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A Workshop Format for Developing Technology Transfer Materials

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Value engineering, or value analysis, has been used by numerous state highway agencies since the early 1970s, but it has not been widely applied on a smaller scale by local agencies such as counties, municipalities, and townships. The purpose of this project, which was funded under the Rural Technical Assistance Program, is to develop training materials that will support the transfer of the value engineering technique to local highway agencies. In an attempt to ensure that the training materials produced in this project would be appropriate and responsive to local needs, they were developed in a series of four, 1 ½-day workshop sessions held over a 4-month period. The project team provided instruction in value engineering principles, and two value engineering studies were conducted by nine persons from nine different local highway agencies. The participants' comments and questions about the instructional techniques and training materials were used to develop a new 1 ½-day seminar for local highway agencies. Several months later, the participants and the researchers met again, in a day-long session, to review the revised materials, including a slide-tape presentation. The experience gained in the workshop proved to be valuable in clarifying for the researchers the needs of local highway personnel and in identifying the limited applicability of previously developed value engineering training materials.

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Earlier attempts at transferring technology to local transportation agencies have had mixed results. The principal problem appears to have been that the investigators have overestimated or underestimated the level of sophistication and understanding of the audience, primarily local administrators and roadmasters. The purpose of this paper is to describe the lessons learned from using a workshop-oriented approach for developing technology transfer training materials. The project, "Value Engineering for Local Highway Agencies," was sponsored by the Pennsylvania Department of Transportation in cooperation with the Federal Highway Administration, U.S. Department of Transportation, using Rural Technical Assistance Program funds. The objective of the project was to develop a 1 ½-day seminar that would support the transfer of value engineering techniques to local highway agencies.

The development of the 1 ½-day seminar entailed the preparation of an introductory slide-tape presentation, a participants' notebook, and an instructor's guide. The entire package was to be designed so that the course could be offered by instructors with a variety of backgrounds. In an attempt to ensure that the training materials for this project would be appropriate and responsive to local needs, a new approach was attempted. The training materials were developed in a workshop in which the participants came from local highway agencies. In the workshop sessions, the participants were instructed in the application of value engineering techniques; they undertook two value engineering studies related to local maintenance problems and evaluated the training aids prepared by the researchers.

VALUE ENGINEERING

Value Engineering (VE) is the systematic application of recognized techniques that identify the function of a product or service, establish a value for that function, and provide the necessary function reliability at the lowest overall cost. VE has been used by numerous state highway agencies since the early 1970s, but it has not been widely applied on a smaller scale by local highway agencies such as counties, municipalities, and townships. VE is more than cost cutting; it is a combination of techniques to reduce costs without loss of quality.

The first distinguishing characteristic of value engineering is its emphasis on function. A VE study defines the functions that must be performed and seeks less costly alternatives for performing those functions. The second characteristic of value engineering is its use of creativity. Value engineering makes a concerted effort to expand the number of choices by identifying as many alternatives as possible. The third characteristic of VE is the job plan, which is an organized plan of action for the accomplishment of VE studies. It consists of eight phases:

1. Selection: The specific object to be studied is chosen. Projects worth studying include costly or complex projects and routine procedures that need updating.
2. Investigation: The project functions and related costs are identified. Comparisons of present design costs versus minimum possible costs are made to identify the areas with the greatest potential for savings.
3. Speculation: A variety of speculative techniques, including brainstorming, are used to assemble a large number of alternatives for the necessary functions of the project or procedure.
4. Evaluation: The creative ideas generated are evaluated, and the best alternatives are selected for development.
5. Development: The best alternatives are refined by assembling supporting cost data, sketches, and life-cycle cost analyses.
6. Presentation: The refined alternatives are presented to management as recommended changes to the original design or procedure.
7. Implementation: The accepted ideas are put into practice.
8. Audit: A simple system is devised to track the savings and costs of VE efforts.

