in the ongoing highway work in New Mexico, which adopted the traditional approach in 1977. The traditional approach included partnership in a design team and commitment to quality as the design team explored cost-saving alternatives. Value engineering was applied to design standards and

specifications, high-cost projects and items, construction contracts, and operations.

Initially the role of upper management was to support the idea without direct involvement in practice; however, the results were modest. Then two major changes took place: first, the Department adopted quality management procedures; second, the state undertook a major capital improvement program.

New Mexico had started its largest-ever highway program, \$1.2 billion to improve highways and develop economic corridors. The Department was able to support the program by combining innovative financing with value engineering. Top management provided the necessary vision, environment, support, encouragement, and focus.

The Department revised the value engineering practice of the previous two decades and applied new principles to several major projects. New Mexico (NM) 44 provides a good example of how the Department used formal value engineering studies and informally implemented value engineering throughout the highway's design and development.

Innovative Financing

NM 44 is a two-lane, a 146-mile state highway that runs northwest from Bernalillo, north of Albuquerque, to Bloomfield, near the Four Corners region, where Utah, Colorado, Arizona, and New Mexico meet. The road is legendary for severe automobile crashes. Although NM 44 is part of the National Highway System, improvements had been minor. Concerns about public safety, the desire to provide economic development opportunities to the northwestern part of the state, and the poor pavement condition of the highway made the construction of a four-lane NM 44 a priority.

The NM 44 project covers 120 miles of 2 lanes. The Department's initial estimate for this project would have required significant funds from the State Transportation Improvement Program—enough to bring the program to a standstill. Traditional state methods of financing and procurement could have built the project in 5-mile increments but taken 27 years to complete.

New Mexico applied for “innovative financing” under the Intermodal Surface Transportation Efficiency Act of 1991 and as an “innovative contracting” project under Special Experimental Project 14. The application proposed that the state be allowed to pledge future federal-aid highway funds for a term of 18 years to repay bonds.

Following the approval of the applications and concepts, requests for proposals were solicited for the design, construction, management, and warranty of the 120-mile highway facility. The contract was executed in July 1998 with a mandatory completion date of November 2001.

Implementing Recommendations

Value engineering first was applied at the 30 percent design level—that is, when the design was 30 percent complete. The implemented recommendations ranged from minor revisions of construction specifications to major design changes involving horizontal and vertical alignments. The revisions affected the typical roadway section and required modifications to drainage structures and several traffic control elements.

The process was repeated at the 80 percent level. Both studies produced nearly 100 recommendations; 30 became part of the final bid packages. Before value engineering, the construction estimate was \$244 million; afterward, the estimate dropped to \$212 million.

The corridor was initially developed and designed as eight distinct bid packages. The bids on the first sections were high, and the Department realized that the corridor’s completion under a \$185 million budget was in jeopardy. Management rejected the bids and undertook a third value engineering effort, directly participating to retain quality while keeping to the budget.

Targeting Risks

Value engineering targeted areas with the greatest potential risk to bidders, including

1. The availability of aggregate material of sufficient quality and quantity;
2. Alternative structures for earth bearing, such as retaining walls, and for drainage; and
3. The ability to achieve economies of scale.

Specifications were modified to allow for material common to the area—for example, recycling asphalt for various uses. Recycled Asphalt Pavement (RAP) could replace or supplement the base course, reducing the amount of virgin crushed aggregate base required. Asphalt concrete (AC) aggregate could be blended with RAP in the lower AC base mixture.

RAP also was suitable for selected backfill behind abutments as well as for tapers, temporary pavement,

and turnouts. The state added a contract clause encouraging contractors to propose additional uses of RAP to lower costs. The decision produced savings without affecting quality.

The Department also acquired an alternate aggregate source, including all necessary environmental clearances and air quality permits. The use of the aggregate source was not mandated, but minimized unknown contingencies in the bids. Easing the specifications for the aggregate in the base course construction allowed the use of local aggregate.

Alternative structures were evaluated for type, availability, and constructibility. The plan had been to minimize right-of-way by constructing retaining walls; value engineering instead recommended geogrid-reinforced fill slopes to allow steeper slopes within the right-of-way. Several other retaining walls also were eliminated. Alternate drainage structures were made available by allowing various material types, including corrugated metal, high-strength plastic, corrugated multiplated pipes, and portland cement concrete.

Finally, combining bid packages produced economies of scale. The eight original bid packages became four separate construction contracts.

Assuring Success

The redesign and restructuring of the bid packages took 3.5 months. Top management involvement helped drive the efficiency as well as effectiveness of the value engineering. The last bid package was awarded in February 2000 for a total project cost of \$183 million—within the budget.

Value engineering in New Mexico involves management, is results-oriented, and is market-validated. New Mexico’s value engineering practice has completed major projects within budget while maintaining a commitment to quality. Management must be involved not only in initiating a value engineering program but in implementing the solutions, ensuring that the same quality of product is provided at the lowest cost.



Alternate aggregate source material, suggested by value engineering program, played important role in construction on NM 44.



Value engineering program proposed barrier solutions on NM 44 that reduced cost but maintained quality.