VALUE ENGINEERING AT MTA NEW YORK CITY TRANSIT

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OVERVIEW

Since 1988, MTA New York City Transit (NYC Transit) has employed Value Engineering (VE), a recognized engineering design discipline, to review the cost effectiveness of its planned capital construction projects.[1] Value Engineering techniques identify alternative building methods, material specifications and labor allocations that could lower overall construction costs without sacrificing project objectives or safety considerations.

The contribution of the VE Program, which has reduced estimated construction costs by more than $78 million in the last five years, has become even more significant as the MTA's ability to fund needed improvements and extensions of its transit infrastructure becomes more tenuous and uncertain.

To ensure that NYC Transit's Capital Program Management (CPM) maximizes the potential benefits from Value Engineering, we examined all program activities related to capital contracts awarded between 2005 and 2007. While VE Reviews identified an average of 3.5 percent in construction cost reductions, the Office of the MTA Inspector General (OIG) finds CPM missed opportunities for even greater savings.

Although CPM mandates Value Engineering Reviews for all projects equal to or greater than $10 million, our audit found that 15 of the 40 projects awarded above this threshold were denied VE Review through an informal and unauthorized pre-screening process at the design phase. Had VE Reviews been conducted on these projects, and had those VE Reviews found savings similar in range to other NYC Transit projects, CPM might have saved as much as $6.5 million in unnecessary construction costs.

In addition, our review of the VE Program led us to question whether additional construction savings could be identified by expanding VE Reviews to more projects based on the complexity of their scopes rather than on a specific dollar threshold, and by re-evaluating the operational and construction standards that result in high rates of rejection of VE cost-saving proposals.

In its response to our report, NYC Transit accepted our recommendations and has adopted new procedures to ensure that the potential benefits from VE Reviews are extended to an even wider range of capital projects.

[1] The terms Value Engineering, VE Review and VE Program are used synonymously in this Report.

In the sections to follow, we provide background on CPM's VE Program, including a description of the procedures used to review capital projects. We also identify lack of adherence to CPM procedures, which led to the exclusion of projects from the VE Program, and we estimate potential, unrealized cost savings from excluded projects. Further, we recommend that CPM strengthen its enforcement of mandatory VE Reviews for projects of $10 million or more. At the end of this report, we make suggestions for possible ways that CPM might realize even greater savings.

BACKGROUND

Initially developed by General Electric as a means of identifying acceptable substitutes for raw materials, component parts, and skilled labor during World War II, Value Engineering is widely accepted by both the private and public sectors as an important tool in decreasing costs, increasing profits and improving quality. The general principles and requirements for Value Engineering are set forth by the Society of American Value Engineers (SAVE) International, which offers its own certification program.

In 1988, CPM adopted Value Engineering as part of its procedures for reviewing planned rehabilitation of transit infrastructure and the construction of new facilities. As per the agency's Project Management Guideline (PMG) #316 and Project Management Procedure (PMP) #316, CPM mandates VE Reviews for all planned construction projects with an estimated cost at or above $10 million.

CPM employs the following process to initiate, conduct, and implement the VE Program:

Step 1. Project Selection – CPM's in-house engineers who design capital construction projects (Design Managers) are required to submit all technical reports, architectural and /or engineering drawings, and cost estimates related to projects over $10 million[2] to CPM's Value Engineering Officer (VE Officer) at the completion of the projects' Preliminary Engineering (PE) design phase.[3] The VE Officer has the authority to approve such projects for Value Engineering or to request variances for those he deems inappropriate for review. Any such variances must be authorized by the Senior Vice President of CPM. Projects valued at less than $10 million are never considered for VE Review.

Step 2. VE Review – After the VE Officer's approval, a VE Review is performed by an outside consultant.[4] At the conclusion of this five-day analysis, the VE consultant

[2] CPM procedures also employ a $2 million VE threshold for construction projects involving bus maintenance and storage facilities.

[3] According to the VE Officer, the PE design phase and its related PE Cost Estimate occur at the 30-percent-completion stage in the design process.

