BENEFITS OF SMALL PROJECTS TEAM INITIATIVE

By Phillip S. Dunston,[1] Associate Member, ASCE, and
Anthony G. Reed,[2] Student Member, ASCE

ABSTRACT: Ordinarily, minimum design costs are associated with all construction projects regardless of their size or complexity. Consequently, the design costs are a higher percentage of the overall costs for small projects. This paper presents an analysis of the effectiveness of the Small Projects Team Initiative (SPTI) developed and implemented by the Seattle district of the U.S. Army Corps of Engineers. SPTI is intended to lower the design costs on construction projects where the design scope is simple and/or the administrative and construction processes are somewhat routine. The Small Projects team consists of representatives from contracting, construction, engineering, and project management. This team produces specifications for selected projects with simplified design, design by shop drawing, and innovative contracting arrangements. Data from 77 projects completed within the Seattle district are compared with the data from 146 pre-SPTI jobs. Statistically confirmed benefits include reduced design costs and reduced schedule growth (when user requested changes are excluded). Lower median change-order rates are not confirmed, but further analysis of the nature of changes is recommended.

INTRODUCTION

One of the concerns regarding construction projects has been the cost associated with design. Ordinarily, there are minimum design costs for all construction projects regardless of their size, complexity, or simplicity. Consequently, the design costs are a higher percentage of the overall costs for less costly projects (Hathaway and Cassell 1993). Reducing the design time and cost offers the benefits of decreased overall project duration and decreased overall project cost. However, any program to reduce design time and costs would be an exercise in futility if the savings were spent later on modifications due to vagueness or errors in design.

In situations where the design is simple, repetitive, or involves renovation of an existing structure, it would be economical to minimize the design costs. Due to the numerous renovations, minor and maintenance construction-type projects managed by the U.S. Army Corps of Engineers (USACE), minimizing the design costs has been a goal for many years. Many district headquarters within USACE have employed various methods to reduce design expense. The Seattle district, in particular, has developed and implemented the Small Projects Team Initiative (SPTI), a method aimed at reducing the negative cost and time impacts of design on smaller construction projects.

The genesis of SPTI occurred in 1994 during an effort to provide army reserve support centers with more rapid, less costly service of minor repairs and maintenance. A small support team, consisting of personnel from contracting, construction, engineering, and project management, assembled and executed the management of the remaining projects for the reserve centers for that year. This approach was employed again during the summers of 1995 and 1996 to complete major renovations to four Ft. Lewis elementary schools, which were approximately 40 years old. The schools had to remain in service, so the renovations had to take place only during the summer. The team assembled, scoped, designed, negotiated, and managed the execution of $3,500,000 worth of renovations in two 90-day time periods for the four schools within the two summer periods. The success of this team led to the establishment of a formal process to provide rapid project execution by reducing the design effort and streamlining the entire project delivery process. The concept was approved on July 25, 1996 and currently over 100 projects have been completed with the SPTI program (Berg 1994).

The Seattle district USACE employees are confident that the SPTI is saving taxpayers' money through reduction of design costs and decreased change orders (COs). This paper presents the results of a study on the effectiveness of the SPTI program in reducing time and costs associated with small construction projects. The hypothesis for this study was that the assumed savings are true. The goal of this study was to quantify the savings trends in terms of dollars, days, and/or percentages. An objective of the writers was to demonstrate whether the SPTI method is effective and efficient enough to convince other districts and similar organizations to implement it.

APPROACHES TO INCREASE EFFICIENCY

There are several programs being used by various organizations in an attempt to streamline construction processes and reduce costs for small construction projects. Some have similar procedures or use some of the steps found in the SPTI process. Limited information on small project process streamlining exists in widely circulated documents, such as periodicals and textbooks; therefore, the majority of the sources noted here are agency documents. The alternative methods discovered in the literature are grouped into the following four main categories: (1) methods involving paperwork reduction; (2) methods involving teamwork or reorganization; (3) methods involving simplified design; and (4) innovative procurement strategies. Of course, some organizations' procedures include more than one of the aforementioned categories.

Paperwork Reduction

The first category, methods involving paperwork reduction, has widespread use in both the public and the private sectors. Most businesses and governmental organizations realize that not every form or document applies to all situations. There is a trend to reduce the amount of forms and documents involved in a transaction. The Paperwork Reduction Acts of 1980 and 1995 constitute attempts by the U.S. government to reduce waste and confusion, and capitalize upon rapidly expanding computer technology.

In construction, paperwork reduction is generally achieved by eliminating unnecessary specifications, drawings, or contracting documents. Various state highway agencies throughout

[1]Assoc. Prof., Dept. of Civ. and Envir. Engrg., Univ. of Washington, Seattle, WA 98195-2700.