The VE study is conducted by a multidisciplinary team. A mix of talent is desirable to bring different points of view to the study. Through the VE approach local managers can free their thinking from the restraints imposed by precedent, standard practice, habit, and even past experience. VE supports and encourages innovation, and it produces a substantial return on investment.

SELECTION OF WORKSHOP PARTICIPANTS

The objective in selecting participants was to ensure a cross section of persons and levels of government responsible for local roads and bridges. Ten participants were selected from Pennsylvania and two from Maryland. To identify potential participants from Pennsylvania, the researchers contacted the Pennsylvania State Association of Township Supervisors, the Pennsylvania Boroughs Association, and the Pennsylvania League of Cities. It was agreed that the following breakdown of names would be supplied by these organizations: two names each would be suggested for cities (population greater than 50,000), boroughs, and townships of the first class. Four names would be supplied for townships of the second class, the most numerous category in Pennsylvania (1,459 of 2,572 municipalities). In addition, the names of two county road supervisors from the state of Maryland were to be provided in order to have representation from a state where the county has significant responsibility for roads and bridges.

Although two-person teams from six agencies were originally planned, representatives of the Pennsylvania municipal organizations stressed that taking two individuals from the same organization for 2 days would place sufficient hardship on some of the smaller organizations that they might decline to participate. As a result, the workshop plan was altered to provide for one individual from each agency.

Representatives of the Pennsylvania municipal organizations strongly urged that they be allowed to make the initial contact with potential participants. They were able to emphasize to the participants the importance to the study and to the municipal organization of their involvement. Another advantage of having these representatives select and contact the potential participants was their broad knowledge of individuals in their organizations. However, only 10 names were provided instead of the 12 originally requested. Those contacted were open-minded, experienced people (although not necessarily engineers) and were known to be forthright in offering criticism. In general, the selection process worked satisfactorily. When the researchers contacted the individuals regarding their interest in the study, only one person declined to participate.

The participants proved to be the type of individuals desired. Their educational backgrounds did not appear to be crucial. Of the nine persons who agreed to participate in the study, three had a bachelor's degree, two had a master's degree, and four had an engineering degree. In this project, experience in planning and managing resources and a positive attitude toward

making changes were the most important criteria for successful participation.

CONDUCT OF THE WORKSHOP

Communicating the Workshop Objectives

Before the first group session, each participant was sent a description of the project and a six-page introduction to value engineering. At the beginning of the workshop, the objectives of the project and the workshop sessions were explained. There appeared to be a widespread misunderstanding of the objectives of the workshop. The participants believed that they had been assembled to develop a manual on drainage and shoulder maintenance. In retrospect, it appears that the amount of explanation given, both before and during the first workshop session, was inadequate. The purpose of the participants' involvement, namely, to assist in the development of the training materials for the seminar, should have been more carefully explained both in the initial contact and in the follow-up material sent to them.

Size of the Group

The initial plan was to divide the participants into two subgroups consisting of five persons each. Of the 10 persons originally suggested by the representatives of local municipal organizations, one declined to participate. A second person, although agreeing to participate, did not attend any of the sessions. The eight remaining participants attended the first session, but that number declined to five at each of the subsequent sessions.

Attendance declined for several reasons, including illness, increased workloads, and previous commitments. Although the reasons were varied, lack of interest is perceived by the researchers to have been a significant cause. The time frame for the sessions was also a factor in the decline in attendance. Because of the project schedule, the four sessions had to be held between January and April. On more than one occasion participants were absent because they were on snow alert. It appears reasonable in such efforts to plan for an attrition rate of about one-third.

Length of Sessions and Timing

The length of the sessions was a function of the objectives and scope of the study. For this project, four, 1 ½-day sessions were held at 1-month intervals. Each session began after lunch on the first day and concluded at about 3 p.m. on the second day. This schedule was selected to reduce the need for lodging to one night and to allow participants to travel during daylight hours. The available time appeared to be adequate.

