BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Greater Use Of Value Engineering Has The Potential To Save Millions On Wastewater Treatment Projects

Value engineering is a method of analyzing a product or service so that its function can be provided at the lowest possible overall cost without sacrificing quality. When applied to the Environmental Protection Agency's (EPA) construction grants program, EPA reported that value engineering reduced construction costs about $400 million over a 7-year period. EPA, as required by federal law, mandates value engineering reviews during the design of wastewater treatment projects costing more than $10 million, but it does not require its use during the design of less expensive projects or at all during the construction phase regardless of project cost.

GAO found that value engineering techniques were seldom used on treatment projects when there was no federal or state requirement to do so. EPA regional and state program officials have not extended value engineering requirements primarily because federal and state governments do not require them to do so.

GAO estimates that extending the use of value engineering during design to projects costing from $1 million to $10 million and to all projects during construction has the potential to save from $25 million to $57 million in federal funds annually. GAO makes recommendations to the Congress and EPA to extend value engineering.

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JULY 16, 1985

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D.C. 20548

B-218936

To the President of the Senate and the
Speaker of the House of Representatives

This report describes how value engineering can be extended to more grant-funded wastewater treatment projects to reduce construction costs and thereby help fund the $109 billion worth of additional treatment projects that the Environmental Protection Agency estimates will be needed by the year 2000.

We made this review because of the recognized potential benefits to be derived from using value engineering. Specifically, we examined whether cost reductions could be achieved for wastewater treatment projects by extending value engineering to

--design plans of projects costing from $1 million to $10 million and

--the construction phase through the use of construction incentive clauses.

Copies of this report are being sent to appropriate House and Senate committees; the Director, Office of Management and Budget; the Administrator, Environmental Protection Agency; and other interested parties.

Charles A. Bowsher
Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

GREATER USE OF VALUE ENGINEERING HAS THE POTENTIAL TO SAVE MILLIONS ON WASTEWATER TREATMENT PROJECTS

D I G E S T

Value engineering is a method of analyzing a product or service so that its function can be performed at the lowest possible overall cost without sacrificing quality. Achieving the lowest cost may require redesigning or eliminating components by using different, new, or more efficient technology. GAO's longstanding position is that, while wider use of value engineering is favored, savings will be realized only when value engineering is applied properly.

Value engineering can be used during a construction project's design phase or during construction. During design, value engineering is performed by independent professionals who study proposed project plans to identify and evaluate alternatives for accomplishing project functions. Value engineering during project construction includes a construction incentive clause in the contract that authorizes the contractor to suggest cost-saving measures and, if the suggestions are accepted, to share in the savings.

The Environmental Protection Agency's (EPA) construction grant program awards local communities grants to plan, design, and build wastewater treatment facilities needed to control water pollution. Between 1972 and 1985, EPA obligated about $45 billion for the grant program. EPA estimated in 1984 that an additional $109 billion would be required for publicly owned treatment facilities by the year 2000.

To help ensure that the most economical, cost-effective wastewater treatment projects are used, EPA recommends--and in some cases, requires--value engineering design reviews and construction contract incentive clauses. EPA, however, only requires value engineering, as mandated by federal law, during the design phase on wastewater treatment projects costing more than $10 million and does not require it at all during construction regardless of project cost.

Recognizing the potential benefits to be derived from value engineering, GAO reviewed whether the cost of constructing wastewater treatment plants could be reduced by

--conducting value engineering studies on designs of projects costing from $1 million to $10 million and

--using construction incentive clauses in all contracts.

WHAT GAO FOUND

Benefits of value engineering have been demonstrated. Increased use of value engineering techniques on EPA grant-funded projects has the potential to reduce construction costs. On the basis of various reported actual results of value engineering and current program funding levels, GAO estimates that increased use of value engineering on wastewater treatment plants can potentially save from $25 million to $57 million annually in EPA grant funds. Although EPA recommends using value engineering on all project designs and during project construction, grantees seldom use value engineering except when required.

BENEFITS OF EXTENDING VALUE ENGINEERING HAVE BEEN DEMONSTRATED

GAO found merits for extending value engineering to the design of wastewater treatment projects costing from $1 million to $10 million as demonstrated by the following:

--For six EPA-funded projects costing $10 million or less, about $1.7 million, or 5.1 percent of total project costs, were saved and/or project designs improved as a result of value engineering. (See p. 15.)

--Value engineering on similar sized projects funded by other agencies, including wastewater projects, also produced savings. About $1.3 million, or 6.3 percent of total costs, on wastewater treatment projects and about $20.9 million, or 8.3 percent of total costs, on general construction projects. (See pp. 17 and 42.)

--Of the 60 state and EPA regional officials GAO contacted, 50 (83 percent) reported that value engineering would benefit projects costing $10 million or less. (See p. 18.)

--A 1984 EPA staff study of value engineering recommended its use on all projects costing $1 million or more. (See p. 18.)

GAO also found that value engineering during construction through contract incentive clauses have benefited federal projects, as indicated by the following:

--The Departments of Transportation and Defense have reported savings or potential savings from using value engineering contract incentive clauses. The Department of Defense, for example, reported saving $1.4 billion over a 20-year period. (See pp. 27 and 28.)

--On 3 of 32 EPA-funded wastewater treatment project contracts containing incentive clauses, about $855,000 was saved between 1981 and 1983. Savings represented about 0.3 percent of the total costs (about $248 million) of the 32 projects. (See pp. 26 and 27.)

POTENTIAL SAVINGS FROM INCREASED USE OF VALUE ENGINEERING

GAO estimates that extending value engineering to the design of projects costing from $1 million to $10 million has the potential to save from $19 million to $42 million in federal funds each year (see p. 19), and using value engineering incentive clauses during project construction has the potential to save an additional $6 million to $15 million in federal funds each year. (See p. 29.) In addition, grantees and states could potentially realize savings proportionate to their project contributions.

These estimated savings are net after deducting various costs, for example, the costs of value engineering studies and assume continued funding at the fiscal year 1985 level. The savings in EPA grant funds do not revert to the U.S. Treasury. Rather, they would become available to build other needed wastewater treatment projects.

GAO's estimates are expressed in terms of a range of potential savings because data

limitations required that GAO use reasoned assumptions giving consideration to available data. Also, GAO did not verify the accuracy of data reported on the results of value engineering. (See apps. II and III.)

GAO selected EPA's staff study recommendation of $1 million as the minimum sized treatment project that should be value engineered during design because estimated benefits that can be expected from such sized projects would still exceed the costs of value engineering studies according to EPA study team members. (See p. 18.)

GRANTEES DO NOT USE VALUE ENGINEERING UNLESS REQUIRED

Out of 2,750 EPA-funded projects costing $10 million or less under construction during fiscal year 1983, state officials reported that only 7 had been value engineered during project design--6 resulted in construction cost savings and 1 increased construction costs so as to improve project efficiency and reliability and reduce operation and maintenance costs. Similarly, less than 1 percent of the 4,965 project contracts awarded during fiscal years 1981-83 were reported by state officials to contain construction incentive clauses. (See pp. 13, 15, and 26.)

EPA regional office and state program officials have not required value engineering primarily because state and federal governments do not require them to do so. (See pp. 20 and 29.)

Few grantees are likely to voluntarily use value engineering during design because most savings are passed on to the states for use on other projects while study costs are paid from the grantees own funds. Since EPA and the states provide most of the funds, grantees share of any savings is proportional to its smaller investment. Additionally, grantees having projects costing $10 million or less must pay the entire cost of value engineering studies, because the EPA design allowance recognizes such expenses only for projects costing more than $10 million. An EPA value engineering coordinator estimates the costs

of studies for projects costing $1 million to $10 million at about $25,000 to $50,000 a project. (See pp. 22 and 23.)

The success of a construction incentive clause program depends, in part, on the level of management support and promotion given to it. With some exceptions, the 60 state and EPA regional officials GAO contacted reported that they had not taken any formal action to promote the use of incentive clauses and they were not supportive of construction incentive clauses. The officials were concerned that using such clauses might increase administrative work, reduce project reliability, and not generate enough savings to justify the effort. (See pp. 30 and 31.)

RECOMMENDATIONS TO THE ADMINISTRATOR, EPA

GAO recommends that the Administrator, Environmental Protection Agency, revise regulations to (1) require value engineering reviews on designs of projects costing more than $1 million and (2) make the value engineering design study costs for projects costing from $1 million to $10 million eligible expenses of the construction grant. (See p. 24.) GAO also recommends that the EPA Administrator test the value of using construction incentive clauses by requiring their use in EPA-funded wastewater treatment construction project contracts and promoting their benefits during the test period. If the results are positive, GAO recommends that the EPA Administrator require construction incentive clauses on a permanent basis. (See p. 33.)

AGENCY COMMENTS AND GAO's EVALUATION

EPA agreed with GAO's conclusion that value engineering lower cost projects would reduce construction costs of wastewater treatment projects. However, EPA commented that in section 218(c) of the Clean Water Act (Federal Water Pollution Control Act) the Congress established $10 million as the threshold for requiring value engineering; and that, in light of apparent congressional intent, it elects to encourage but not require value engineering on lower cost projects. EPA also outlined several actions it had taken or plans

to take, including studying the possibility of increasing the allowance for value engineering design studies, to encourage and assist grantees in using value engineering for small projects. (See pp. 55 and 56.)

While federal law does not require value engineering to be used on projects costing from $1 million to $10 million, neither does it prohibit EPA from requiring value engineering on such sized projects. GAO continues to believe that value engineering must be required to maximize savings on projects costing from $1 million to $10 million. Value engineering reviews have been rarely used by states and grantees voluntarily on such sized wastewater treatment facilities, most state program and EPA officials do not mandate or promote its use primarily because it is not required by federal or state governments, and grantees have little incentive to voluntarily initiate value engineering.

Given this situation, GAO believes that without a requirement to conduct value engineering reviews, EPA's actions to encourage grantees to conduct value engineering studies on lower cost projects will continue to result in few such projects being value engineered. (See p. 25.)

EPA also commented that the construction incentive program should be more appropriately run as a voluntary effort and it does not intend to test its value by requiring its use over a period of time as GAO recommended. EPA said that it will improve its monitoring and data collection efforts and examine the effectiveness of the program in the future. (See p. 56.)

GAO believes that relying on voluntary efforts to use construction incentive clauses will not provide a valid test of their value. Under a voluntary system, less than 1 percent of the 4,965 EPA-funded wastewater treatment facility construction contracts awarded during fiscal years 1981-83 contained construction incentive clauses. GAO believes that only by requiring the testing of incentive clauses and evaluating the results achieved can EPA determine the value of construction incentive clauses.

RECOMMENDATION TO THE CONGRESS

In view of EPA's decision to encourage but not require value engineering on lower cost wastewater treatment projects during design because of the existing $10 million legislative threshold for requiring value engineering, GAO recommends that the Congress revise the Federal Water Pollution Control Act to require value engineering review on designs of wastewater treatment projects costing more than $1 million. (See p. 25.)

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ABBREVIATIONS

GAO General Accounting Office

EPA Environmental Protection Agency

CHAPTER 1

INTRODUCTION

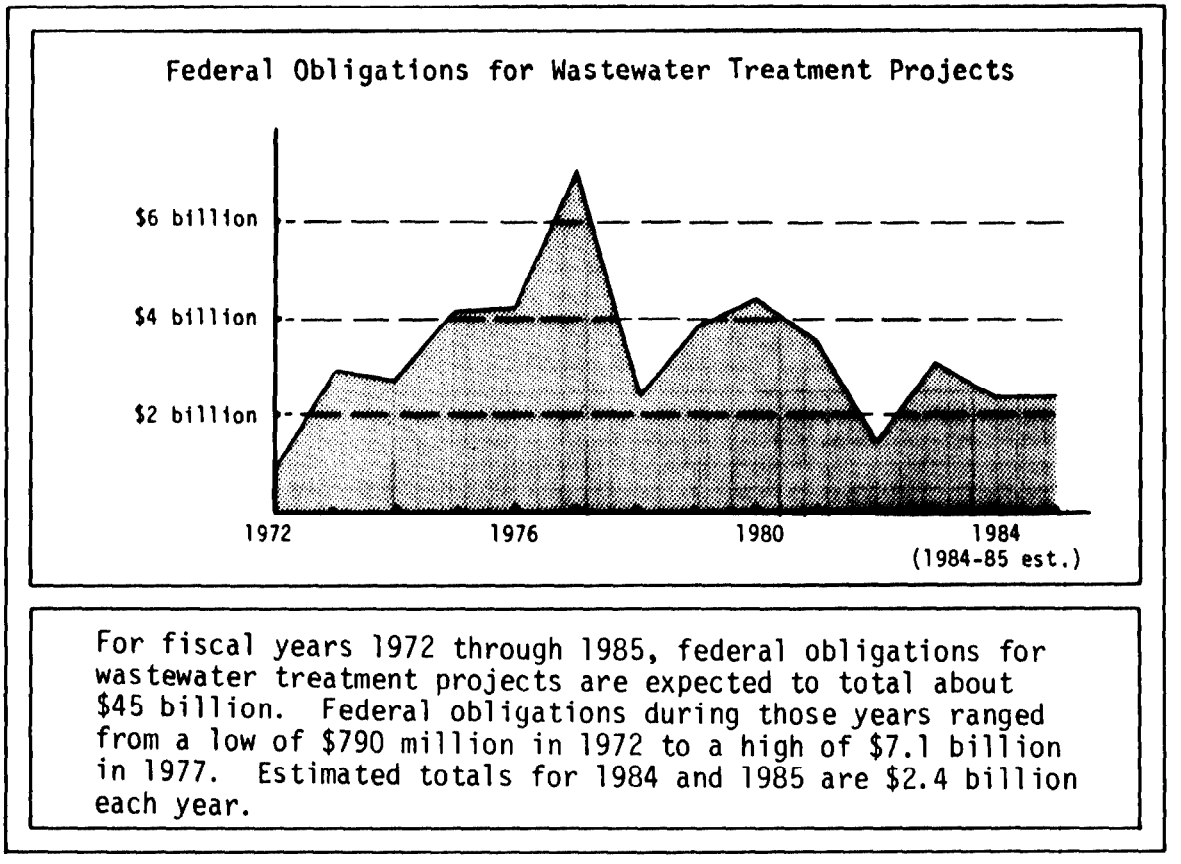
Billions of gallons of polluted wastewater are generated each day from homes, businesses, and industries nationwide. Left untreated, this contaminated waste may enter the nation's waterways, damage the environment, and leave the water unfit for human use. To prevent the continued degradation of the nation's waters and restore already contaminated rivers, lakes, streams, and ocean shorelines, wastewater must be treated to remove damaging pollutants. The Environmental Protection Agency's (EPA) construction grant program helps communities plan, design, and build the wastewater treatment plants needed to control water pollution.