[2]Captain, Seattle Dist., U.S. Army Corps of Engrs., Box 3755, Seattle, WA 98124-3755.

Note. Discussion open until July 1, 2000. To extend the closing date one month, a written request must be filed with the ASCE Manager of Journals. The manuscript for this paper was submitted for review and possible publication on March 2, 1999. This paper is part of the ***Journal of Construction Engineering and Management***, Vol. 126, No. 1, January/February, 2000. ©ASCE, ISSN 0733-9634/00/0001-0022–0028/ $8.00 + $.50 per page. Paper No. 20402.

J. Constr. Eng. Manage., 2000, 126(1): 22-28

the United States have applied this understanding to construction contracting and design on small projects. On projects costing less than $100,000, the Iowa Department of Transportation (DOT) uses the abridged version of *Federal Highway Administration-1273,* which specifies required contract provisions. The abridged version reduces the standard 10-page document to two pages by omitting inapplicable contract provisions and consolidates the text of the remaining provisions (Heitzman and Kennedy 1998).

The Washington State DOT (WSDOT) operates on the principle that tailored contracting documents are more economical than standardized documents for projects that are relatively simple. The main area of paperwork reduction is in the planning sheets. Each type of work (i.e., paving, drainage, striping) on a project may have four or five planning sheets. From a recently published *Plans preparation manual*, the six regions of WSDOT have specific guidance on how to limit the number of planning sheets to an absolute minimum for each type of work (*Ad-ready* 1998).

The Savannah and Norfolk districts of USACE match construction design and management services to each project. The customers are able to view all of the services offered by the district with prices or design percentage next to each item. The customers can choose which activities they want USACE to perform. The Savannah district's list is divided into fixed-price activities and variable-price activities with some conditions of the variability. Record keeping, specification sheets, and contracting documents are kept at a minimum (Clark 1998). The Norfolk district's list is organized by project size, extent of design, and procurement method (Reilly 1998).

Teamwork and Reorganization

The next strategy is to reduce costs by creating a team, facilitating teamwork, or by reassigning responsibilities within an organization. The value in this method is that specific disciplines are integrated, providing focus and efficiency to selected projects (*Organizing* 1985). Two of the most well-known methods are partnering and design/build (D/B). In partnering, two or more organizations must trade traditional relationships for ''a shared culture without regard for organizational boundaries.'' Through a relationship of trust and understanding, the effectiveness of each participant's resources is maximized (Katz 1993; Eckstein 1994).

The D/B method empowers the contractor to obtain the design professional via several alternative contractual arrangements, produce the design, and then construct the project. The responsibilities and relationships of the contractor, design professional, and owner are altered to facilitate project delivery.

An example of reorganization under special conditions was demonstrated by WSDOT on a specific high-priority project. Engineers and design professionals were ''hand-picked'' to work exclusively on an interchange project that met the short project timeline for a major business owner. A 50-month process was compressed to 28 months for a total project cost of $18,400,000, saving an estimated $900,000 (*Ad-ready* 1998).

Another method of teamwork and/or reorganization is used by the Ft. Worth district of USACE. The district assigns small project-design teams of two to three personnel directly to its customers. The design team is essentially collocated with the customer, thus enhancing rapport. The design team's sole mission is to accomplish the small projects for the customer. The team cuts costs by minimizing reviews and by maintaining close contact with all parties involved in ongoing projects. These teams also utilize simplified design processes such as using photos, sketches, or updating existing drawings (Hal Smith, personal communication, Mobile district, USACE).

Simplified Design

The overall objective in simplified design is to limit the design detail to a point where the contractor can execute the project without consuming the savings with COs. It may consist of any of the following: photographs, written descriptions, limited number of drawings, existing drawings with ''pen and ink'' changes, reduced-size drawings that can be easily photocopied, sketches, and/or reused parts from unrelated previous designs.

The Maine DOT also uses simplified design techniques on small or routine projects. Maine has specifically targeted projects involving multiple ''like'' structures, wearing surfaces, and intersection projects used to reduce the costs and delivery time of construction (Todd and Waldo 1998).

USACE offers a three-day course in simplified design for their design professionals and project managers. The Japan district of USACE has expanded the basic simplified design procedures into a concept called the Simplified Design Acquisition Methodology. This process captures the life-cycle management of a project and includes all facets (planning and project management, design, cost engineering, construction, contracting, and safety) as an integrated service. The process is described within a detailed standard operating procedures guidebook (''Installation'' 1997).

