The journal of the value profession

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VM giving direction to highway projects
In this issue of Value World, we focus on applications of the value methodology (VM) in the transportation sector. The authors describe how to quantify the performance of VM alternatives, how to reduce risk using VM, and how to apply FAST diagrams to highways. Also, there are articles about improving peer reviews with VM and using VM to improve university procedures. Each VM tool and technique stimulates interaction among team members and, in the end, raises ordinary projects to extraordinary levels.

This is accomplished through the intensive learning that takes place between the study team members and the project stakeholders. As Rosa García Sánchez from Spain explains in her article on page 18, members of her university’s VM study experienced continuous learning, reaching beyond functions of their own specific area, giving a much wider picture of other university activities.

This learning experience comes from improved communication across multidisciplinary boundaries, something the VM Job Plan facilitates very effectively. Team leaders and team members often express this benefit of enhanced communications as an afterthought, almost as if it were something magical.

In the half-century that the value methodology has been developed and practiced, there have been many attempts to explain the magic of this problem-solving technique. How is it that the VM Job Plan gives us all the tools we need to enhance communications? How do value teams change the ordinary project, process, or product into an extraordinary one?

USE OF TIME
One simple answer: VM enhances communication because it makes excellent use of time. Ann Morrow Lindberg in her book, Gift from the Sea, says that communication is enhanced when we have an abundance of time. Surely time is a key. The VM process takes a team of professionals out of their daily routine and isolates them so that they can focus—with an abundance of time—on a problem to be solved. This expansion of time (time that is not ordinarily taken in most of our hurried endeavors) allows for longer and deeper conversations between individuals. And in using the tools of VM, we are able to structure those conversations into creative thinking and objective evaluation to find extraordinary solutions to ordinary problems.

MORE THAN ONE RIGHT ANSWER
An abundance of time in VM studies also leads to a patient search for more than one right answer. The right answer of the original concept can be compared with the second, third and fourth right answers; the best one can transform the ordinary to the extraordinary. Dewitt Jones, a photographer for National Geographic Magazine, has his personal methods for taking extraordinary photographs. Because his photos compete with hundreds of others submitted to the magazine, his need to be special.

In the video, Everyday Creativity, Jones illustrates how patient study of a problem, such as photographing salmon fishing in Scotland, resulted in several right answers. The river where fishermen caught their salmon looked rather uninteresting when he first saw it, but after spending some time with the fishermen and watching the mist on the river he captured several dramatic—yes, extraordinary—photos.

Thus it is with VM: patience fosters creativity. We allow time to be our ally, not our enemy. Instead of “fighting the clock” to find the one right answer, we “go with the flow” and let time nurture the creative impulses of the value team members. More right answers emerge because we give them time to be born.

TURNING AROUND
Another way to find multiple right answers is to turn around and look the other way. This is what Jones does when the viewfinder of his camera fails to show him something special. By looking behind him one morning he saw the mist on the river with a different eye. The picture he took in that moment of turning around was the one that was chosen for the magazine article.

Looking at the problem differently—turning around—is often the way VM studies turn the ordinary into the extraordinary. The analysis of functions serves to turn us around and look the other way—to see the problem differently. Understanding the relationship of functions teaches us to look in new directions to find new creative solutions.

By making good use of time, by searching for more than one right answer, and by turning around to look in new directions, VM allows us to change the ordinary into the extraordinary.

SAVE International is the only professional society in the United States totally devoted to advancing and promoting the value methodology, a powerful problem-solving tool that uses a professionally applied, function-oriented, systematic team approach to analyze and improve value in a product, facility design, system, or service.
Beyond the Cost Savings Paradigm: Evaluation and Measurement of Project Performance

George Hunter, PE, CVS, and Robert B. Stewart, CVS

THE COST SAVINGS PARADIGM

Value Engineering (VE) too often has been negatively stereotyped as a cost-cutting technique, instead of a value-enhancing tool. Part of the reason for this perception came about because VE was first applied in the manufacturing industry, focusing on removing unnecessary costs from manufactured products. The cost reductions on a unit price basis were small but became large when extended over the life of the production of the item. Because of this, VE results consistently have been reported in dollars.

The California Department of Transportation's (Caltrans) Value Analysis Program has been working diligently during the past five years to change this paradigm, so that studies develop and report value enhancements—not just cost reductions. The following steps describe the evolution of the present methodology:

- In 1995, Caltrans' value engineering procedures began requiring the project manager to "check the box" during the implementation phase of the study in the following categories: improving product quality; building consensus with our transportation partners; solving difficult transportation issues; reducing project delivery time; reducing initial project costs; reducing life-cycle costs.
- In 1998 and 1999, Caltrans' value engineering procedures began requiring VA teams to quantify other benefits of the value engineering alternatives developed during the development phase—i.e., those other than project costs.
- In 2000, the performance measurements, as currently employed, were first developed. This methodology, developed by Rob Stewart, of Value Management Strategies, requires that performance criteria and measurements be integrated throughout the entire study to become, jointly with the cost factors, the basis of the value engineering study.

THE NEED FOR PERFORMANCE MEASUREMENTS

The development and integration of value engineering performance measurements into the value methodology used in Caltrans' studies addressed and overcame the following deficiencies:

- VE studies are carried out in highway project studies with defined cost parameters but no project performance parameters. A reliable, measurable methodology defining the project performance of the original design concept followed by the performance of the value engineering alternatives was needed in order to develop and present alternatives in a complete, comprehensive manner.
- Implementation dispositions of the value engineering alternatives were not based on objective criteria. VE alternatives were easily rejected by project design staff because there was no measurable way to compare the performance of the alternative to that of the original design concept. The development of reliable, quantifiable project performance measurements provided an objective way to discuss the merits, or lack thereof, of the value engineering alternatives.
- VE alternatives with cost increases were rejected due to a lack of reliable, credible quantification of project performance increases necessary to justify the increased value associated with the cost increase (Value = Performance/Cost).
- VE studies were not the most effective during the early phases of project development when project scope and performance are at critical phases of development.
- VE studies rarely contributed to major changes in project concepts and were mainly a tool to refine costs during the final design phases.
- The perspective and input of project stakeholders participating in the VE studies, such as local government agencies and permitting agencies, were not easily captured. Project performance measurement techniques helped capture the input of all the study participants in a constructive and objective manner.

TECHNIQUES FOR MEASURING PERFORMANCE

The technique developed to measure the performance of Caltrans' projects, as well as alternative concepts developed during the course of a value engineering study, includes the following steps:

1) Define Criteria; 2) Determine Hierarchy; 3) Establish Baseline; 4) Evaluate Alternatives; 5) Compare Concepts.

Define Criteria

The first step in the process is to identify the criteria that will be used to measure the performance of the project. This is best accomplished using a team approach that includes representation from the project management staff, design team, and other project stakeholders as well as the VE team. The VE team's facilitator should moderate this session and actively encourage the participation of all team members. The facilitator should address the aforementioned entities in turn, asking each to identify the project's primary objectives and requirements, recording each of these so that they are visible to the group (such as on a large flip chart) as they are presented. When the group has
a satisfactory comprehensive list, the facilitator should then ask
the group which items on the list are essential to the project’s
overall success. Many items then can be consolidated, or even
eliminated. It is advisable to limit the criteria to no more than
eight. Each of these then should be given a formal definition that
everyone can refer to during subsequent evaluations. While
having more than eight criteria is certainly feasible, a larger
number tends to make the process more cumbersome to facilitate.
These remaining criteria should provide a well-rounded
“yardstick” for measuring how well a concept meets the project’s
objectives and requirements. They will be referred to as the
project’s “performance criteria.”