EPA's CONSTRUCTION GRANTS PROGRAM

The construction grants program which is designed to prevent, reduce, and eliminate water pollution is carried out under the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq.). The act's primary objective is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The construction of wastewater treatment plants is the principal means being used to achieve the nation's clean water goals. The Water Pollution Control Act Amendments of 1956 (Public Law 84-660) created the wastewater treatment construction grants program and authorized federal financial assistance of up to 30 percent of the cost of constructing municipal wastewater treatment plants. Subsequent amendments increased the federal share of the construction costs to a maximum of 55 percent in fiscal year 1966 and 75 percent in fiscal year 1972. Under 1981 amendments, starting in fiscal year 1985 the federal share declined to 55 percent for those projects that had never received any construction funds. The local share of project funding can consist of state and grantee funds and also federal funds obtained from other sources.

Next to the interstate highway program, EPA's program is the nation's largest construction grants program. From fiscal years 1972 through 1985, net federal obligations for construction grants are expected to total about $45 billion[1] as shown on page 2.

[1]This sum as well as all sums in this report are in nominal (actual) dollars.



For fiscal years 1972 through 1985, federal obligations for wastewater treatment projects are expected to total about $45 billion. Federal obligations during those years ranged from a low of $790 million in 1972 to a high of $7.1 billion in 1977. Estimated totals for 1984 and 1985 are $2.4 billion each year.

A wastewater treatment plant is often the single largest physical asset owned by a municipality. The cost of constructing a plant depends on both its size and the complexity of the treatment process. Plants range in capacity from a few hundred thousand gallons to several hundred million gallons of wastewater flow each day. Construction costs can range from several hundred thousand dollars to several hundred million dollars.

The program's grants are available for planning, designing, erecting, altering, and expanding municipal wastewater treatment facilities. EPA awards grants to states, municipalities, and other eligible units from funds allotted to each state according to a formula prescribed by law. The states, within parameters established by the 1972 amendments and EPA, set the priorities for determining which municipalities and other eligible grantees will receive grant funds. To determine the grantees having the greatest need for treatment plant construction, states conduct needs surveys that prioritize or rank treatment needs of all communities in each state.

The 1977 amendments to the act provided for an increased state role in managing the construction grants program. Delegation agreements can be entered into between the EPA region and the state after the regional administrator is assured that the state can and will administer the construction grants program in accordance with EPA requirements. Most states are responsible for the majority of the program's administration in their states. EPA, however, is responsible for ensuring that federal requirements are met by all grantees.

The grantees are responsible for managing their projects to assure their successful completion. To ensure that the construction conforms to approved plans and specifications, the grantees are to provide and maintain competent and adequate engineering supervision and inspection of their projects. Depending on the grantee's size and expertise, the engineering supervision is provided either by the grantee's staff or by an architect/engineering firm. Operation and maintenance costs--unlike construction costs, which are shared by the federal government--are borne solely by the grantee.

By April 1981, about 2,600 of the projected 19,000 treatment facilities needed were complete. Also, EPA's survey of treatment facility needs at that time (1980 survey) reported a total additional program funding need for about $120 billion by the year 2000, of which the federal share would be $90 billion.

In 1981 the prospect of limited federal funding stimulated some economy-oriented amendments to the act. The Municipal Wastewater Treatment Construction Grant Amendments of 1981 expressed congressional policy that any federally assisted treatment project must constitute the "most economical and cost-effective" system. In furtherance of this policy, the 1981 amendments required, before approval of any grant, value engineering reviews of all wastewater treatment projects expected to cost more than $10 million. EPA has required value engineering on such sized projects since 1976.

VALUE ENGINEERING: WHAT IT IS, HOW IT WORKS

Value engineering is a method of analyzing a product or service so that its function can be achieved at the lowest possible overall cost without sacrificing quality. Achieving the lowest cost may require redesigning or eliminating unnecessary project components by using different, new, or more efficient technology. In addition to identifying and eliminating unnecessary project costs, value engineering may also produce other benefits, such as making facilities more reliable or easier to maintain. Value engineering can be used during a project's design phase or during its construction. These two value engineering methods work quite differently, as explained in the following sections. Although the 1981 amendments require value

engineering to be used during a treatment project's design phase when expected to cost more than $10 million, federal law does not require value engineering to be used during the construction phase.

Value engineering during project design

Value engineering during the design process is performed by an independent team of professionals. EPA guidelines recommend that on wastewater treatment projects these professionals should have expertise in design, structural, sanitary, electrical, and mechanical engineering.

After selecting the value engineering team, the plant's owner/operators and designers brief the team on the project's purposes, requirements, capacities, costs, and other specifics. The value engineering team then studies the project plans and specifications to identify and evaluate alternatives for accomplishing project functions at less cost or improved efficiency.

When the analysis is completed, the team formulates and presents its recommendations to the project owners and designers. The owners and designers determine which of the value engineering team's recommendations to implement. When these judgments have been made, the designer incorporates the accepted recommendations into the project design. This process is illustrated on page 5.

Value engineering guidelines published by EPA and professional engineers emphasize that value engineering studies have the greatest affect when done early in the design process, that is, before major decisions have been incorporated into the detailed design documents. According to these guidelines, value engineering need not delay a project if studies are held early in the design process and factored into the overall design schedule from the start.

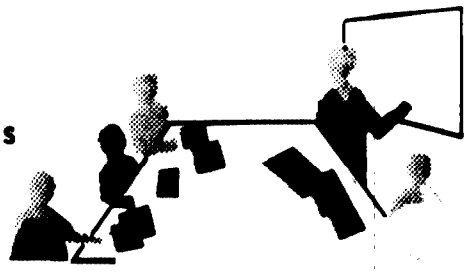
Illustrations of value engineering recommendations on three wastewater treatment plants are contained on page 6 and discussed below:

--Reduce the size of a project's main control room from about 1,100 square feet to about 500 square feet by using a computer-based control station to eliminate more bulky control panels.

Value Engineering During Project Design

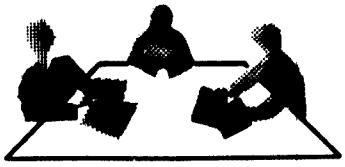
Step 1: Owner and designer brief the value engineering team

--project's purpose and functions
--capacities
--expectations
--costs
--constraints

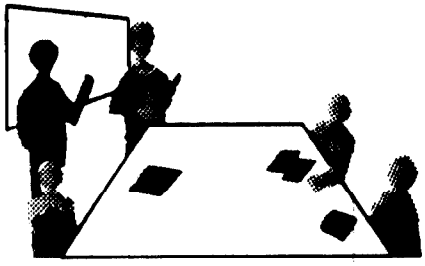


Step 2: Value engineering team examines plans and specifications

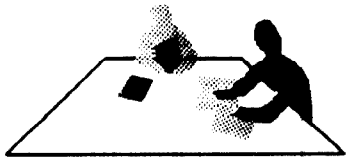
--unnecessary costs
--alternatives
--inadequate elements



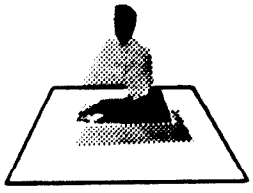
Step 3: Value engineering team proposes design changes to owner and designer



Step 4: Owner and designer review and assess proposed changes



Step 5: Designer incorporates accepted recommendations



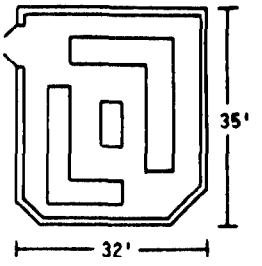
How Value Engineering Can Save Money During a Project's Design

Examples From Completed EPA Projects

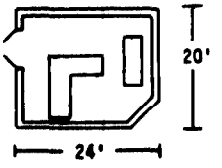
Smaller, more efficient space

A value engineering team suggested changes in the design of a control room for a treatment plant. The result was a room of 480 square feet instead of 1,120 and a computerized control system instead of 90 feet of control panels.

Original concept



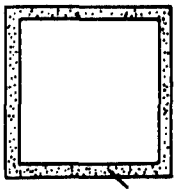
Recommended concept



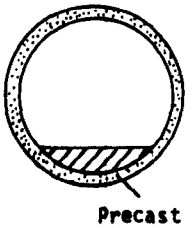
Less costly materials

A value engineering team reviewed a design for a concrete tunnel. The design called for a rectangular tunnel that would need to be cast in place. The team suggested using precast concrete pipe for a less costly project.

Original concept



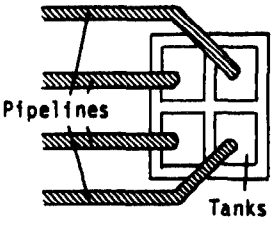
Recommended concept



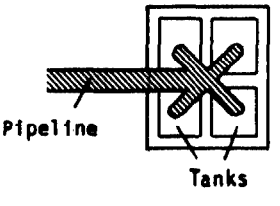
More efficient construction

A value engineering team recommended consolidating four pipelines into a single pipeline. The original design called for separate pipelines to each of four adjacent tanks.

Original concept



Recommended concept



--Substitute precast concrete pipe instead of a cast-in-place concrete tunnel.

--Use a single pipeline instead of separate pipelines to each of four separate tanks.

EPA reported that from 1977-83, net savings realized from value engineering during project design totaled about $400 million on 273 EPA-funded projects. These savings were associated with larger projects inasmuch as EPA only requires value engineering on projects costing more than $10 million. The average net savings amounted to about $1.47 million for each project, or about 5.4 percent of the total cost of the projects, after deducting value engineering design and related implementation costs averaging about $100,000 a project.

Value engineering during project construction

Construction-phase value engineering takes advantage of contractors' know-how in reducing unnecessary project costs. Called a "construction incentive program," value engineering during this phase is designed to motivate contractors to reduce overall contract costs by offering to share any savings the contractors identify.

To facilitate this program, a construction incentive clause is included in the bid package and the subsequent contract. The incentive clause allows the contractor to propose cost-savings measures for the grantee/owner to consider subsequent to the contract award. If the owner agrees to the proposal, a contract change order is processed specifying the revised construction measures, the reduction in the contract price, and the contractor's share of any savings. EPA instructions specify that changes made pursuant to the incentive provisions will not be allowed to alter the required plant functions, reliability, or safety.

Contractors can propose changes in either construction techniques or material at any time during construction. For example, value engineering proposals suggested by three contractors and accepted by the Department of Defense reduced costs a total of about $117,000 by

--revising sewer-main elevations to reduce the need for excavating, water pumping, and retaining walls;

--substituting a less expensive steam piping material that still exceeded performance criteria; and

--revising grading plan and manhole elevations to reduce work and improve drainage.

EPA does not require that construction incentives be used and does not accumulate or report information on cost savings or other benefits that are realized.

OBJECTIVES, SCOPE, AND METHODOLOGY

EPA reported that, since 1976, value engineering has been an effective tool for reducing the costs of EPA-funded waste treatment plants. However, value engineering is only required during the design phase on projects costing more than $10 million and is not required at all during the construction phase regardless of project cost. Recognizing its success when used, and our long-standing interest in value engineering as a cost-control tool (see app. I for a listing of our prior reports on value engineering), led us to inquire whether extending the use of value engineering techniques to more wastewater treatment projects might further reduce program costs. More specifically, we examined whether EPA-funded wastewater treatment plant construction costs could be reduced by

--conducting value engineering studies on design plans of projects costing from $1 million to $10 million and

--using construction incentive clauses in all contracts.

Review of design phase value engineering

To determine the potential and realized cost reductions of conducting value engineering studies of designs on projects costing $1 million to $10 million, we interviewed federal, state, and other officials responsible for the construction grant program; examined construction grant project files; reviewed value engineering studies and reports; and solicited data from EPA regional offices and state offices.

We sent questionnaires to all 10 EPA regional offices to find out for projects costing $10 million or less

--the extent that the regions require value engineering studies,

--the reasons when such studies were not required or used,

--the potential benefits of using value engineering,

--regional officials' opinions of value engineering, and

--regional actions taken to promote the use of value engineering.

We also sent questionnaires to all 50 state offices responsible for administering the EPA construction grant program to find out for projects costing $10 million or less

--the extent that states require value engineering studies,

--the extent that value engineering studies were used on such projects,

--the reasons when such studies were not required or used,

--the results attained when studies were used on projects during the then most current fiscal year 1983,

--state officials' opinions of value engineering,

--state actions taken to promote value engineering studies on such projects, and

--the potential benefits of using value engineering studies on such projects.