Innovative Procurement Strategies

Although it is generally easier for private work than public work, some public agencies are adapting certain contract methods to fit their need of obtaining the best value for their construction dollars. For example, the University of Washington's Facility Management Section is attempting to obtain legislative approval to use job order contracts (JOC) for some of its contracting. JOC is one type of indefinite-delivery, indefinite-quantity (ID/IQ) contract used by USACE for the past several years. JOC is competitively bid, fixed-price contracting. The terms and conditions are valid for the life of the contract rather than individual projects. It includes a collection of detailed minor construction tasks and specifications with established unit prices. It is usually placed with a single contractor. It uses the established unit prices factored with the contractor's pricing coefficient to determine the cost of an individual project (Susan Sharrol, personal communication, Seattle district, USACE).

Another innovative procurement ID/IQ method used by USACE is the Multiple Award Task Order Contract (MATOC). MATOC is very similar to JOC. However, MATOC enables USACE to select and retain a set number of contractors, usually three, who can perform on a large contract that is subdivided into multiple, minor projects. USACE can use any of the three contractors on any portion of the contract but could also go to an outside source, if necessary (Sharrol 1998).

The benefits of innovative contracting techniques such as JOC and MATOC are that they reduce the advertising and qualification burden to a minimum while being able to rapidly mobilize a contractor who is familiar with the overall project. Greater familiarity of the contractor with the overall project equates to reduced design requirements and minimizes COs. Such innovative contracting strategies facilitate simplified design for minor construction and maintenance-type work.

SPTI MECHANICS

The standard USACE procedure for small construction projects was similar to that for large projects. A request for work was controlled by a program manager (PM). The PM would gather enough information about the job in order for USACE to design the job internally or contract with a design

J. Constr. Eng. Manage., 2000, 126(1): 22-28

firm. At a minimum, the design was completed in two phases, 35% and 90%. If the project were designed internally, numerous functional groups and disciplines would have to contribute. A review group would have to periodically examine the design. A government estimate would have to be completed before bidder inquiries could be sent out. All of this preliminary work may require advance compensation from the customer. A great amount of time and money would normally be invested into a project before the parties had sufficient information to commit. Maneuvering through this expensive and timely process was even less attractive for small projects.

The small projects consumed an inordinate amount of the allocated design and overhead costs in proportion to the cost of construction. This reduced the amount of funds available for adequate management of larger, more complex projects. The relatively high administrative costs for managing small projects also discouraged potential customers. As a result, many districts now use some of the various streamlining methods described earlier to manage small construction projects.

What makes the SPTI unique is that it combines all four categories of the basic streamlining methods into one formal process. It reduces paperwork by applying only absolutely critical specifications and contracting documents. It reorganizes various disciplines into an integrated team focusing their efforts on selected projects. It provides a close working relationship between the owner, project manager, and contractor (basically using the partnering concept on every job). It expressly uses simplified design techniques to obtain adequate bids from contractors. It almost exclusively uses innovative procurement techniques. It consists of a formal, yet flexible step-by-step process. The following sections describe characteristics of potential projects for SPTI, the Project Management Plan (PMP), the steps involved in project development, and the team composition and responsibilities.

Potential Project Candidates

There are no hard and fast rules in determining which project should be accomplished with the SPTI. However, there are some criteria that indicate which projects can be most economically delivered through the process. The most important criterion is that there is potential for savings on design costs. Projects that have the following characteristics should be considered for the SPTI:

- Repetitive/routine work
- Simple/uncomplicated construction process
- Renovations/remodelings/upgrades
- Detail of design sufficient with simplified design measures
- Total project costs less than $1,000,000 (≤$500,000 preferred)
- Maintenance projects

PMP

The PMP is a written two-to-four–page document that outlines the project process. It is as complete as the known information allows. The PMP is mandatory for every USACE project, but fits the SPTI exceptionally well because it supplies vital information that may not be found elsewhere in a streamlined process. It provides the customer and USACE team a means to visualize the project in terms of schedule, costs, and concept. It provides a key opportunity for the customer to give feedback on how well the project manager understands the customer's intent and desires. The PMP addresses the following issues:

- Project scope
- Points of contact (POCs) for the customer
- Customer expectations (as perceived by USACE)
- Procurement method
- Scoping strategy
- Small project team assignments
- Preliminary budget
- Schedule (rough timeline)
- Special considerations

SPTI Project Development—Steps

The SPTI process consists of nine steps for developing a small project. These steps are illustrated in Fig. 1 and are explained below.