Example: A highway improvement project proposing the
widening of the mainline and the replacement of an interchange
might include the following performance criteria:

- **Mainline Operations**—Freeway’s level of service.
- **Local Access**—Level and degree of access between the main
  line and local arterials.
- **Project Schedule**—Time required to complete the project
  (both design and construction).
- **Compliance with Design Standards**—Level of compliance
  with highway design standards.
- **Construction Impacts**—Degree of temporary construction
  impacts (i.e., noise, traffic delays, etc.)
- **Environmental Impacts**—Effect on the environment (i.e.,
  socioeconomic, biological, etc.)

Determine Hierarchy

Once the group has agreed upon the project’s performance criteria,
the next step is to determine individuals’ relative importance in
relation to each other. This is accomplished through the use of an
evaluative tool termed in this article the “Performance Criteria
Matrix” (Figure 1.1). This matrix compares the performance
criteria in pairs, asking the question: “Which one is more
important to the project?” A letter code (e.g., “a”) is entered into
the matrix for each pair, identifying which of the two is more
important. If a pair of criteria is considered to be of essentially
equal importance, both letters (e.g., “a/b”) are entered into the
appropriate box. This, however, should be discouraged as it has
been found that in practice, a tie usually indicates that the pairs
have not been adequately discussed. When all pairs are discussed,

Figure 1.1: Performance Criteria Matrix

<table>
<thead>
<tr>
<th>Criteria</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td></td>
<td></td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td>b</td>
<td>b</td>
<td>b</td>
<td>b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td></td>
<td>e</td>
<td>f</td>
<td>f</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1.2: Performance Criteria Matrix—Highway Improvement Project

<table>
<thead>
<tr>
<th>Criteria</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Traffic Operations</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>5</td>
<td>31</td>
</tr>
<tr>
<td>B. Local Access</td>
<td>b</td>
<td>b</td>
<td>b</td>
<td>b</td>
<td>b</td>
<td></td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>C. Project Schedule</td>
<td>d</td>
<td>e</td>
<td>f</td>
<td></td>
<td></td>
<td></td>
<td>0(1)</td>
<td>6</td>
</tr>
<tr>
<td>D. Compliance with Design Standards</td>
<td>d</td>
<td>f</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>E. Construction Impacts</td>
<td>f</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>F. Environmental Impacts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>19</td>
</tr>
</tbody>
</table>

Note: The “Project Schedule” criterion did not receive any votes; however, it was given a token vote by making the initial list.
Figure 2.1: Performance Rating Matrix (a)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Unit of Measurement</th>
<th>Criteria Weight</th>
<th>Concept</th>
<th>Performance Rating</th>
<th>Total Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Rating Parameters

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Unit of Measurement</th>
<th>Rating Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>low 1 2 3 4 5 6 7 8 9 10 high</td>
</tr>
</tbody>
</table>

2. Unit of Measurement—"Degree of Impact" on other quantitative measures (e.g., accidents, schedule days).
3. Criteria Weight—Percentage weight developed on the Performance Criteria Matrix.
4. Concept—"No build," original design(s).
5. Performance Rating—Selected rating on a scale of 1 (low) to 10 (high).
7. Rating Parameters—A correlation of quantifiable performance criteria to the performance rating (1 to 10).
   It is necessary to list only those performance criteria that are quantifiable.

Figure 2.2: Performance Rating Matrix (b)

Note: The total performance for the "no build" concept is 511 while the total for the Original Design concept is 571, indicating that the Original Design concept provides a +12 percent improvement in performance.
the number of votes for each are tallied and percentages (used as weighted multipliers later in the process) are calculated. It is not uncommon for one of the criterion to receive no votes. If this occurs, the criterion is given a token vote, as it made the list in the first place and should be given some degree of importance.

It is important for the facilitator to remind the group that as they evaluate each pair of criteria, they should think of performance trade-offs in hypothetical terms. For instance, the facilitator might state: “If we were considering a concept that would improve traffic operations but, in turn, caused greater environmental impact, which criterion would take priority?” The team also should be reminded that these performance criteria will be used to evaluate the merits of alternative concepts generated during the course of the VA study. As such, the group should keep an open mind and base their evaluation on what is possible rather than what exists in terms of the current design concept.

Example: Using the Performance Criteria Matrix (Figure 1.1), the group evaluates the six performance criteria they will use to evaluate the current design concepts as well as alternative design concepts developed during the VA study, producing Figure 1.2.

Establish Baseline
The next step in the process is to evaluate how well the original design concept(s) address the performance criteria. This step establishes a “baseline” against which the VE alternative concepts can be compared. The Performance Rating Matrix (a) (Figure 2.1) is used to assist the VE team in determining the performance ratings for various design concepts.

The VE team leader should first ask the group to establish the performance of the existing, or “no build,” condition. The performance criteria, and its relative weights, are first entered into the matrix. Next, the group should identify the unit of measurement for each of the performance criteria. If possible, the units of measurement should be quantifiable; however, this is not always possible or practical. Criteria such as Project Schedule and Traffic Operations are quantifiable and might use “months” or “level of service” (LOS) as units of measure. Criteria such as Environmental Impacts or Construction Impacts might use qualitative measures, as they are criteria that typically involve a number of lesser factors that have been grouped together. Other possible criteria may be wholly subjective.

In any case, it generally is advisable to evaluate the “no build” condition first in order to establish a relative baseline for evaluating the current design concept. The next step is to assign a 1-to-10 rating for each of the criteria, with 1 being low and 10 high. Rating parameters also should be identified whenever quantifiable measures are used. These associate specific measures to the 1-to-10 ratings.

When the ratings for the various criteria have been established, their total performance should be calculated by multiplying the criteria’s weight by its rating. Once the total performance for each of criteria has been determined, the

![Figure 3.1: Performance Measures Form (a)](image-url)

1. **Project Specific Criteria**—Criteria derived from the Performance Criteria Matrix; comments compare the alternative concept with the original concept for each criterion:
2. **Performance**—Three parameters defining the contribution for both the original and alternative concepts:
   a. **Measure**—Units of measure (e.g., days) or degree (of impact) for each criterion
   b. **Rating**—Rating on a scale of 1-to-10 for each criterion
   c. **Weight**—Weight for each criterion derived from Evaluative Criteria Matrix
   d. **Contribution**—Arithmetic product of rating times weight for each criterion
3. **Total Performance**—Arithmetic sum of contributions for all criteria for both original and alternative concepts.
4. **Net Change in Performance**—Percentage change of alternative total performance measures with original total performance measures taken as 100% performance (+%= increased performance for the alternative; -%= reduced performance).
The concept’s total performance can be calculated by adding all of the scores for the criteria. The concept’s total performance will be somewhere between 100 and 1,000 points. A concept scoring 1,000 would represent a hypothetically perfect concept, with all performance criteria addressed to the theoretical maximum.

Example: Using the Performance Rating Matrix (a) (Figure 2.1), the group establishes “no build” and baseline performance, yielding Figure 2.2.

### Evaluate Alternatives

Once the performance baseline has been established for the original design concept, it can be used to help the VE team develop performance ratings for individual VE alternative concepts as they are developed during the course of the VE study. The Performance Measures form is used to capture this information as alternative concepts are developed, allowing a side-by-side comparison of the original design and VE alternative concepts to be performed.

When developing performance ratings for the alternative concept, it is important to consider the alternative concept’s impact on the entire project, rather than on discrete components.

Example: Using the Performance Measures Form (a) (Figure 3.1), the group establishes performances for individual alternatives resulting in Figure 3.2.

### Compare Concepts

The last step in the process completes the Performance Rating Matrix that was begun initially to develop the performance ratings for the original design concept. The performance ratings developed for the VE alternative concepts are entered into the matrix, completing the summary portion of the Performance Rating Matrix. The summary provides details on net changes to cost, performance, and value.
Figure 4.1: Performance Rating Matrix—Overall Performance (a)

<table>
<thead>
<tr>
<th>Concept</th>
<th>Total Performance</th>
<th>Total Cost</th>
<th>Value Index (P/C)</th>
<th>% Value Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Design Concept</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

1. Total Performance—Arithmetic sum of total performance for each VE alternative concept.
2. Total Cost—Estimated cost for each VE alternative concept ($ million). The cost figure should be expressed with the base number to 3 places in front of the decimal point. For example, $145,620,000 should be expressed as 145.6 in order to have a value ratio in the magnitude of 1-to-10.
3. Value Index—Arithmetic division of total performance by cost. The value will be between 1 and 10 with two decimal places.
4. Percent Value Improvement—Net increase (+) or decrease (-) of value index in percent.