We interviewed EPA headquarters officials, attended value engineering workshops, and reviewed documents and reports to find out EPA officials' opinions of value engineering, their actions to promote value engineering, the proportion of EPA projects that received value engineering reviews, the results attained, and the reasons why value engineering is not used on projects costing $10 million or less. We also interviewed officials and examined reports and documents at some federal agencies--the Departments of Defense and Transportation and the General Services Administration--that have made use of value engineering to determine the extent of its use, the circumstances when it is used, and the results attained.

We interviewed officials of four professional design-engineering firms and obtained the results of value engineering efforts on a wide range of construction projects from them. These firms were Arthur Beard Engineers; James M. Montgomery, Consulting Engineers; Lewis & Zimmerman Associates, Incorporated; and Smith, Hinchman and Grylls Associates, Incorporated. Also, we engaged the services of Smith, Hinchman and Grylls Associates' Vice President and Director of the Value Management Division, Mr. A.J. Dell'Isola, to help us assess the appropriateness of using value engineering on lower cost wastewater treatment plants. Mr. Dell'Isola's assessment was based on an analysis of

--the similarities between treatment facilities costing more than $10 million and those costing $10 million or less;

--the elements of treatment facilities that are subject to value engineering;

--the similarities between elements of treatment facilities and other types of construction facilities that are subject to value engineering;

--any expressed objections to using value engineering on treatment facilities costing $10 million or less;

--the savings expectations that value engineering can reasonably be expected to produce on facilities costing $10 million or less; and

--the comparability of the value engineering savings expectations on treatment facilities costing more than $10 million, treatment facilities costing $10 million or less, and construction projects other than treatment plants.

Review of construction phase value engineering

We used similar procedures to assess the potential for reducing project costs by applying value engineering during the construction phase to all contracts. We sent questionnaires to all 10 EPA regional offices to find out the

--extent the various regions required states and grantees to use construction incentive clauses,

--regions' actions taken to promote construction incentives,

--reasons when such incentives were not required or used,

--regional officials' opinions of construction incentives, and

--potential benefits of using construction incentive clauses to promote contractors' use of value engineering.

We also sent questionnaires to all 50 state offices responsible for the construction grant program to determine the

--extent that states require grantees to use construction incentive clauses;

--frequency that such clauses were used during the then most current 3-year period, fiscal years 1981, 1982, and 1983, and the results achieved;

--reasons when construction incentives were not required or used;

--actions taken by state officials to promote the use of construction incentives;

--potential benefits of using construction incentives; and

--state officials' opinions of construction incentives.

We interviewed officials at EPA headquarters and regional offices and state construction grant project offices regarding construction incentives. We also discussed incentive clauses with officials of Department of Defense agencies and the Department of Transportation and reviewed studies and reports on the use of incentive clauses.

Limitations and locations

Our work was to assess value engineering's potential for reducing costs during project design and construction. We did not attempt to identify or assess other mechanisms that states or grantees may have used to enhance project cost-effectiveness.

As part of our observations, this report presents our estimates of the range of potential savings that could result by using value engineering on more EPA-funded projects. We based these estimates, in part, on information obtained from available EPA records and budgetary data, value engineering results from federal and private sector organizations, informed judgments from officials of private sector value engineering firms, and conservative assumptions. Because we intended these estimates only to generally indicate the range of potential savings, rather than precise amounts, we did not verify the accuracy of the data reported by EPA or the other sources. Also, an important part of developing estimates of future cost savings is the need to discount such savings. Savings realized in the future should be discounted by an appropriate rate of interest. Discounting, in this case, determines the amount of money which, if invested today at a selected interest rate, would be sufficient to meet expected future savings. However, for this refinement to be meaningful, an accurate year-by-year savings amount would be necessary. For this reason, we did not discount our savings projections.

Our estimated savings are net savings after deducting the costs of value engineering studies; costs of implementing the recommended changes; amount of savings received by the contractor, states, and grantees; and increases in government costs attributable to construction incentive clauses. However, our estimates do not reflect any increased administrative costs that the state, grantees, or EPA may incur because of value engineering design studies. According to the EPA headquarters value engineering coordinator, such costs would be insignificant.

Appendixes II and III explain our methodology and the assumptions and calculations we made to estimate potential cost savings possible from extending the use of value engineering to less expensive projects during design and to all projects during construction.

We made our review between March and October 1984 at the following locations:

--EPA offices in Washington, D.C.; Atlanta, Georgia; Dallas, Texas; San Francisco, California; and Seattle, Washington;

--State construction grant administration offices in California, Georgia, North Carolina, Oregon, South Carolina, Vermont, New Mexico, and Washington;

--Other federal agencies that have used value engineering, including the General Services Administration--Public Buildings Service, Washington, D.C.; Department of Defense Product Engineering Services Office, Alexandria, Virginia; Department of Defense Army Corps of Engineers--Chief of Engineers, Washington, D.C.; and Department of Transportation--Federal Highway Administration, Washington, D.C.; and

--Municipal offices of program grantees in Albuquerque, New Mexico; Las Vegas, Nevada; San Francisco, California; and Seattle, Washington.

We selected EPA regional offices and state project offices to provide geographical representation, diversity in climatic conditions and, in certain cases, to examine some special value engineering emphasis or accomplishment such as the only EPA regional office that had a full time value engineering coordinator, state project offices that reported applying value engineering during design to some projects costing $10 million or less, and one state that had reported substantial savings by using value engineering during construction on highway construction contracts. We selected the four municipal grantees because of their prior use of value engineering. Aside from EPA, we contacted those federal agencies cited by knowledgeable individuals as having made considerable use of value engineering techniques for controlling costs.

Except for not verifying the accuracy of data reported by agencies on the results of value engineering, we performed our work in accordance with generally accepted government auditing standards.

CHAPTER 2

EXTENDING VALUE ENGINEERING TO MOST PROJECT DESIGNS CAN SAVE MILLIONS OF DOLLARS

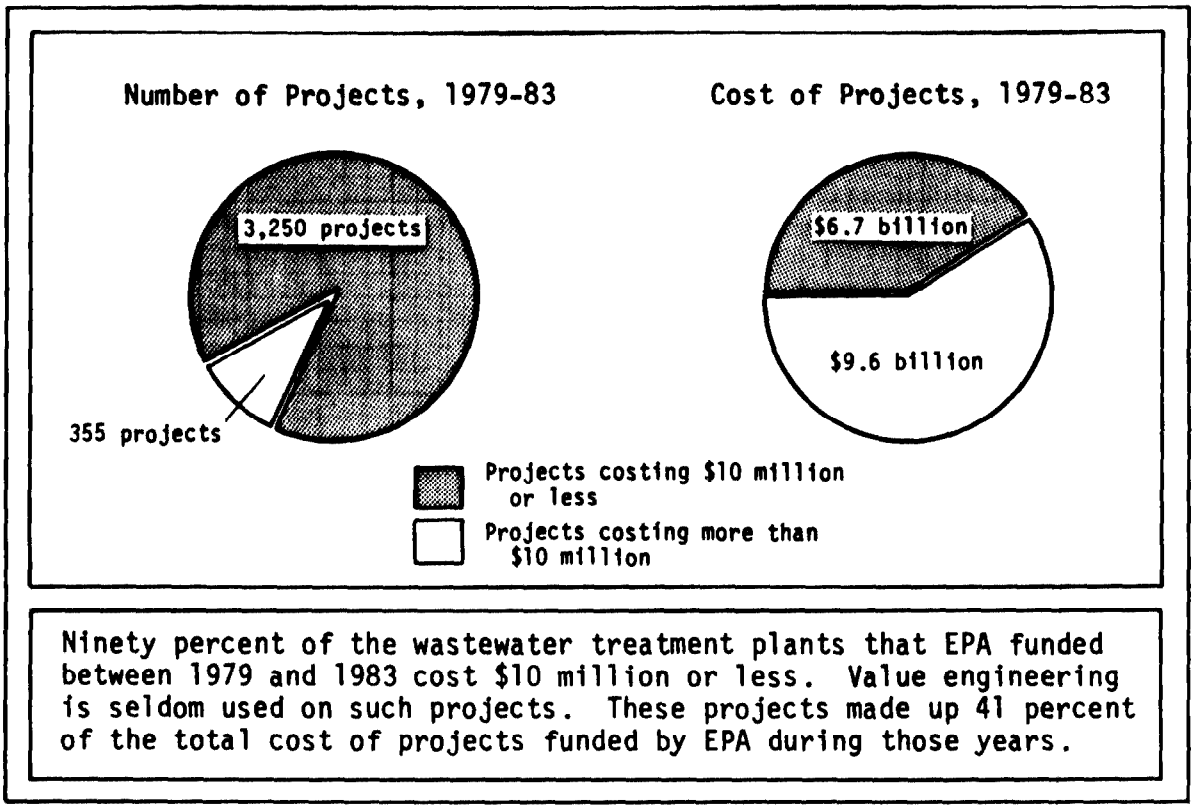
EPA has reported savings of about $400 million from 1977-83 by requiring value engineering studies on wastewater treatment facility construction projects costing over $10 million. Although these savings are noteworthy, potentially additional savings and benefits can be achieved by requiring value engineering studies on designs of wastewater treatment projects costing from $1 million to $10 million. The $1 million minimum level represents the amount on which estimated benefits can be expected to still exceed study costs according to EPA's value engineering study team. Projects of this size are rarely subjected to value engineering review because it is not required by federal or state governments. Grantees have little incentive to voluntarily initiate value engineering, since most savings are passed on to the states for use on other projects while study costs are paid from their own funds.

Although about $45 billion in federal funds are expected to be obligated between 1972 and 1985 for treatment facility construction, the need and cost for new treatment facilities remain large. In its 1984 needs survey, EPA estimates the cost for constructing treatment facilities needed by the year 2000 to be about $109 billion.

VALUE ENGINEERING IS SELDOM APPLIED TO PROJECTS COSTING $10 MILLION OR LESS

Value engineering reviews are rarely conducted on EPA-funded wastewater treatment projects costing $10 million or less. We asked program officials in the 50 states to determine how often value engineering studies were conducted on such projects during fiscal year 1983. State officials reported that 7 of the 2,750 such projects under construction during that year received value engineering reviews.

Construction grant projects costing $10 million or less constitute a significant amount of the total program dollars and a majority of projects. We estimated that between 1979 and 1983 EPA funded about 3,200 such projects totalling about $6.7 billion that were not required to have value engineering reviews. As the following chart shows, this constitutes about 41 percent of all costs and about 90 percent of all projects.



In future years the number and total costs of projects not subject to value engineering may increase, according to EPA's headquarters value engineering coordinator. He expects the number of projects costing $10 million or less to increase as the larger cost projects are completed and more lower cost projects are funded.

VALUE ENGINEERING PROVIDES BENEFITS TO PROJECTS COSTING $10 MILLION OR LESS

Value engineering can be beneficially applied to projects costing $10 million or less. We found that

--project costs were reduced and/or project quality was improved on EPA-funded wastewater treatment projects costing $10 million or less where value engineering was applied,

--other federal agencies that applied value engineering studies to projects costing $10 million or less including wastewater treatment projects reported a savings;

--most state and federal program officials that we contacted believe benefits result from value engineering projects costing $10 million or less; and

--a 1984 EPA internal study recommended requiring value engineering on projects costing above $1 million.

Value engineering studies were applied to some wastewater treatment projects costing $10 million or less

Project costs were reduced and/or project quality was improved where value engineering studies were conducted on EPA-funded wastewater treatment projects costing $10 million or less. Through our questionnaire to the 50 states, we identified seven projects costing $10 million or less that were being constructed during fiscal year 1983 and had received value engineering review. The projects had net[1] estimated construction costs saved as shown below.

Location	Estimated construction cost	Net construction costs saved	Savings as a percent of construction cost
Jacksonville, AR	$ 5,780,000	$ 536,800	9.3
Rockhill, SC	9,276,000	632,200	6.8
Spearfish, SD	4,500,000	215,800	4.8
Red River, NM	4,945,000	119,100	2.4
Morro Bay, CA	6,697,000	154,000	2.3
Montpelier, VT	2,420,000	44,000	1.8
Total	$33,618,000	$1,701,900	5.1
Las Vegas, NV	$6,096,000	($1,005,800)	(16.5)

Six value engineering studies saved about $1.7 million by identifying less costly facilities, equipment, or construction methods than those originally designed. For example, accepted value engineering recommendations eliminated

[1]Net construction cost saved is the dollars saved from accepting value engineering study recommendations less the costs of conducting the study and implementing the recommended changes.

--an unnecessary maintenance facility on the Jacksonville project and

--unneeded process equipment and substituted less costly prefabricated buildings on the Red River project.

On the remaining project--the city of Las Vegas' wastewater treatment facility, the value engineering design study resulted in accepted recommendations which according to the Nevada State construction grant office increased construction costs by about $1 million, or 16.5 percent of construction costs, so as to improve plant efficiency and reliability. The major change made was necessary to avoid spillage of untreated sewage into Lake Mead in violation of a court order, according to the city of Las Vegas' director of public works. In addition, the project's design engineer estimated that value engineering recommendations had the potential to reduce plant operation and maintenance costs by $2.5 million over the life of the project. EPA's headquarters value engineer coordinator said that he could recall only one other project on which value engineering resulted in increased construction costs.

As illustrated by the Las Vegas project, in addition to reducing construction costs value engineering can provide other benefits such as increased project efficiency and reliability and/or lower project operations and maintenance costs that are paid by the ratepayers. Value engineering study recommendations accepted on two of the seven projects, including the Las Vegas project, resulted in

--improved operating efficiency of the effluent process,

--increased reliability of pumping activities, and

--the marketing of methane gas generated by sewage decomposition to reduce plant operating and maintenance costs that are charged to the ratepayers.

