The Impact of the Small Projects Team Initiative on Construction Projects Managed by the U.S. Army Corps of Engineers

by

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Abstract

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This thesis presents an analysis of the effectiveness of the Small Projects Team Initiative (SPTI) that was developed and implemented by the Seattle District of the U.S. Army Corps of Engineers (USACE). Commonly, there are minimum design costs associated with all construction projects regardless of their size, complexity, or simplicity. Consequently, the design costs are a higher percentage of the overall costs for less expensive projects. SPTI is intended to lower the relatively high 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. Designs on some projects have been reduced to photographs or sketches. The design process time is reduced, which reduces design costs, yet change order costs have also decreased. This thesis analyzes the results of 77 projects that have been completed within the Seattle District and compares the results with 146 Pre-SPTI jobs.

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CHAPTER I: INTRODUCTION

Each party associated with construction projects has certain objectives. The owner wants quality results at the best price. The contractor wants a smooth process with a reasonable profit margin. The project manager wants to deliver a quality product through an efficient and timely process. To obtain these objectives, numerous contracting methods have been developed, intended to improve the effectiveness and efficiency of construction project delivery. These methods range from reducing paperwork to reorganization. Each method must be evaluated to determine how well it has met the original objectives. Since each construction project is unique, no single method can be suitable for all conditions. Some methods initially seem to offer monetary savings but actually cost more in the long term. Some methods trade efficiency for risk. The most attractive solution is to implement a method that actually takes little or no additional effort over alternative methods yet provides increased benefits for all parties involved.

One of the concerns of construction projects has been the cost associated with design. Commonly, there are minimum design costs (usually a percentage of construction cost) 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 development duration and decreased overall project cost. These benefits can help each party involved realize some of their objectives. However, any program to reduce design costs would be an exercise in futility if the savings during design were spent later on modifications due to vagueness of 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 to reduce the negative cost and time impacts of design on smaller construction projects.

The birth of the 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 $3.5 million dollars 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 the 25th of July 1996 and currently over 100 projects have been completed with the SPTI (Berg 1998).

The Seattle District USACE employees are confident that the SPTI is saving taxpayers' money due to reduction of design costs and decreased change orders (COs). The hypotheses for this thesis is that their assumptions are true; the goal of this thesis is to quantify the savings trends in terms of dollars, days, and/or percentages. An objective of the thesis is to demonstrate that the SPTI method is effective and efficient enough to convince other districts and similar organizations to implement it.

CHAPTER II: 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. Although none are identical to SPTI, 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. For the purpose of organization, the alternative methods discovered during a literature review are grouped into four main categories: 1) methods involving paperwork reduction, 2) methods involving teamwork or reassigning responsibilities, 3) methods involving simplified design, and 4) innovative procurement strategies. Of course, some organizations' procedures include more than one of the aforementioned.

Paperwork Reduction

The first category, methods involving paperwork reduction, has widespread use in the civil sector as well as state and federal government sectors. Over the course of many years of doing business, safeguards in the form of written and signed documents are implemented. In certain situations, these safeguarding measures become excessive. Largely due to the fact that the government is responsible for protecting the public's pocketbook, the former has a tendency to create a lot of 'red tape' transactions. 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 are an attempt by the U.S. Government to reduce waste and confusion and capitalize upon rapidly expanding computer technology.

In construction, often this reduction is in the form of unnecessary specifications, drawings, or contracting documents. Various state highway agencies throughout the U.S. have applied this understanding to construction contracting and design on small projects. The Iowa Department of Transportation (DOT) uses the abridged version of the Federal

Highway Administration-1273 (FHWA-1273), which specifies required contract provisions. The Iowa DOT uses the abridged version of FHWA-1273 only on projects costing less than $100,000. 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).

In an effort similar to Iowa's, the Maine DOT uses simplified plan criteria, alternate specifications, and contracting procedures for design, construction, and management of small and/or routine projects. Less intense measuring requirements, streamlined construction practices, standardized plans, and abbreviated processes are being used to reduce costs and delivery time of projects (Todd and Waldo 1998).

Another example of decreasing costs by paperwork reduction is from the Washington State DOT (WSDOT). 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 apiece. With 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 (WSDOT 1998).

A final example of decreasing costs by paperwork reduction is from the Savannah and Norfolk Districts of USACE. They match construction design and management services to each project. The customer is able to view all of the services offered by the district with prices or design percentage next to each item. The customer 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/Reorganization

The next set of examples is methods 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 (Dekker 1985). Various methods of team building or assigning individuals dual hats are currently used all over the world. Two of the most well known methods are partnering and design/build (D/B). The Construction Industry Institute (CII) Partnering Task Force defined partnering as follows:

> "a commitment between two or more organizations for the purpose of achieving specific objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organizational boundaries. The relationship is built upon trust, dedication to common goals, and an understanding of each other's individual expectations and values" ((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.

Other methods used to cut construction costs by teamwork or some sort of reorganization includes a technique employed by WSDOT on a 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 prospective new business. A 50-month process was compressed into a 28 month time period. The total cost of the project was $18.4 million and the streamlined process is estimated to have saved $900,000 (WSDOT). This method worked mainly due to the project's high priority, intense communication, and a dedicated project group.

Another method by teamwork and/or reorganization was used by the Ft. Worth District of USACE. The District assigned small project design teams of two to three personnel directly with its customers. This method is difficult because most organizations are reluctant to dedicate internal personnel to a sole application but the payoff can be worth the cost. The design team is essentially collocated with the customer, which enhances rapport. The design team has a very good understanding of the precise needs of the customer. The design team's sole mission is to accomplish the small projects for the customer. The success of this kind of assignment depends to a great extent upon the motivation of the individuals selected for the team. 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 (Smith 1998). Simplified design is discussed more fully in the next section.

Simplified Design

Simplified design is used by numerous construction organizations to one extent or another. The overall objective in simplified design is to limit the design just to a point where the contractor can execute the project without consuming the savings with change orders (COs). It may consist of any of the following: photographs, written descriptions, limited number of drawings, existing drawings with 'pen and ink' changes, reduced sized drawings which can be easily photocopied, sketches, and/or reused parts from unrelated previous designs.

Along with the efforts to control the amount of paperwork, 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 (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 (SDAM). 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 Procedure (SOP) guidebook (Japan District 1997).

Innovative Procurement Strategies

The final category of methods to streamline the construction management process for small projects is innovative procurement strategies. Although this 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 Contracting (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 (Rogers 1998). JOC is competitively bid and is 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 (Sharrol 1997).

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 maintain (similar to a retainer) 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, is 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 while minimizing COs. Such innovative contracting strategies facilitate simplified design for minor construction and maintenance type work.

Simplified Facility Support Process

A method that is very similar to the SPTI and generally uses the four categories just mentioned is called the Simplified Facility Support Process (SFSP). This process was developed by the Operations and Maintenance Engineering Enhancement (OMEE) section of the USACE Huntsville Center (Dimichele 1998) (Rizvi 1998). However, there are three differences between the SFSP and the SPTI. The first is that SFSP exclusively utilizes ID/IQ procurement strategies for projects. Typically, the ID/IQ contract is already established and then the SFSP is initiated. The second difference is that the SFSP is targeted for operations and maintenance type work and is rarely, if ever, used for new construction. Thirdly, the structure of the management team is different. In fact, the team make-up depends upon the project and may include agencies not with USACE. Otherwise, there are some close similarities between the SPTI and the SFSP.

CHAPTER III: SPTI MECHANICS

Historically, USACE managed small construction projects in a manner similar to 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 externally. The external method would require negotiations and a contract with an architectural/engineer (A/E) firm for the design. At a minimum, the design was completed in two phases, 35% and 90%. If the project were designed internally, numerous functional groups would have to complete a portion. For example, the specification section would have to write the specifications. The mechanical, electrical, and structural sections would also complete portions of the design. A review group would have to periodically examine the design. A government estimate would also have to be completed before bidder inquiries could be sent out. All of this preliminary work may require money up-front 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. For example, the customer would have to decide whether the designed project met his needs and the contractor whether he wanted to submit a bid. 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 high administrative costs for managing small projects also turned away potential customers. Many Districts now use some of the various methods described in Chapter II to manage small construction projects.

What makes the SPTI unique to the other methods is that it combines all four categories of the basic streamlining methods into one formal systematic 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. This chapter discusses characteristics of potential projects for SPTI, the Project Management Plan (PMP), the steps involved, 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 accomplished with the process. The most important criteria 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/remodeling/upgrades
- Detail of design sufficient with simplified design measures
- Total project costs less than $1 million (≤$500,000 preferred)
- Maintenance projects

Project Management Plan (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. It 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 an excellent 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 Process - Steps

SPTI has a series of nine steps in order to execute a project under the program.

- STEP 1 – Request work – This is normally accomplished with a verbal or written request by the customer or Program/Project Manager.
- STEP 2 – Select 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 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 a life-cycle view is established and maintained.
- STEP 3 – Prepare 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 customer & proposed project team – Getting the PMP to the customer is a critical step by the PL that is basically a draft offer by the Corps to accomplish a project. The customer is able to

assess whether or not their needs and desires for the project are understood and can be accomplished. The customer can also see what the project will cost in terms of design, award, and S&A (supervision and administration). 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 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 of the project could change or be canceled altogether. If the customer does agree to the process outlined on the PMP, such approval is basically an authorization by the customer to proceed with the project. This does not imply 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 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 project description, point of contact (POC) list, customer's expectations, tentative schedule, unusual and/or important features, acquisition tool selection rationale, participant roles, 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 (SOW)) on the scope of the work required will also be composed at this time.

- STEP 8 – Visit 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 all parties are "on the same sheet of music".
- STEP 9 – Select 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 Purchase Order (PO), Job Order Contract (JOC), Indefinite Delivery/Indefinite Quantity (ID/IQ), 8a Negotiated (Minority Business Enterprise (MBE) or Women's Business Enterprise (WBE)), Invitation For Bid (IFB), Multiple Award Task Order Contract (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 overall 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 is essentially a customer of SPTI.

- Project Lead (Project Engineer) - This is the person responsible for integrating all facets of the project. This is the government's representative to ensure the project specifications are adequate and that can help alleviate any discrepancies, either in design or the construction process. This person does not have to be a licensed professional engineer. (A design professional is used if specialized design (i.e. structural, electrical, or HVAC) is required.) This person 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/Quality Assurance Personnel – This individual monitors all phases on the construction process. This person will be the on-site representative to assist in answering questions and concerns the contractor or owner may have about the project. This person will also ensure the project is constructed to specified standards. This includes verifying test results for materials and ensuring proper construction techniques and procedures are used.

Construction in the Seattle District

The Seattle District of USACE is responsible for the administration and management of construction projects as authorized by Congress. These projects are normally federally funded and for the protection or benefit of the general public. The District manages both military and civil works projects. The responsibility for the military portion includes construction, installation support, and real estate services. The area of responsibility for military construction extends to all active duty and guard/reserve bases, and depots throughout Washington, Idaho, Montana, and Oregon.

The responsibility for the civil portion includes the efficient development, management, and conservation of the region's water resources. The area of responsibility for civil construction encompasses the Columbia River system upstream of the mouth of the Yakima River, much of eastern Washington, northern Idaho and western Montana to the Rocky Mountains.

The District Headquarters is located in Seattle, with two Area Offices: one at Ft. Lewis and one at Spokane. The District Headquarters prepares and awards all contracts, provides cost estimating, in-house design, technical expertise on construction issues, and legal counsel. The Area Offices are generally the direct liaison between the contractor and the owner. The Area Offices provide contracting and quality control representatives directly to projects. The Area Offices also process all contract related actions including, requests for information (RFIs), modifications, review and approval of submittals, and requests for payment.