- Step 1—Request work. This is normally accomplished with a verbal or written request by the customer or program/project manager.
- Step 2—Select the project lead (PL). The PL is the office and project engineer, and can also be the lead designer. The PL performs the duties of a project engineer (described in the next section) on jobs that are chosen for the SPTI. This is the person who will be the driving force for the project, integrating all facets. The PL will almost always be the same person for the entire duration of the project to ensure that a life-cycle view is established and maintained.
- Step 3—Prepare the project management plan (PMP). The PL prepares the PMP. Minimum information includes a brief project description, potential contracting methods, proposed level of design, probable participants, and scoping/award budget.
- Step 4—Deliver the draft PMP to the customer and proposed project team. Getting the PMP to the customers is a critical step for the PL. It is basically a draft offer by the Corps to accomplish a project. The customers are able to assess whether or not their needs and desires for the project are understood and can be accomplished. The customers can also see what the project will cost in terms of design, award, and supervision and administration (S&A). The PMP at this point is an excellent communication tool that facilitates open feedback from both sides. Getting the PMP to the proposed team also sets other actions in motion to prepare for the potential job.
- Step 5—Agree to a preliminary project budget. If the customer does not agree to the process and the budget outlined in the PMP, the PL evaluates the concerns to determine if there is a suitable solution. At this point, the scope

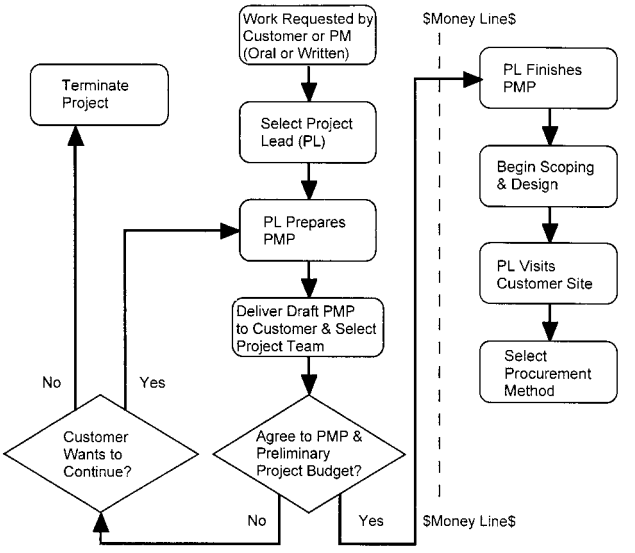

FIG. 1. SPTI Process Steps

J. Constr. Eng. Manage., 2000, 126(1): 22-28

of the project could change or be canceled altogether. If the customer does agree to the process outlined in the PMP, such approval is basically an authorization by the customer to proceed with the project. This does not imply that the total project is approved, but simply allows the PL to proceed with the scoping and contracting process. At this point, the customer will incur charges for time spent working on the project, but still has the ability to provide input into the project's development and contracting process. Different customers prefer different levels of their involvement in the project. It is generally a good idea at this time to determine how often the customer would like to be updated on the project and establish an acceptable level of rapport.

- Step 6—Finish the PMP. The PL incorporates any comments by the customer and the proposed project team into the PMP. When the PMP is completely finished, it will include a project description, POC list, the customer's expectations, a tentative schedule, unusual and/or important features, acquisition tool selection rationale, participant roles, a scope/award budget breakdown, closeout requirements, quality assurance (QA) requirements, and permit requirements.
- Step 7—Begin scoping and design. The PL will choose and execute the design method, whether it be photos, sketches, or other means. A written narrative (statement of work) on the scope of the work required will also be composed at this time.
- Step 8—Visit (by the PL) the customer site. Although this step has most likely occurred prior to this point, it is important that it happens at this time. This step basically marks the point of no return before the actual construction of the project. It provides an opportunity to ensure that all parties are ''on the same sheet of music.''
- Step 9—Select the procurement method. Based upon the requirements and known quantities of the project, the PL can select the most effective procurement method. The different procurement methods available include the purchase order, JOC, ID/IQ, 8a negotiated (Minority Business Enterprise or Women's Business Enterprise), invitation for bid, MATOC, existing contract, service contract, Visa card purchase, and equipment rental.

SPTI Team

The workforce of the SPTI is a team of representatives from functions within USACE such as contracting, construction, engineering, and project management. This team produces specifications for a construction project with simplified design and/or performance specifications, and utilizes innovative contracting arrangements. The Small Projects team for the Seattle district of USACE has the following members:

- Small-projects-advocate manager. This is the person responsible for the processes, staffing, and administration of all projects accomplished with SPTI.
- Program manager. This is the Corps' local representative who handles a specific customer's needs consistently. This person operates on either a regional basis or a customer-base concept. This is the person the customer office will be most familiar with and who functions essentially as a customer of SPTI.
- PL (project engineer). This is the person responsible for integrating all facets of the project. This is the government's representative to ensure that the project specifications are adequate and who can help alleviate any discrepancies, either in design or in the construction process. This person does not have to be a licensed professional engineer. A design professional is used if specialized design (e.g., structural, electrical, or heating, ventilation, and air-conditioning is required. The PL writes the PMP and lays out the framework for the contracting, specification, and construction documents.
- Program analyst. This individual is responsible for the financing arrangements for the project. This person initiates labor and project funding accounts based upon the PMP.
- Contracting specialist. This person assembles, advertises, and awards the contracts.
- Government estimator. This person prepares the government fair-cost estimate.
- Construction representative/QA personnel. This individual monitors all phases of the construction process. This person will be the on-site representative to assist in answering questions and fielding concerns that the contractor or owner may have about the project. This person will also ensure that the project is constructed to specified standards. This includes verifying test results for materials and ensuring that proper construction techniques and procedures are used.