Our consultant stated that it has been his experience that 10 percent to 15 percent of implemented recommendations reduced plant operation and maintenance costs. An analysis of 27 treatment plant value engineering reports by his firm showed that many of these savings were achieved by reducing plant energy demands.

Other federal agencies applied value engineering studies during design to projects costing under $10 million

Department of Defense agencies and three civil agencies that we contacted had used value engineering on buildings, utility systems, and civil projects. The following agencies all reported having used value engineering during design on projects costing under $10 million:

Agency	Usual or common minimum project cost for using value engineering during design (millions)
Corps of Engineers	$2.0
Naval Facilities Engineering Command	$2.0
Federal Highway Administration	$1.5
Coast Guard	$0.5
General Services Administration[a]	$0.2

[a]Since 1977 the General Services Administration's Public Buildings Service has deemphasized its value engineering program. Currently it is preparing to reemphasize the program according to the Service's Deputy Director for Value Management.

These agencies[2] have reported average saving between 4 percent and 8 percent of construction costs by using value engineering during design.[3] While savings achieved by these agencies are not reported separately for projects costing over and under $10 million, included in the projects the Corps of Engineers has value engineered were wastewater treatment facilities costing $10 million or less for which we obtained savings results. During the 1979-83 period, the Corps of Engineers reported saving about $1.3 million (6.3 percent) on 13 wastewater treatment projects costing $10 million or less. The Corps is responsible for the construction of wastewater treatment facilities at Department of Defense facilities.

Most state and EPA regional program officials believe value engineering benefits projects costing $10 million or less

In our questionnaire to the 50 states and the 10 EPA regions, we asked program officials whether benefits could be obtained from conducting value engineering studies on projects costing $10

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[2]Federal Highway Administration savings were reported to us by state highway departments.

[3]The General Services Administration's Public Buildings Service saved an average of about 6 percent of construction costs during fiscal years 1972 through 1976 according to the Service's Deputy Director for Value Management.

million or less. All 60 state and EPA regional officials responded, of which 50 (83 percent) said that some benefits can be derived from value engineering studies. For example:

--Thirty-one state and 9 regional officials said that cost effectiveness would be maximized,

--Twenty-seven state and 5 regional officials said that cost awareness would be increased, and

--Twenty-six state and 6 regional officials said that value engineering could make funds available for other unfunded priority projects.

EPA is aware that value engineering studies can achieve cost savings

Although value engineering studies are only required on projects costing above $10 million, it does not mean that value engineering studies conducted on projects costing less would be ineffective. EPA recommends value engineering studies on projects costing less than $10 million because they ". . . have a high potential for achieving substantial cost savings." This savings potential is substantiated by a 1984 EPA staff study, which determined, in part, that construction cost savings rates for value engineering studies on projects costing $10 million or less would be similar to the savings rate (5.4 percent) obtained for projects costing greater than $10 million. Relying on the 5.4 percent savings rate, EPA's staff study recommended that EPA's administrator require value engineering studies on projects costing $1 million or more. EPA selected the $1 million minimum level after considering historical benefits and costs of value engineering.

EPA's staff study team members told us that they had concluded that value engineering study costs would offset related construction cost savings for projects costing about $500,000. They estimated value engineering study costs at about $25,000 on projects of this size and construction cost savings at about 5 percent of costs which would also amount to $25,000. Establishing a minimum construction cost level for conducting value engineering at $1 million would provide a worthwhile benefit in excess of study costs according to study team members. As of May 1985 EPA had not taken action to extend value engineering to projects costing $10 million or less.

Our consultant agreed that the benefits derived from value engineering wastewater treatment projects costing $1 million or more would exceed costs. He told us that it has been his experience that net construction cost savings of about 5 percent can be expected on wastewater treatment projects costing $1 million or

more. Also, value engineering design studies should be able to reduce annual operation and maintenance costs of such projects by about 5 percent, according to our consultant.

According to the EPA official responsible for value engineering activities in 1976, EPA initially established the $10-million project cost level to limit value engineering only to a few projects while the agency gained more experience with the studies. Even though EPA recognizes that value engineering can benefit projects costing $10 million or less, the requirement has not been extended to such projects.

POTENTIALLY SAVINGS ARE POSSIBLE BY CONDUCTING VALUE ENGINEERING ON PROJECTS COSTING FROM $1 MILLION TO $10 MILLION

Potentially, savings in the wastewater treatment construction program as well as other benefits have not been maximized because projects costing from $1 million to $10 million have not been subject to value engineering review. We estimate that about $128 million to $288 million in federal funds might have been saved by value engineering projects costing from $1 million to $10 million during 1979-83. Furthermore, conducting value engineering studies on such sized projects in future years might potentially save $19 million to $42 million annually in EPA construction costs assuming continued program funding at the fiscal year 1985 level. Additionally, grantees and states could potentially realize savings proportionate to their project contributions.

Rather than reverting to the U.S. Treasury, federal value engineering savings remain as part of the states' funding allocation to be used for funding additional wastewater treatment construction projects. These savings would help fund the $109 billion worth of additional projects that EPA estimates will be needed by the year 2000.

We estimated the potential savings possible from conducting value engineering studies on projects costing from $1 million to $10 million by

- --developing an estimate of the dollar value of such projects that would be subject to value engineering review;
- --determining a percentage savings range, as a percentage of construction costs, that might be realized from value engineering such projects; and
- --calculating the range of potential dollar savings possible by multiplying the estimate dollar value of these projects by the percentage savings range.

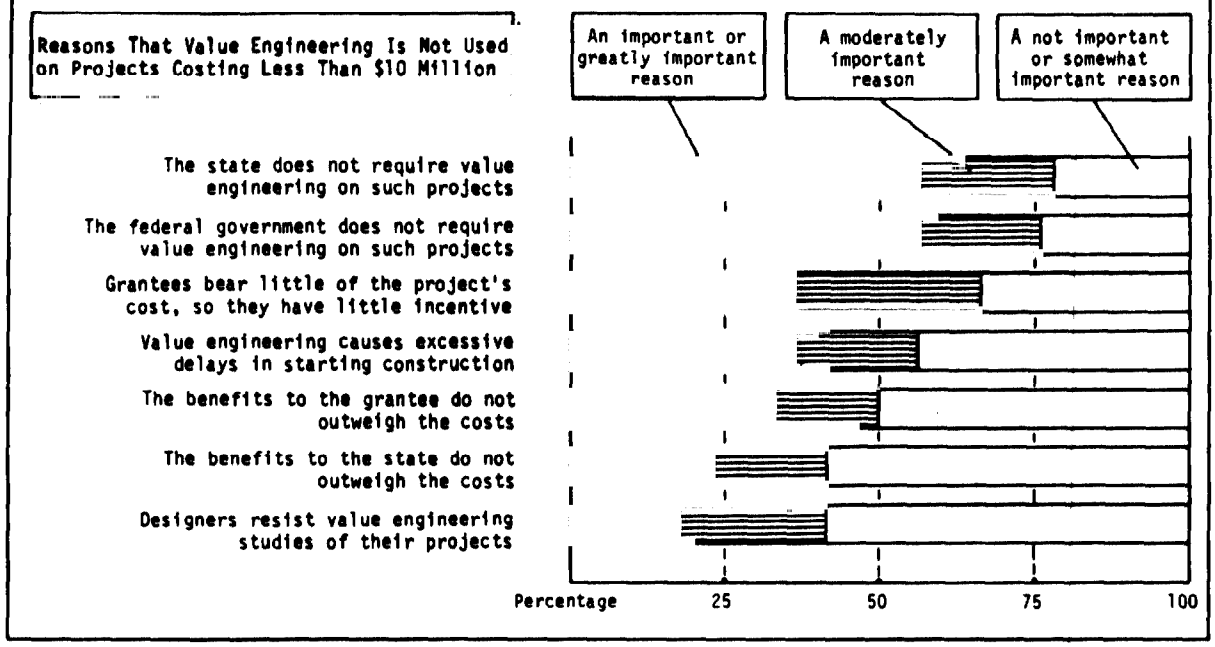
In developing these estimates, we compared value engineering savings attained on various sizes of wastewater treatment plants and other types of construction projects. These estimates are not precise because we did not verify the accuracy of the data used, and limitations in the data required that we apply reasoned assumptions giving consideration to available data. These estimates are intended only to indicate a general magnitude of potential savings. A detailed discussion of our methodology and the assumptions and computations we made in arriving at these estimates is contained in appendix II.

VALUE ENGINEERING IS NOT REQUIRED AND GRANTEES LACK INCENTIVES TO USE IT VOLUNTARILY

Most EPA regional office and state program officials do not require value engineering on treatment projects costing $10 million or less primarily because there is no state or federal value engineering requirement. In addition, grantees lack incentives to conduct studies voluntarily since most cost savings are returned to the states' EPA grant allocation rather than retained by the grantees.

In our questionnaire to the 50 states, we asked state program officials their opinions as to why value engineering studies were not conducted on projects costing $10 million or less.[4] As shown in the following chart, because neither the state nor the federal government requires value engineering on such projects were the most important and frequent responses.

[4]The questionnaires listed several possible reasons suggested by some program officials during preliminary discussions on this subject.



GAO asked officials in all 50 states to indicate why value engineering is not used on projects costing $10 million or less. The officials said the main reasons were that neither the state nor the federal government requires value engineering on such projects. Doubts about the actual benefits of value engineering were less important than this lack of a formal requirement.

We asked the same question of the 10 EPA regional program officials, and their consensus was even greater than the states. Nine of 10 officials believed that the lack of a requirement was the most important reason why value engineering studies were not conducted.

Our questionnaire to state and EPA regional officials asked what actions they had taken to promote the use of value engineering studies on projects costing $10 million or less. Of the states

--thirty-four said that they had taken no action to promote the use of value engineering,

--seven said that they orally recommended the use of value engineering to grantees,

--eight said that they took other action such as conducting reviews of project plans and specifications, and

--one did not respond to the question.

None of the states issued their own written policies or instructions for using value engineering studies on projects costing $10 million or less.

The responses from the 10 EPA regions were again similar to the state responses:

--Seven regions said that they had taken no action to promote value engineering and

--three regions said that they orally recommended the use of value engineering to states and grantees.

None said they issued their own written policies or instructions.

Next to the absence of a requirement, our questionnaire results show that the second most important and frequently cited reason for not conducting value engineering studies is that grantees do not have an economic incentive to save project funds. Grantees can have a relatively small investment in the project, since most of the projects' funds are provided by EPA and the remaining local share is provided by the states, the grantee, and sometimes other federal funding sources. Accordingly, the grantees share of any savings is proportional to its investment with most of the savings accruing to EPA and the states for allocation to other projects. As a result, grantees may have little motivation to reduce costs.

In its comments to our draft report (see app. IV), EPA said that the above statements concerning grantees economic incentives needed to be updated. EPA said that while the comments may have been valid a year ago, currently grantees have more financial incentive to use value engineering due to recent program changes. According to EPA, grantees' financial obligation has increased due to the federal government's reduction of grant moneys for wastewater treatment projects. For example, the federal government has reduced its funding share from 75 to 55 percent and eliminated reserve capacity and collector sewers as eligible costs, requiring that grantees assume a greater financial obligation.

We recognize, as discussed on pages 1, 47, and 54, that starting in fiscal year 1985 the federal share declined to 55 percent for those projects that had never received any construction funds. We also recognize that eliminating, at that same time, reserve capacity and collector sewers as eligible costs may require that grantees assume a greater financial obligation. It should be noted that our statement regarding grantees economic incentive was based on a questionnaire we sent to the 50 state program officials in June 1984. Most responses were received by the end of July 1984 about 2-1/2 years after the December 29, 1981, enactment of the Municipal Wastewater Treatment Construction Grant Amendments of 1981 which established the program changes commented on by EPA and just 2 months before the October 1984 effective date of the recent program changes. Also, as previously discussed, the local share is provided by the states and sometimes other federal funding sources in addition to grantees.

In addition to not having an economic motivation to voluntarily conduct value engineering studies, several EPA regional

officials said that grantees are penalized by having to pay the full costs of the value engineering studies and related costs. Grantees receive an allowance to defray planning and design costs, but this allowance does not consider the cost of value engineering studies conducted on projects of $10 million or less. Allowances are based on the historical proportion of planning and design costs compared to construction costs. Since projects costing $10 million or less have rarely been subjected to value engineering, allowances do not reflect value engineering study costs. An EPA value engineering coordinator estimated study costs on such sized projects at about $25,000 to $50,000 a project.

A smaller number of state program officials considered potential project construction delays and questionable cost-effectiveness as obstacles to conducting value engineering reviews. EPA instructions point out, however, that project delays are avoided by scheduling value engineering studies early in the design process. Furthermore, the time required for the value engineering review is small when compared to the estimated 7 to 9 years necessary to complete a municipal wastewater treatment facility. Also, agency reported savings, as summarized on page 42, indicates that value engineering can potentially reduce costs.

CONCLUSIONS

EPA's construction grants program can potentially achieve increased cost savings and improved workability of project design and reliability by employing value engineering studies on projects costing from $1 million to $10 million. While value engineering reviews are proven effective in many types of projects at varying cost levels, it is rarely employed by states and grantees on wastewater treatment facilities costing $10 million or less. Most state program and EPA officials are aware of the benefits that value engineering studies provide, yet they do not mandate or promote its use primarily because it is not required by federal or state governments. In addition, grantees potentially may not voluntarily conduct value engineering studies because of the economic disincentive. In conducting value engineering reviews on projects, grantees (1) pass most of the savings back to the states for reallocation to projects at other locales and (2) pay for the study from their own funds.