Figure 4.2: Performance Rating Matrix—Overall Performance (b)

<table>
<thead>
<tr>
<th>Concept</th>
<th>Total Performance</th>
<th>Total Cost ($ millions)</th>
<th>Value Index (P/C)</th>
<th>% Value Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Design Concept</td>
<td>571</td>
<td>37.0</td>
<td>15.4</td>
<td>+48%</td>
</tr>
<tr>
<td>VE Alternative Concept #1</td>
<td>627</td>
<td>35.0</td>
<td>17.9</td>
<td>+1%</td>
</tr>
<tr>
<td>VE Alternative Concept #2</td>
<td>531</td>
<td>34.0</td>
<td>15.6</td>
<td>-3%</td>
</tr>
<tr>
<td>VE Alternative Concept #3</td>
<td>580</td>
<td>39.0</td>
<td>14.9</td>
<td></td>
</tr>
</tbody>
</table>

Note: This example demonstrates the importance of using both cost and performance in evaluating the potential benefits of alternative concepts developed during the course of a VE study. Without performing this analysis, it may be unclear to decision makers whether VE Alternative Concepts 2 and 3 offer improved value.

Example: Completing the Performance Rating Matrix (a) (Figure 4.1), the group compares the performance of alternative concepts, producing Figure 4.2.

SUMMARY AND CONCLUSION
Developing performance measurements and integrating them into the value methodology employed in Caltrans' studies have improved the effectiveness of the value methodology as applied to highway projects by providing a reliable, integrated method of measuring the other side of the value equation (Value = Performance/Cost). This in turn has allowed the following benefits within the program: easier discussion of alternate implementation dispositions; justification of alternatives with cost increases; more effective application of the value methodology to projects in the earlier stages of project development; and more effective input from participating project stakeholders.

George Hunter, PE, CVS, has been in charge of the Value Analysis Program for California Department of Transportation (Caltrans) since 1995. This program provides improvements in quality, performance, and costs in its projects and processes. In the last three years, 91 project studies have been completed in the program, reducing $7.3 billion project costs by $478 million.

Robert Stewart, CVS, is a professional value engineering consultant and is vice president of Value Management Strategies Inc., managing its operations in the Pacific Northwest. In addition, he is an adjunct professor teaching value engineering at Portland State University.

This article was extracted from a paper originally presented to the July 11–13, 2001, American Association of State Highway Transportation Officials (AASHTO) Value Engineering Conference in San Diego, California.
INTRODUCING PEER REVIEW

Peer review has existed ever since one person asked another for an opinion. Formal application has included review of scientific papers, medical procedures, safety programs, and articles for publication. Individuals have sought the opinion of others through a technique called the “360 review,” which uses peers to rate a person’s growth in key areas such as leadership, adaptability, and communication. In recent years, business leaders have sought review of their business strategies by people from other businesses.

Peer review also is used to analyze proposed project construction, including the selection of process equipment. Formal procedures for this type of peer review have been authored, case by case, by various groups including project owners, designers, consultants, and constructors. The basis for peer review of construction projects and the processes they contain can be an existing methodology with a long history of success. Equally important, this method is universal and also can be used for peer review of strategies and products.

THE ESSENCE OF PEER REVIEW

Essential features provided by a peer review include:

- a variety of critical expert backgrounds
- objective evaluation
- a conclusion providing direction

The goals may require assurance of a state-of-the-art solution. Peer review also can enhance public oversight by providing the objective, expert critique desired before expending capital.

Prior to a peer review, in many cases, the designing organization has assembled a design team of professionals to gather information and propose their best design solution. The team may or may not include the highest level of expertise possible. Because the team has developed the solution, their objectivity is somewhat converted to subjectivity due to their ownership of the solution concept. There is a natural tendency to defend it or be affected by remaining capital or resources.

A peer review is an inspection by people who should remain objective. These people, because of their training and experience, will ask questions that the average project owner or consumer may miss. If the initial design passes inspection by peers, it reinforces the expertise of the original design team. If improvements are possible, then the “owner organization” can benefit by making the improvements. If the improvements increase value by doing a better job of delivering the desired benefits (e.g., efficiency, safety, effectiveness, durability, convenience, desirability, maintainability) at a better life cycle cost, then the original design team learns and the owner and customers benefit.

Organizations and those they serve seek the features of peer review to gain assurance that the proposed project solution will achieve the desired benefits at the optimum cost for ownership. In other words, they seek best value. Peers should be testing for best value. Gaining the best value is the greatest motive for proposing a peer review.

OBSTACLES TO OPTIMAL VALUE

The term “value” has varying connotations. If we say, “Value is the lowest cost reliably meeting the expectations of the customer,” we can relate it to the goals of the request for a peer review.

Professionals usually include delivery of best value as one of their responsibilities and will do their best to adhere to that. However, obstacles blocking best value can be subtle. They include miscommunication, misunderstanding, deficiencies in the information, biases, misconceptions, habitual thinking, reluctance to seek additional advice, time constraints, resource constraints, unknown changes in technology, old specifications, and lack of means for measuring and discussing value. It is difficult for any professional to avoid the impact of all of these normal human conditions. The public acknowledges this by asking for a peer review. Thus tools explicitly addressing value are helpful.

A PEER REVIEW EXAMPLE

The following is a list of tasks identified by a major U.S. city for a peer review of one of its projects. The peer review (PR) consultant should:

- Coordinate all activities. Meet with the city’s director and the original designer to gather information and the necessary documents for the PR study.
- Assemble the PR team, including those specifically identified by the city for inclusion on the team.
- Coordinate a four-hour question-and-answer session to allow the PR team to discuss the details of the proposed design with the original designer.
- Conduct a PR workshop with the PR team. The PR consultant should state the number of workshop hours estimated for this task. The workshop should consist of the following phases: information, investigation, analysis, documentation, recommendation, presentation, and final report.
THE VALUE METHODOLOGY
For more than half a century, private organizations and governments throughout the world have adopted the structured methodology (VM)—also called value analysis, value engineering, and value management—originated by Lawrence D. Miles to ensure best solution value. It has been applied to strategic planning as well as project, process, and product development. The value methodology relies on having the best experts available on its teams and the analysis of functional cost. It contains the elements necessary for successful peer review including a review of essential characteristics of the solution. SAVE International protects and encourages the value methodology and certifies its practitioners.

Examples of acceptance of this value-improving method in the United States include ASTM E-1699-00 Standard Practice for Performing Value Analysis of Buildings and Building Systems and Federal Law 104-106, as well as adoption by certain state and county governments. Federal agencies using the methodology include the Federal Highway Administration, Army Corps of Engineers and the Defense Logistics Agency.

The value methodology uses an agenda called the Job Plan, which includes the following steps: organize, gather information, analyze function, create ideas, evaluate ideas, develop solution(s), recommend solution(s). The Job Plan produces more efficient thought. Use of this methodology and its unique tools enables a team of experts to better understand customer expectations and to identify ways to deliver best value results. A trained and certified value specialist generally facilitates the meetings involving a group of experts. Portions of the Job Plan are best handled in a workshop environment.

APPLYING THE VALUE METHODOLOGY TO PEER REVIEW
A peer review is best accomplished by addressing the information methodically and always with a focus on the highest purpose—receiving best value. Methodical procedures are more effective and more efficient than random or untested procedures.

The value methodology is an obvious template for conducting a peer review. It assembles the critical panel of experts and provides a certified value professional as the facilitator to conduct an objective value-focused evaluation and provide the written report of the findings.