The 1-month interval between sessions was also satisfactory. The level of interest remained high among individuals who continued to attend. Participants were asked to assemble information and cost records in the time between sessions, and several individuals regularly did so. A time interval longer than 1 month, it is believed, would have resulted in declining interest.

VE Studies

In the workshop sessions, the researchers provided instruction in value engineering principles, making use of previously developed training materials, including *Value Engineering for Highways: Study Workbook (1)* developed by the Federal Highway Administration, and a completed VE study conducted in Pennsylvania. A brief (20-page) guide prepared by the researchers was also distributed. Participants were then divided into two study teams, each of which conducted a value engineering study of a topic appropriate to municipal and county responsibilities. The rationale was that by performing a VE study themselves, participants could readily identify those concepts that were difficult to understand and the researchers could evaluate the appropriateness of VE training materials already available.

The two study teams were directed to develop project scenarios for shoulder maintenance and drainage. These were logical choices because they are of considerable interest to local agencies. Although hypothetical in nature, the project conditions and other factors were carefully chosen by the study teams as being typical of the type of work performed and the conditions routinely encountered.

The shoulder maintenance group selected a typical treatment of a 1-mi segment of roadway, which included rehabilitation of the full shoulder length and reconstruction of a 500-ft section. The shoulder was said to have been originally constructed of surface-treated gravel and was 6 to 10 ft wide. The drainage group selected a 1,200-ft section of secondary roadway subject to degradation because of standing water. The environment was considered to be suburban, with restricted speeds, and some private and commercial abutting properties. The sample project included a variety of drainage features, including underdrain, parallel drainage, driveway pipes, and heavy-duty storm drains at commercially developed intersections. The design features and costs of both projects were based on standard municipal and county practice, and, where applicable, on state and local specifications.

In the course of the workshop sessions, it became clear that having the participants select their own study problems caused some difficulties. In designing their problems, participants considered various alternatives for design, materials, equipment, and so forth. Thus, when they reached the speculation and evaluation phases of the study, they felt constrained by the analysis they had made earlier. The researchers believe that the participants would have engaged in greater creativity and experienced more satisfaction in conducting the studies if the study problems had been selected in advance.

From time to time the study teams needed assistance, and the researchers acted as facilitators. Certain concepts of value engineering appeared to present difficulty, particularly the con-

cept of worth. Also, participants were reluctant in the speculation phase to consider ideas that they "knew" to be impractical. The researchers elaborated on particular concepts and encouraged the study teams to be more wide-ranging in their search for alternative ideas.

This hands-on approach to learning about value engineering proved to be invaluable in identifying concepts that were most difficult to comprehend. Indeed, the researchers revised their approach to such VE elements as the FAST diagram and the concept of worth.

Input from Participants

As part of the overall development process, time was set aside at each session to discuss the materials assembled for the course and where improvements could be made by the researchers. Participants' input was solicited for the study guide, visual aids, and the study workbook.

Study Guide

Before the first workshop session, the researchers had condensed the 111-page FHWA guidebook *Value Engineering for Highways (2)* (used by state highway agencies) into a 20-page guide. This guide was a typical academic approach to the problem even though the text had been significantly simplified and condensed. Participants were quick to point out that the potential audience was not inclined to embrace this form of study guide, and a new draft was written before the third session. This version was reduced to eight pages and was written in a question and answer format. This draft was well-received by participants, and additional revisions were suggested. The guide subsequently was reviewed by representatives of municipal organizations and by the Pennsylvania Department of Transportation (PennDOT) and FHWA personnel. Among the suggestions made were to revise certain sections to make them more applicable to local situations, and to include specific examples of savings that had resulted from VE studies of smaller-scale projects.

Visual Aids

A ½-hour slide presentation using slides assembled for previous studies and activities was made at the first workshop session. Most of the slides contained relevant information but needed to be revised for uniformity of format, greater clarity and simplicity, and greater applicability to the problems faced by local roads and street managers. Moreover, the slide presentation was too long.