The dollar savings that result from value engineering studies is large and can potentially fund other needed but unfunded treatment projects. If value engineering studies are conducted on projects costing from $1 million to $10 million, the potential savings can contribute toward helping fund the EPA estimated $109 billion project need that will be necessary by the year 2000.

It has been our longstanding position that, while wider use of value engineering is favored, agencies should proceed

carefully. Requiring the use of value engineering, in itself, will not necessarily generate savings. Savings will be realized only when value engineering is applied properly. This requires aggressive support from top level management extending down through the organization to the working level and personnel that are adequately trained.

EPA has required value engineering on treatment projects costing more than $10 million since 1976, and it has been mandated for such sized projects by federal law since 1981. We believe that sufficient time has elapsed for EPA and the states to have gained sufficient experience with the concept to justify lowering the dollar threshold to cover more projects.

Even though requiring value engineering of projects costing from $1 million to $10 million might reduce somewhat a state's and grantee's flexibility in administering its grant, states and grantees would retain flexibility in managing how to carry out the requirement and EPA's control over program costs would be enhanced. States and grantees would determine when and by whom, during design, value engineering would be performed, and which value engineering recommendations should be implemented. EPA's program responsibilities include ensuring that federally assisted wastewater treatment projects constitute the most economical and cost-effective system. Requiring that value engineering be conducted on such sized projects can help ensure that savings are maximized.

RECOMMENDATIONS TO THE ADMINISTRATOR, EPA

Because value engineering during design can potentially result in savings that could be applied to help meet the large need for wastewater treatment facilities, we recommend that the Administrator, Environmental Protection Agency, revise regulations to require value engineering review on designs of construction grant projects costing more than $1 million. So as to remove the potential penalty grantees may incur by paying the cost of the value engineering design studies on lower cost projects ($25,000 to $50,000 a project), we also recommend that the EPA Administrator revise regulations to make the value engineering design study costs for projects costing from $1 million to $10 million eligible expenses of the construction grant.

AGENCY COMMENTS AND OUR EVALUATION

In its comments to our draft report (see app. IV), EPA agreed with our conclusion that value engineering of lower cost projects would reduce construction costs of wastewater treatment projects. However, EPA commented that in section 218(c) of the Clean Water Act (Federal Water Pollution Control Act) the Congress established $10 million as the threshold for requiring value engineering, and that, in light of apparent congressional intent, it elects to encourage, but not require, value engineering on lower cost projects.

EPA also commented that it has taken several actions regarding value engineering in order to reduce costs. It has encouraged grantees to conduct value engineering studies on lower cost projects and recently requested that each state designate a value engineering coordinator to explain the benefits of value engineering and to encourage and assist grantees in the use of value engineering. In addition, EPA said that it will prepare a publication in fiscal year 1986 to encourage and assist grantees in using value engineering for small projects.

The Municipal Wastewater Treatment Construction Grant Amendments of 1981 to the Federal Water Pollution Control Act required, before approval of any grant, value engineering reviews of all wastewater treatment projects expected to cost more than $10 million. While federal law does not require value engineering to be used on projects costing from $1 million to $10 million, neither does it prohibit EPA from requiring value engineering on such sized projects.

Value engineering reviews have been rarely employed by states and grantees voluntarily on lower cost wastewater treatment facilities as discussed on page 13. Most state program and EPA officials do not mandate or promote its use primarily because it is not required by federal or state governments as discussed on page 20. In addition, grantees have little incentive to voluntarily initiate value engineering, since most savings are passed on to EPA and the states for use on other projects while study costs are paid from their own funds. Given this situation, we believe that without a requirement to conduct value engineering reviews, EPA's actions to encourage grantees to conduct value engineering studies on lower cost projects will continue to result in few such projects being value engineered.

With regard to our recommendation that value engineering design study costs for projects costing from $1 million to $10 million be made eligible expenses of the construction grant, EPA commented that it plans to evaluate the possibility of increasing the allowance for grantees who conduct value engineering studies on lower cost projects.

RECOMMENDATION TO THE CONGRESS

In view of EPA's decision to encourage but not require value engineering on lower cost wastewater treatment projects during design because of the existing $10 million legislative threshold for requiring value engineering and the potential result in savings that could be applied to help meet the large need for wastewater treatment facilities, we recommend that the Congress revise the Federal Water Pollution Control Act to require value engineering review on designs of wastewater treatment projects costing more than $1 million.

CHAPTER 3

VALUE ENGINEERING THROUGH THE USE OF CONSTRUCTION INCENTIVE CLAUSES COULD REDUCE PROJECT COSTS

Value engineering through construction incentive clauses which provide a means to motivate a construction contractor to suggest ways to save money during the construction phase of a project are seldom used in EPA-funded wastewater treatment construction contracts. EPA and state agency officials primarily attributed this to the absence of a federal or state requirement mandating the grantee to use them. Potentially, savings can be achieved by requiring the use of construction incentive clauses in all wastewater treatment projects construction contracts.

CONSTRUCTION INCENTIVE CLAUSES ARE SELDOM INCLUDED IN EPA-FUNDED CONSTRUCTION CONTRACTS

According to state officials responding to our questionnaire, less than 1 percent of the 4,965 EPA-funded wastewater treatment facility construction contracts awarded during fiscal years 1981-83 contained construction incentive clauses. Officials in 43 of 50 states reported that construction incentive clauses were not used at all in EPA-funded construction contracts during this period, and the officials of the seven other states said that construction incentive clauses were seldom used.

Through our questionnaire to the 50 states, we identified three instances during fiscal years 1981-83 in which construction incentive clauses resulted in savings and reduced costs of EPA-funded wastewater treatment construction projects. Details of these three instances are discussed below.

--The city and county of San Francisco accepted a construction incentive clause proposal for changing sewer-pipe joints. The changes met all design specifications, improved reliability, and reduced total construction cost by $1.2 million. The contractor's share of the saving amounted to $539,500, and the remaining $658,100 will be shared between the grantee and the state's EPA grant allocation.

--The city of Keokuk, Iowa, accepted a construction incentive clause proposal for reducing the labor and material cost of a project modifying the city's existing wastewater treatment system. The changes met all functional, reliability, and safety requirements and saved about $105,000. While the contractor's share of the savings amounted to $52,500, the state's EPA grant allocation and the grantee will share in the remaining $52,500.

--A joint project between the U.S. Army (Ft. Stewart) and the city of Hinesville, Georgia, to upgrade a regional wastewater treatment plant, adopted a construction incentive clause proposal for using alternate materials that met design criteria but cost less than the material specified in the construction contract. The use of the construction incentive clause resulted in saving $289,000. The contractor's share amounted to $144,500. Because the Army provided 56 percent of the funding for this project, about $80,900 of the remaining $144,500 will be returned to it, and the remaining $63,600 will be shared between the state's EPA grant allocation and the city of Hinesville.

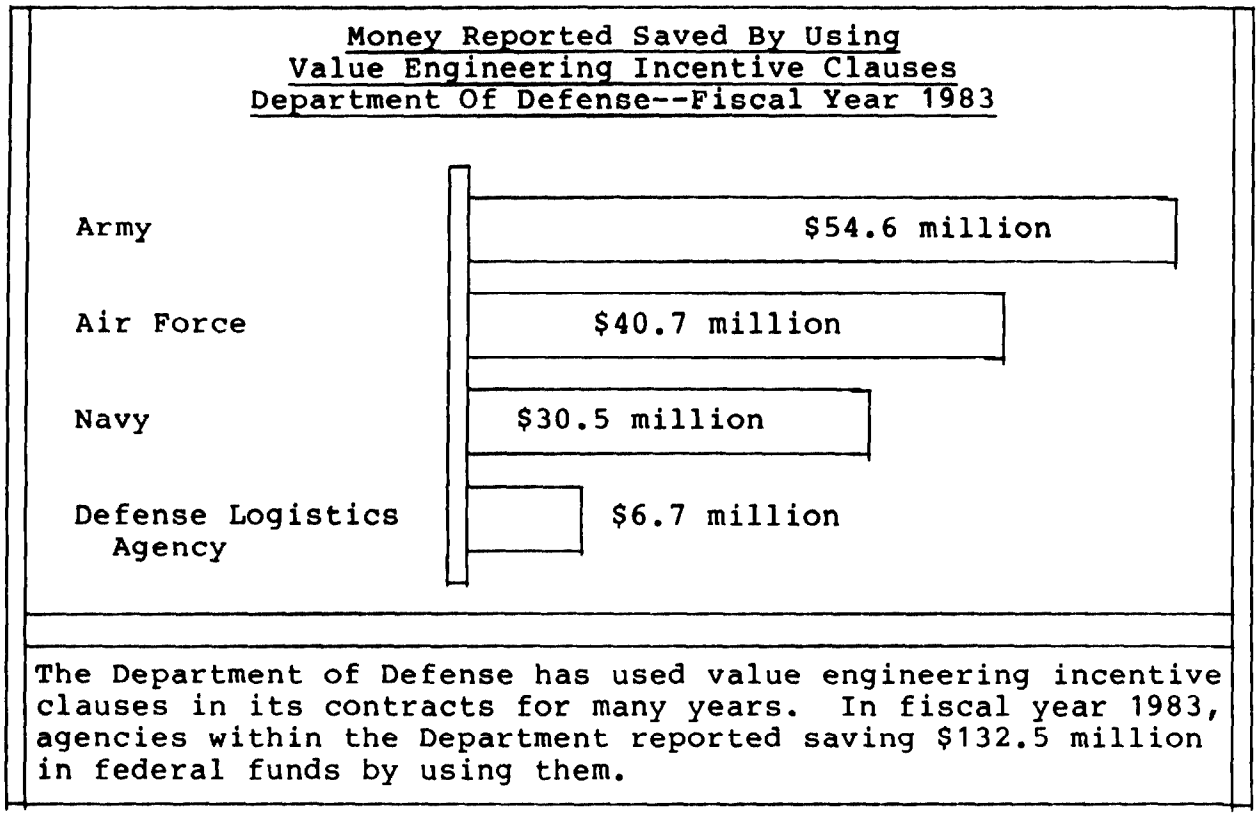
Net savings for the three EPA-funded projects totaled about $855,000, after deducting contractors' share and the cost of implementing the proposals. These net savings ranged from 0.4 percent to 2.2 percent of total project cost and represented about 0.3 percent of the estimated $248 million cost of 32 contracts that contained incentive clauses during fiscal years 1981-83.

Project	Total eligible project cost	Net construction costs saved	Savings percent of cost
City and County of San Francisco, CA	$166,000,000	$658,100	0.40
Hinesville/Ft. Stewart, GA	23,200,000	144,500	0.62
City of Keokuk, Iowa	2,343,269	52,500	2.24
Total	$191,543,269	$855,100	

VALUE ENGINEERING INCENTIVE CLAUSES USED BY OTHER FEDERAL AGENCIES

Federal regulations have required some federal agencies to use value engineering incentive clauses for many years. Since 1967, the Armed Service Procurement Regulations required the Department of Defense agencies to use value engineering incentive clauses when contracting for most goods and services, including construction activity, that cost $100,000 or more. In April 1984 the Federal Acquisition Regulations required all federal civil agencies to use value engineering incentive clauses in most construction contracts costing $100,000 or more.

Because of the procurement requirement, the Department of Defense has used value engineering incentive clauses for about 20 years and has reported saving about $1.4 billion. For example, in fiscal year 1983, the Department of Defense agencies reported saving $132.5 million, as shown in the following chart.



These savings represent the federal government's share of savings and exclude the amount of savings shared by contractors. These savings also take into account the cost of implementing the proposals.

Construction incentive clauses essentially similar to value engineering provisions have also been used to reduce the cost of some Department of Transportation-funded highway construction projects. For example, the state of Florida has used construction incentive clauses for several years to reduce highway construction cost. During calendar year 1983, Florida's Department of Transportation reported the use of incentive clauses in five construction contracts saved $454,450. Savings ranged from $12,000 to $327,000 after deducting the cost of implementing the proposals. These savings were shared equally by the state and the contractors.

Although the U.S. Department of Transportation does not accumulate information on the savings that states have realized from using construction incentive clauses, a 1984 study for the Department of Transportation concluded that construction incentive clauses could save the federal highway construction program between $65 million and $130 million each year. A Department of Transportation official said that these estimates were based on savings ranging from 0.5 percent to 1.0 percent of highway construction costs.

Even though the primary benefit of using construction incentive clauses is eliminating unnecessary costs, other benefits, such as improved product quality or performance, can be achieved from their use. For example, the American Ordinance Association randomly selected and studied 193 implemented incentive proposals and concluded that product quality and reliability were generally improved from using incentive clauses. These improvements included a higher instance of meeting performance requirements, a greater ease of repair, and the elimination or simplification of material and operations. The use of incentive clauses did not adversely affect product quality.