The overhead or administrative costs of managing projects for USACE is called Supervision & Administration (S&A) costs. The S&A fund is the monetary account the Corps uses to pay for their 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 rate is set annually. Congressionally funded projects receive an S&A rate at 5.7% of the overall construction cost, while customer requested projects (reimbursable) receive 6.5% of the overall construction cost. Although the amount can change from year to year, reimbursable projects have been stable at 6.5% for several years.

A USACE employee working full-time on one project can generate an S&A cost up to $500 per day (direct salary and associated costs). An average USACE project does not receive full attention everyday during its life. In addition, the amount of work just processing a final payment can accumulate up to $1,000. A change order could easily require $1,000 worth of effort as well. All of these expenses are covered from the S&A and reduce the amount left for inspections and other beneficial functions. An S&A allowance on a $100,000 project would be $6,500 (6.5%). Subtract the amount required to process final payments, progress payments, any change orders, and required inspections on a 200-day project and one can see how rapidly the funds can be depleted.

An S&A of $6,500 on a 200-day project would allow approximately $33 worth of effort per day or $163 per week, assuming a 5-day workweek.

CHAPTER IV: RESEARCH METHDOLOGY

The study for this thesis primarily compares the 'old' way (called Pre-SPTI) of managing small projects to the SPTI within the Seattle District. A total of 146 completed Pre-SPTI jobs were compared to 77 completed SPTI jobs. This comparison merely seeks an indication of a trend. In order to actually make analogous comparisons, the projects would have to be identical or each detail would have to be scrutinized to weed out discriminators on individual jobs. Therefore, the most conclusive findings that can be obtained from this study are a general trend from a large number of samples.

The majority of the sample projects selected for the study are less than $1 million 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; the oldest projects occurred in 1986. The SPTI sample projects occurred over a two-year period, from 1996 to 1998. This thesis presents comparisons made based upon cost and schedule. Augmenting this evaluation was a poll of contractors and customers who have had experience with projects delivered through SPTI. The poll was obtained by questionnaires designed to obtain comparable information from a contractor's or customer's perspective.

Parameters Analyzed

Based upon the general hypotheses that the SPTI is saving money and time, the following measures were compared for the 146 Pre-SPTI and the 77 SPTI samples:

- Project Cost – The total cost of any given project from design to the end of construction.
- Design Cost – The cost to produce the design, expressed as a percentage of the overall project cost.

- Project Duration – The amount of time to construct the project, expressed in days.

  - overall project duration
  - percentage of days a project changed from the original duration (increase, decrease, or neutral regardless of whether the change resulted from a CO)
  - percentage of days a project changed from the original duration (increase, decrease, or neutral considering the duration change may have resulted from a CO)

- Construction Placement Rate – The cost of construction work accomplished each day in terms of dollars.

- Change Orders (COs) – The changes and modifications to the project deviating from the original contract, expressed as a percentage and dollar amount.

  - percentage of project cost of COs, only of jobs with COs, including user requested (UR)
  - percentage of project cost of COs, of all jobs, including UR COs
  - percentage of project cost of COs, only of jobs with COs, excluding UR
  - percentage of project cost of COs, of all jobs, excluding UR

There are a variety of factors that impact the preceding measures for any given construction project, which could distort the results of such a study. This situation is further exacerbated by the fact that not all of the data was available on each project. Table 1 provides a snapshot of the completeness of the data that was available for the total of 223 projects.

TABLE 1: NUMBER OF PROJECT SAMPLES

MEASURE	PRE-SPTI	SPTI
Total Projects	146	77
Projects with/Overall Costs	146	77
Projects w/Design Costs	86	40
Projects w/Duration	143	76
Projects w/Duration Change Information	83	71
Construction Placement Rate	143	76
Projects w/CO data (some jobs did not have COs)	146	77

The overall cost and/or size of a project can have a significant impact upon the percentage of design costs, project duration, and the amount of change orders. Therefore, a sensitivity analysis was also completed upon the results to check if any high dollar or low dollar projects were perhaps skewing the trend. The following projects were removed by category to examine the impact upon the overall results.

- All projects exceeding $1 million in total cost
- All projects meeting or exceeding $500,000 in total cost (this category also excludes projects over $1 million, yet constitutes a step closer to the preferred cost of ≤$500,000 for an SPTI project than does the previous category)
- All projects less than $30,000 in total cost

The first two categories were removed step by step in order to assess whether the high construction costs were offsetting the relative impact of the cost and time factors and if so, at what dollar amount. The third category was selected as a variable to investigate if the low cost construction jobs were giving an unfair advantage to the SPTI jobs.

Each of the samples was also put into one of the following three categories: new construction, renovation, or repair. The samples were then evaluated in the same manner as initially, by design costs, duration, and change orders. This was done in an attempt to discover if there was any indication of which type of project was better suited to the SPTI or traditional method of managing small projects.

Statistical Analysis

It is important to know whether the data used is significantly different using the 5% level. This means that a difference as big or bigger than observed between the sample measurements could have occurred only 5 times out of 100 by chance alone (Kranzler and Moursund 1999). This will indicate whether the results occurred by chance or if the differences were more likely a result of the management method. In order to determine which test to utilize to test the differences, one must first conclude if it would be better to use the mean or the median for statistical analysis. If the results are normally distributed (parametric), the mean is used as the best measure of central tendency. If the results are not normally distributed (non-parametric), the median is used. There is a myriad of tests to judge whether the data is parametric. This study utilized histograms and normal probability plots from the Anderson-Darling Normality Test in the Mini-Tab® software program (McKenzie, Schaefer, and Farber 1995).

If the results are parametric and there are only two sample categories, one should use the two-sample-t-test to examine the differences. If the results are parametric and there are more than two sample categories, one should use the Analysis of Variance (ANOVA) procedure to examine the differences. However, if the data is non-parametric, the Mann-Whitney test (also known as the Mann-Whitney U test) or the Kruskal-Wallis H-test should be used. The Mann-Whitney test is used for non-parametric distributions when there are only two sample categories. The Kruskal-Wallis H-test is used for non-parametric distributions when there are more than two sample categories. In all cases in this study, the null hypothesis assumed that the means and/or medians are not significantly different. The null hypothesis is rejected if the differences are less than 5% significant.

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 of the contractor questionnaires were answered and returned. Only three of the eight customer questionnaires were answered and returned. The poll was intended to obtain feedback from organizations outside USACE. Ideally, the poll results provide a valuable outside view that would support the analysis results from the construction project samples positively or negatively. A blank sample of each questionnaire is located in Appendices D and E. A table with a summary of the results is offered in the next chapter. However, more detailed results are tabulated from the contractors' and customers' feedback in Appendices F and G, respectively.

Data Sources

It was necessary to obtain information on as many projects as possible to ensure a valid indication of a trend and it was necessary to investigate a variety of resources. The following sources and documents were used in obtaining the information on each of the sample projects at both the Headquarters and the Ft. Lewis Area Office:

- RMS (Resident Management System) – a computer database that provides a variety of information (excluding design costs) on active projects, completed projects, and future projects
- CIMS (Contract Information Management System) – a computer database that provided information on project schedule, change orders, points of contact, project dollar amounts, and dates of completion for project milestones, but not design costs
- PROMIS (Project Management Information System) – the computer database designed to replace CIMS

- CEFMS (Corps of Engineers Financial Management System) – the computer database system for all financial transactions on a project
- DD Form 1354-E, Transfer and Acceptance of Military Real Property – used at the completion of a project to indicate substantial completion, initiate final payment, and to transfer responsibility of the project to the user/owner
- DD Form 1155, Order for Supplies and Services – used by contracting as an official request for supplies and services for a project
- DA Form 3953, Purchase Request and Commitment (PR&C) – used by contracting as an official authorization/request for project funds
- ENG Form 93, Start/Statement of Work – a document for recording the start of a project and contains a brief project description
- ENG Form 3013, Work Order/Completion Report – a document for recording brief project description and project costs (including design costs) authorizing work to start or symbolizing project completion
- ENG Form 3039, Miscellaneous Commitment Document – a document for recording commitment of funds to a project
- RMS Form 747, Basic Change Document – a document that explains necessary modifications, the responsibilities of the parties involved, and the costs
- Project Historical Files (Project and Contract Files) – paper files containing the majority of all paperwork created on a project

CHAPTER V: DATA ANALYSIS RESULTS

The results of each comparison of the measures will be described in the following sections. Although many of the areas analyzed indicated efficiencies and savings, not all of them produced conclusive results. The two areas that produced notable results were design and cost growth (change orders). The amount of estimated savings from each of these areas are $1,685, and $2,864, respectively, for a total of $4,549 per $100,000 worth of project.

In the majority of the tables in this chapter, the median value is shown since it was the best measure of central tendency in this case (the data was non-parametric). The average is shown in parentheses immediately after the median value in order to provide insight for the reader.

Data Summary

Although the total construction cost of each set of the samples is a difficult factor to compare due to so many variables, 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.

TABLE 2: COST SUMMARY OF SAMPLE PROJECTS

Project Type	Total Costs of Samples	Median (Average)	Standard Deviation	Range
Pre-SPTI	$41,214,412	$151,793 ($282,291)	$323,591	$1,678,768
SPTI	$13,988,038	$85,657 ($181,663)	$289,884	$1,956,102

Table 2 shows that the median cost for a Pre-SPTI job was $151,793, while the mean cost for a Small Project job was $85,657. Although it appears that the difference could be a saving from the SPTI, the conclusion can not be made without further examination. There is no direct way of comparing the construction costs for the samples simply because each job is different. The costs will be different for dissimilar projects regardless of the method of management. An additional factor that injects variability is the time period (current cost of normal construction). Also, the way a project was viewed and handled with the previous method is different than SPTI because the latter targets smaller projects by nature.

Design Costs

The design costs are expressed as a percentage of the overall cost of the construction projects. 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%.

Not all of the samples had design costs available. Recall from Table 1 that 86 of the 146 Pre-SPTI jobs had design costs available (59%), while 40 of the 77 Small Project jobs had design costs available (52%). So the ratio is nearly the same and the quantities are sufficient to indicate a trend.

Table 3 indicates that the median design cost percentage was significantly lower for the SPTI projects. 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 saving of $1,685 per $100,000 worth of project.

TABLE 3: MEDIAN PERCENT OF DESIGN COSTS
CONSTRUCTION COSTS
(Average Design Costs Shown in Parentheses)

	PRE-SPTI	SPTI
Median Design Cost Percentage	6% (11%)	4% (4%)

Testing for normality in the design cost percentages indicated that the data was non-parametric for both the Pre-SPTI and the SPTI. Therefore, the Mann-Whitney test was used to examine the differences since there were only two sample categories. The Mann-Whitney test reported that the results were significantly different at .0045. So 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.

Durations

The project durations are expressed in days. This factor was examined not only as the total average duration of all sample projects, but also 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.

It appears from Table 4 that the median duration of a project can be reduced to more than half when accomplished with the SPTI. However, this comparison of project durations is inconclusive due to the potential for dissimilar projects and differences in selecting projects for the SPTI method and the traditional method.

TABLE 4: MEDIAN DURATION FOR SAMPLE PROJECTS
(Average Durations Shown in Parentheses)

	PRE-SPTI	SPTI
Average Project Duration	269 days (289)	120 days (135)

In an attempt to evaluate the efficiency of the SPTI, duration change was analyzed, with two primary considerations. The first was that perhaps some of the original estimates were simply inaccurate. The number of sample projects should alleviate this concern by providing a general consensus. Table 5 shows that 65 Pre-SPTI jobs had duration changes (55 increases and 10 decreases) while 18 were neutral. The remaining 63 had no duration change details available. Table 5 also shows that only 20 Small Project jobs had duration changes (20 increases and 0 decreases) while 51 were neutral. The remaining 6 had had no duration change details available.