In the example of peer review tasks used here, one can see similarities of the steps followed in the value methodology—from gathering information through analysis to recommendation. But the peer review tasks contain a fallacy. An underlying assumption exists that review by peers alone causes best value for the municipality. Best value cannot be ensured unless a unique vocabulary and specific tools are being used to measure existing value, to identify opportunities for improving value, and to evaluate the recommendations on the basis of value delivered. That is best accomplished through the value methodology. Peer review using the value methodology as its basis will meet the true goals of the peer review process.

SUGGESTED VALUE-FOCUSED PEER REVIEW METHOD
To use a value-focused peer review method, a municipality should specify that the peer review consultant (PRC) company adhere to the following:

- Provide a trained value specialist to facilitate the peer review effort—preferably a person registered with SAVE International as an associate value specialist, a value methodology practitioner, or a certified value specialist.
- Organize and conduct the peer review activity applying value methodology to measure value and to identify opportunities for improving value and preparing recommendations for value improvement.
- Meet with the city to discuss the design program and discover underlying issues. Customer expectations must be explicitly stated.
- Schedule the peer review study acknowledging that time is of the essence.
- Recommend the peer review team of experts including those specifically identified by the city for inclusion on the team. The experts must be able to provide the kinds of information necessary to support the pending workshop activity. This can include administrative expertise, operational expertise, technical expertise, and life cycle cost expertise. Upon approval to proceed, the PRC shall assemble the PR team.
- Assemble information and documents necessary for the PR study. The PRC should distribute copies of the information and prepare the PR team members with appropriate background information allowing time for study.
- Coordinate session(s) enabling the solution designers to present their design philosophy and solution.
- Coordinate a tour of the project site by the PR team.
- Coordinate a question-and-answer process, which allows the PR team to discuss the proposed design's details with the original designer and disseminate the discussion among PR team members.
- Sort facts from assumptions with the PR team and identify unknowns. The PR team requests that the city assist in this effort. The city shall answer the unknown issues to permit the PR to continue. The PR team will issue this information document for comment by the city.
- Conduct a workshop with the PR team. The PR consultant states in the proposal the number of workshop hours estimated for this task. The workshop consists of the
following phases: final information discussion, function analysis to enhance understanding and identify issues displaying less than optimal value, solicitation of alternative ideas, evaluation of ideas, additional development of selected ideas to identify feasible alternatives, and presentation of recommendations. Idea development takes place during the workshop. The peer review team is not responsible for activities such as physical testing or detailed engineering that may be required. Such requirements should be stated in the report.

- Solicit comments from the city regarding the preliminary report of findings and recommendations, which is made by the PR team at the conclusion of the workshop. The PR consultant assembles a response to questions within an agreed time period.
- Participate with the PR team in a public presentation of the findings. Comments are solicited and documented by the PR consultant.
- Prepare a final report. Ten copies shall be provided to the city; the city shall reimburse publication costs for additional copies.
- Recommendations should consider impacts upon schedule and cost of producing the design solution.
- Provide with selected PR team members, as an option, a service to audit inclusion of approved recommendations in the design with the purpose of answering questions, explaining intent, and testing for receipt of value.

PEER REVIEW PERSONNEL
The peer review facilitator must exhibit experience and professionalism in managing teams and conducting the work. It is less important that this person be an expert in the subject under review and more important that he/she be an expert in the review process. Formal training and understanding of value management principles also are important in facilitation of a team. Credentials, history, and references will help demonstrate the necessary characteristics.

The peer review team members must exhibit knowledge and experience in the subject under review. The team may be selected to represent varying viewpoints. These viewpoints may reflect different past solutions to similar problems, or they may reflect different kinds of expertise, including executive viewpoints, administrative viewpoints, operational viewpoints, and customer/user viewpoints. It is important to create balance and avoid unnecessary duplication on the team. (Caution: Some apparent duplicates may later display differences.) Team members who have received formal training in value methodology will have additional advantages over those unfamiliar with the teamwork and function focus. Recommending formal training in value methodology prior to conducting the peer review can enhance peer reviews.

The peer review consultant and team members should be compensated for their services in a manner that allows them to present an objective and unconstrained opinion. It is an expert and professional service; however, the cost of a peer review generally is more than offset by the benefits it delivers. Also, time must be allowed to enable services to occur in the manner desired.

CONCLUSION
Professionals apply their training to the best of their ability to deliver solutions for their clients. Oftentimes the public wants extra assurance that capital will be expended most effectively, recognizing that obstacles to optimal value can occur due to normal human conditions. Thus peer review has become a mechanism to aid in that assurance.

The value methodology, originated by Lawrence D. Miles, provides a natural and proven template for meeting the expectations of a thorough solution review by peers. The value methodology requires assembling the appropriate experts and seeks to identify customer expectations thoroughly. Its vocabulary and tools create a value context for solution review. A long-recognized history of success attests to value methodology's efficiency and effectiveness.

Peer reviews conducted with the value methodology as the basis will aid in selecting the optimal solution.

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FAST Diagramming for Transportation Projects

William F. Lenzer, PE, CVS, FSAVE

ABSTRACT
The use of the Function Analysis System Technique (FAST) often is overlooked or not considered by VE facilitators for highway or other transportation projects. This article demonstrates how FAST diagramming can benefit VE studies by identifying and displaying key functions of the project and their associated costs in a visual format that improves communication and helps the VE team understand and focus on the major issues.

Specific examples include a High Occupancy Vehicle (HOV) Lane/Ramp Addition Project, an Access Improvement Project, and a Traffic Operations System Project. These projects, taking place in Texas and California, were led or co-led by the author. The actual results of the VE studies are included. Key methods that make FAST diagramming easier and quicker to use during a VE study are summarized.

BACKGROUND ON FAST
The basic concept of the Function Analysis System Technique or FAST was developed in the mid-1960s by Charles Bytheway. He was applying VE in the computer industry when he began to notice that function statements (verb-noun) seemed to form a logic pattern. As he followed this idea further, he found that function statements could be arranged in a linear order, answering the question “How?” when reading from left to right. He also found these same functions answered the question “Why?” when read in reverse (right to left).

Enhancements in FAST diagramming have been made during the subsequent decades. Today, there are three types of FAST methods recognized by SAVE International:

• Classical
• Technical
• Customer/User

A fourth type, three-dimensional FAST, evolved in the 1990s, which I first presented at the 1998 SAVE International Conference (Axis Z FAST Diagramming). In 1999, an expanded concept was included in a paper (“American Applications of FAST”) presented at the Value Engineering and Technology Innovation Conference in Hangzhou, China.

Classical and technical models of FAST are very similar. Customer/user FAST differs because it is developed from the customer/user standpoint. Any of these approaches can be used in transportation projects.

Most VE facilitators develop their own style and preferences and may use a combination of the academic methods. Presented in this article is a combination that most closely fits the technical approach.

GROUND RULES FOR TECHNICAL FAST
There are several ground rules for the technical method of FAST.
The following are customized somewhat and include:

• The functions must answer the question “How?” when reading from left to right.
• The functions must answer the question “Why?” when reading from right to left.
• “Necessary” or “required” functions will follow a “critical path.”
• There can be more than one critical path.
• Function statements parallel to one or more critical path lines should answer the question “When?” or represent something that happens “at the same time.”
• Scope lines, which serve to define the scope of the project or component under study, should be shown in all cases.
• Functions that are located beyond (left of) the left scope line are “high order”; the function or functions to the immediate left of this scope line are basic.

HOV LANE ADDITION
This project consisted of new HOV lanes (two bidirectional lanes) extending east from existing I-10 traffic lanes on the west side of downtown Houston, approximately two miles to the I-10 and I-45 interchange and then into the Houston central business district (CBD). Essentially the entire HOV lane is elevated.