RESEARCH METHODOLOGY

A total of 146 completed pre-SPTI jobs were compared to 77 SPTI jobs to detect indications of cost or time savings. The majority of the sample projects selected for the study were less than $1,000,000 in total construction cost (in keeping with the general guidelines for an SPTI candidate). The pre-SPTI sample projects occurred over a 12-year time period beginning in 1986. The SPTI sample projects occurred over a two-year period, from 1996 to 1998.

Considering the general hypotheses that the SPTI is saving money and time, comparisons were made between the pre-SPTI and SPTI samples based upon total project cost, design cost (percentage of the total cost), project duration increase (schedule growth), construction placement rate, and change-order rate (COR). Table 1 provides a snapshot of the completeness of the data that were available for the total of 223 projects.

A sensitivity analysis of the results was also completed to check if any high-dollar or low-dollar projects were perhaps skewing the trend. Projects exceeding $500,000 in total cost (the preferred upper boundary for an SPTI project) and projects less than $30,000 in total cost were removed in turn. Each of the two data sets was also divided into three categories—new construction, renovation, or repair—to determine whether a particular type of project was more suited to benefit under the SPTI program. The samples were then evaluated in the same manner as initially, by design costs, duration, and COs.

Statistical Methods

Statistical comparisons of data from the two sample groups were made using the Mann-Whitney *U* test or the Kruskal-Wallis *H* test, both appropriate for nonparametric data of this

TABLE 1. Number of Project Samples with Specific Data

Measure (1)	Pre-SPTI (2)	SPTI (3)
Total projects	146	77
Projects with overall cost	146	77
Projects with design costs	86	40
Projects with duration	143	76
Projects with duration change	83	71
Construction placement rate	143	76
Projects without CO data (some jobs did not have COs.)	146	77

J. Constr. Eng. Manage., 2000, 126(1): 22-28

sort. A 5% significance level was used and the null hypotheses always assumed that the medians were equal (not significantly different). The reader is referred to Reed (1998) for a more detailed explanation.

Contractor/Customer Poll

A questionnaire was developed and sent out to six contractors and eight customers who have actually had experience with the SPTI. All six contractors responded, while only three customers responded. The poll was intended to obtain feedback from organizations outside USACE.

ANALYSIS RESULTS

The two areas that produced notable results were design percentage and cost growth (COs). The amounts of estimated savings from each of these areas are $1,685 and $2,864, respectively, for a total of $4,549 per $100,000 of project costs.

In the majority of the following tables, the median value is shown, since it is the better measure of central tendency for the data. The average is shown in parentheses immediately after the median value in order to provide additional insight for the reader.

Overall Project Costs

Project duration, type of construction, current cost of normal construction, and variations in management approach invalidate any direct comparison on the basis of cost alone. However, it is important to note the totals and observe the relationship of the pre-SPTI and the SPTI samples. Table 2 displays the basic descriptive data for the two sets of projects. The median cost for a pre-SPTI job was $151,793, while the median cost for a small project job was $85,657.

Design Cost Percentage and Schedule Growth

USACE has produced written guidelines establishing maximum desired design cost percentages for specific categories and sizes of projects. These ceilings vary according to type of project (i.e., civil or military construction, etc.), but generally range from 6% to 16%.

The median values for the design cost percentage were 6% (11% average) and 4% (4% average) for the pre-SPTI and SPTI project samples, respectively. These values proved to be significantly different statistically. It appears that the difference between the medians of the pre-SPTI and the SPTI projects is not just due to chance, but may have resulted from the new management method. Given that the median total cost for all sample projects was $118,725, the SPTI could potentially save an estimated $2,000 per project on design cost alone. This is equivalent to a savings of $1,685 per $100,000 worth of project.

The project duration (days) was examined in terms of the amount of time a project changed from its original estimated duration (also known as project slippage or schedule growth). To ensure objectivity, all information available was included, whether it showed an increase, a decrease, or no change.

The median project duration was 269 days (289 days average) and 120 days (135 days average) for the pre-SPTI and SPTI project samples, respectively. Explanations for this magnitude of difference more likely stemmed from project requirements rather than management method. Project type was also eliminated as an explanation because the SPTI pool had a larger percentage of new construction (26%–17%) and the percentage of renovation projects was nearly equal (59% pre-SPTI and 61% SPTI). Projects in these two categories may be expected to have longer durations than repair projects.