TABLE 5: PROJECTS WITH DURATION CHANGES

	PRE-SPTI	SPTI
Projects w/Increased Duration Details	55	20
Projects w/Decreased Duration Change Details	10	0
Projects w/Neutral (0) Duration Change Details	18	51
Projects without Duration Change Details	63	6

The second consideration was that some of the duration changes were likely due to COs. For the purpose of this thesis, it was more important to capture those change orders 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 behind schedule. In order to visualize the impact of UR COs as opposed to engineering COs, the former were included and then excluded. Table 6 shows the division of this data in terms of the median percentage that a project increased and the number of days.

TABLE 6: MEDIAN PERCENT & DAYS DURATION INCREASED
(Average Percent of Increase Shown in Parentheses)

	PRE-SPTI		SPTI	
CONSIDERING PROJECTS THAT ↓	% of Increase	# of Days	% of Increase	# of Days
Increased or decreased	15% (17%)	60 (72)	42% (52%)	100 (83)
Increased, decreased or neutral	10% (13%)	31 (56)	0% (15%)	0 (24)
Increased or decreased for reasons other than UR COs	12% (12%)	32 (50)	40% (35%)	52 (50)
Increased, decreased, or were neutral for reasons other than UR COs	5% (10%)	13 (39)	0% (10%)	0 (19)

Table 6 strongly indicates the advantage of the SPTI projects being completed on time. There was an enormous difference between the median SPTI results when considering the large number of projects that did not change duration. Conversely, there was only a slight difference between the median Pre-SPTI results considering the small number of projects that did not change duration. It appears that the user requested COs have more of an impact upon the Pre-SPTI samples than the SPTI samples.

In an effort to further qualify the duration change details, a statistical analysis was performed. The data were non-parametric, so the Mann-Whitney test was used to evaluate the differences of the medians. The Mann-Whitney test reported that all rows of information in Table 6 except for the second were significantly different. So it appears that the difference between the medians of the duration changes for the Pre-SPTI and the SPTI projects are not just due to chance but may have resulted from the new management method.

A reduction in project slippage could also have a positive impact upon the S&A allowance in terms of the quality of supervision. 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

Many organizations use construction placement rate as a measurement of efficiency. Construction placement rate is the dollars worth of construction that can be accomplished in a given day. Generally, the more construction accomplished the greater the efficiency.

The rate can be determined easily after the fact by dividing the project construction cost by the project duration. This is done for each sample project and then medians were computed. The median placement rate was $683 for the Pre-SPTI projects. The median placement rate was $740 for the SPTI projects. The construction placement rate for jobs managed by SPTI was over 8% higher (or more efficient) than for those managed by the Pre-SPTI method. The difference in placement rates is further emphasized by the fact that the Pre-SPTI projects had higher median project costs. The increase in efficiency is most likely due to intangible factors unless one assumes that contractors who construct Small Project jobs are simply more efficient than those who construct other jobs. These intangible factors may be the numerous advantages the contractors and customers have cited, such as increased teamwork, improved rapport, or greater flexibility. More will be said about these advantages under the discussion of the poll results. Surprisingly, the statistical analysis on the non-parametric placement rates indicated the rates are not significantly different.

Change Orders (COs)

COs or modifications to a project play a key role in determining the effectiveness of an improvement management method. If the method used to improve the construction process results in numerous COs, any initial gain by the improvement may be nullified. As mentioned in the previous section of durations, this study was more concerned with changes that occurred due to design or engineering inadequacies rather than user requested changes. However, an analysis was done including then excluding user request type COs in order to isolate their effect. Table 7 shows the breakdown of the projects' COs accordingly.

TABLE 7: PROJECTS WITH COs

	PRE-SPTI	SPTI
Excluding User requested	85 (58% of 146)	13 (17% of 77)
Including User requested	94 (64% of 146)	21 (27% of 77)

Of the 146 Pre-SPTI samples, 85 (58%) had non-user requested COs. There were only nine additional Pre-SPTI jobs which had COs exclusively from user request bringing the total of Pre-SPTI jobs with COs to 94 (64%). Only 13 of the 77 (17%) SPTI jobs had COs other than user requested. There were eight additional SPTI jobs which had COs exclusively from user request bring the total of SPTI jobs with change orders to 21 (27%).

The percentage that a CO increases the overall construction costs is often referred to as the change order rate (COR). Although the COR is primarily a measure for how well the project requirements were initially captured in the design, it has value in this study for indicating if a general trend in efficiency exists for either management method. Table 8 shows the results of the analysis of the COR.

TABLE 8: MEDIAN CHANGE ORDER RATE (COR)
(Average COR Shown in Parentheses)

	PRE-SPTI	SPTI
CONSIDERING	COR	COR
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%)

The CO results from Table 8 suggest that the SPTI provides a slight advantage when considering the COR effect on all samples. 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.

In an effort to more accurately 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 cost of an average CO would be $340 and $0 respectively. The difference of $340 is an estimated saving 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 median associated cost of a CO for Pre-SPTI and SPTI, $3,400 and $0 respectively, should be subtracted from the median CO cost. Approximately 20% of the remainder of the CO cost would be considered the premium cost of a CO. The remainders would be $3,060 and $0, therefore 20% of these amounts would be $612 and $0, respectively. The difference of $612 is an estimated saving for the median project cost of $118,725. 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 savings for the premium and associated cost for a CO is $802.

The statistical analysis on the CORs indicated that the data was non-parametric. The Mann-Whitney test reported that the null hypothesis could not be rejected, so it is assumed that the data were not significantly different.

Sensitivity Analysis

The SPTI is preferred for projects that have a project cost of $500,000 or less. In some cases, projects that cost in excess of $500,000 or even $1 million are accomplished with SPTI. In order to determine the impact of high and low dollar projects, it is necessary to isolate them from the samples and then perform the same analysis as before on the remaining samples. A series of three isolations were conducted: 1) projects with a cost greater than $1 million, 2) projects with a cost greater than $500,000, and 3) projects with a cost less than $30,000.

The results of this step-by-step isolation did not yield significantly different results from the overall original results. The results from the statistical analysis rendered the same results as all the overall original results as well. Appendix C contains a more detailed discussion of the results of the sensitivity analysis.

Categorical Analysis

The types of projects managed by USACE are diverse, including civil and military works with new construction, renovation, repair, and maintenance. It would be of interest to determine whether or not the type of project had any impact upon the results. 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's certain that some renovation projects are more complex than some new construction projects. For the purpose of this study, all sample projects were classified into one of three categories: new construction, renovation, and repair. The quantities of samples in each category are shown in Table 9.

TABLE 9: QUANTITY OF PROJECTS BY CATEGORY

	PRE-SPTI	SPTI
New Construction	25	20
Renovation	86	47
Repair	36	10

Table 10 shows the comparison against the original results in order to visualize the amount of influence from the project type.

TABLE 10: MEDIAN RESULTS FROM PROJECT SAMPLES BY PROJECT TYPE
(Original (ORIG.) Results Lead Each Cell)
(Average Results Shown in Parentheses After the Median)

	PRE-SPTI	SPTI
Total Dollar Amount of Projects Analyzed	ORIG. – $41.2 MILLION New – $7.4 million Ren. – $27.9 million Rep. – $5.9 million	ORIG. – $14 MILLION New – $4.9 million Ren. – $7.9 million Rep. – $1.2 million
Design Costs	ORIG. – 6% (11%) New – 6% (9%) Ren. – 5% (11%) Rep. – 8% (12%)	ORIG. – 4% (4%) New – .5% (4%) Ren. – 4% (4%) Rep. – 5% (5%)
Project Duration	ORIG. – 195 DAYS (289) New – 238 days (262) Ren. – 307 days (311) Rep. – 254 days (253)	ORIG. – 120 DAYS (135) New – 76 days (93) Ren. – 120 days (144) Rep. – 205 days (177)
Increase for jobs that increased or decreased in duration	ORIG. – 15% (17%) New – 16% (17%) Ren. – 15% (19%) Rep. – 14% (21%)	ORIG. – 42% (52%) New – 18% (21%) Ren. – 44% (51%) Rep. – 73% (73%)
Increase for jobs that increased, decreased or were neutral	ORIG. – 10% (13%) New – 6% (11%) Ren. – 12% (16%) Rep. – 14% (21%)	ORIG. – 0% (15%) New – 0% (3%) Ren. – 0% (18%) Rep. – 0% (18%)
Increase for jobs that increased or decreased in duration, when changes may have resulted from COs except UR	ORIG. – 12% (12%) New – 6% (9%) Ren. – 7% (13%) Rep. – 13% (11%)	ORIG. – 40% (35%) New – 11% (11%) Ren. – 33% (43%) Rep. – 51% (51%)
Increase for jobs that increased, decreased, or were neutral, when changes may have resulted from COs except UR	ORIG. – 5% (10%) New – 6% (9%) Ren. – 2% (10%) Rep. – 6% (7%)	ORIG. – 0% (10%) New – 0% (1%) Ren. – 0% (12%) Rep. – 0% (13%)
Average COR only for jobs with COs, including UR	ORIG. – 12% (35%) New – 6% (26%) Ren. – 14% (40%) Rep. – 16% (26%)	ORIG. – 13% (29%) New – 37% (44%) Ren. – 10% (21%) Rep. – 26% (37%)
Average COR for all jobs, including UR	ORIG. – 2% (23%) New – 3% (17%) Ren. – 1% (25%) Rep. – 3% (17%)	ORIG. – 0% (8%) New – 0% (15%) Ren. – 0% (6%) Rep. – 0% (12%)

TABLE 10 (continued): MEDIAN RESULTS FROM PROJECT SAMPLES BY PROJECT TYPE
(Original (ORIG.) Results Lead Each Cell)
(Average Results Shown in Parentheses After the Median)

Average COR only for jobs with COs, excluding UR	ORIG. – 9% (33%) New – 4% (15%) Ren. – 9% (37%) Rep. – 12% (24%)	ORIG. – 10% (13%) New – 62% (62%) Ren. – 7% (6%) Rep. – 11% (15%)
Average COR for all jobs, excluding UR	ORIG. – 1% (19%) New – 1% (10%) Ren. – 1% (22%) Rep. – 1% (14%)	ORIG. – 0% (2%) New – 0% (4%) Ren. – 0% (1%) Rep. – 0% (3%)

From Table 10, one can compare the median of one of the three categories against the original median of any given factor to determine if a certain type of project has had better success with Pre-SPTI method or the SPTI method. It appears that there are mixed results from evaluating the samples by project type. In order to assist in interpreting the results, Table 11 displays a summary of the results by listing if a type of project was under (-) or over (+) the total overall results.

TABLE 11: SUMMARY OF RESULTS OF COMPARING MEDIANS OF PROJECT SAMPLES BY PROJECT TYPE TO TOTAL SAMPLE MEDIANS

TYPE / FACTOR	New		Renovation		Repair	
	Pre-SPTI	SPTI	Pre-SPTI	SPTI	Pre-SPTI	SPTI
Design Cost	same	+	-	same	+	+
Duration Increase	-	same	+	same	+	same
Change Order Rate	+	same	-	same	+	same

The results of Table 11 can be deceiving if one simply glances at the number of instances the medians were under (-) or over (+) for Pre-SPTI and SPTI Projects. Neither management method performs significantly better than the other for any given category. The SPTI results indicate a balance in each factor for the different categories rather than extremes. The overall results do indicate that both types of managing methods (Pre-SPTI and SPTI) work best for renovation type construction, fairly well for new construction, but SPTI performs better at repair type construction.

The statistical analysis for this portion of the study examined each measure of each category of construction individually. For example, design percentages for new construction of SPTI was checked against design percentages for new construction of Pre-SPTI. All of the data was non-parametric and there were only three measures that yielded significant differences. The duration changes were significant at .0227 for new construction when considering all projects that increased, decreased, or were neutral. The CO rate was significant at .0431 for new construction when considering only those projects with COs, with or without UR COs. The CO rate was also significant at. .0047 for renovation when considering all projects, with or without UR COs. The results provide minor indication that the new management method of SPTI may have had an impact upon the projects within these measures rather than chance. The finding of the significant difference of the duration changes is consistent with the original overall results. However, this was the only division of data for which there was a significant difference detected in the change order rates.