GREATER USE OF CONSTRUCTION INCENTIVE CLAUSES COULD POTENTIALLY SAVE MILLIONS OF DOLLARS

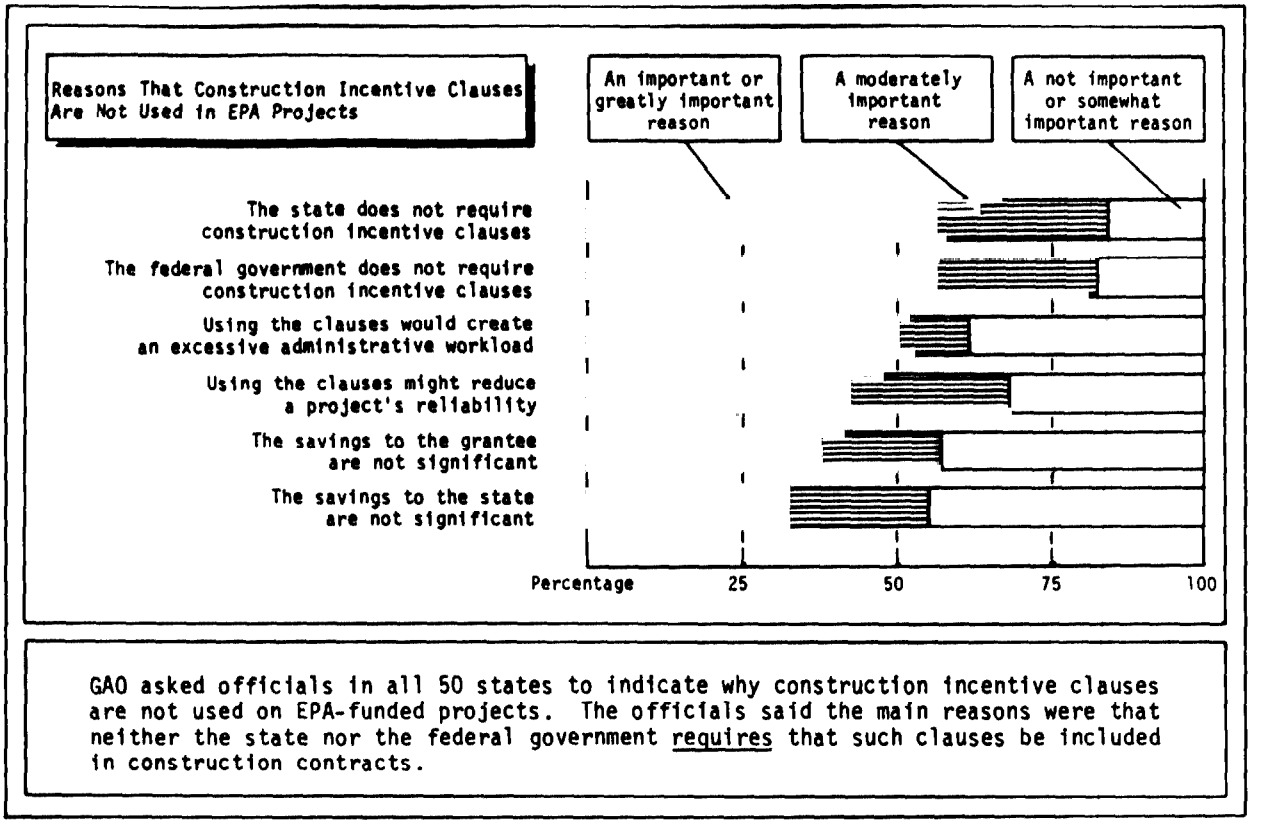
We estimate that potential savings of about $21 million to $49 million in federal funds might have been saved if construction incentive clauses had been used in EPA-funded construction contracts during fiscal years 1981-83. Furthermore, using construction incentive clauses in future years might potentially save $6 million to $15 million annually in EPA construction costs. Additionally, grantees and states might potentially realize savings proportionate to their project contributions. Rather than reverting to the U.S. Treasury, these savings, remain as part of the states' funding allocation to be used for funding additional wastewater treatment construction projects.

We estimated the potential savings possible from including construction incentive clauses in EPA-funded project contracts in a manner similar to our estimate of value engineering savings during design. In developing these estimates, we compared incentive clauses savings attained by other federal agencies on their contracts. These estimates also are not precise because we did not verify the accuracy of the data used, and limitations in the data required that we apply reasoned assumptions giving consideration to available data. These estimates are intended only to indicate a general magnitude of potential savings. A detailed discussion of our methodology and the assumptions and computations we made in arriving at these estimates is contained in appendix III.

CONSTRUCTION INCENTIVE CLAUSES ARE NOT REQUIRED OR PROMOTED

Construction incentive clauses are not used on EPA-funded projects primarily because there are no federal or state requirements mandating their use. State officials responding to our questionnaire reported that they did not require construction incentive clauses in wastewater treatment construction contracts because there were no federal or state requirements to do so. The following chart shows the various reasons and the level of importance

that state officials gave for grantees not using construction incentive clauses on EPA-funded wastewater treatment projects.



The responses were similar when we asked officials in the 10 EPA regional offices the same question. Nine of 10 EPA officials believed that the lack of any federal requirement was the most important reason why construction incentive clauses were not used.

While EPA does not require construction incentive clauses to be used in wastewater treatment construction contracts, it does have a policy and procedures for letting contractors develop and submit construction incentive clause proposals on a voluntary basis. EPA headquarters recommends using construction incentive clauses, but this policy is not strongly promoted or supported by EPA regional offices or state offices. For example, 9 out of 10 EPA regional officials responding to our questionnaire reported that they had not taken any formal action to promote the use of construction incentive clauses. Similarly, 48 of the 50 state officials reported that they had not taken any action to promote the use of construction incentive clauses.

EPA and state agency officials were not supportive of using construction incentives. Only 2 of 10 EPA regional officials and 8 of 50 state agency officials responding to our questionnaire favored using construction incentive clauses.

EPA and state officials expressed concern that using construction incentive clauses might cause an inordinate amount of administrative work, reduce project reliability, and not generate enough savings to justify the effort. However, according to the Chief of Army Corps of Engineers' value engineering staff, the Corps has been using construction incentive clauses for about 20 years and has not found them to create a significant or excessive workload. Also, the American Ordinance Association randomly selected and studied 193 of 2,627 implemented construction incentive clause proposals and found that product quality was improved 71 percent of the time and that product reliability was enhanced 63 percent of the time. In no instance did construction incentive clauses adversely affect product quality or reliability according to the American Ordinance Association.

Although savings have been achieved by using construction incentive clauses, they are not costly to use. Including a construction incentive clause provision in a construction contract costs little or nothing according to the Federal Acquisition Regulations. Furthermore, the contractors bear the cost of developing the change proposals, while the costs of implementing the changes are deducted from the savings.

Many of the problems and concerns that EPA regional and state agency officials expressed about the use of construction incentive clauses were similar to the problems and perceptions that public agency personnel expressed on the use of construction incentive clauses in the U.S. Department of Transportation highway construction projects. A 1984 study on the use of construction incentive clauses in highway construction projects found that public agency personnel feared "getting taken" by unscrupulous contractors and being inundated with proposals. The study stated that, after a construction contract had been awarded, public agency personnel viewed any changes proposed to it, especially if the changes were proposed by the construction contractor, with suspicion.

The Department of Transportation study concluded that public agency personnel generally did not understand the use and benefits of construction incentive clauses and stated that construction incentive clauses were nothing more than change orders where the contractor and public share in a reduction of cost. The study stated that there is little difference between a negotiated supplemental agreement that cost the government money and one submitted under a construction incentive clause that saves the government money. The study recommended publicity, training, and assignment of responsibility for remedying these misconceptions and bringing about more effective use of construction incentive clauses. The study stated that public agency personnel . . . "need to be convinced that the process is worthwhile and that there is nothing to fear in its conduct."

The problems and concerns that EPA regional and state agency officials expressed about incentive clauses appear based on perceived problems rather than problems actually encountered. About 92 percent, 55 of the 60 EPA and state officials responding to our questionnaire, indicated that they had little or no direct experience with the use of construction incentive clauses.

Incorporating a construction incentive clause provision into a contract will not, in itself, guarantee productive results. The success of a construction incentive clause program is dependent upon the level of management support and promotion given to it. In prior reports we have concluded that successful incentive clause programs must provide

--top level management attention and support,

--contractor awareness and encouragement,

--staff training and incentives, and

--goals for program accomplishment.

Our 1983 report,[1] for example, observed that the Army had a well established incentive program that had management support, program promotion and encouragement, staff training, and savings goals. As a result, the Army program had been more effective than the other services. In contrast, the Navy's program did not have adequate management support, promotion encouragement, staff training, and savings goals. Consequently, the Navy's incentive program produced proportionately less than the Army's program.

CONCLUSIONS

Although costing little to employ, construction incentive clauses can be an effective tool for identifying and eliminating unnecessary costs. We estimate that if properly implemented and promoted, construction incentive clauses could reduce EPA-funded construction cost between $6 million and $15 million a year. These savings could be used to fund other wastewater treatment facility construction contracts for cleaning up the nation's waters.

Currently, there is no requirement to use construction incentive clauses, and EPA has done little to promote their use even though it has been EPA's policy to allow such clauses on a voluntary basis. State officials are reluctant to require

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[1] Value Engineering Should Be Improved as Part of the Defense Department's Approach To Reducing Acquisition Cost (GAO/AFMD-83-78, Sept. 27, 1983).

construction incentive clauses in the absence of a federal or state requirement. In addition, most EPA regional officials either disliked or opposed the use of construction incentive clauses and most state officials were not supportive of their use. Most EPA regional and state officials, however, had little or no direct experience using construction incentive clauses and their concerns seemed based on perceived problems rather than on problems actually encountered. Given these perceptions, it is likely that many projects will not use construction incentive clauses as a tool for identifying and eliminating unnecessary costs, unless EPA takes steps to require their inclusion in EPA-funded wastewater treatment construction contracts and actively promotes their use at least on a test basis.

Even though requiring testing of construction incentive clauses might somewhat reduce a state's and grantee's flexibility in administering its grant, states and grantees would retain flexibility in managing how to carry out the requirement and EPA's control over program costs would be enhanced. States and grantees would determine which contractor recommendations should be implemented and which should not. EPA's program responsibilities include ensuring that federally assisted wastewater treatment projects constitute the most economical and cost-effective system. By testing incentive clauses, EPA can help ensure that savings are maximized.

RECOMMENDATIONS TO THE ADMINISTRATOR, EPA

Because construction incentive clauses can potentially result in savings that could be applied to help meet the large need for wastewater treatment facilities, we recommend that the Administrator, Environmental Protection Agency, test the value of using construction incentive clauses by requiring their use for a period of time in EPA-funded wastewater treatment construction project contracts, evaluating the results achieved, and assessing whether such a technique is effective on a permanent basis in controlling costs. So that the test results are representative of what can be achieved, we also recommend that the EPA Administrator promote the benefits of identifying cost-saving measures through the use of construction incentive clauses among applicable EPA, state, and grantee staff and contractors during the test period. If the results are positive, we recommend that the Administrator require construction incentive clauses on a permanent basis.

AGENCY COMMENTS AND OUR EVALUATION

In its comments on our draft report, EPA commented that the construction incentive program should be more appropriately run as a voluntary effort and it does not intend to test its value by requiring its use over a period of time. EPA also commented that it will improve its monitoring and data collection efforts and will examine the effectiveness of the program in the future.

We believe that relying on voluntary efforts to use construction incentive clauses will not provide a valid test of their value. Under a voluntary system, less than 1 percent of the 4,965 EPA-funded wastewater treatment facility construction contracts awarded during fiscal years 1981-83 contained construction incentive clauses as discussed on page 26. We continue to believe that although costing little to employ, construction incentive clauses can be an effective tool for identifying and eliminating unnecessary costs. We recognize that most EPA regional and state officials do not support the use of construction incentive clauses as discussed on pages 30 and 31. However, only by requiring the testing of incentive clauses and evaluating the results achieved can EPA determine the value of construction incentive clauses.

EPA also commented that our draft report accurately states that it does not compile information on cost savings or other benefits realized from using the construction incentive clause. EPA said that it realizes this fact and, although not specifically recommended, it planned to compile such information in the future.

In addition, EPA commented that our draft report inappropriately defines value engineering to include the use of a construction incentive clause. More accurately, value engineering is an organized team effort to study alternative ways of reducing costs. Construction incentive clauses, on the other hand, are not the result of an organized study, but a solicitation from a contractor on cost saving ideas according to EPA.

As discussed on pages 3 to 8, value engineering is a method of analyzing a product or service so that its function can be performed at the lowest possible overall cost without sacrificing quality. It can be used during a construction project's design phase or during construction. During design, value engineering is performed by independent professionals who study proposed project plans to identify and evaluate alternatives for accomplishing project functions. Value engineering during project construction includes a construction incentive clause in the contract that authorizes the contractor to suggest cost-saving measures and, if the suggestions are accepted, to share in the savings.

We recognize that EPA's construction grant guidelines do not define value engineering to include the use of incentive clauses. However, incentive clauses are considered one form of value engineering by other federal agencies. The literature on value engineering suggests that until the early 1970's the primary thrust of value engineering in the federal government was centered around such incentive clauses for contracts. The Federal Acquisition Regulations, Part 48-Value Engineering, specifies that under the incentive approach to value engineering, contractors may voluntarily submit suggestions for cost savings and share in the savings of any accepted suggestions. Since 1963 the Department of

Defense has used incentive clauses, allowing contractors to propose and share in contract savings. The Department of Defense refers to such proposals as value engineering change proposals.

PREVIOUS GAO REPORTS ON VALUE ENGINEERING

Information on the Use of Value Engineering in Federal Design and Construction (GAO/GGD-85-44, Apr. 5, 1985).

Greater Use of Value Engineering Has the Potential To Save the Department of Transportation Millions in Construction Costs (GAO/RCED-85-14, Nov. 2, 1984).

Value Engineering Should Be Improved as Part of the Defense Department's Approach To Reducing Acquisition Cost (GAO/AFMD-83-78, Sept. 27, 1983).

Improvements Needed in the Air Force's Design Process for Military Construction Projects in Europe (GAO/NSIAD-83-21, July 19, 1983).