The bridge design consisted predominantly of concrete sections. Four long span steel sections are indicated at complex interchange crossovers. What was considered unique at the time, a Y-shaped column design incorporating “reveals,” was included. Since the elevated HOV structure would be the highest and most visible structure at the I-10/I-45 interchange at the northwest corner of the CBD, it was proposed that the underside of the transitway be painted.

In addition, I-10 was being widened as part of an overall improvement program. The project was approximately 30 percent into the final design stage, with an estimated construction cost of $26.7 million, when FAST was put to use.

The FAST diagram developed during the study is shown in Figure 1. Costs were distributed to major function components, as shown. While the team looked at many things, they focused on two functions, which appeared to present a value mismatch: “Avoid Floodplain” and “Project Image.”
One major proposal was developed to locate the HOV lane at grade, except where it crossed over the existing I-10/I-45 interchange. This was reasonable to the VE team because a floodplain lay at grade termination at both ends of the HOV project.

Eliminating painting the underside of the elevated concrete structure was another proposal developed by the team. In turn, this would eliminate the need to repaint the surface every five to seven years. In this case, the FAST diagram helped the VE team focus on what jumped out at them as mismatches. It also stimulated the team's creativity.

The study generated 89 ideas, which resulted in 20 developed proposals. The proposals offered maximum-coincident potential savings of $9.8 million, or 37 percent of the estimated cost, plus more than $1 million in Life Cycle Cost (LCC) savings.

ACCESS IMPROVEMENT PROJECT
The intersection of I-280/380 marks the current western terminus of I-380 in San Mateo County, California. This project proposed to extend two of the mainline 380 lanes and connect them to one of the existing Collector/Distributor (C/D) roads and to install two ramps for access to another C/D road.

Funding for the project totaled $3.8 million, with $2.7 million for construction. At the study's beginning, the VA team estimated $4.3 million for construction, without considering many, as yet, undefined conditions.

The FAST diagram developed by the VE team is shown in Figure 2. The basic function was identified as "Improve Access," and the two major design approaches were "Add Ramps" and "Extend I-380 Main Lanes." As the study progressed and more information surfaced, it became apparent that getting to and from the two major Interstate highways and the two main local access feeder roads were of concern. In addition, the I-380 termination originally had been configured for extension beyond the termination at I-280, and subsequent events eliminate that possibility completely.

The team generated 78 ideas, from which 23 proposals and four design suggestions were developed. From these, one major concept change was accepted, providing more than $2 million (47 percent) in initial cost improvement and assisting in the key project objective of improving local access. This was achieved by using collector/distributor (C/D) roads instead of ramps.

TRAFFIC OPERATIONS SYSTEM FINISH PROJECT
This last study included 17 traffic operation system (TOS) projects that remained to be funded, designed, and constructed to complete the Area Traffic Management System (ATMS) 10-year plan. These 17 projects were designed by three engineering firms and were approximately 60 percent completed when introduced to the value study. The total of these projects represented roughly
$74 million in construction costs and covered 234 miles of roadway.

The team was asked to focus on technological issues and developments and to evaluate the 17 individual projects from a global perspective. Site-specific details were not evaluated. The FAST diagram developed for this project is shown in Figure 3. Here, costs are represented in a percentage of total format. The four basic functions of the TOS are shown just inside the left scope line. They are:

- Observe Activity
- Inform Public
- Monitor Activity
- Control Activity

To the right of these are six functions, which define how the project satisfies the basic functions. Far down the line is a function, identified as “Install Conduit,” which represents 30 percent of the cost of the project. This function's high cost was associated with a requirement that all of the conduit that crossed existing structures should be concealed within the structure. The team labeled this a value mismatch and identified several options to reduce the cost of this feature.

The team generated 91 ideas on the project. From these, 12 proposals and 14 design suggestions were developed. Five proposals were implemented outright or on a conditional basis. These provided a total present worth savings of at least $6 million.

Several proposals added initial cost but resulted in LCC savings. One such proposal was to change all copper cable to fiber optic cable and upgrade transmitting equipment. This added $261,000 in initial cost (including all 17 projects) but saved $1.8 million over the life of the project by avoiding abandoning the copper conductors and upgrading the lines and equipment to fiber optics in the future.

On this particular project, the project management (PM) team was so impressed with the FAST diagram that they enlarged it to poster-board size for use in the PM office.

**SUGGESTIONS**

FAST diagramming can improve communication and understanding among the VE team members and often make it easier to present concepts and changes to project management. While developing a FAST diagram for a project isn’t always necessary, using some of the FAST logic in generating functions and ideas is helpful. Here are several suggestions that may help utilize this technique to its optimum effectiveness:

- Decide for yourself, what some of the high order and basic functions of a project might be prior to the start of the study. Use these to start your function identification process with the team. Some typical higher-level functions are Reduce Congestion, Improve Access, Increase Capacity, Reduce Pollution, and Reduce Accidents.
- Define functions for a team by writing individual functions on

![Figure 2: Access Improvement Project East](image-url)
self-stick notes or something similar, arranging them on a wall or a large sheet of paper. Make sure that you have adequate wall or other surface space.

- When generating random functions, try positioning them in what you think is a logical FAST order. You can always move them around later, on your own or with the team.
- You do not have to teach the team how to use FAST, and do not force the team to help you finish it.
- A team that has not been through several VE sessions will become bored or annoyed if you spend too much time on FAST without showing them some benefit.
- Explain the FAST logic to the team after you have arranged some of the major functions in logical order. Then try to identify which functions represent the most significant cost components.
- Remember that FAST is a communication tool. When you apply it, use it in whatever way is most comfortable for you. Do not worry about academic perfection.

CONCLUSION

FAST diagramming does not have to be a laborious process. You must practice the technique often in order to improve your skills. The examples presented here are intended to give you ideas and examples of how the process can be applied in transportation projects. Once you have completed a FAST diagram on a particular type of project (for example, a HOV lane addition), you can apply some of the same function and logic to all other projects of the same type.

William Lenzer, PE, CVS, FSAVE, is president of VEI Inc., a subsidiary of Edwards and Kelcey Inc. (EK), which specializes in value engineering. He also is a vice president with EK, a registered PE (35 states), and a certified value specialist. Lenzer has facilitated or managed more than 500 VE studies since 1980. More than 50 percent of these studies have been related to transportation (highways, light rail, heavy rail, and related facilities). He’s a past president and fellow of SAVE International.

This article was presented at the American Association of State Highway Officials Value Engineering Conference July 11–13, 2001, in San Diego, California, and has been edited.
ABSTRACT
This article contends that due to the nature of transportation projects, various forms of risk and project schedule can have significant impact on the value of a project. The article then demonstrates by example how the value methodology can reduce risk and improve schedule to yield better value from transportation projects.

IN TRANSPORTATION, SAFETY IS NO. 1
From facilitation of 17 transportation value studies, and discussions with a great number of practitioners, it is clear that safety is the most important universal evaluation criterion for transportation projects. The safety factor holds such importance in transportation projects that safety audits have become common practice. Recently, attempts to incorporate safety audits into the value study have proven quite successful. This emphasis on safety essentially targets three areas of risk:

- First, the risk to the drivers in terms of property damages, injury, and even loss of life, to themselves and others.
- Second, the risk to society with broader effects such as insurance rates, productivity loss, medical benefits, death benefits, traffic delays, and the impact of infrastructure repair and liability on various tax rates.
- Third, the risk to public agencies and their consultants and contractors regarding liability, reputation, and career advancement.

OTHER TRANSPORTATION PROJECT RISKS
In addition to safety-related risks, four other areas of risk associated with property and right-of-way are common to transportation projects. These include dislocation of residents and businesses; removal of commercially viable land from the property tax rolls; public and media scrutiny; and political pressure. Actually, political risk is an area of concern in its own right. Projects can be on a cusp of approval, where cost problems, schedule concerns, and many other issues can lead to project delay or even cancellation. In addition, there is environmental risk, which can lead to extra cost, realignment, public outcry, difficulty with other agencies, and project derailment. Finally, a perhaps less-recognized risk is the appearance of poor stewardship. If a project gets a label like “boondoggle,” “white elephant,” or “a waste of the taxpayer’s money,” the media will have a field day and there may be political and professional fallout. Considering the power of public perception, a value study with stakeholder involvement is great protection from such labels.