One important consideration was that some of the duration changes were likely due to COs. It was more important to capture those COs that may have resulted from inadequate design or poor-quality engineering or construction practices. The results may have also been distorted by user request (UR) modifications due to the fact that a customer may be inclined to ask for a change when the construction project is going very well as opposed to running behind schedule. To visualize the impact of UR COs as opposed to engineering COs, the former were included and then excluded. Table 3 shows the division of these data in terms of the median percentage that a project increased.

Table 3 strongly indicates the advantage of the SPTI projects being completed on time. There was an enormous improvement in the median SPTI results when the projects that did not change duration were included. Conversely, there was only a slight improvement in the median pre-SPTI results when the projects that did not change duration were included.

The Mann-Whitney *U* test reported that all rows of information in Table 3 except for the second (all projects including UR COs) were significantly different. The best comparison is shown in the last row of Table 3, which excludes UR COs and includes the projects delivered on time. The results in the last row indicate that the SPTI projects were delivered with less schedule growth. Since UR COs did have an impact upon the results, the exact nature of UR COs should be examined in a future evaluation.

A reduction in project slippage could also have a positive impact upon the S&A allowance in terms of the quality of supervision. [The S&A allowance pays for the Corps' time for accomplishing all inspections, making progress payments (including final pay), negotiating/writing all modifications, and any other management or administrative functions. The S&A allowance is currently set at 6.5% of the overall construction cost.] Applying an S&A cost of 6.5% to all sample projects provides one prospective of the impact of shorter project duration in terms of the amount of funds available per day to manage any given project. The median allowance for a pre-SPTI job would be $9,867. The median allowance for an SPTI job would be $5,568. Dividing these S&A allowances by the median number of days for project duration of pre-SPTI and SPTI jobs results in the amount of funds available per day for USACE to provide project management. The results are $37 and $46 per day, respectively. Thus, one can see that the SPTI may very well allow for more funds per day for management and administrative costs in the case of the sample projects by 24%. This should translate into a higher-quality project due to the fact that there is more time allowed for proper execution of management and administrative functions.

Construction Placement Rate

Construction placement rate—dollars worth of construction that can be accomplished in a given day—can be determined

TABLE 2. Cost Summary of Sample Projects

Project type (1)	Total costs of samples (2)	Median (average) (3)	Standard deviation (4)	Range (5)
Pre-SPTI	$41,214,412	$151,793 ($282,291)	$323,591	$2,271 to $1,678,768
SPTI	$13,988,038	$85,657 ($181,663)	$289,884	$3,898 to $1,956,102

J. Constr. Eng. Manage., 2000, 126(1): 22-28

TABLE 3. Median Percent Duration Increased (Average Percent of Increase Shown in Parentheses)

Category (1)	Schedule Growth (%) Pre-SPTI (2)	SPTI (3)
Projects that increased or decreased	15% (17%)	42% (52%)
Projects that increased, decreased, or were neutral	10% (13%)	0% (15%)
Projects that increased or decreased for reasons other than UR COs	12% (12%)	40% (35%)
Projects that increased, decreased, or were neutral for reasons other than UR COs	5% (10%)	0% (10%)

by dividing the project construction cost by the project duration. The median placement rate was \$683 for the pre-SPTI projects. The median placement rate was \$740 for the SPTI projects, over 8% higher (or more efficient). However, the statistical comparison of the placement rates indicated that the rates are not significantly different. Note that the less schedule growth for SPTI projects when placement rates are essentially the same as those of pre-SPTI projects implies better management of the SPTI projects.

COs

The number of COs or modifications to a project plays a key role in determining the effectiveness of a management method. If the method used to improve the project development process results in numerous COs, any initial gain by the improvement may be nullified. As stated earlier, this study was more concerned with changes that occurred due to design or engineering inadequacies rather than user-requested changes. Therefore, an analysis was done to isolate the effect of UR COs. Including UR COs, 58% of the pre-SPTI samples had COs, while only 13% of the SPTI samples had COs. Excluding UR COs, 64% of the pre-SPTI samples had COs, while 27% of the SPTI samples had COs.

The percentage that a CO increases the overall construction costs is often referred to as the COR. Although the COR is primarily a measure of how well the project requirements were initially captured in the design, it has value in this study for indicating if a general trend in project development efficiency exists for either management method. Table 4 shows the breakdown of CORs. The CO results suggest that the SPTI provides a slight advantage when considering the COR effect on all samples (combining cost and frequency of changes).