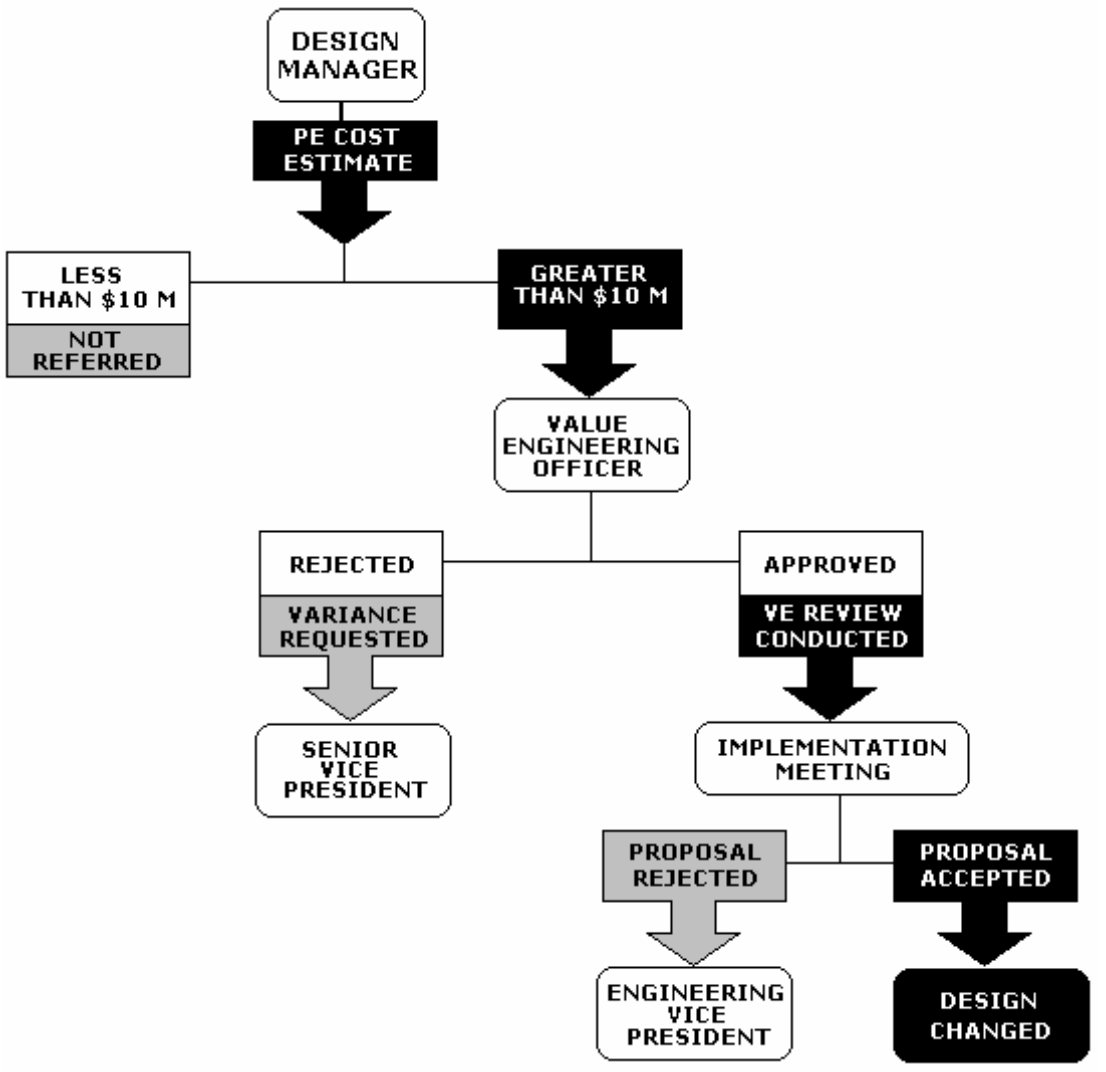
[4] Since 1997 the engineering firm of Edwards and Kelcey has provided Value Engineering services to CPM under a series of requirement contracts with the agency. In late 2008, they were succeeded by Arcadis of New York, formerly Lewis and Zimmerman Associates.

submits a report that proposes alternatives to the original design and estimates the cost savings that such proposals could achieve.

Step 3. Implementation Meeting – After the VE recommendations are made, they are reviewed by the VE Officer, the entire Design Team (Design Manager, discipline engineers, design consultants) as well as the Construction Manager, Estimating, User/Sponsors and System Safety as applicable for comments. While CPM is not required to adopt the proposals, any decisions to reject or amend VE Review recommendations must be authorized by the Vice President for Engineering Services.

A flow chart of CPM's current Value Engineering process appears below:

EXHIBIT 1: Flow Chart of NYC Transit's Value Engineering Process



Over the years, CPM's VE Program has succeeded in containing the costs of planned capital projects. The VE Officer's "Summary of Value Engineering Studies" reported significant benefits obtained between January 2003 and December 2007:

- 38 reviews lead to the adoption of design changes that lowered project costs by more than $78 million, or approximately 3.5 percent of the pre-VE estimates. Such savings represented a significant return on the $2 million in consultant fees paid for these studies; and

- Past Value Engineering proposals were incorporated into subsequent CPM engineering design guidelines for the rehabilitation of passenger stations, electrical and communication systems and tunnel ventilation plants.