TRANSPORTATION PROJECT SCHEDULE
Schedule is critical in most transportation projects. Changing the schedule should be avoided for three main reasons.

- Reason No. 1 is simply cost: Any extension of the project schedule leads to additional project cost. At any stage, delay can mean escalation in eventual construction costs. In planning and design stages, delay can mean greater agency administration costs and increased consultant costs. In construction, delay can boost agency, consultant, and contractor costs through increased contract administration, construction supervision, and legal and other related services.
- Reason No. 2 is potential negative impacts on other projects, such as material, labor, and/or equipment shortages or conflicting detour requirements. In many cases, one project cannot start until another project is finished.
- Reason No. 3, perhaps the most important of the three, is that with the extension of a project comes the extension of the disruption to the community. Traffic detours and delays have a societal cost in terms of lost productivity, fuel use, and increased accidents. Traffic disruption leads to public discontent—with political implications.

In short, extension of the construction schedule increases the risks of increased cost, reduced safety, and political fallout.

REDUCED RISK + IMPROVED SCHEDULE = BETTER VALUE
Based on the problems above that can impact a transportation project, those components that cause risk or influence schedules are definite targets for a value study. If the related risks can be reduced, better value is obtained through improved safety and through reduced liability, capital, life cycle costs, and/or societal costs. If the project schedule can be improved, better value is realized through reduced risk, reduced discontent, and reduced project and/or societal costs. Table 1 presents a snapshot of 15 transportation project value studies, demonstrating how many value proposals had an impact on project risk and schedule for each project. The result that the proportion of proposals affecting risk and schedule varies widely from project to project should come as no surprise. To better demonstrate the impact of the value methodology on project risk and schedule, value studies of five specific projects will be discussed. These examples should provide generic lessons that can be applied to many other transportation projects, as well as projects outside of transportation.
## Table 1: Proposal Characteristics from 14 Transportation Projects

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>MAJOR IMPACT</th>
<th>TOTAL PROPOSALS</th>
<th>REDUCING SCHEDULE</th>
<th>REDUCING RISK</th>
<th>REDUCING COST</th>
<th>ADDING VALUE</th>
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</thead>
<tbody>
<tr>
<td>*Hwy 410 Extension, Brampton, ON</td>
<td>Yes</td>
<td>35</td>
<td>4</td>
<td>1</td>
<td>28</td>
<td>0</td>
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<tr>
<td>*QEW Gap FTMS, Region of Halton, ON</td>
<td></td>
<td>27</td>
<td>1</td>
<td>5</td>
<td>10</td>
<td>5</td>
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<tr>
<td>*Hwy 401 Rehabilitation, Windsor, ON</td>
<td>Yes</td>
<td>48</td>
<td>4</td>
<td>2</td>
<td>37</td>
<td>4</td>
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<tr>
<td>*Hwy 69, Seguin Trail Interchange, Seguin, ON</td>
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<td>1</td>
<td>2</td>
<td>5</td>
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<td>Hwy 40, Churchill Rd to Hwy 402, Sarnia, ON</td>
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<td>1</td>
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<td>13</td>
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<td>4</td>
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<td>Young's Point Bridge, Hwy 28, Peterborough, ON</td>
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<td>5</td>
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<td>2</td>
<td>12</td>
<td>14</td>
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<tr>
<td>Whitemud Drive/Terwillegar Drive, Edmonton, AB</td>
<td>Yes</td>
<td>17</td>
<td>7</td>
<td>1</td>
<td>9</td>
<td>2</td>
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<tr>
<td>*Anthony Henday Drive Extension, Edmonton, AB (a)</td>
<td>Yes</td>
<td>15</td>
<td>4</td>
<td>7</td>
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</table>

*Projects discussed in this article.

### BEWARE OF PROJECT DERAILMENT

The environmental assessment for the Highway 410 Extension Project in Brampton, Ontario, had been approved 10 years before the value study, after nearly 10 years of effort. The project had languished because its projected cost exceeded its political priority. The VM team was instructed to maintain the project alignment and avoid the risk of reopening the environmental approval process, with long-term project delay implications. The alignment was accepted as a given. As it turned out, two other risks took center stage in getting the project restarted.

The first risk was identified during the information phase. A developer had decided to reactivate a gravel quarry just north of the extension. Without the extension of Highway 410, large gravel trucks would have to access existing Highway 410 via residential streets with several busy intersections. The potential safety and societal risks could be avoided by implementing the extension. Combined with the economic benefits of the gravel operation to the region, the project now had increased political priority. In addition, the VM team identified a potential reduction of 29 percent in total project costs, while maintaining the alignment. The capital risk of the project had been reduced. The worth of the project’s political priority now exceeded the projected cost and the project moved into final design.

### IF IT AIN’T BROKE...

The 4.1 km section of Highway 401 outside Windsor, Ontario, hadn’t been rehabilitated in 40 years. With a $22 million price tag and no serious safety deficiency, it was in danger of being passed by again. Enter the value methodology. By modeling the cost of each project element, and comparing the cost to the risks that were being mitigated, the VM team was able to prioritize the project elements. Retaining a left-hand merge that had worked well for 40 years and eliminating a major realignment with minimal benefit, the VE team was able to generate an implemented cost reduction of nearly $6 million. The construction schedule was reduced significantly, yielding less traffic disruption and related societal costs. The risk of project deferral was avoided (meeting the basic project function of Maintain Public Investment), as was the risk of spending public monies for minimal benefit (poor stewardship). With the addition of...
several minor design improvements by the VM team, the basic project function of Reduce Collisions also was provided.

**SOCIETAL COST IMPLICATIONS**

The Queen Elizabeth Way (QEW) is an extremely congested urban freeway connecting Toronto with southern and western Ontario. With no remaining right-of-way available, the congestion is mitigated by diverting traffic to parallel roads to the north and employing a freeway traffic management system (FTMS). A 23 km “Gap” in the QEW FTMS was the subject of a VM study. Since the last major deployment of an FTMS system in Ontario happened 20 years before, the VM team was reminded that their recommendations would have an impact throughout Ontario. The VM study focused on reducing the risks of user delay and other societal costs. The VM team’s recommended combination of VE proposals reduced capital savings on the $8.3 million project from $2.5 million to $0.8 million but raised societal savings from $2.9 million to $180 million during 30 years. An hour spent stuck in traffic is an hour taken from productivity for thousands of users. Such lost productivity is the societal cost of the risk of user delay, along with aggravation and excessive fuel use.

**THE FEAR OF PROPERTY ACQUISITION**

As part of the four-lane project for Highway 69, in Seguin, Ontario, a full-directional interchange with a service road was required at Seguin Trail to accommodate local, tourist, recreational, and summer and/or weekend “cottager” traffic. To avoid the risk of relocating a residence, the preliminary design included a long, sweeping, curved structure across Highway 69. The VM team found that a straight bridge structure at 90° to Highway 69 would reduce the project schedule, significantly reduce cost, and offer fewer risks to drivers. It was recommended that the risk of relocating the homeowner be explored. When finally asked, the homeowner said that he preferred selling to having a sweeping embankment in his back yard. It turned out the risk of property acquisition had a much lower cost than the risk of not asking the question.