The median CO costs were \$3,400 for pre-SPTI projects and \$0 for SPTI projects. The difference of \$3,400 is the estimated savings for the median cost of all sample projects of \$118,725. In terms of the index of \$100,000 worth of project, the estimated savings for COs would be \$2,864. The Mann-Whitney *U* test revealed that the median CORs were not significantly different.

In an effort to more specifically identify the savings from COs, a further review was done based upon speculated conservative figures. The Seattle district estimates that a typical CO would conservatively cost 20% more in construction costs than it would have if originally included in the design. This is referred to as the premium cost of a CO. Furthermore, the Seattle district estimates that approximately 10% of the CO cost represents the cost of doing the engineering or design changes. This is referred to as the associated costs of COs. The median CO costs were \$3,400 for pre-SPTI projects and \$0 for SPTI projects. Therefore, the associated costs of an average CO would be \$340 and \$0, respectively. The difference of \$340 is an estimated savings for the median project cost of \$118,725. Accordingly, the estimated savings for the associated cost of a CO per \$100,000 of project costs would be \$286.

The premium costs of COs for the median construction costs of \$3,060 (pre-SPTI) and \$0 (SPTI) would be \$612 and \$0, respectively. Accordingly, the estimated savings for the premium cost of a CO per \$100,000 of project costs would be \$516. Managing with SPTI, the estimated total median savings for the premium and associated costs for a CO is \$802 per \$100,000 of project costs.

Sensitivity Analysis

The sensitivity analysis did not yield significantly different results from the overall original results. This indicates that any trend of the study was not distorted by the variances in the sample projects' overall costs.

Project Type

The types of projects managed by USACE include new construction, renovation, repair, and maintenance. One might presume that a renovation project might require more design detail than a repair/maintenance project, but not as much as for new construction. On the other hand, it is certain that some renovation projects are more complex than some new construction projects. All sample projects were classified into one of the following three categories: new construction, renovation, and repair (including maintenance), and were analyzed as were the overall data in the original format. The quantities of samples in each category are shown in Table 5.

There were only three measures that yielded significant differences in a statistical analysis by project type: duration increase for all jobs; COR only for jobs with COs, including UR; and COR for all jobs, including UR. Evaluating the samples by project type provided mixed results. Addressing the most significant results, the SPTI method proved to be extremely effective for new construction design costs. The median for design costs for SPTI new construction was 0.5% as opposed to 4% for all of the SPTI samples. The median duration increase for SPTI samples was 0% in all categories when considering all samples. But the duration increase was quite substantial for those few SPTI jobs in which it occurred for all three project types. The median values for CORs decreased for both pre-SPTI and SPTI for all project types when counting all samples instead of only those with COs, as would be expected. However, the decrease was strikingly significant for SPTI new construction (from 37% to 0%) and slightly less so for repair (from 26% to 0%). Evaluating the COR with and without UR COs indicated that further analysis on the types of COs may be beneficial.

TABLE 4. Median Change Order Rate (COR) (Average COR Shown in Parentheses)

Category (1)	Pre-SPTI (2)	SPTI (3)
Projects with COs, including UR	12% (35%)	13% (29%)
All projects, including UR	2% (23%)	0% (8%)
Projects with COs, excluding UR	9% (33%)	10% (13%)
All projects, excluding UR	1% (19%)	0% (2%)

TABLE 5. Quantity of Projects by Category

Category (1)	Pre-STPTI (2)	SPTI (3)
New construction	25	20
Renovation	86	47
Repair	36	10

J. Constr. Eng. Manage., 2000, 126(1): 22-28

Poll Results

Of the six contractor questionnaires and eight customer questionnaires that were distributed, there were six and three responses, respectively. The six contractors had completed 141 small-project jobs. For advantages, all of the contractors cited increased profit margins, improved efficiency, reduced duration, and increased design flexibility. Five of the contractors stated that they were very satisfied, while one was somewhat satisfied with SPTI. The three customers had experienced 37 small-project jobs. For advantages, all of the customers cited increased rapport and increased design flexibility. Two of the customers were very satisfied, while one was somewhat satisfied with SPTI.

It appears overall from the contractors' and customers' viewpoints that the SPTI program has been well received. The disadvantages cited were relatively few and without consensus, but easily addressed. The majority of the suggestions were positive and workable. Overall, the questionnaires indicate satisfaction, increased rapport, and efficiency.

SUMMARY AND CONCLUSIONS

The USACE Seattle district Small Projects Team Initiative was developed for the purpose of streamlining the process of project delivery for small projects, preferably those costing no more than $500,000. The SPTI team consists of representatives from contracting, construction, engineering, and project management, and the process makes use of all four popular methods for streamlining the construction process—paperwork reduction, teamwork and reorganization, simplified design, and innovative procurement. The SPTI process consists of a flexible nine-step program. Reduction of design costs was the prime motivator for development of the program. This paper has presented the results of a study aimed at assessing how effective the program has been in achieving the overall reduction of costs.