In addition to cost savings, CPM's VE Program has won numerous accolades from industry leaders. In 2000, SAVE International awarded the agency its "Outstanding Accomplishment in Government - Gordon H. Frank Award" recognizing outstanding achievement and accomplishment of a government program. In 2003, the VE consultant also received a "Distinguished Award" from the New Jersey Consulting Engineer's Council in its annual awards competition for the Metropolitan NY/NJ area based on the consultant's success with CPM's VE Program.

Nevertheless, there is room for improvement.

VALUE ENGINEERING REQUIREMENTS WERE NOT MET

CPM's Project Management Procedure #316 (section 2.1.1) establishes the overall criteria for determining which projects should be included in the agency's VE Program. It states:

> ***"Value Engineering Design Reviews (VEDRs) shall be performed for all projects with an estimated bid cost of $10 million and more unless an approved variance is received from the Sr. Vice President."***

Design Managers seeking to exempt projects from mandatory VE Reviews must first submit written variance requests to the VE Officer. Upon his approval, such requests must be authorized by CPM's Senior Vice President.

For a three-year period, from January 1, 2005 to December 31, 2007, CPM awarded 40 contracts that met the $10 million threshold for mandatory VE Reviews. These contracts, worth more than $1.4 billion in total, primarily involved capital projects for the rehabilitation and/or replacement of rapid transit infrastructure including passenger stations, signal systems, electrical substations, tunnel ventilation plants, and pump rooms.

OIG found that Design Managers submitted 25 of the 40 projects to the VE Officer as required by CPM procedures (17 projects were approved for VE Reviews; the VE Officer recommended variances as to the other eight). As to the remaining 15 projects, however, the Design Managers neither referred them for review nor obtained the required variances.

In examining this apparent lapse in compliance with the Value Engineering requirements, we interviewed the eight Design Managers responsible for the 15 unreferred projects, which were worth $341 million. They provided the following information to the OIG:

- 11 projects collectively worth $250 million were not referred because the Design Managers had assessed their work scopes as too limited to benefit from VE Review; and

- 4 projects collectively worth $91 million were not referred because the projects' individual cost estimates did not exceed the $10 million threshold until after the Preliminary Engineering design phase.

After reviewing the cases, the VE Officer told the OIG that the Design Managers who judged the 11 projects as inappropriate for Value Engineering had acted without notifying him or obtaining his concurrence.[5] He further noted that PMG #316 (section 2.1) specifically precluded such unilateral exemptions by the Design Managers:

> ***"The Value Engineering Officer (VEO) shall determine whether a project requires a Value Engineering Design Review (VEDR). . ."***

The VE Officer did not believe, however, that CPM procedures required variances for the remaining four projects because their individual Preliminary Engineering design estimates fell below $10 million. He further stated that Design Managers were not required to reconsider such projects for Value Engineering even when later design changes raised the estimates above the minimum $10 million threshold.

Our review of PMP #316 and PMG #316, however, indicates there certainly is room for discretionary VE Review. While both documents identify the Preliminary Engineering design phase as the time when VE Reviews are generally performed, neither prohibits reviews at later design stages. Indeed, PMP #316 (section 2.1.5) identifies later stages in the design process where Value Engineering can occur, including:

> ***"…at approximately 70% design completion for very complex designs or projects with difficult construction phasing."***

In both the spirit and letter of its procedures and guidelines, CPM encourages the use of Value Engineering to identify possible cost savings in capital projects. As such, we believe that Design Managers should have sought VE Reviews for these four projects when their costs estimates rose significantly after the Preliminary Engineering design phase.

[5] The VE Officer's views as to whether or not he would have sought variances for these projects are discussed in the next section.

UNREALIZED SAVINGS FROM PROJECTS EXCLUDED FROM VALUE ENGINEERING

To assess, as a practical matter, whether any of the 15 unreferred projects would have been approved for Value Engineering had they been submitted to the VE Officer, we performed the following audit tests:

- We identified the general criteria used by the VE Officer for choosing which projects over $10 million are approved for VE Reviews and which are given variances from such requirements;

- We examined past VE Reviews to determine the types of construction projects most frequently approved for Value Engineering; and

- We consulted with the VE Officer regarding the appropriateness of VE Reviews for all 15 projects.