Poll Results

Of the six contractor questionnaires and eight customer questionnaires that were distributed there were six and three responses, respectively. The results from the contractor questionnaires are displayed in Table 12 and the results from the customer questionnaires are displayed in Table 13. The number in parentheses after a response indicates how many responders made that comment.

TABLE 12: SUMMARY OF RESULTS FROM CONTRACTORS' QUESTIONNAIRES

# of Contractors Polled	6
Total # of Small Projects Completed by Contractors Polled	141
Pros	• Increased profit margin (5) • Improved efficiency (5) • Reduced duration (6) (bid, design, overall) • Increased rapport (with USACE-5) (with customer-4) • Increased design flexibility (6) • Fewer change orders (1) • More team approach (1)
Cons	• Vagueness of design (3) • Difficult to estimate/bid (1) • Paperwork still cumbersome (1)
Satisfaction Level	• 5 Very satisfied • 1 Somewhat satisfied
Suggestions	• Negotiate projects • Increase interaction during design phase • Compensate contractor for time spent on jobs not funded • Apply design/build concept to submittals not typical USACE requirements • Minimize paperwork • Distribute projects evenly throughout the year
Comments	• Good, valuable program saving time and money • Facilitates rapport, communication, and quality projects • Provides benefits for all parties involved

TABLE 13: SUMMARY OF RESULTS FROM CUSTOMERS' QUESTIONNAIRES

# of Customers Polled	3
Total # of Small Projects Completed for Customers Polled	37
Pros	• Improved efficiency (1) • Increased rapport with USACE (3) and contractor (1) • Reduced project duration (1) • Increased flexibility of design (3) • Increased flexibility during construction (1) • PMP feedback (1) • Increased emphasis on life-cycle mgt. (1) • Response, execution time, and contractor accountability make this method ideal (1)
Cons	• Vagueness of design (1) • Difficulty obtaining as-built drawings of project (1) • Lack of manpower in Small Projects Office; tied up with left over MILCON deficiencies (1)

TABLE 13 (continued): SUMMARY OF RESULTS FROM CUSTOMERS' QUESTIONNAIRES

Satisfaction Level	• 2 Very satisfied • 1 Somewhat satisfied
Suggestions	• Provide Resident Office more contracting decision authority • Assign more manpower to Small Projects Group; stop assigning left over MILCON deficiencies to this group
Comments	• Excellent and flexible method allowing rapid execution of construction projects • Best program for small/medium projects • Sometimes impeded by contracting difficulties

It appears overall from the contractors' and customers' viewpoints, the SPTI program has been well received. The disadvantages cited were very limited and without consensus. The majority of the suggestions were positive and workable.

The advantages cited by the contractors help them realize their objectives of delivering a timely, quality project with a team spirit and yet increased profit margin. Even though vagueness of design was cited as a disadvantage, the effects are mitigated because the contractor has the flexibility to add valuable input on the design. Note that 5 out of 6 contractors were very satisfied. Each suggestion offered by contractors was not repeated by another. Also, the disadvantages listed can be addressed relatively easily. Overall, the contractors' questionnaires indicate satisfaction, enhanced teamwork, and efficiency.

The advantages cited by the customers also address improved teamwork, flexibility, and communication. All three of the customer respondents listed increased flexibility of design as an advantage. None of the disadvantages were cited by more than one customer. While the manpower issue may never be resolved due to shrinking budgets, the other two disadvantages are relatively easy to improve upon. Although a larger response pool is still desired, the customers' questionnaire indicates satisfaction, enhanced teamwork, and efficiency, as has the contractors' questionnaires.

CHAPTER VI: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Variable factors in construction projects require that comparisons between projects or groupings of projects be made on a conservative basis. The apparent savings consist of reduced design costs and reduced percentage of change orders. The apparent estimated total savings per $100,000 worth of project are $4,549, or slightly over 4.5%.

Based upon the sensitivity analysis, the statistical analysis, and the poll results, the following conclusions can also be made:

- There is statistical evidence that the SPTI program is potentially the contributing factor for reducing the design costs and the duration changes. However, additional testing must be accomplished in order to determine the mechanism(s) for the impact.
- There is no significant deviation from the trend set by the overall samples when considering only those jobs having project costs between $30,000 and $500,000 (see Appendix C).
- There is an indication that the SPTI is more effective than Pre-SPTI on new construction and renovation type projects.
- Both the contractors and customers who have experience with SPTI generally prefer it to the traditional method due to the fact that it helps them achieve desirable benefits from construction projects.

Recommendations

The author recommends that the Seattle District evaluates the feedback from the contractors and customers and develop strategies to address shortcomings of the SPTI approach. The author also recommends that the Seattle District work with the Operations and Maintenance Engineering Enhancement (OMEE) section of the USACE Huntsville Center to develop and distribute a training plan for SPTI. Ideally, the implementation for this training should be accomplished by the Huntsville Center. This recommendation will be further discussed as follows.

Arill Berg, the Resident Engineer at the Ft. Lewis Area Office of the Seattle District has briefed the SPTI consecutively for two years at the annual USACE Resident Engineer's conference. While the briefing sparked some interest, it has been short-lived and the initiative to change has been most likely overcome by the rigors of day to day business back at home districts.

Since this approach has not worked and based upon the significance of the savings of SPTI, the author recommends that the Seattle District assist the OMEE section to develop and distribute a three to five day training plan for SPTI. Once that program is established, USACE should send resident engineers and project managers from other districts to Huntsville for training. This training should be made available to other organizations as well, particularly those managing projects for state and municipal governments.

The prospective trainees should read something along the lines of Chapter 3 of this thesis prior to attending training to develop a basic understanding of how SPTI functions. This will provide a solid foundation for the actual training. The number of trainees per session should be limited to one to two districts at one time. A lower number of trainees promotes the individual ability to learn. The SPTI concept must be grasped securely by the trainees in order for them to effectively apply the lessons learned once they are back in their home district. An ideal method would be for a district to send a representative from each of the disciplines required composing a small projects team. In this manner, the team would participate in the training together and be able to collectively mold the concept to fit their district.

The author recommends that the training opportunity be afforded to the districts on a volunteer basis initially as long as there is a sufficient number of volunteers. The trainees must see the opportunity and desire to apply the techniques of SPTI within their own district. Once they return to their district, it is their SPTI program and the success will largely depend upon the personalities of the individuals involved.

Over time, as the concept advances in each district, the author recommends that USACE study the successes and refine the SPTI concept as required to enable each district to capitalize upon the strengths of not only the process but the individual districts. Districts will be able to put the SPTI into practical application. The performance should be tracked by project type and by year group. They will be able to continue to improve the management of small projects fulfilling their responsibilities for efficient and effective project management for the people of the United States and around the world.

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APPENDIX A: TABLE OF SMALL PROJECT SAMPLES

CONTRACT #	PROJECT	CONSTR. COSTS	DESIGN COSTS	CHANGE ORDERS	DUR.
DACA67-94-D-1005, DO#101	RENOVATE CLARKMORE SCHOOL, FT. LEWIS	$610,781	(4%)		53 days
DACA67-94-D-1005, DO#102	RENOVATE CLARKMORE SCHOOL, FT. LEWIS	$493,656	(4%)	$24,000 (5%) User-$20,000 Constr-$4,000	126 days (7)
DACA67-94-D-1005, DO#103	RENOVATE CLARKMORE SCHOOL, FT. LEWIS	$528,224	(4%)	$9,252 (2%) Engineering	167 days (7)
DACA67-94-D-1005, DO#104	RENOVATE CLARKMORE SCHOOL, FT. LEWIS	$677,908	(4%)	$58,061 (9%) User-$8,061 Constr.-$50,000	241 days (15)
DACA67-94-D-1005, DO#105	RENOVATE CLARKMORE SCHOOL, FT. LEWIS	$590,199	(4%)	$11,953 (2%) (Constr.)	152 days (7)
DACA67-96-G-0001, TO#001	REP. PHONE SYSTEM BLOCK FT. LAWTON	$180,000	?	$+1,035 User	120 days
DACA67-96-G-0001, TO#005	REVISE JP-8 FUEL ARM & VENTILATION, MANCHESTER	$234,762	?	$157,794 (67%) User-$156,667 Other-$1,127	361 days (241)
DACA67-96-G-0001, TO#007	FUEL PIER PIPELINE, MANCHESTER	$238,317	?		142 days
DACA67-96-G-0001, TO#010	EXPAND BORDER PATROL STAT., BELLINGHAM	$137,732	?	$50,345 (37%) User-$50,345	120 days
DACA67-96-G-0001, TO#011	REPL. ROOF, TUMWATER	$234,000	?	$92,800 (40%) User-$92,800	315 days (75)
DACA67-96-G-0001, TO#014	CONSTR. SECURITY BARRIERS, McCHORD AFB	$1,960,000	?		300 days

CONTRACT #	PROJECT	CONSTR. COSTS	DESIGN COSTS	CHANGE ORDERS	DUR.
DACA67-96-G-0001, TO#015	INST. PIPING, MANCHESTER	$232,616	?		120 days
DACA67-96-G-0001, TO#017	STEEL LINING IN TRASHRACK, MUD MTN DAM	$662,718	?		138 days
DACA67-96-G-0002, TO#001	REP. ELECT. SYSTEM, PIER 23, PORT OF TACOMA	$105,650	?	$61,474 User-$37,675 Engineer-$8,900 Oth-$14,899	225 days (60)
DACA67-96-G-0002, TO#003	REVISE SEWER OUTFALL, FT. LEWIS	$172,650	?	$152,116 (88%) User-$166,886 Engineer-$14,770	248 days (46)
DACA67-97-C-0046	CRUSHED ROCK, YTC	$131,880	?		60 days
DACA67-97-C-0087	REMOVE FEMA TANKS, USARC	$327,738	?		365 days
DACA67-97-D-1002, TO#001	EXPAND POV PARKING LOT	$26, 242	$2,800 (11%)		210 days
DACA67-97-D-1002, TO#002	RENOVATE BDLG, FT.LEWIS	$68,151	$0		120 days
DACA67-97-D-1002, TO#003	REP./REPL. ROOF, AMSA 2	$39,968	$2,786 (7%)		120 days
DACA67-97-D-1002, TO#004	REP. POV PARKING, WALKER USARC	$48,228	$2,406 (5%)		210 days
DACA67-97-D-1002, TO#005	REP. ROOFS, WALKER USARC	$19,754	$2,406 (12%)		215 days
DACA67-97-D-1002, TO#006	REPL. ROOF, AMSA 74	$103,767	$4,375 (4%)		120 days
DACA67-97-D-1002, TO#007	INST. ROOFS, RPR WALLS SALEM	$83,500	$3,165 (4%)		134 days (75)
DACA67-97-D-1002, TO#008	KANDLE DRILL HALL LIGHTS/ RENOVATE CORRIDOR	$20,263	$2,352 (12%)		75 days
DACA67-97-D-1002, TO#009	MODIFY BDLG. ENTRY, SHARFF HALL	$104,738	$2,931 (3%)		300 days (180)
DACA67-97-D-1002, TO#010	REPL. INTERIOR LIGHTS, OSWALD USARC	$27,251	$2,395 (9%)		75 days