Improvements Needed in the Army's Design Process for Military Construction Projects in Europe (GAO/NSIAD-83-22, July 19, 1983).

Water Resource Construction Costs Could Be Reduced If Value Engineering Were Applied to More Designs and Applied Earlier in the Design Process (GAO/RCED-83-127, May 11, 1983).

Value Engineering Has the Potential To Reduce Mass Transit Construction Costs (RCED-83-34, Dec. 29, 1982).

Potential Exists To Reduce Construction Costs Through More Effective Promotion of the Value Engineering Incentive Program in the Department of the Interior (RCED-085636, Dec. 1, 1982).

Letter from the Comptroller General to the Chairman, Senate Committee on the Budget discussing GAO's position on the value engineering technique (B-165767, Feb. 5, 1979).

Department of Defense Value Engineering Program Needs Top Management Support (PSAD-78-5, Nov. 16, 1977).

Potential of Value Analysis For Reducing Waste Treatment Plant Costs (RCED-75-367, May 8, 1975).

Need for Increased Use of Value Engineering, a Proven Cost Savings Technique in Federal Construction (B-163762, May 6, 1974).

Value Engineering Program Needs To Be Improved and Reinstated (B-118779, May 10, 1972).

Opportunities for Increased Savings By Improving Management of Value Engineering (Design and Manufacture Simplification) Performed By Contractors (B-165757, Aug. 25, 1969).

ESTIMATED POTENTIAL DOLLAR SAVINGS FROM USING VALUE ENGINEERING ON PROJECTS COSTING FROM $1 MILLION TO $10 MILLION

We estimated the magnitude of potential savings possible from conducting value engineering studies during the design of projects costing from $1 million to $10 million by

--developing an estimate of the dollar value of such projects that would be subject to value engineering review;

--determining a percentage savings range, as a percentage of construction costs, that might be realized from value engineering such projects;

--calculating the range of potential dollar savings possible by multiplying the estimated dollar value of projects costing from $1 million to $10 million by the percentage savings range.

We estimated the range of potential dollar savings that might have been realized if value engineering studies had been conducted on projects costing from $1 million to $10 million during fiscal years 1979-83. We also estimated potential annual savings if value engineering were conducted on projects during future years.

These estimates are based on our analysis of actual results of value engineering studies, EPA data on the cost of construction projects, informed opinions from experienced value engineering officials in public and private organizations, and conservative assumptions. Since our estimates only indicate a range of potential cost reduction and not precise estimates, we did not assess the accuracy of the data reported by EPA or other sources.

ESTIMATING THE VALUE OF PROJECTS COSTING FROM $1 MILLION TO $10 MILLION

To estimate potential dollar savings from conducting value engineering reviews on projects costing from $1 million to $10 million, we first determined the number of projects and total dollar value for this category of project. EPA's Grant Information and Control System maintains the status of the construction grant program's funding and contains specific information on each wastewater treatment project receiving EPA funding. This information includes a record of (1) each grant awarded, (2) projects receiving the grant funds, (3) grant award dates, (4) the amount of EPA grant funds awarded, and (5) the total amount of construction costs eligible for grant participation. Using the system's data records, we totaled the numbers of projects receiving funds and the eligible costs of such projects. We tabulated this data

to show the numbers of projects by year of initial funding and the related eligible costs of such projects.

Some EPA program grants represent one grant in a series of grants for constructing one large program project. In deriving the cost and number of EPA funded wastewater treatment projects costing more than $10 million and $10 million or less, we consolidated all construction grant awards having the same serial numbers[1] into one project, unless the system's data records showed that the series of grant awards was interrupted by a separate planning grant award. When this occurred, separate projects were established. The overall effect of such consolidation was to increase the dollar value and number of projects costing more than $10 million.

As shown in table 1 on page 41, for projects with initial construction grants in 1979-83, projects costing over $10 million represented about 59 percent of the total dollars, projects costing from $1 million to $10 million represented about 37 percent of the total dollars, and projects costing less than $1 million represented about 4 percent of the total dollars.

DETERMINING A PERCENTAGE RANGE OF POTENTIAL SAVINGS ON PROJECTS COSTING FROM $1 MILLION TO $10 MILLION

Our analysis of value engineering savings realized on a variety of projects indicates that using value engineering on projects costing from $1 million to $10 million could average savings ranging from 2.4 percent to 5.4 percent of project cost. We obtained information from public agencies and private sector firms that were identified as having an active value engineering program. As shown in table 2 on page 42, for 29 wastewater treatment projects of the EPA, Corps of Engineers, and private value engineering firms costing less than $10 million, an 8.0-percent average savings rate was reported, and 275 wastewater treatment projects (273 EPA and 2 Corps of Engineers projects) costing over $10 million averaged a 5.4-percent reported savings rate.

The 2.4 percent minimum savings expectation is the median percent savings rate realized from value engineering the seven EPA-funded projects costing $10 million or less (see page 15). We selected 2.4 percent as the minimum savings expectation because (1) the lowest average savings rate actually achieved on wastewater treatment plants costing $10 million or less by the three

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[1]The serial number is part of EPA's financial assistance identification number formally called a grant identification number.

groupings shown in table 2 on page 42 were the EPA-funded projects, (2) the median percent savings result tends to eliminate extreme results that can occur when data available is minimum, and (3) the experience of federal agencies in value engineering wastewater and nonwastewater construction costing more and less than $10 million exceeded this rate of savings. The 5.4-percent maximum potential savings was based on (1) the rate of savings actually achieved by EPA on 273 wastewater treatment projects costing more than $10 million during a 7-year time period 1977-83, (2) EPA's 1984 internal staff report which stated that value engineering treatment projects under $10 million would produce benefits similar to those obtained from value engineering projects costing more than $10 million, and (3) the experience of other federal agencies and organizations in value engineering wastewater and nonwastewater construction costing more and less than $10 million exceeded or equalled this rate of savings.

In addition, according to our consultant, comparisons between wastewater treatment projects of various cost levels are feasible inasmuch as the same elements (e.g., grit removal, pumping, sedimentation, solids handling, biological treatment, disinfection, and support facilities) are present in all plants, notwithstanding the cost or size of the plant. Also, the type of work entailed with wastewater treatment plant construction--steel erection and reinforcement; piping; motor and generator installation; pump installation; masonry work; heating, ventilating, air conditioning equipment installation; and earth excavation--is common to other types of construction, according to our consultant.

These estimated savings rates are net savings after deducting (1) the cost of conducting the value engineering study and (2) the cost of implementing the accepted value engineering recommendations. Value engineering design and related implementation costs average about $100,000 for each of the 273 EPA-funded projects costing over $10 million. The estimates do not reflect any increased administrative costs that the state, grantee, or EPA regions may incur because of the studies. According to the EPA headquarters value engineering coordinator, the cost of administering a greater number of value engineering studies would be insignificant for the states, grantees, and EPA regions.

CALCULATION OF POTENTIAL VALUE ENGINEERING SAVINGS ON PROJECTS COSTING BETWEEN $1 MILLION AND $10 MILLION

We estimate that if EPA had required value engineering studies on wastewater treatment construction projects costing from $1 million to $10 million, during fiscal years 1979-83, from

$128 million to $288 million in federal funds potentially could have been saved. In addition, states and/or grantees could have realized savings proportionate to their project contributions, during the same time period. These amounts were determined by applying the expected range of savings (2.4 percent to 5.4 percent) to the net obligations available for construction of projects costing from $1 million to $10 million (see table 3 on p. 44).

We also estimate that extending value engineering efforts to future projects costing from $1 million to $10 million potentially may save $19 million to $42 million in federal funds annually, based on current funding levels. States and grantees would also realize savings proportionate to their project contributions. As shown in table 4 on page 46, these savings were determined by applying the expected range of savings (from 2.4 percent to 5.4 percent) to the estimated funding available for construction of projects costing from $1 million to $10 million. These calculations indicate that such projects would total about $775 million annually.

Besides future funding levels, projected annual federal savings that might be realized also depend on the continued existence of the program. In this regard, EPA's proposed fiscal year 1986 budget requests $2.4 billion for construction grants. This budget request represents the first step of a proposed 4-year phaseout of the program. Because the current authorization for the program expires at the end of 1985, EPA is developing a reauthorization proposal, the details of which are not yet complete. Although EPA expects this proposal will probably call for less federal financing of the program, EPA expects to maintain its commitment to fund existing projects that have already received federal funds.

Table 1

Determination Of Cost Ratios For Projects Between $1 Million And $10 Million Based On EPA's Grants Information And Control System For The Years 1972-83[a]

Project size and fiscal years[b]	Construction costs[c] Millions	Percent
Less than $1 million		
1972-78	$ 741	2.6
1979-83	642	3.9
Total	1,383	3.1
$1 million to $10 million		
1972-78	$ 7,539	26.8
1979-83	6,101	37.3
Total	13,640	30.6
Over $10 million		
1972-78	$19,887	70.6
1979-83	9,599	58.7
Total	29,486	66.2
All projects		
1972-1978	$28,167	100.0
1979-1983	16,342	100.0
Total	$44,509	100.0

[a]Grant records are contained in EPA's information system only for the years 1972-83.

[b]Data accumulated for all 50 states.

[c]Construction cost estimates used were those made in the initial construction grant year of each project.

Table 2

Summary Of Reported Savings Obtained By Value Engineering During Design

Agency	Number of projects	Construction costs	Construction cost savings realized	Average percentage savings	Range of savings realized (percentage)
		-----millions-----			
Wastewater treatment projects costing $10 million or less					
EPA[a]	6	$ 33.6	$ 1.7	5.1	1.8-9.3
Corps of Engineers[b]	13	20.8	1.3	6.3	.04-88.9
Value engineering firms[c]	10	66.2	6.7	10.1	2.6-24.7
Total	29	$120.6	$ 9.7	8.0	
Wastewater treatment projects costing more than $10 million					
EPA[d]	273	$7,487.2	$401.4	5.4	3.5-6.8
Corps of Engineers[b]	2	44.5	4.5	10.0	.08-28.6
Total	275	$7,531.7	$405.9	5.4	
Total for all wastewater treatment projects	304	$7,652.3	$415.6	5.4	
General construction projects costing $10 million or less					
Naval Facilities Engineering Command[e]	52	$ 252.4	$ 20.9	8.3	1.2-26.0
General construction projects costing more than $10 million					
Naval Facilities Engineering Command[e]	16	$406.1	$ 27.4	6.7	.5-15.0

[a]EPA-funded wastewater treatment projects under construction during fiscal year 1983.

[b]Corps of Engineers studies on wastewater treatment projects under construction during 1979-83.

[c]Results reported by two private sector consulting engineering firms on EPA-funded wastewater treatment facilities. These 10 EPA funded projects are in addition to and not duplicative of the seven EPA funded projects costing $10 million or less we identified as being constructed during fiscal year 1983 and discussed in Chapter 2.

[d]Results reported by EPA during the period 1977-83. Range represents yearly averages achieved during this period.

[e]Sixty-eight studies by Naval Facilities Engineering Command on all construction projects during fiscal year 1983.

Table 3

Value Engineering Savings Not Realized On Projects Costing From $1 Million To $10 Million Fiscal Years 1979-83

	Federal share 75 percent[a]	Nonfederal share 25 percent	Total
	(Millions)		
EPA construction program obligations, FY 1979-83[b]	$16,495		
Less: State administration costs[c]	(469)		
Net funds available for projects	$16,026	$5,342	$21,368
Less: Projects costing more than $10 million[d]	(9,455)	(3,152)	(12,607)
Less: Projects costing less than $1 million[e]	(641)	(214)	(855)
Funds available for projects costing from $1 million to $10 million	5,930	1,976	7,906
Less: Planning and design costs[f]	(593)	(198)	(791)
Funds available for construction of projects costing from $1 million to $10 million	$ 5,337	$1,778	$ 7,115
Unrealized savings:[g]			
Minimum average expectation @2.4 percent	$128	$43	$171
Maximum average expectation @5.4 percent	$288	$96	$384

[a]Federal share for wastewater treatment facility construction projects was limited to 75 percent by federal law during this period.

[b]Represents net obligations obtained from EPA's annual budget submittals to the Congress. These amounts represent the federal share and exclude the amount of obligated funds recovered from prior periods which reduced the annual amount obligated.

[c]We deducted 2 percent for 1979 through 1981 when EPA allowed states to use up to 2 percent of their authorized funding for program administration. We deducted 5 percent for 1982-83 after the 1981 amendments increased the maximum allowance to 4 percent and also reserved 1 percent of a state's allocation for water quality management planning.

[d]Since value engineering is already required on projects costing over $10 million, funds for this category of project are subtracted. Projects costing over $10 million accounted for about 59 percent of the total construction funds spent for projects with initial construction grants during fiscal years 1979-83. See table 1.

[e]Value engineering may not benefit projects costing less than $1 million according to an EPA study. These projects accounted for 4 percent of the total construction funds during fiscal years 1979-83. See table 1.

[f]Facility planning and design costs are estimated by EPA to average between 7 and 10 percent. The 10 percent figure is used to be conservative.

[g]Estimated average savings range from p. 38.