**SOMETIMES SOONER IS BETTER**

The Anthony Henday Drive Extension in Edmonton, Alberta, is a project of great importance, with an approximate cost of $180 million. As a result, VM studies were held on both the functional plan and the preliminary design, with consideration given to both project elements to be constructed in the near term and as part of the ultimate design at least 20 years ahead. The VM team had an impact on the project schedule in three ways. First, the team developed 30 different proposals aimed at improving the construction schedule, including design improvements, element simplification, contract packaging, and various incentives in the contract documents. Second, the team adjusted the design and schedule of a major interchange to coordinate better with an adjacent related project, leading to less overall disruption and avoiding a significant amount of throwaway costs. Finally, the VM team recommended near-term construction of the ultimate design for two interchanges. Benefits of expediting the ultimate plan included an improved level of service 20 years early, less overall life cycle cost, and elimination of the risk of two “basket weave” conditions.

Although at least 14 VM proposals reduced risk, four deserve mention here. First, one complete interchange was deleted because the risk of the interchange’s weave pattern outweighed the minor convenience of having it. Second, the highway alignment was shifted to miss an old surface mine area, resulting in less risk to structures and the environment. Third, two spans were added to the bridge across the river to avoid a very risky embankment. Finally, it was recommended that risk analysis with risk sharing should be applied to all contracts.

**CONCLUSION**

As demonstrated by the projects shown in Table 1 and by the five examples discussed in this article, the value methodology can reduce risk and improve schedule for transportation projects, resulting in better value from the projects, whether through reduced cost (capital, life cycle, and societal) and/or increased benefits (better safety, improved level of service, less disruption, etc.). Therefore, in selecting projects for value study, broaden your paradigm to include risk reduction and schedule improvement along with cost criteria. After all, unrecognized risk and schedule problems can make a cost-effective project go bad.

Scot McClintock, PE, CVS-Life, is a director of the Team Focus Group with 24 years in the construction industry. He has led highway VM studies in New York, Rhode Island, Ontario, Alberta, and Saskatchewan. He is an adjunct professor of VE/VM at Syracuse University, president of the Mid New York State Chapter of SAVE International, and Northeast regional director for SAVE International.
Value Management in Higher Education: A Pilot Project at a Spanish University

Rosa García Sánchez, Ph.D.

PROLOGUE
In recent years, I have attended national and international conferences about quality management and operations management in Spain, and I have analyzed many articles written by well-known European reviewers of management. While participating in these activities, I was surprised to hear nothing about value management. Quality improvement is unquestionably one of the most important objectives of any organization. For most companies, more than ever before, continuous improvement of product and process in addition to quick adaptation to changes in the business environment are some of the most important strategic objectives. “Quality” has assumed a broad meaning in recent years. This article explains how I applied value management to develop improvements in procedures at the University of Sevilla, improving upon the quality improvement paradigm.

INTRODUCTION
Universities, as any other service organization, must evolve continuously and quickly adapt to their environment’s changing needs. In fact, the functions of universities—teaching and research—must focus on the satisfaction of society’s needs. During the 1980s and early 1990s, different models for evaluating the quality of universities emerged and were established among the European Community (later European Union, EU) member states, within the framework of their respective higher education legislation. In 1991, the European Council recommended European cooperation in the area of quality assurance in higher education. Later, the Quality Evaluation Pilot Project (1995) marked a significant starting point for a real systematic evaluation for genuinely improving the European university system. Since then, the concern for improving the system of universities in the EU has shown itself to be far reaching, affecting all member states. So in 1995, the Spanish University Board stated the National Plan for Quality Assessment of Universities, aiming to assure a certain level of quality for the whole Spanish university system. This quality improvement project emerged at the end of 1997 as a way of implementing quality improvement within the university context, as presented in this article.

From the project’s beginning, the focus was on the University Management and Business Administration field because the areas of teaching already were being analyzed in other projects. Value management (VM) was the chosen methodology for this project, for it is a management approach aimed at improving the value of products, processes and services of the whole organization, according to EN-1325-1, the European Standard. It is true that this is a very subjective concept; it has different meanings for different people. “Value” depends on the time, people, subject, and circumstances.

The value concept generally accepted by value managers is a ratio between the level of quality required (no more, no less) and the cost of achieving it. Today this ratio has a more customer-oriented notion than at VM’s beginning. However, at present VM is considered far more than a strict methodology aimed only at cost reduction. It includes a range of tools designed to gain customer satisfaction at minimum cost. VM fits perfectly with the project I wanted to develop at my university.

APPLICATION OF VALUE MANAGEMENT TO UNIVERSITY SERVICES
The project concerns the improvement and redesign of administrative processes performed at universities. The first of six VM phases into which the project was structured is the Preparation/Orientation Phase (see Figure 1). The most important tasks in this phase were defining the subject to be analyzed, fixing the objectives, and selecting the working group members.

Within the University Management and Services field, the subject to be analyzed was the Secretariat of a University Department (SoUD). To create a “culture of quality” and to spread and promote a “continuous improvement” philosophy, it is necessary to “practice what we preach” and set a good example. Therefore, we wanted to seek improvements in our own immediate environment—our own university department. The main aim was to identify strengths and weaknesses in the SoUD’s operations and the specific services that might be more susceptible to improvement, from among the services provided to the users (basically teachers and students) who come to the secretariat on a day-to-day basis.

Figure 1. Value Management Cycle
With the project’s concrete subject defined, three broad lines of objectives were proposed:

a. We proposed the study, analysis and reorganization of the work undertaken in the SoUD, trying to avoid periods when the secretariat staff were either overloaded or, alternatively, underemployed. In short, we wanted to even out the workload of the secretariat staff. In addition, this objective served a double purpose: to increase all users’ satisfaction and to improve the satisfaction of the secretariat staff, who were providing the services being analyzed.

b. We wanted to train a group of people in value management and benchmarking methodology and, at the same time, make them aware of the importance of continuous improvement philosophy, both for users and staff.

c. We wanted to contribute to the creation of a culture of quality in the university context.

The next step was to select the VM team members. We didn’t want a group of exclusively academic department members; therefore, the group included teaching and research (T/R) staff, administration and services (A/S) staff, management teams (MT), and a student representative. With this composition, all the department strata were represented; the group would be a team with an overall perspective as well as its own points of view. The participation of the department’s MT held great importance because managers’ support is critical for the success of the project.

The final point to be resolved was the clearest possible definition and delimitation of the analyzed services. The group managed to classify the tasks involved in the provision of the different services in several meetings. Equally important was agreeing who the users of the studied services were, and their relative importance or priority.

The project continued with the Information Phase, in which a plan was drawn up for gathering all of the information necessary for implementing the project. A large part of this information consisted of data related to the daily work activities in the SoUD, (e.g., which periods of time are critical or represent the greatest volume of work, the approximate time spent on each area of work or task, and identifying the main users to the secretariat). Difficulties were encountered in carrying out estimates of the time required to perform the administrative tasks. The main problem related to resistance within the secretariat staff.

Once the services provided by the secretariat and the users were determined, it was necessary to define the needs of different users. The T/R staff group was first. A questionnaire was prepared to ascertain the characteristics of the services that this group needed from the SoUD. The conclusions obtained from the analysis of the responses were very useful, for they told us their major needs in terms of the support services offered by the SoUD. Another questionnaire was prepared for the A/S staff in the same set of university departments. It had two objectives: 1) to identify the characteristics of the services performed by the secretariat of these departments that could be considered “best practices” (as in an internal benchmarking) for activities that were similar for all of the secretariats; 2) to analyze and compare the opinions expressed by the T/R staff regarding the functioning, or general efficiency, of the different areas of work performed in these SoUDs.

In addition to the information obtained from these questionnaires, two other documents were used: the Statutes of the University of Sevilla and the A/S Staff Manual of Functions. After information was gathered and analyzed, possible improvements in the areas or services in support of teaching and research were concentrated on first.

For this VM project, as in any quality improvement project, it was essential that any objectives agreed upon should be based on parameters that could be measured to monitor progress over time. The accepted principle was: “Only things that could be measured could be improved.” For each objective, there remained the task of defining a unit of measurement that would allow for gauging whether or not the objective had been achieved following the implementation of the changes proposed as a result of this project.