CONTRACT #	PROJECT	CONSTR. COSTS	DESIGN COSTS	CHANGE ORDERS	DUR.
DACA67-97-D-1002, TO#011	CLASSROOM POD. FT. LEWIS	$805,790	$102,277 (13%)		92 days
DACA67-97-D-1002, TO#012	REP./UPGRADE CLASSROOM, VANCOUVER BRRKS	$28,477	$2,457 (9%)		255 days (75)
DACA67-97-D-1002, TO#13	ASPHALT CONCRETE PAVING PLANT FAIRCHILD AFB	$220,639	$1,995 (1%)	$49,936 (22%) User-$49,936	255 days (210)
DACA67-97-D-1002, TO#14	LIGHTING RETROFIT, LUGENBEEL USARC	$207,028	$518 (.3%)		180 days
DACA67-97-D-1002, TO#15	LIGHTING RETROFIT, JOHNSON HALL, ALFRED HALL	$116,285	$518 (.4%)		180 days
DACA67-97-D-1002, TO#16	LIGHTING RETROFIT, MANN,WALKER & McCARTER HALL	$158,221	$518 (.3%)	$2,636.39 (2%) User-$2,636.39	180 days
DACA67-97-D-1002, TO#17	REPL. ELECT. PANELS, FT. LEWIS	$113,966	?		120 days
DACA67-97-D-1002, TO#18	CONSTR. STORM DRAINAGE, FT. LEWIS	$34,179	$0	$29,995 (87%) User-$29,995	90 days (60)
DACA67-97-D-1002, TO#19	MODIFY ENTRY WAYS, FT. LAWTON	$47,806	?	$14,793 (30%) User-$14,793	330 days (180)
DACA67-97-D-1002, TO#20	UPGRADE HANDICAP, FT. LAWTON	$38,502	?		300 days (180)
DACA67-97-D-1002, TO#21	REWIRE ELECT. FT. LEWIS	$158,886	$0		120 days
DACA67-97-D-1002, TO#22	ROAD CLOSURE	$56,333	?		45 days
DACA67-97-D-1002, TO#23	RENOVATION OSWALD USARC	$85,657	$1,813 (2%)	$8,893 (10%)	180 days (120)
DACA67-97-D-1002, TO#24	RENOVATE KANDLE HALL	$103,002	$2,407 (2%)		180 days (120)
DACA67-97-D-1002, TO#26	INST. CROSS CONNECTION CONTROLS, YTC	$36,264	?		120 days

CONTRACT #	PROJECT	CONSTR. COSTS	DESIGN COSTS	CHANGE ORDERS	DUR.
DACA67-97-D-1002, TO#27	UPGRADE STORM WATER DRAINAGE, YTC	$93,293	?		240 days
DACA67-97-D-1002, TO#28	NCO CLUB TRUSSES REPAIR, YTC	$319,655	$2,193 (1%)	$82,791 (26%) User-$46,880 Constr.-$35,911	200 days
DACA67-97-D-1002, TO#29	TRUSS REPAIR BLDG 321 & 323 YTC	$211,658	$4,239 (2%)		240 days
DACA67-97-D-1002, TO#31	CONSTR. UPPER DECK, FT. MISSOULA	$44,129	$0		120 days
DACA67-97-D-1002, TO#32	TRUSS REPAIR BDLG. 319 YTC	$105,829	$4,239 (4%)		240 days
DACA67-97-D-1014, TO#001	DEMO WOODEN BDLGs., FT. LEWIS	$1,032,423	?		120 days
DACA67-97-F-5143	REPL. SIGNS, USARC	$101,016	?		90 days
DACA67-97-M-0013	REPL. BOILER TUBES, YTC (YAKIMA TRAINING CENTER)	$42,000	$2,485 (6%)		30 days
DACA67-97-M-090	INST. SNOW GUARDS, MADIGAN AMC	$22,652	$0		68 days
DACA67-97-M-0122	REPL. BOILER, SPOKANE	$37,161	$1,700 (5%)	$5,578 (15%)	44? days (30?)
DACA67-97-M-0344, PO#344	CABLING SERVICES, FT. LAWTON	$11,500	?		20 days
DACA67-97-M-0355	REPL. INCINERATOR DOORS, FT. LEWIS	$40,067	$250 (1%)		153 days
DACA67-97-M-0502, PO#502	REP. FIBERGLASS TANK, FT. LEWIS	$109,044	?	$10,512 (10%) Constr.-$10,512	165 days (45)
DACA67-97-M-0614, PO#614	INST. HANSON CREEK CULVERTS & FORDS, YTC	$37,502	?		30 days
DACA67-97-M-0633, PO#633	INSTALL CULVERTS, YTC	$48,540	?		60 days

CONTRACT #	PROJECT	CONSTR. COSTS	DESIGN COSTS	CHANGE ORDERS	DUR.
DACA67-97-M-0655, PO#655	ADD BATHROOM, VANCOUVER	$61,174	?	$38,445 (62%) Other-$38,445	84 days (75)
DACA67-97-M-0670, PO#670	INST. LIGHTS AND ELECTRICAL, FT. LAWTON	$67,178	$0		115 days
DACA67-97-M-0705, PO#705	UPGRADE HVAC, FT. DOUGLAS, UTAH	$42,508	?		30 days
DACA67-97-M-726	REPL. BOILER, YTC	$45,843	$4,300 (8%)	$4,821?? (11%)??	30 days
DACA67-98-M-087, PO#087	REROUTE STEAM LINE, McCHORD AFB	$62,255	?		45 days
DACA67-98-M-0110, PO#110	ELECT. WORK, CHITTENDEN LOCKS, SEATTLE	$41,087	?	$3,223 (8%) User-$3,223	60 days
DACA67-98-M-0172, PO#172	INST. GRAVEL PARKING, FT. LEWIS	$87,850	$1,089 (1%)		30 days
DACA67-98-M-0209, PO#209	INST. CONTROLS, CHITTENDEN LOCKS, SEATTLE	$40,800	?		50 days
DACA67-98-M-0239, PO#239	IMPROVE DRAINAGE, FT. LEWIS	$22,089	?		90 days
DACA67-98-M-0241, PO#241	CONSTR. SIDEWALK & MISC. WORK, McCHORD AFB	$20,832	?	$2,057 (10%) User-$2,057	60 days
DACA67-98-M-0256, PO#256	CONSTR. CONCRETE TURNING PAD, McCHORD AFB	$9,500	$0		14 days
DACA67-98-M-0272	HOT REFUEL PROJECT FOLLOW-ON WORK, FT. LEWIS	$44,060	?		75 days

CONTRACT #	PROJECT	CONSTR. COSTS	DESIGN COSTS	CHANGE ORDERS	DUR.
DACA67-98-M-0285	MISC. FOLLOW-ON WORK, McCHORD AFB	$12,180	?		60 days
DACA67-98-M-0300	CABLE SPLICING, BLDG PO3957, FT.LEWIS	$3,898	?		7 days
DACA67-98-M-0314	R/R ROLLING STEEL CURTAIN DOOR, YTC	$4,500	?		30 days
DACA67-98-M-0332	INST. SECURITY FENCE, HAYWARD, AIWAY HEIGHTS	$14,571	?		30 days
DACA67-98-M-0337	INST. WATER SUPPLY PUMP & PIPE, FAIRCHILD AFB	$29,708	?		7 days
??	RENOVATE HANGARS, FT. LEWIS	$500,000	$10,000 (2%)		120 days
??	RENOVATE MEDICAL CLINIC, YAKIMA	$250,000	$6,000 (2%)		?
??	REPL. UNDERGROUND STORAGE TANK, FT. LEWIS	$99,197	$7,000 (7%)		14 days

APPENDIX B: TABLE OF PRE-SMALL PROJECT SAMPLES

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-86-C-0040	UPGRADE DINING FACILITY, FT. LEWIS	$811,591	?	$52,835 (7%) DD-$33,526 OTV-$19,309	323 days (199)
DACA67-86-C-0101	REP. & RENOVATE BLDGs, FT. LEWIS	$115,300	?	$141,161 (122%) UR-$35,445 DD-$11,766 OT9-$94,150	593 days (523)
DACA67-86-C-0108	UPGRADE MECH. SYSTEM, FT. LEWIS	$839,000	?	$82,977 (10%) UR-$33,052 DD-$26,432 OTV-$10,924 V-$12,569	334 days (302)
DACA67-86-C-0121	REPL. EXTERIOR LIGHTING	$498,894	?	$253,387 (51%) UR-$191,379 DD-$37,063 OTV-$24,945	855 days (639)
DACA67-86-C-0122	REPL. FURNACES, FT. LEWIS	$1,681,039	?	$52, 139 (3%) UR-$+440 DD-$48,051 OTV-$4,528	360 days
DACA67-87-C-0018	REPL. FIRE ALARM SYSTEM, FT. LEWIS	$588.000	?	$4,022 (1%) UR-$2,949 OTV-$1,073	671 days (555)
DACA67-87-C-0021	REP./REPL. INTERIOR ELECT., VANCOUVER BARRACKS	$110,353.75	?	$27,061 (25%) UR-$24,750 DD-$375 OTV-$1,936	209 days (188)
DACA67-87-C-0061	REPL. BOILERS & REWIRE PLANT, FT. LEWIS	$342,143	?	$9,055 (3%) UR-$9,311 OTV-$+256	396 days (352)
DACA67-87-C-0063	CHAPEL ANNEX, FT. LEWIS	$201,081	?	$12,554 (6%) UR-$11,200 OTV-$1,354	204 days
DACA67-87-C-0064	EQUIP. STORAGE BLDG., LWSC, SEATTLE	$127,500	?	$3,740 (3%) DD-$3,740	240 days (225)

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-87-C-0074	ALTER BLDG #106 IMPROVE TOP SITE, NEAH BAY	$848,740	?	$243,787 (29%) UR-$117,979 DD-$8,776 OTV-$117,032	427 days (417)
DACA67-87-C-0083	REPL. FURNACES FT. LEWIS	$830,500	?	$10,910 (1%) UR-$8,021 OTV-$2,889	213 days
DACA67-87-C-0089	REPL. ROOF, USARC, FT. LAWTON	$269,473	?	$47,427 (18%) DD-$34,916 OTV-$12,511	316 days (276)
DACA67-87-C-0093	HVAC, BLDG 30, NAVAL STATION	$54,359	?	$13,080 (24%) DD-$10,566 OTV-$2,514	412 days (223)
DACA67-87-C-0094	PAINT INTERIOR MISC REPAIRS, USARC, RENTON	$74,500	?	$9,967 (13%) UR-$906 DD-$650 OTV-$8,411	308 days (294)
DACA67-87-C-0098	REP./REPL. WATER LINES, FT. LEWIS	$103,141	?	$32,490 (32%) UR-$32,490	478 days (265)
DACA67-87-C-0099	CORRECT LIFE SAFETY DEFICIENCIES, FT. LEWIS	$219,877	?	$86,466 (39%) UR-$57,104 DD-$17,900 OTV-$11,462	802 days (530)
DACA67-87-C-0100	REPL. FURNACES, FT. LEWIS	$26,891	?		1,120 days (967)
DACA67-87-C-0101	INST./REPL. FIRE ALARMS, FT. LEWIS	$134,500	?	$232,679 (173%) UR-$28,450 DD-$11,086 OTV-$1,143 OE-$192,000	409 days (389)
DACA67-87-C-0105	ASBESTOS ABATEMENT, FT. LEWIS	$889,700	?	$59,643 (7%) DD-$51,315 OTV-$8,328	526 days (350)
DACA67-87-C-0107	RENOVATE BDS FOR NCO ACADEMY, FT. LEWIS	$474,554	?	$71,155 (15%) UR-$1,328 DD-$11,572 OTV-$58,255	600 days (268)