The following measures discovered by the study indicate the effectiveness of the SPTI program:

- Design costs are lower for SPTI projects, at a savings of $1,685 per $100,000 of project costs (statistically confirmed).
- Schedule growth is less for SPTI projects when considering the median impact on all jobs (statistically confirmed).
- Change-order costs are lower for SPTI projects, at an apparent median savings of $2,864 per $100,000 of project costs (not statistically confirmed).
- A sensitivity analysis revealed no impact on the comparison when the smallest (under $3,000) and the largest (over $500,000) projects were excluded.
- Renovation projects appear to reap the greatest benefit, while new construction projects are experiencing high change-order rates, but interestingly without more schedule growth.
- The majority opinion of contractors and customers is that they are very satisfied with the program, citing improved efficiency, rapport, and flexibility, among other things.

The primary objective of reducing design costs has been achieved apparently without transferring those costs to the construction phase. A further examination of the nature of sample projects' change orders, especially UR changes, would provide a more complete assessment of how the process has performed. The program has room for further refinement, as indicated by survey comments. This study has provided the basis for future evaluations.

ACKNOWLEDGMENTS

The writers wish to express their gratitude to Arill Berg, Al Gaspasin, Fred Rambac, and Gene Scott of the U.S. Army Corps of Engineers (USACE) Seattle district and to numerous other USACE representatives for providing tireless assistance and support in obtaining the information for this paper.

APPENDIX. REFERENCES

Ad-ready PS&E manual. (1998). Olympic Region Proj. Devel., Washington State Department of Transportation, Olympia, Wash.

Anderson, C. (1997). ''Job order contracting briefing to the state of Washington Alternative Public Works Oversight Committee.'' Seattle district, U.S. Army Corps of Engineers, Seattle.

Berg, A. (1994). ''Information paper: Seattle district small projects team initiative.'' Ft. Lewis Area Office, U.S. Army Corps of Engineers, Ft. Lewis, Wash.

Bubshait, A. A., Al-Said, F. A., and Abolnour, M. M. (1998). ''Design fee versus design deficiency.'' *J. Arch. Engrg.*, ASCE, 4(2), 44–46.

Clark, T. (1998). *Installation support services manual*. Savannah district, U.S. Army Corps of Engineers, Savannah, Ga.

Dimichele, R. (1998). ''Innovative acquisition process saves government time and money.'' U.S. Army Corps of Engineers, Huntsville, Ala.

Eckstein, J. (1994). ''The impact of partnering on construction contracts,'' MS thesis, University of Washington, Seattle.

Gardiner, P. D., and Simmons, J. E. L. (1998). ''Conflict in small- and medium-sized projects: Case of partnering to the rescue.'' *J. Mgmt. in Engrg.*, ASCE, 14(1), 35–40.

Hathaway, J. L., and Cassell, J. W. (1993). ''Managing design performance.'' Logistics Management Institute, Bethesda, Md.

Heitzman, M., and Kennedy, G. (1998). ''Abridged version of the *FHWA-1273*.'' Federal Highway Administration, Iowa division, U.S. Department of Transportation, Iowa.

''Installation support: Simplified design acquisition methodology (SDAM).'' (1997). U.S. Army Corps of Engineers, Japan.

''Interstate 5 South DePont: Interchange design process report.'' (1997). Washington State Department of Transportation, Olympia, Wash.

Katz, N. F. (1993). ''Partnering: Trend or fad?'' Associated Builders and Contractors, Inc.

Kranzler, G., and Moursund, J. (1999). *Statistics for the terrified*. Prentice-Hall, Englewood Cliffs, N.J.

McKenzie, J., Schaefer, R. L., and Farber, E. (1995). *The student edition of mini-tab for Windows*. Addison-Wesley, Reading, Mass.

Organizing for small project management. (1985). Marcel Dekker, New York.

Reed, A. G. (1998). ''The impact of the small projects team initiative on construction projects managed by the U.S. Army Corps of Engineers,'' MS thesis, University of Washington, Seattle.

Reilly, P. (1998). ''Matrix of services and costs.'' Norfolk district, U.S. Army Corps of Engineers, Norfolk, Va.

''Standard operating procedures for administration of Indefinite Delivery/Indefinite Quantity construction contracts for installation support.'' (1997). U.S. Army Corps of Engineers, Ft. Worth, Tex.

Todd, K. T., and Waldo, J. (1998). ''Reduced specifications and contract procedures: Alternate contracting procedures for small projects.'' Federal Highway Administration, Maine division, U.S. Department of Transportation and the Maine Department of Transportation, Augusta, Maine.