The next phase of the project is the Function Analysis Phase, in which the needs of the various users were translated into the corresponding functions and then classified, ranked by priority, and weighted (see the right hand side of Figure 1). This phase finished with determining the relationship among the contribution each function makes, the satisfaction of users, and the relative cost associated with the performance of each function. It ended with the calculation of the “value index” for each function. For this identification, the following techniques were employed:

- Natural or Intuitive Search, which consists of applying common sense to make an initial identification of the functions of the product or service. In most cases, it is usually sufficient to identify at least half of the functions rapidly.
- Analysis of Movements and Efforts, which consists of analyzing the user’s movements in order to study the service; it enables the detection of some important functions involved in that service.
- Analysis of Sequences, also known as the SAFE method (Sequential Analysis of Functional Elements) concerns a way of approaching the preceding method. It consists of identifying each function typically corresponding to each sequence of utilization of the service.

After the functions were described, identified and characterized, they were ranked in importance. A FAST diagram (Fowler, 1990; Thiry, 1997) was used to rank the functions defined for the services provided to T/R staff users.

In the Innovation/Creativity Phase, alternative solutions that comply with the functions previously established were generated, and the most interesting were selected later (in the Evaluation Phase). Introducing more innovative and interesting ideas, the rest of the Spanish Universities contributed information (both private and public), as in a functional benchmarking project.

An initial letter with information about the project was sent to the general manager of every university, requesting collaboration and information regarding the design and development of the processes and operations carried out in the SoUD. At the same time, information also was requested on past studies of workloads and on the analysis of the functions of the A/S staff. In this light, the volume of information gathered was great, and the study and analysis required more time than was initially foreseen, as it had
become a project in collaboration with members of more than a
dozens Spanish universities—and some of those universities were
conducting similar experiments or studies.

Once this phase was completed, the project continued in the
Phase, with the analysis of all the alternative proposals,
to select the representation of the "best value." These proposals
were presented to the responsible managers at the University of
Sevilla for their consideration and for implementation in the rest
of the university departments in the Application/Implementation
Phase. A final report is being prepared to send to all universities
interested in our experiment.

PROJECT RESULTS
Notable improvements clearly have been achieved with this value
management project:
• First, there is awareness shown by all the personnel surveyed,
both academic and administrative, of the importance of
quality and continuous improvement as a philosophy. A
variety of suggestions were recorded, which now are being
analyzed. Equally encouraging is that some of the personnel
contacted in other Spanish universities have shown a
favorable opinion toward this initiative and proposals for
achieving quality improvements. Therefore, it is important to
continue to advance step by step, even though results may be
obtained only in the long term.
• Second, the study conducted on the activities performed in the
SoUD has proved very beneficial, serving to identify the
periods of greatest volume of work, which will be useful in
achieving a more even workload over time—one of the
specific project objectives set. The participation in the
discussions during the meetings was very positive, indicating
that the desired results are being achieved.
• Another result is the continuous learning experienced by all
members of the working group. This is true not only for the
value methodology employed in the project, but also for the
detailed functioning of the organization in which we all work.
At the start of the project, each person knew only the
functions and processes specific to his/her own professional
or working area. But after undergoing this experience,
everyone now has a wider picture of the other activities that
take place only in the university.
• Regarding the need expressed by the surveyed T/R staff to
define what support services they are entitled to request from the
secretariat of their department, there is a need to create a
document specifying such information. We already have
confirmed that the A/S Staff Manual of Functions is little
known or used among the T/R staff surveyed (34.5 percent
reported knowing of the existence of this document, but only
11.5 percent had consulted it on any occasion). In
comparison, A/S Staff used it extensively (100 percent
reported knowing and using it).

CONCLUSION AND RECOMMENDATIONS
Value management and benchmarking are very useful
methodologies. The project described in this article has
contributed to extending the use of VM and increasing its
knowledge, in both the university and business community. The
relevance of this is apparent because of enormous current efforts
being made by the European Commission to promote the use of
value analysis, value management, and all of the tools included
within the Innovation Management Techniques.

Using VM helps to achieve quality improvement in any
organization, and in the specific case at the Spanish universities,
where it is necessary for all involved to be committed to improving
quality across the whole organization. Several decades ago,
recognized experts of Total Quality Management said that if an
organization is to improve its quality, all of its members must
understand what this really means and participate in a continuous
process of improvement.

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When does a value career begin? Does it begin with the formal application of the SAVE International value methodology, or does it begin with a conscious effort to improve value through some other formal or informal means?

CAREER STEPS
It is a sobering thought, at least for me, that my career started 38 years ago (in the days of the slide rule and a booming UK construction industry). This period includes working for consulting, contracting and utility organizations. The breakdown by type of work follows:

• 10 years working on design details and construction quality control for building and civil engineering projects
• 16 years program and project management for building, civil engineering, and environmental work, including master planning, commissioning and operations management
• 12 years as a management consultant functioning as an interim coordinator/team leader for consensus development regarding strategic planning, needs definition, and improvement of project delivery

Breakdown by geography shows 16 years in England, 10 years in western Canada and 12 further years of nomadic existence assisting clients worldwide in the continuing quest for defining and improving projects.

EARLY VE AWARENESS
In the late ’60s, I was somewhat aware of value engineering—for it was used extensively (in the deliberate guise of value analysis) by a local manufacturer of components for the burgeoning automobile manufacturing industry. My inquisitiveness was drummed out of me by those apparently “in the know” who said it was a fad, it would never catch on, and it was entirely inappropriate in construction work. All that being said, I used to scratch my head at the way we seemed to chop and change projects constantly as different people with fresh viewpoints became involved over time.

I became a chartered civil engineer and a chartered municipal engineer in 1974. By 1988, I had become a fellow of both the Institution of Civil Engineers and the Institution of Water and Environmental Management. Transfer to these heady professional heights meant that my experience had been deemed by peers as sufficiently broad and senior in terms of management of significant programs and projects.

CHANGING FOCUS
Out of necessity, my early efforts had been focused inwardly. Later, as I progressed in seniority, my efforts were focused more outwardly—to relationships with other projects and other stakeholders, and overall economics of project viability. It had always seemed an implicit duty to endeavor to provide best value for money and satisfy stakeholders’ other needs. I didn’t know then that there was a much easier and quicker means to achieve this worthy cause. If only I had used formal VE techniques 20 years earlier! My experiences working with developers, financial experts, and operations and maintenance personnel certainly broadened my outlook and assists me today in seeing beyond the “nuts and bolts” of a specific situation. Officer training in both the UK and Canadian Defense Reserve Forces also has provided a different and valuable perspective.

BROADER APPLICATION
In 1989, I had succumbed to the lure of using my experience and new qualifications for the purpose of management consulting. Value engineering was a natural fit; it provided the means to focus on programs and projects both outwardly and inwardly. This was the start of my second career and extensive air travel—I had the privilege of working on a variety of fascinating projects worldwide. I soon found myself propelled toward SAVE International’s formal VE training and certification, and I became a CVS in 1996. Despite a deep regard for the traditional value methodology, I felt that there was a need to recognize a broader application of VE. Accordingly, I have been working on an approach to improve and simplify the application of the standard value methodology through a holistic technique for guiding project development. This approach uses the Value Spiraling Technique (VST), which has been overviewed in SAVE International’s newsletter, Interactions.

In 1998, I joined forces with Michael Thompson in the UK and Scot McClintock in the state of New York to form the TEAM FOCUS Group, which provides tremendous synergy, as does interaction with all my colleagues in SAVE International and other value societies in different countries. Participation in the annual SAVE International conferences continually has renewed acquaintances and enthusiasm. Participation as a member of the SAVE International board of directors has added a new dimension and several challenges.

So, back to the beginning of this reflection, when does a value career begin? I think that VE is much more than a methodology; it is a philosophy, an outlook, and, for some of us, a way of life. I believe that my value career began taking shape as long ago as 1964.
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