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-87-C-0110	PRODUCTION WELL, FT. LEWIS	$297,000	?	$21,264 (7%) DD-$20,092 OTV-$1,172	266 days (206)
DACA67-87-C-0113	REP./CONSTR. POL STATIONS	$747,190	?	$103,455 (14%) UR-$102,323 DD-$290 OTV-$842	445 days (265)
DACA67-87-C-0114	FACILITY ENERGY IMPROVEMENTS, McCHORD AFB	$385,600	?	$+73,580 UR-$+82,663 DD-$6,093 OTV-$9,755 OTS-$+6,765	218 days
DACA67-87-C-0121	REROOF FAMILY QUARTERS, FT. LEWIS	$1,022,000	?	$30,180 (3%) UR-$7,426 DD-$15,869 OTV-$12,636 VE-$+5,751	458 days (416)
DACA67-87-C-0124	ABATE ASBESTOS & INST. WALL HEAT EXCHANGERS, FT. LEWIS	$313,540	?	$32,880 (11%) UR-$32,880	455 days (382)
DACA67-87-C-0126	REP. ADA BILLETS, FT. LEWIS	$1,156,783	$102,018 (9%)	$398,046 (34%) UR-$289,332 DD-$44,235 OTV-$64,479	257 days (137)
DACA67-88-C-0008	REP. MECH ROOM DOORS & PAINT STEAMLINE POLES YAKIMA	$371,000	?	$129,800 (35%) UR-$250 DD-$125,000 OTV-$4,550	335 days (372)
DACA67-88-C-0011	REROOF & REGRADE ARMED FORCES RC, BELLINGHAM	$165,537	?	$5,391 (3%) DD-$2,594 OTV-$2,797	379 days (347)
DACA67-88-C-0027	ASBESTOS ABATEMENT, BELLINGHAM	$76,525	?	$10,868 (14%) UR-$6,474 OTC-$4,394	246 days (170)
DACA67-88-C-0043	OTH/B TRANSMIT PERIMETER ROAD, BUFFALO FLAT, OR	$778,825	?		178 days

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DAC(W?)A67-88-C-0046	LINCOLN PARK SHORELINE EROSION CONTROL, SEATTLE	$542,700	?	$3,000 (1%) QT-V-$3,000	215 days (210)
DACA67-88-C-0050	REMOVE/DISPOSE ASBESTOS AT BLDG 350, FT. LEWIS	$159,679	?	$+2,034 OTV-$+2,034	175 days
DACA67-88-C-0053	REP./REROUTE SEWER LINES, FT. LEWIS	$501,128	$71,928 (14%)	$12,300 (3%)	322 days (304)
DACA67-88-C-0060	REMOVE/DISPOSE ASBESTOS, RECONSTR. VARIOUS BLDGs., FT. LEWIS	$577,025	$45,582 (8%)	$1,000 (.2%) OTV-$1,000	491 days (431)
DACA67-88-C-0067	REP. WOOD TRUSSES IN BLDGs. 12C75,3A3, & 9560, FT. LEWIS	$45,000	?	$74,450 (165%) DD-$74,450	425 days (243)
DACA67-88-C-0070	REMOVE/DISPOSE ASBESTOS, RECONSTR. VARIOUS BLDGs., FT. LEWIS	$832,849	?	$72,766 (9%) DD-$72,766	434 days (342)
DACA67-88-C-0071	INST./REPL. FIRE ALARM SYSTEM, FT. LEWIS	$450,000	$25,663 (6%)	$5,597 (1%) DD-$12,891 OTV-$3,754 VE-$+11,048	322 days (284)
DACA67-88-C-0073	REPL. BOILERS, VARIOUS BLDGs, VANCOUVER BARRACKS	$143,965	?	$13,312 (9%) UR-$3,812 OTV-$9,500	251 days
DACA67-88-C-0075	REMOVE/DISPOSE ASBESTOS, RECONSTR. VARIOUS BLDGs., FT. LEWIS	$343,228	$60,000 (18%)	$46,250 (14%) UR-$46,250	371 days (261)
DACA67-88-C-0076	REP. ROOF & PAINT MUSUEM, FT. LEWIS	$148,965	?	$50,160 (34%) UR-$13,000 DD-$22,443 O-$10,060 ?-$4,657	457 days (413)
DACA67-88-C-0080	PAINT INT./EXT. MISC. REPAIRS USARC, CORVALLIS,OR	$98,975	?	$5,685 (6%) DD-$5,685	221 days (191)

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-88-C-0081	MISC. REPAIRS, CAMP BONNEVILLE, WA	$114,949	$34,607 (30%)		197 days
DACA67-88-C-0082	CORRECT NOISE & FUME PROBLEM, BLDG 9850, FT. LEWIS	$346,495	$15,530 (5%)	$31,749 (9%) UR-$4,000 DD-$43,969 OTV-$2,389 VE-$+18,609	288 days (197)
DACA67-88-C-0083	REPL. LIGHT FIXTURES & MODIFY SEWER LINES, USARC, SALEM, OR	$19,521	?	$57,803 (296%) UR-$12,303 OE-$45,500	310 days (246)
DACA67-88-C-0086	REP. ROOF, USARC, TUMWATER	$91,942	$19,353 (21%)	$1,106 (1%) DD-$553 OTV-$553	244 days
DACA67-88-C-0087	REPL. BOILER & CONTROLS, USARC, PORTLAND	$56,300	?		336 days
DACA67-88-C-0088	OVERLAY PAVEMENT, MISC. REPAIRS, USARC, PORTLAND	$59,949	?	$25,450 (43%) UR-$25,450	269 days (209)
DACA67-88-C-0089	UPGRADE & REP. RANGES, FT. LEWIS	$118,000	?	18,500 (16%) UR-$15,000 DD-$3,500	277 days (258)
DACA67-88-C-0090	UPGRADE ELECT. & KITCHEN WORK, USARC LONGVIEW	$243,327	?	$43,080 (18%) DD-$21,400 OTV-$21,680	378 days (374)
DACA67-88-C-0091	MISC. ALTERATIONS, USARC, SALEM	$111,529	?	$6,250 (6%) UR-$900 DD-$5,350	266 days (317)
DACA67-88-C-0093	OSHA CORRECTIONS, VARIOUS BLDGs, FT. LEWIS	$377,188	$41,336 (11%)	$47,315 (13%) UR-$12,763 DD-$18,309 DD/V-$4,800 DD/U-$4,252 OTV-$7,191	429 days

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-88-C-0094	CONSTR. ARMS ROOM, FT. LEWIS	$407,086	?	$59,645 (15%) UR-$8,384 DD-$49,413 V-$1,848	465 days (399)
DACA67-89-C-0030	EXT. REPAIRS & PAINTING, FAMILY HOUSING FT. LEWIS	$587,788	$15,545 (3%)	$157,466 (27%) UR-$47,142 DD-$23,994 DD/V-$21,884 V-$7,012 KV-$57,434	405 days
DACA67-89-C-0091	ALTER SECTION, BLDG 852, McCHORD AFB	$337,526	?	$50,969 (15%) UR-$7,339 DD-$17,198 OTV-$14,649 V-$11,783	230 days (168)
DACA67-90-C-0091	UPGRADE SHELTER, SEATTLE	$144,000	$9,385 (7%)	$409 (.3%) OTV-$409	121 days (141)
DACA67-92-C-0004	CHANGES TO ABC SYSTEM, MADIGAN AMC	$29,772	$0		34 days (24)
DACA67-92-C-0032	LOG CENTER UNDERGROUND TREATMENT, FT. LEWIS	$1,377,000	$891,235 (65%)	$97,231 (7%) UR-$24,990 OTV-$19,824 OT-V-$11,432 VE-$+23,142 CQ-$+74,314 CV-$135,441 CVB-$3,000	379 days (406)
DACA67-92-C-0070	REPL. AIRPORT LIGHTING SYSTEM, FT. LEWIS	$118,049	$31,400 (27%)	$92,804 (77%) UA-$37,780 CVB-$43,712 C1A-$931 C4B-$10,381	496 days (232)
DACA67-92-C-0077	ELECT. DISTRIBUTION REPAIRS, UMATILLA DEPOT, OR	$228,330	36,465 (16%)		250 days (369)
DACA67-92-C-0086	PAINE FIELD	$182,000	?	$34,130 (19%) C1-$24,130 C7-$10,000	304 days (311)

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-92-C-0093	VENTILATION IMPROVEMENTS BLDG. 9630, FT. LEWIS	$247,900	$71,352 (29%)	$2,968 (1%) C2-$2,968	443 days
DACA67-92-C-0095	CONSTR. HAZ. WASTE FACILITY, VARIOUS SITES, WASH. & OREG.	$363,899	$19,921 (6%)	$+7,199	482 days (405)
DACA67-92-C-2001	ROOF & REP. WATER RESERVOIR, FT. LEWIS	$458,520	$0	$10,627 (2%) CV-$6,127 C2-$4,500	416 days (446)
DACA67-92-C-2009	UPGRADE BLDGs 9660 & 9665, FT. LEWIS	$321,327	?	$+2,257	300 days
DACA67-92-C-2010	REP. KIMBRO POOL & MCVEIGH GYM, FT. LEWIS	$589,875	?	$689,679 (117%) CV-$5,483 CVB-$6,000 C1B-$12,631 C2-$69,992 C4B-$12,900 C5-$364,644 K6B-$2,300 UA-$215,729	366 days (420)
DACA67-94-D-1005/007	REPL. FENCE, INSTALL GATE	$6,898	$976 (17%)		182 days
DACA67-94-D-1005, D.O. #27	INST. FENCING, LIGHTING, FT. LEWIS, WA	$6,903	$6,866 (100%)	$20,684 (300%) Addl. Fencing, Gate	307 days
DACA67-94-D-1005/41	INST. A/C FOR ADMIN., PORTLAND	$75,201	$407 (.5%)	$246 (.3%)	523 days
DACA67-94-D-1005/42	PAINT/CARPET INTERIOR, EUGENE, OR	$11,434	$955 (8%)		279 days
DACA67-94-D-1005/50	YAKIMA FIRING CENTER, WA	$93,660	$2,480 (3%)	$885 (1%)	357 days
DACA67-94-D-1005/53	WALLS & DOORS, FT. LAWTON	$24,894	$1,105 (4%)	$89,906 (360%)	762 days
DACA67-94-D-1005/55	HS DOMST WTR P FT. LEWIS	$367,609	$5,000 (1%)		410 days
DACA67-94-D-1005/56	HL ELECTRICAL, FT. LEWIS	$79,387	$563 (.7%)		405 days
DACA67-94-D-1005/60	HS EXTERIOR/ SITE, FT. LEWIS	$223,892	$1,750 (.8%)		?