The VE Officer stated that he generally approves all projects over $10 million for VE Reviews unless the Design Managers can demonstrate that the projects' work scopes preclude reasonable alternatives to the construction methods and materials identified in the Preliminary Engineering designs. Such limitations usually involve the following types of projects:

> In-kind Equipment Replacement – projects that provide for the replacement of worn out or obsolete transportation equipment with little or no new construction activity to the surrounding infrastructure (e.g., installation of communication cables).
>
> Uncomplicated Infrastructure Improvements – projects that provide routine upgrades of passenger stations, bus depots, tunnels and other transportation infrastructure (e.g., roof repairs, painting contracts, etc.).
>
> Mandated Specifications – projects in which material types, work locations, and equipment specifications are fixed by the standards and practices of NYC Transit operating departments (e.g., safety standards).

Our review suggested that nine of the 15 unreferred projects had the type of limited work scopes (i.e., the installation of station elevators, the replacement of station escalators, and simple tunnel repairs) that met the VE Officer's criteria for initiating a variance from mandatory VE Review requirements. Upon his review of the nine cases, the VE Officer stated that he would have requested VE variances for the projects had they been submitted for his consideration.

The remaining six projects worth $187 million, however, appeared to meet the VE Officer's work scope criteria for approving Value Engineering. Our review also found that other projects with similar work scopes had indeed been approved for Value Engineering between 2003 and 2007 (see Table 1). The VE Officer confirmed that he likely would have included the six projects in the VE Program had the Design Managers referred them for his consideration as required by CPM procedures.

TABLE 1: Scope of Work for Six Unreferred Projects

	Unreferred Projects		Similar Projects Approved for VE Review (2003-07)	
	# of Projects	Contract Value ($ = Millions)	# of Projects	Contract Value ($ = Millions)
Station Rehab	2	$69.1	21	$1,181.6
Substation Rehab	2	$31.1	4	$64.6
Vent Plant Rehab	1	$60.7	1	$25.5
Pump Room Rehab	1	$26.4	1	$18.8
Total	**6**	**$187.3**	**27**	**$1,290.5**

The following OIG case study is an example of why Value Engineering would have been appropriate for projects now routinely excluded from VE Review:

Case Study
Contract # A35857
Station Rehabilitation (Jerome Avenue Line)

When this project initially passed through the Preliminary Engineering design phase, its scope of work covered only the 183rd Street Station, one of eleven on the Jerome Avenue Line scheduled for rehabilitation. According to the Design Manager, the project was not referred for VE Review because its PE Cost Estimate was $8.3 million, well below the $10 million threshold.

According to the VE Officer, Station Rehabilitation projects represent the largest category of construction work approved for Value Engineering. As such, the VE Officer said that he probably would have approved a VE Review for the Jerome Avenue project had it been referred for his consideration.

Subsequently, CPM repackaged the project by adding four other Jerome Avenue stations to its work scope. This scope change brought the final cost estimate to almost $53 million. Although the Design Manager never submitted the repackaged project for VE Review, he acknowledged that he would have done so if the station rehabilitation mergers had occurred at the Preliminary Engineering design phase.

Using the average savings rate obtained by VE Reviews conducted between 2003 and 2007, it appears that CPM might have achieved as much as $6.5 million (3.5% of $187 million) in capital cost reductions if Value Engineering had been performed on these six projects. While detailed reviews of each project's designs and specifications would be needed to definitively estimate the amount of lost savings, it should be noted that the exclusion of these cases eliminated the potential to reduce the cost of the six capital projects.

RECOMMENDATIONS

To maximize the cost savings derived from CPM's VE Program, we offer the following recommendations:

1. CPM should confirm that all projects over $10 million have received either (a) a mandated VE Review by the end of the design process or (b) an authorized variance from such reviews.

2. CPM should amend the provisions of PMP #316 and PMG # 316 to require Value Engineering for projects whose cost estimates rise above the $10 million threshold after the Preliminary Engineering design phase.

In its response to this report dated January 14, 2009, NYC Transit accepted both recommendations and noted the following modifications to PMP/PMG #316 that will be instituted to address our concerns:

- *The Design Manager must include a statement (signed by the VE Officer) that VEDR [Value Engineering Design Review] was either conducted and all recommendations resolved or an approved variance issued in the Preliminary and Final sign-off package. This is then submitted to the Deputy Vice President, Engineering Services for approval.*

- *The Design Manager must refer projects for Value Engineering whose cost estimate rises above the $10 million threshold following Preliminary Engineering.*

OPPORTUNITIES FOR GREATER COST SAVINGS

Over the past twenty years, NYC Transit CPM has successfully employed Value Engineering techniques to identify alternatives that have lowered the cost of capital projects. Because of these past accomplishments and current initiatives such as implementing risk assessments for capital projects, we take this opportunity to pose the question of whether CPM could do more to maximize the potential savings from the VE Program. In this section, we offer suggestions for how NYCT may evaluate this potential. These suggestions are based on OIG observations made while reviewing VE Program activities.