The researchers, together with the Instructional Design and Production Division of The Pennsylvania State University, arrived at a concept for a slide-tape presentation that was considered to be motivational rather than purely instructional. The concept was that of a municipal engineer buying, in a toy department, a value engineering kit that could be played like a game. The engineer brings the kit to his office and the "VE team" moves the pieces around the board, thus going through the various phases of the VE job plan. It was judged that in a 10-min presentation, the primary objective was to whet the appetite of seminar participants to learn more about value engineering rather than to try to explain the principles of VE in depth.

Study Workbook

The Value Engineering Study Workbook *(1)* developed by the FHWA is a blank workbook used to develop and record a value engineering study. It was found to be satisfactory for use at the local level, but workshop participants believed detailed instructions should be given on how it should be completed. The workbook as revised by the researchers has a page of instructions facing each page of forms to be completed. For each phase of the job plan, a checklist is included of questions to be asked, techniques to be used, and tasks to be performed.

Preview Session

Eight months after the fourth workshop session, participants were reconvened, together with personnel from PennDOT and FHWA, to review the plans for the pilot seminar. The purpose of the preview session was to review both the revised training materials and the outline for the conduct of the seminar in order to avoid any major problems at the pilot offering of the seminar. As a result of the preview, some suggestions were made for revisions to the slide-tape script and the VE guide. The value of the preview session was that it was held before master copies of the materials had been made and reproduced, and therefore the changes could be made easily and at little cost.

VALUE ENGINEERING FOR LOCAL AGENCIES

The VE Team

From discussions with the workshop participants it was clear that the usual, multidisciplinary, five-to-six person VE study team would be difficult to implement at the local level. Participants believed most local agencies could not marshall that number of people for a 40-hr study. The participants suggested that a team of three to five persons could be assembled, and even agreed with the statement (included in the revised guide) that "If necessary, one person can conduct a valid VE study as long as the systematic procedure of function analysis and the creative search for alternatives is followed."

In general, it has been found in VE studies that potential savings in construction are usually 10 percent of the construction costs. A $50,000 project can reasonably be expected to identify $5,000 in potential savings. However, all of the recommended savings may not be implemented. Implemented savings resulting from VE studies are estimated to be at least 5 percent of project costs. The cost of a VE effort is usually less than 10 percent of the implemented savings. For a $50,000 project, therefore, an effort of 3 to 4 person-days is justified. One of the workshop participants reported at the preview session that he had recently conducted a VE study at his agency,

with two other people (one of whom was a private citizen), and that they had worked at it part-time over the course of a week. He regarded the effect as successful.

Potential Study Topics

Local agencies often have responsibilities that are broader than highways and bridges. They may have concurrent responsibilities for fire and police protection, fee collection, utility monitoring, building and office construction, and so forth. Topics for VE review and analysis might include the following:

- Procurement: hardware, material, contractors, labor;
- Construction: new; improvements (capacity, alignment); reconstruction; (heavy maintenance); bridge replacement (priorities); bridge rehabilitation; and
- Maintenance: total program (priorities), routine, emergency, preventive.

CONCLUSIONS

The objective of the research project was to develop a 1 ½-day seminar on value engineering for local highway agencies. The training materials for this seminar were developed by means of a series of workshop sessions attended by persons typical of the intended audience for the seminar. In the workshop sessions, participants were given instruction in VE techniques; they conducted two VE studies and commented on the training materials distributed.

The workshop sessions proved immensely valuable to the researchers for the following reasons:

1. The suggestions made and the questions asked by workshop participants clarified for the researchers the needs of local agencies, the difficulty in understanding certain VE concepts, and the limited applicability, to local agencies, of the VE training materials already developed.
2. The training materials developed by the researchers could be tried out as soon as they were developed, and they could be revised at an early stage in the project, thus saving considerable time and expense.
3. The experience of the researchers with the workshop participants provided an initial confirmation of the assumption behind the project, namely, that the VE technique can be successfully applied by local highway personnel.

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