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-94-D-1005/62	GW ELECTRICAL FT. LEWIS	$61,611	$3,000 (5%)		86 days
DACA67-94-D-1005/65	BW INTERIOR, FT. LEWIS	$726,227	$4,500 (.6%)		56 days
DACA67-94-D-1005/66	GW EXTERIOR SITE, FT. LEWIS	$180,851	$3,500 (2%)		64 days
DACA67-94-D-1005/68	BEACHWOOD ELEM. FT. LEWIS	$183,736	$1,906 (1%)		302 days
DACA67-94-D-1005/69	BW FIRE SPRINKLER SYSTEM, FT. LEWIS	$291,320	$1,400 (.5%)		43 days
DACA67-94-D-1005/71	BW INTERIOR, FT. LEWIS	$376,559	$1,500 (.4%)		33 days
DACA67-94-D-1005/72	BW EXTERIOR SITE, FT. LEWIS	$248,247	$1,200 (.5%)		44 days
DACA67-94-D-1005/73	BW HAZ. MAT. ABUTMENT, FT. LEWIS	$349,466	$2,300 (.7%)		54 days
DACA67-94-D-1005/74	GW HAZ. MAT. ABUTMENT, FT. LEWIS	$629,650	$3,700 (6%)		61 days
DACA67-94-D-1005/75	HS HAZ. MAT. ABUTMENT, FT. LEWIS	$523,750	$2,500 (5%)		390 days
DACA67-94-D-1005/76	GW INTERCOM, FT. LEWIS	$73,627	$1,000 (1%)		30 days
DACA67-94-D-1005/77	HS INTERCOM	$80,055	$3,000 (4%)		30 days
DACA67-94-D-1005/79	ADD SHOWER, SALEM, OR	$7,444	$1,118 (15%)		149 days
DACA67-94-D-1005/80	DEPMEDS AREA, VANCOUVER BRRKS, WA	$61,735	$1,508 (2%)		151 days
DACA67-94-D-1005/81	REPL. WINDOWS, RENTON	$66,439	$1,873 (3%)		239 days
DACA67-94-D-1005/88	R/R ROOF LEISY SEATTLE	$215,691	$2,435 (1%)		311 days
DACA67-94-D-1005/89	PRP BATHROOMS, FT. LAWTON	$48,329	$1,877 (4%)		170 days
DACA67-94-D-1005/90	R/R ROOF SHARFF PORTLAND	$157,257	$2,103 (1%)		281 days
DACA67-94-D-1005/092	RPR SIDEWALKS FT. LAWTON	$11,032	$1,081 (10%)		161 days
DACA67-94-D-1005/93	RPR PARKING LOTS, VANCOUVER BRRKS, WA	$58,591	$1,396 (2%)		255 days

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-94-D-1005/94	METAL STORAGE BLDG., PORTLAND, OR	$114,270	$2,444 (2%)		273 days
DACA67-94-D-1005/95	REP. SUPPORT CENTER, FT. LAWTON, WA	$60,014	$1,295 (2%)	$20,653 (34%)	224 days
DACA67-94-D-1005/96	INTERIOR UPGRADE, VANCOUVER BRRKS, WA	$154,622	$1,677 (1%)		316 days
DACA67-94-D-1005/109	RPR MEP GRAY FD, FT. LEWIS	$110,261	$1,975 (2%)		80 days
DACA67-94-D-1005 DO#122	VANC. BLDG. DEMO, VANCOUVER BRRKS, WA	$99,027	$2,878.98 (3%)		60 days
DACA67-94-D-1005 DO#123	DEMO BLDG., FT. LEWIS	$182,879	$6,554 (4%)	$25,624 (14%) UR-$9,208 OTH-$16,416	150 days (90)
DACA67-94-D-1006/1	REPAIR AIR CONDITIONING, TRENTWOOD,WA	$64,610	$1,653 (3%)	$127 (.2%)	140 days
DACA67-94D-1006/02	RPL SPRINKLER SYSTEM, SPOKANE	$36,503	$3,145 (9%)	$63 (.2%)	198 days
DACA67-94-D-1006/03	CONSTR. MEZZANINE, SPOKANE	$49,763	$2,994 (6%)		90 days
DACA67-94-D-1006/04	CONSTR. ENTRY CANOPY, BILLINGS, MT	$5,233	$2,535 (49%)		90 days
DACA67-94-D-1006/08	INST. FLRG, LGHTG, PAINT, FT. MISSOULA, MONTANA	$62,689	$6,625 (11%)	$344 (1%) Latex Concrete Underlayment prior to Vinyl Flooring	90 days
DACA67-94-D-1006/09	REPL. HYDRANT, PAVE	$35,653	$5,834 (+ DESIGN C/O $792) (17%)	$3,987 (11%)	60 days
DACA67-94-D-1006/010	MEP AREA MOD, MONTANA	$60,064	$6,625 (11%)	$8,285 (14%)	221 days
DACA67-94-D-1006/011	PAVE PARKING LOTS, FT. MISSOULA, MONTANA	$136,137	$1,067 (.8%)		238 days

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-94-D-1006/013	RE-SURFACE PARKING LOTS, TWIN FALLS, ID	$21,791	$2,317 (11%)		238 days
DACA67-94-D-1006/014	CONSTR. BATTERY ROOM, BOISE, IDAHO	$7,154	$2,318 (32%)		237 days
DACA67-94-D-1006/15	PAINT INTERIOR, LUGENBEEL HALL	$2,271	$2,318 (102%)		253 days
DACA67-94-D-1006/16	INSTALL SPRINKLER SYSTEM, BILLINGS, MT	$33,295	$2,968 (9%)		201 days
DACA67-94-D-1006/17	DEPMEDS, MANN HALL, SPOKANE	$31,900	$3,435 (11%)	$2,233 (7%)	90 days
DACA67-94-D-1006/18	REPAIR ROOF, BOISE, IDAHO	$23,492	$2,861 (12%)		90 days
DACA67-94-D-1006/20	INSTALL SPRINKLER SYSTEM, BOISE IDAHO	$39,066	$3,326 (9%)		274 days
DACA67-94-D-1006/21	REP./REPL. GUTTERS, FT. MISSOULA, MO	$38,380	$2,152 (6%)		308 days
DACA67-94-D-1006/25	REP./REPL. PORCHES, FT. MISSOULA, MT	$40,011	$6,330 (16%)	$8,224 (21%)	304 days
DACA67-94-D-1006/29	REPL. CEILING FAN, SPOKANE	$35,534	$2,269 (6%)	$1,146 (3%)	120 days
DACA67-94-D-1006/33	FENCE COMP. GREAT FALLS, USARC, MT	$19,077	$1,215 (6%)		120 days
DACA67-94-D-1006/35	REP. OMS ROOF, FT. MISSOULA,MT	$12,822	$1,687 (13%)		120 days
DACA67-94-D-1006/42	MODIFY PARKING, BOISE	$9,495.00	$65 (.7%)		120 days
DACA67-95-C-0073	DEMO GOLF CLUBHOUSE, FT. LEWIS	$190,976	$0	$20,296 (11%) CVB-$20,296	337 days (332)
DACA67-95-M-0426	FABRICATE SIGNS, FT. LAWTON, WA	$8,492.50	$3,244 (39%)		?
DACA67-95-M-0911	YAKIMA FIRING CENTER, WA	$10,578	$642 (6%)	$1701 (16%)	181 days
DACA67-95-M-0976	INSTALL FENCE, YAKIMA, WA	$20,756	$2,487 (12%)		115 days

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-96-C-0041	STORM WATER TREATMENT, FT. LEWIS	$613,118	$47,480 (8%)	$30,295 (5%) C1-$8,085 C7-$18,800 C9A-$3,410 $18,800	420 days
DACA67-96-C-0054	REPAIR HOT REFUEL POINT, FT. LEWIS	$79,944	?	$14,900 (19%) CV-$14,900	180 days
DACA67-96-C-0071	RELINE 6 STORAGE TANKS, MANCHESTER	$328,505	?	$774,694 (236%) CV-$8,223 C4-$6,000 C5U-$215,613 C7-$19,095 U4-$519,843 ??-$5,920	450 days (360)
DACA67-96-C-2002	REP. SEWER LINE MURRAY CREEK TO LOG CENTER, FT. LEWIS	$581,660	?	$489,925 (84%) CV-$10,700 C4-+$10,000 C5-$394,225 K6-$95,000	386 days (220)
DACA67-96-C-2003	REP. SEWER LINES, FLORA ROAD & PENDLETON AVE. FT. LEWIS	$543,485	?	$890,723 (164%) C5-$890,723	210 days (232)
DACA67-96-F-5164	INST. STORAGE BLDG. TACOMA	$79,440	$726 (.9%)		60 days
DACA67-96-G-0001, TO 001	REMOVE ASBESTOS, EUGENE, OR	$118,000	$1,934 (2%)	$705 (1%)	155 days
DACA67-96-G-0001, TO 001	REMOVE ASBESTOS, PORTLAND,OR	$208,000	$1,957 (.9%)	$32,028 (15%)	155 days
DACA67-96-G-0001, TO 002	PURCHASE CONSTR. BOOM, TACOMA, WA	$181,000	$2,158 (2%)	$24,500 (14%)	122 days
DACA67-96-G-0001, TO 009	GUARD HOUSE/ MASK TEST FACILITY, UMATILLA	$169,500	$0	$319,715 (188%) UR-$161,913 Engineering-$157,802	90 days (47)
DACA67-96-M-0666	PLACE CONCRETE PAD, FT. LEWIS	$9,500	$1,967 (21%)		?

CONTRACT #	PROJECT	CONSTRUCT. COST	DESIGN COST	CHANGE ORDER $	DUR.
DACA67-96-M-0876	UPGRADE BOILER, IDAHO	$44,931	$9,559 (21%)	$4162 (9%)	?
DACA67-97-C-0001	FURNISH OIL WATER SEPARATORS, MANCHESTER	$157,788	?	$750 (1%) CV-$750	553 days (180)
DACA67-97-C-0022	OIL/WATER SEPARATOR, MANCHESTER	$851,789	?	$400,843 (47%) CV-$328,983 U4-$71,860	547 days (384)
DACA67-97-C-0032	C-17 UNDERGROUND UTILITIES, McCHORD AFB	$832,415	?	$251,734 (30%) CQB-$23,400 CQU-$54,000 CVB-$9,800 C1B-$59,950 C7B-$39,584 U4B-$65,000	412 days (422)
DACA67-97-C-0033	C-17 ELECTRICAL SUBSTATION, McCHORD AFB	$784,456	?	$264 (.03%) CIB-$264	439 days
DACA67-97-C-0037	C-17 RELOCATE HYDRANT SYSTEM, McCHORD AFB	$925,250	?	$360,000 (39%) C9U-$360,000	375 days
DACA67-97-C-0060	ACCESS ROADS, UMATILLA, HERMISTON,OR	$685,750	?		221 days (180)
DACA67-98-C-0015	REMOVE SIMULATOR DEBRIS, MANCHESTER	$139,295	?	$83,010 (60%) CVB-$83010	207 days (147)

APPENDIX C: RESULTS OF ISOLATION SENSITIVITY ANALYSIS

Isolation Sensitivity Analysis

The SPTI is preferred for projects that have a project cost of $500,000 or less. In some cases, projects that cost in excess of $500,000 or even $1 million are accomplished with SPTI. In order to determine the impact of high and low dollar projects, it is necessary to isolate them from the samples and then perform the same analysis as before on the remaining samples. A series of three isolations were conducted: 1) projects with a cost greater than $1 million, 2) projects with a cost greater than $500,000, and 3) projects with a cost less than $30,000. The results of this step-by-step isolation did not yield significantly different results from the overall original results. The results from the statistical analysis rendered the same results as all the overall original results as well. Table 1 shows how many projects fit into each case.

TABLE 1, APPENDIX C: QUANTITY OF PROJECTS FOR ISOLATION

	PRE-SPTI	SPTI
Projects >$1 million	5	2
Projects ≥ $500,000	30	9
Projects < $30,000	21	14
Projects <$500,000 >$30,000	90	52

Sensitivity Analysis – Projects Equal to or Under $1 million

Only five Pre-SPTI samples and two SPTI samples were over $1 million in costs. The results of the remaining samples less than $1 million in Table 2 are then compared to the original overall results to evaluate the sensitivity.