Table 4

Potential Annual Value Engineering Savings On Future Projects Costing From $1 Million To $10 Million[a]

	Federal share (55%)[b]	Nonfederal share (45%)	Total
	(Millions)		
Estimated funding	$2,400		
Less: State administration costs of 3 percent[c]	(72)		
Net funds available for projects	$2,328	$1,905	$4,233
Less: Projects costing more than $10 million[d]	(1,374)	(1,124)	(2,498)
Less: Projects costing less than $1 million[e]	(93)	(76)	(169)
Funds available for projects costing from $1 million to $10 million	861	705	1,566
Less: Planning and design costs[f]	(86)	(71)	(157)
Funds available for construction of projects costing from $1 million to $10 million	$ 775	$ 634	$1,409
Estimated average annual savings:[g]			
Minimum average expectation @2.4 percent	$19	$15	$34
Maximum average expectation @5.4 percent	$42	$34	$76

[a]Calculations assume continued funding at the current $2.4 billion (fiscal year 1985) level, and that funds will be spent on projects during the year, rather than spent in a later year. EPA's fiscal year 1986 budget proposal requests $2.4 billion for the construction grants program.

[b]Starting in fiscal year 1985, federal funding for construction of new treatment projects is limited to 55 percent for all projects that have not received prior federal construction funding.

[c]We deducted 3 percent because beginning in fiscal year 1986, 2 percent of a state's allotment is available for grant administration and 1 percent for water quality planning.

[d]Since value engineering is already required on projects costing over $10 million, funds for this category of project are subtracted. Projects costing over $10 million accounted for about 59 percent of the total construction funds spent for projects with initial construction grants during fiscal years 1979-83. See table 1.

[e]Value engineering may not benefit projects costing less than $1 million according to an EPA study. These projects accounted for 4 percent of the total construction funds during fiscal years 1979-83. See table 1.

[f]Facility planning and design costs are estimated by EPA to average between 7 and 10 percent. The 10 percent figure is used to be conservative.

[g]Estimated average savings rates from p. 38.

ESTIMATED POTENTIAL DOLLAR SAVINGS FROM USING CONSTRUCTION INCENTIVE CLAUSES IN EPA FUNDED WASTEWATER TREATMENT CONSTRUCTION CONTRACTS

We estimated the magnitude of potential savings possible from using value engineering incentive clauses in wastewater treatment contracts by

--developing an estimate of the dollar value of contracts that would be subject to construction incentive clauses;

--determining a percentage savings range, as a percentage of construction costs, that might be realized from such clauses; and

--calculating the range of potential dollar savings possible by multiplying the estimated dollar value of contracts subject to construction incentive clauses by the percentage savings range.

We estimated the range of potential dollar savings that might have been realized if construction incentive clauses had been required on projects during fiscal years 1981-83. We also estimated potential annual savings if construction incentive clauses were used during future years.

We based these estimates on EPA budgetary and other financial data, actual results attained by using construction incentive clauses on EPA projects and on projects of other federal agencies, and conservative assumptions. Since our estimates only indicate a range of potential cost reduction and not precise estimates, we did not assess the accuracy of the data reported by EPA or other sources.

ESTIMATING THE VALUE OF CONTRACTS THAT WOULD BE SUBJECT TO CONSTRUCTION INCENTIVE CLAUSES

To estimate potential dollar savings that construction incentive clauses might generate on wastewater treatment construction contracts, we ascertained the dollar value of such contracts for two separate time periods--fiscal years 1981-83 to estimate potential savings that could have been realized in the past and 1 fiscal year to estimate potential future annual savings. We selected fiscal years 1981-83 because this represented the latest period of time in which data was available on the use of incentive clauses in EPA-funded construction projects. For this period, we obtained the amount of wastewater treatment program funds

obligated from EPA's annual budget submittals to the Congress. This excluded the amount of obligated funds that were recovered from prior periods.

For estimating future annual savings, we used EPA's most current funding level (fiscal year 1985) because this level was consistent with funding levels of prior years (fiscal years 1982-84) and EPA's fiscal year 1986 budget request.

To calculate the amount of obligated funds available for construction contracts, we reduced obligated funds by amounts used for purposes other than construction contracts. These included (1) state allowances for administrative costs and reserves for water quality management planning grants and (2) allowances for planning and design costs. The remainder represented the amounts of EPA funds available for wastewater treatment construction activity for fiscal years 1981-83 and for 1 fiscal year at current funding levels that could be subject to construction incentive clauses. Tables 1 and 2 on pages 51 and 53 contain details on these computations.

DETERMINING A PERCENTAGE RANGE OF POTENTIAL SAVINGS

Savings experienced by EPA and other federal agencies using incentive clauses provide a range of possible savings that might potentially be achieved on EPA-funded projects. Savings experienced by federal civil agencies is sparce, since they have just recently (April 1984) been required to use construction incentive clauses. The Department of Defense has the best historical data on savings achieved over a period of years from using value engineering incentive clauses.

Our analysis of savings realized on a variety of projects indicates that using construction incentive clauses on EPA-funded projects could realize savings ranging from 0.3 percent to 0.7 percent of project cost. We selected the 0.3 percent as the minimum savings expectation because (1) it was the minimum annual rate that the Army achieved over a 7-year period and (2) the Army's figure was based on more projects and was more conservative than the 0.5 percent estimate of potential savings for Department of Transportation highway construction projects (see pp. 37, 38, and 39). We did not consider the Air Force or Navy results inasmuch as our prior review had found their programs did not have adequate management support, promotion encouragement, staff training, and savings goals as discussed on page 32.

We selected the 0.7 percent as the maximum potential savings expectation because (1) it was more conservative than the Army's 1.0 percent annual maximum realized and (2) the Department of Defense maintains that this level of savings is reasonably

attainable. While the Army and other agency data includes the results of incentive clauses on a variety of projects, our review did not include an assessment of the extent that incentive clauses would produce the same results on EPA grant funded projects as on other types of projects. Nevertheless, we believe that the 0.3-percent to 0.7-percent savings range provides a reasonable basis for estimating the general magnitude of potential savings that construction incentive clauses may achieve on EPA wastewater treatment construction projects if actively supported and promoted.

These estimated savings rates are net savings after deducting (1) the amount of savings received by contractors, (2) the cost of implementing the accepted contractor recommendations, and (3) increases in government costs.

CALCULATION OF POTENTIAL SAVINGS BY USING CONSTRUCTION INCENTIVE CLAUSES

We estimate that if EPA had required construction incentive clauses in wastewater treatment construction contracts during fiscal years 1981-83, from $21 million to $49 million in federal funds could have been saved. In addition, states and/or grantees could have realized savings proportionate to their project funding contributions during the same period. These amounts were determined by applying the expected range of savings (0.3 percent to 0.7 percent) to the net obligations available for construction of projects. (See table 1 on page 51.)

We also estimate that using construction incentive clauses on future projects potentially may save $6 million to $15 million in federal funds annually, based on current funding levels. States and grantees would also realize savings proportionate to their project funding contributions. As shown in table 2 on page 53, these savings were determined by applying the expected range of savings (from 0.3 percent to 0.7 percent) to funds available for construction of projects.

Besides future funding levels, projected annual federal savings that might be realized also depend on the continued existence of the program. In this regard, EPA's proposed fiscal year 1986 budget requests $2.4 billion for construction grants. This budget request represents the first step of a proposed 4-year phaseout of the program. Because the current authorization for the program expires at the end of 1985, EPA is developing a reauthorization proposal, the details of which are not yet complete. Although EPA expects this proposal will probably call for less federal financing of the program, EPA expects to maintain its commitment to fund existing projects that have already received federal funds.

Table 1

Construction Incentive Clause Savings Not Realized During Fiscal Years 1981-1983

	Federal share[a] (75 percent)	Nonfederal share (25 percent)	Total
	(Millions)		
EPA construction program obligations, FY 1981-83[b]	$8,241		
Less: State administration cost[c]	(304)		
Net funds available for projects	7,937	$2,646	$10,583
Less: Planning and design costs[d]	(794)	(265)	1,059
Funds available for construction contracts	7,143	2,381	9,524
Less: Construction contracts with construction incentive clauses[e]	(186)	(62)	(248)
Funds not subject to construction incentive clauses	$6,957	$2,319	$ 9,276
Unrealized savings:[f]			
Minimum average expectation @0.3 percent	$21	$ 7	$28
Maximum average expectation @0.7 percent	$49	$16	$65

[a]Federal share for wastewater treatment facility construction was limited to 75 percent by federal law during this period.

[b]Represents net obligations obtained from EPA's annual budget submittals to the Congress. These amounts represent the federal share and exclude the amount of obligated funds recovered from prior periods which reduced the annual amount obligated.

[c]We deducted 2 percent for fiscal year 1981 when EPA allowed states to use up to 2 percent of their authorized funding for program administration. We deducted 5 percent for 1982-83 after the 1981 amendments increased the maximum allowance to 4 percent and also reserved 1 percent of a state's allocation for water quality management planning.

[d]Facility planning and design costs are estimated by EPA to average between 7 and 10 percent. The 10 percent figure is used to be conservative.

[e]We deducted the estimated dollar value of construction contracts that contained construction incentive clauses. According to state officials responding to our questionnaire, 32 contracts awarded during the 3-year period had construction incentive clauses.

[f]Estimated average savings range from p. 49.

Table 2

Potential Annual Savings From Using Construction Incentive Clauses In The Future

	Federal share[a] (55 percent)	Nonfederal share (45 percent)	Total
	(Millions)		
Estimated funding[b]	$2,400		
Less: State administrative cost[c]	(72)		
Net funds available for projects	2,328	$1,905	$4,233
Less: Planning and design costs[d]	(233)	(191)	(424)
Funds available for construction contracts	$2,095	$1,714	$3,809
Estimated average annual savings:[e]			
Minimum average expectation @0.3 percent	$ 6	$ 5	$11
Maximum average expectation @0.7 percent	$15	$12	$27

[a]Starting in fiscal year 1985, federal funding for construction of new treatment projects is limited to 55 percent for all projects that have not received prior federal construction funding.

[b]Calculations assume continued funding at the current $2.4 billion (fiscal year 1985) level, and that funds will be spent on projects during the year, rather than spent in a later year. EPA's fiscal year 1986 budget proposal requests $2.4 billion for the construction grants program.

[c]We deducted 3 percent because beginning in fiscal year 1986 states will be allowed 2 percent of authorized funding for program administration and 1 percent for water quality management planning.

[d]Facility planning and design costs are estimated by EPA to average between 7 and 10 percent. The 10 percent figure is used to be conservative.

[e]Estimated average annual savings rates from p. 49.

APPENDIX IV

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
POLICY, PLANNING AND EVALUATION

MAY - 3 1985

Mr. J. Dexter Peach
Director
Resources, Community, and Economic
Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

On April 2, 1985, the General Accounting Office (GAO) sent a draft report to the Environmental Protection Agency (EPA) for review and comment. The report is entitled "Greater Use of Value Engineering Has The Potential To Save Millions on Wastewater Treatment Projects". As required by Public Law 96-226, EPA prepared this response to the report.

EPA agrees with the report's conclusion on page 23 that value engineering (VE) studies on projects costing $10 million or less would reduce construction costs of wastewater treatment projects. The Agency has taken several actions regarding value engineering in order to reduce costs. EPA has encouraged grantees to conduct VE studies on projects costing $10 million or less, and EPA recently requested that each State designate a VE coordinator to explain the benefits of VE and to encourage and assist grantees in the use of VE. In addition, EPA will prepare a publication in FY 1986 to encourage and assist grantees in using VE for small projects.

The report's statements concerning the incentives for grantees to conduct value engineering on pages 21 and 23 need to be updated. While the comments may have been valid a year ago, currently grantees have more financial incentive to use VE. Recent program changes now provide additional financial incentive to grantees because their financial obligation has increased due to the Federal government's reduction of grant monies for wastewater treatment projects. For example, the Federal government has reduced its funding share from 75 to 55 percent and eliminated reserve capacity and collector sewers as eligible costs, requiring that grantees assume a greater financial obligation.

On page 24, the report recommends that EPA revise its regulations to require VE studies on projects costing over $1 million. However, in section 218(c) of the Clean Water Act, Congress established $10 million as the threshold for requiring value engineering. In light of apparent congressional intent, EPA elects to encourage but not require VE on projects costing less than $10 million. In addition to the activities promoting the use of value engineering discussed above, EPA plans to evaluate the possibility of increasing the allowance for grantees who conduct VE studies on lower cost projects.

EPA disagrees with the report's statements (pages 13, 18, 20, 26, 29, and 32) that EPA views any decision to require VE on smaller projects, or to require construction incentive (CI) clauses, as contrary to state delegation. In delegating program administration to the States, EPA retains responsibility for establishing minimum program requirements.

[GAO COMMENT: The statement included in our draft report that EPA views decisions to extend value engineering requirements as contrary to state delegation was based on discussions with EPA's headquarters value engineering coordinator. In view of EPA's comment, this statement has been deleted from the final report.]

EPA disagrees with the report's recommendation that EPA test the value of the CI clause by requiring its use over a period of time. EPA believes the CI program should be more appropriately run as a voluntary effort and does not intend to make it a requirement at this time. The Agency will improve its monitoring and data collection efforts and will examine the effectiveness of the program in the future.

The report inappropriately defines value engineering to include the use of a CI clause. More accurately, VE is an organized team effort to study alternative ways of reducing costs. CI, on the other hand, is not the result of an organized study, but is a solicitation from a contractor on cost savings ideas. On pages 17 and 42, the report is unclear whether the data pertains to VE, CI or both.

[GAO COMMENT: Statements have been added to the final report that data on the pages referred to pertain to value engineering during the design phase.]

APPENDIX IV

The report accurately states that EPA does not compile information on cost savings or other benefits realized from using the CI clause. EPA realizes this fact and, although not specifically recommended, we plan to compile such information in the future.

We appreciate the opportunity to comment on the draft report.

Sincerely yours,

Milton Russell

Milton Russell
Assistant Administrator
for Policy, Planning and Evaluation

GAO note: Page references in this appendix were changed to reflect their location in this final report.

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