Expand VE Reviews to Projects with Complex Scopes

CPM's current approach to submitting projects for a VE Review is to determine if the project cost estimate is $10 million or more at the Preliminary Engineering design phase. Between 2005

and 2007, 35 projects collectively totaling $40.7 million, were not considered for VE Reviews because individually each fell below this threshold.

As described previously, projects that benefit greatly from VE Reviews generally share certain characteristics irrespective of their dollar value. In such cases, project scopes are generally not limited to the in-kind replacement of equipment but require complex construction or rehabilitation of existing infrastructure. Our review of the VE Program revealed several projects below this $10 million threshold that had complex scopes similar to projects that have benefited from VE Reviews. Such projects have included the rehabilitation of passenger stations, electrical substations, bus depots, and other complex construction projects. We propose that the $10 million threshold should be just one of several factors considered when identifying projects appropriate for VE Reviews. At least one other factor should be the scope and complexity of the project.

Re-evaluate Construction/Operating Standards

Between January 2003 and December 2007, CPM's consultant performed 38 VE Reviews on agency projects estimated to cost $2.3 billion at their Preliminary Engineering design phase. Although these reviews proposed design changes that would have reduced construction costs by $300 million, CPM Design Managers rejected proposals valued at $222 million. It should be noted that both the VE Officer and the VE consultant stated that the high rejection rate is not an unexpected or inappropriate result given the numerous transportation standards, policy considerations, and safety regulations that guide the designs of CPM projects.

To see if there is room for reducing this rejection rate without violating safety regulations, undermining customer satisfaction or sacrificing transportation standards, we examined four of the VE Reviews. These four reviews presented 41 cost-saving proposals totaling $74 million that CPM did not adopt. In keeping with CPM procedures, the Design Managers fully documented their reasons for rejecting the proposals. Review of these proposals revealed that many were rejected because the operating departments (subways or buses) indicated that the proposals did not adhere to their construction/operating standards.

Given the present serious funding shortfalls and capital budget constraints facing the agency, NYC Transit should consider reviewing these standards with increased openness to ensure that those standards are currently the most cost effective way of both constructing and operating NYC Transit facilities.

In short, CPM might increase savings by expanding VE Reviews to include projects based on their scopes, and by re-evaluating construction/operating standards to appropriately avoid potentially costly VE Program rejections.

APPENDIX A

OBJECTIVES, SCOPE AND METHODOLOGY

Our audit sought to determine whether CPM was obtaining the maximum benefits from its VE Program. Specifically, we wanted to confirm that Design Managers referred all planned construction projects over $10 million for VE Reviews, obtained authorized variances for projects excluded from the program, and complied with CPM procedures for rejecting cost saving proposals.

To meet these objectives, we identified all CPM construction contracts awarded during the three-year period between January 1, 2005 and December 31, 2007 and conducted numerous tests to ascertain the agency's compliance with required VE procedures. These compliance tests included, but were not limited to:

- Reviews of project referrals (both above and below the $10 million threshold) to the VE Officer for Value Engineering consideration;
- Analyses of authorized variances that waived compliance with VE requirements;
- Examinations of Implementation Meetings that resulted in the rejection of VE Review proposals; and
- Interviews with Design Managers, the VE Officer and the VE consultant regarding their activities in the Value Engineering program.

APPENDIX B

VALUE ENGINEERING AT OTHER MTA AGENCIES

In addition to our audit of NYC Transit, we conducted preliminary surveys of the Value Engineering programs at three other MTA constituent agencies – Metro North Railroad (MNR), Bridge and Tunnels (B&T), and the Long Island Rail Road (LIRR). Since the mid-1990's, these three agencies have adopted Value Engineering procedures largely based on the PMPs and PMGs employed by NYC Transit.

Our reviews indicated that during the 2005-07 period, MNR, B&T, and LIRR performed significantly fewer VE Reviews than NYC Transit, due in large part to their lower volume of contracts awarded:

VE Reviews Performed on Contracts Awarded between 2005 and 2007

NYCT	**17**
MNR	**3**
B&T	**3**
LIRR	**1**
Total	**24**

In conducting interviews for this survey, we noted that the Value Engineering managers for the three agencies expressed interest in our on-going audit and particularly sought our opinion on the relative strengths between their VE Programs and that of NYC Transit. In this regard, OIG has met with officials from the three agencies to fully inform them about our audit findings in the belief that sharing such data may be useful in improving or expanding their current Value Engineering programs.