TABLE 2, APPENDIX C: RESULTS EXCLUDING PROJECTS EXCEEDING $1 MILLION
(Original Results From All Samples in Parentheses)
(Average Results Shown in Parentheses after the Median)

	PRE-SPTI	SPTI
Total Dollar Amount of Projects Analyzed	$34.4 million (Compared to $41.2 million)	$11 million (Compared to $14 million)
Design Costs	6% (10%) (Compared to 6% (11%))	4% (4%) (Compared to 4% (4%))
Project Duration	266 days (288) (Compared to 195 (289))	120 days (133) (Compared to 120 (135))
Increase for jobs that increased or decreased in duration	14% (16%) (Compared to 15% (17%))	42% (52%) (Compared to 42% (52%))
Increase for jobs that increased, decreased, or were neutral	10% (13%) (Compared to 10% (13%))	0% (15%) (Compared to 0% (15%))
Increase for jobs that increased or decreased in duration, when changes may have resulted from COs, except user requested (UR)	12% (13%) (Compared to 12% (12%))	40% (47%) (Compared to 40% (35%))
Increase for jobs that increased, decreased, or were neutral, when changes may have resulted from COs, except UR	4% (9%) (Compared to 5% (10%))	0% (10%) (Compared to 0% (10%))
CO rate only for jobs with COs, including UR	14% (37%) (Compared to 12% (35%))	13% (27%) (Compared to 13% (29%))
CO rate for all jobs, including UR COs	1% (22%) (Compared to 2% (23%))	0% (8%) (Compared to 0% (8%))
CO rate only for jobs with COs, excluding UR	9% (33%) (Compared to 9% (33%))	10% (13%) (Compared to 10% (13%))
CO rate for all jobs, excluding UR	1% (19%) (Compared to 1% (19%))	0% (2%) (Compared to 0% (2%))

Sensitivity Analysis – Projects Under $500,000

To narrow the margin of distortion of high dollar samples even further, projects that were $500,000 or greater were excluded from analysis. There were 30 Pre-SPTI and nine SPTI samples that were equal to or greater than $500,000 in cost, which still leaves 113 and 68 samples to analyze, respectively. The results from excluding those samples meeting or exceeding $500,000 in costs from the comparisons are shown in Table 3.

TABLE 3, APPENDIX C: RESULTS EXCLUDING PROJECTS MEETING OR EXCEEDING $500,000
(Original Results From All Samples in Parentheses)
(Average Results Shown in Parentheses after the Median)

	PRE-SPTI	SPTI
Total Dollar Amount of Projects Analyzed	$16.7 million (Compared to $41.2 million)	$6.6 million (Compared to $14 million)
Design Costs	6% (11%) (Compared to 6% (11%))	2% (4%) (Compared to 4% (4%))
Project Duration	246 days (270) (Compared to 195 (289))	120 days (133) (Compared to 120 (135))
Increase for jobs that increased or decreased in duration	15% (18%%) (Compared to 15% (17%))	40% (44%) (Compared to 42% (52%))
Increase for jobs that increased, decreased, or were neutral	12% (14%) (Compared to 10% (13%))	0% (12%) (Compared to 0% (15%))
Increase for jobs that increased or decreased in duration, when changes may have resulted from COs, except user requested (UR)	12% (13%) (Compared to 12% (12%))	33% (36%) (Compared to 40% (35%))
Increase for jobs that increased, decreased, or were neutral, when changes may have resulted from COs except UR	4% (9%) (Compared to 5% (10%))	0% (7%) (Compared to 0% (10%))

TABLE 3, APPENDIX C (continued): RESULTS EXCLUDING PROJECTS MEETING OR EXCEEDING $500,000
(Original Results From All Samples in Parentheses)
(Average Results Shown in Parentheses after the Median)

CO rate only for jobs with COs, including UR	14% (39%) (Compared to 12% (35%))	22% (31%) (Compared to 13% (29%))
CO rate for all jobs, including UR COs	0% (18%) (Compared to 2% (23%))	0% (8%) (Compared to 0% (8%))
CO rate for jobs with COs, excluding UR	9% (36%) (Compared to 9% (33%))	11% (15%) (Compared to 10% (13%))
CO rate for all jobs, excluding UR COs	0% (15%) (Compared to 1% (19%))	0% (2%) (Compared to 0% (2%))

Sensitivity Analysis – Projects Greater Than $30,000

When construction projects have a low dollar amount, the design cost can be a significant portion of the construction cost. To investigate the possibility of this fact providing an advantage or disadvantage to either type of sample, it was appropriate to choose a relatively low dollar cut-off point and analyze the results. The choice of $30,000 was made arbitrarily to coincide with a break in the cost data.

For the Pre-SPTI samples, 21 projects were less than $30,000 in costs. For the Small Project samples, 14 projects were less than $30,000 in costs. The results of excluding those samples less than $30,000 in costs are then compared in Table 4 to the original overall results.

TABLE 4, APPENDIX C: RESULTS EXCLUDING PROJECTS $30,000 OR LESS
(Original Results From All Samples in Parentheses)
(Average Results Shown in Parentheses after the Median)

	PRE-SPTI	SPTI
Total Dollar Amount of Projects Analyzed	$40.9 million (Compared to $42.1 million)	$13.7 million (Compared to $14 million)
Design Costs	4% (7%) (Compared to 6% (11%))	2% (3%) (Compared to 4% (4%))
Project Duration	285 days (295) (Compared to 195 (289))	120 days (148) (Compared to 120 (135))
Increase for jobs that increased or decreased in duration	14% (17%) (Compared to 15% (17%))	40% (51%) (Compared to 42% (52%))
Increase for jobs that increased, decreased, or were neutral	10% (13%) (Compared to 10% (13%))	0% (17%) (Compared to 0% (15%))
Increase for jobs that increased or decreased in duration, when changes may have resulted from COs except user requested (UR)	11% (13%) (Compared to 12% (12%))	37% (45%) (Compared to 40% (35%))
Increase for jobs that increased, decreased, or were neutral, when changes may have resulted from COs except UR	4% (9%) (Compared to 5% (10%))	0% (11%) (Compared to 0% (10%))
CO rate only for jobs with COs, including UR	11% (26%) (Compared to 12% (35%))	15% (28%) (Compared to 13% (29%))
CO rate for all jobs, including UR COs	1% (16%) (Compared to 2% (23%))	0% (8%) (Compared to 0% (8%))
CO rate only for jobs with COs, excluding UR	7% (22%) (Compared to 9% (33%))	10% (13%) (Compared to 10% (13%))
CO rate for all jobs, excluding UR COs	1% (13%) (Compared to 1% (19%))	0% (2%) (Compared to 0% (2%))

APPENDIX D: CONTRACTOR QUESTIONNAIRE SAMPLE (BLANK)

1. Approximately how many small projects jobs have you **completed** in the following years?
   1995:____________
   1996:____________
   1997:____________
   1998:____________

2. Compared to the traditional method of projects, what are the benefits that you enjoy with the Small Projects Initiative?

   (Check all that apply)
   Increased Profit Margin:______________
   Improved Project Efficiency:____________
   Reduced Project Duration:____________
   Increased Rapport with Owner:__________
   Increased Rapport with USACE:_________
   Increased Flexibility of Design:_________

   Other:____

3. Compared to the traditional method of projects, what are the disadvantages that you dislike with the Small Projects Initiative?

   (Check all that apply)
   Increased Competitiveness:________
   Increased Change Orders:________
   Vagueness of Design:________

   Other:____

4. Overall, what is your satisfaction level with the effectiveness of the projects that you have completed through the Small Projects Initiative Concept?
   Very satisfied __________
   Somewhat satisfied __________
   Neutral __________
   Somewhat Dissatisfied __________
   Very Dissatisfied __________

   Comments: ____

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5. What changes would you prefer to see in the way the U.S. Army Corps of Engineers manages the small projects?

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General Comments: ____

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APPENDIX E: CUSTOMER QUESTIONNAIRE SAMPLE (BLANK)

1. Approximately how many small projects jobs have you had **completed** in the following years?
   1995:____________
   1996:____________
   1997:____________
   1998:____________

2. Compared to the traditional method of projects, what are the benefits that you enjoy with the Small Projects Initiative?

(Check all that apply)
    Improved Project Efficiency:__________
    Increased Rapport with Contractor:______
    Increased Rapport with USACE:________
    Increased Flexibility of Design:_________
    Reduced Project Duration:_____________
    Project Mgt. Plan Feedback:____________
    Increased Emphasis on Life-Cycle Mgt. Concept___________

    Other:____

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3. Compared to the traditional method of projects, what are the disadvantages that you dislike with the Small Projects Initiative?
    (Check all that apply)
    Decreased Rapport with Owner:_________
    Decreased Rapport with USACE:________
    Vagueness of Design:________________

    Other:____

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4. Overall, what is your satisfaction level with the effectiveness of the projects that have been completed through the Small Projects Initiative Concept for you?
   Very satisfied ________
   Somewhat satisfied ________
   Neutral ________
   Somewhat Dissatisfied ________
   Very Dissatisfied ________

   Comments: ____

   ____

5. What changes would you prefer to see in the way the U.S. Army Corps of Engineers manages the small projects for you?

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General Comments: ____

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APPENDIX F: CONTRACTOR POLL RESULTS

RESULTS OF CONTRACTOR POLL (Table 1)			
CONTRACTOR	CONTRACTOR #1	CONTRACTOR #2	CONTRACTOR #3
# of Projects Completed	2	6	9
Pros	• Increased profit margin • Improved efficiency • Reduced duration • Increased rapport (with USACE) • Increased design flexibility	• Increased profit margin • Improved efficiency • Reduced duration • Increased design flexibility	• Increased profit margin • Improved efficiency • Reduced duration • Increased rapport (with USACE and customer) • Increased design flexibility
Cons	None	• Paperwork still cumbersome	• Ambiguity of design (requires pre-con conferences, but pleased with USACE's timely responses
Satisfaction Level	Very	Very	Very
Suggestions	Project reviewers of submittals should be cognizant of the design/ build concept rather than applying typical USACE requirements to meet this concept	Minimize paperwork, have a consent of surety and certification on file, omit all delegation letters.	Space work throughout the year; always an abundance in the 4th quarter of the fiscal year
Comments	Highly valuable program; enables USACE and contractor to establish good communication rather than going through the RFI process; motivates contractor to provide USACE and customer a smooth project with minimal problems	Win-Win for USACE, contractor, and customer	Very impressed with the professionalism, accessibility, and courtesy of USACE

RESULTS OF CONTRACTOR POLL (Table 2)			
CONTRACTOR	CONTRACTOR #4	CONTRACTOR #5	CONTRACTOR #6
# of Projects Completed	2	110	12
Pros	• Reduced duration • Increased rapport (with USACE and customer) • Increased design flexibility	• Increased profit margin • Improved efficiency • Reduced duration • Increased rapport (with USACE and customer) • Increased design flexibility	• Increased profit margin • Improved efficiency • Reduced duration (bid, design, overall) • Increased rapport (with USACE and customer) • Increased design flexibility • Less change orders • More team approach
Cons	• Difficult to estimate/bid	• Vagueness of design	• Vagueness of design (Also a Pro; contractor can provide input at the onset)
Satisfaction Level	Very	Very	Somewhat
Suggestions	Negotiate projects	Increase interaction during design phase	Possibly compensate contractor for time spent on jobs not funded
Comments	Good program; will save time and money in procurement of construction	Very satisfied	None

APPENDIX G: CUSTOMER POLL RESULTS

RESULTS OF CUSTOMER POLL			
CUSTOMER	CUSTOMER #1	CUSTOMER #2	CUSTOMER #3
# of Projects Completed	15	15	7
Pros	• Increased rapport with USACE • Increased flexibility of design • Reduced project duration	• Improved efficiency • Increased rapport with USACE and contractor • Increased flexibility of design • PMP feedback • Increased emphasis on Life-Cycle Mgt. • Response, execution time, and contractor accountability make this method ideal	• Increased rapport with USACE • Increased flexibility of design • Increased flexibility during construction
Cons	• Vagueness of design • Difficulty obtaining as-built drawings of project	None	• Lack of manpower in Small Projects Office; tied up with left over MILCON deficiencies
Satisfaction Level	Very	Very	Somewhat
Suggestions	Provide Resident Office more contracting decision authority	None	Assign more manpower to Small Projects Group; stop assigning left over MILCON deficiencies to this group
Comments	Accomplishes great work not possible in the past when not impeded by contracting difficulties	Best Program for Small and Medium sized projects (former project manager of the JOC program at Puget Sound Naval Shipyard)	Great idea; flexibility during design and construction is an asset; an excellent tool for the U.S. Air Force to obtain quick execution of projects