



## MISCLASSIFICATION OF DESIGN ERRORS AND OMISSIONS AT NYC TRANSIT

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### OVERVIEW

When NYC Transit enters into a contract to rehabilitate a subway station, replace the signal system along a segment of track, or perform other capital work, the contractor is required to perform that contract in accordance with its terms. Ideally, all of the work necessary to complete the project would be included within the scope of the contract. In practice, though, the scope of a contract may be expanded, reduced, or otherwise altered. Any change in scope must be processed as an Additional Work Order (AWO), which could significantly affect the cost of a construction project. Some AWOs are unavoidable, as when work is needed to address unforeseeable conditions or changes in technical standards that arise after the contract was awarded. On the other hand, AWOs caused by design errors and omissions (E/Os) are clearly avoidable and should not be repeated in future contracts.

In order to prevent the repetition of mistakes, the New York City Transit Capital Program Management department (CPM) construction managers must accurately classify additional work caused by design errors and omissions, so that other managers can initiate a “lessons-learned” procedure as to what went wrong. Ensuring a properly functioning process is important for NYC Transit, not only as to the 80 percent of its design work performed by in-house engineers, but also for the remaining work, which is performed by outside design consultants and overseen by NYC Transit managers. Indeed, the lessons learned by the managers regarding consultant work will serve the agency not only as to those consultants, who may be financially liable to the agency, but to keep any new consultants from making the same mistakes.

While only 59 of the total 1,422 AWOs (4.1 percent) issued by NYC Transit in 2009 and 2010 were classified by managers as resulting from a design error or omission, our analysis of 46 other AWOs finds that 11 (24 percent) were misclassified as caused by a field condition or user request when they were actually caused by an error or omission during design. Furthermore, we learned that some CPM construction managers are reluctant to properly classify error and omission AWOs because they are hesitant to confront CPM designers, with whom they may work on future projects, or because of the increase in paperwork that E/Os entail. Thus, our findings indicate that a significant number of design error and omission AWOs are misclassified, and that NYC Transit is at risk of repeating design mistakes.

Even if work related to correcting the design errors and omissions would have had to be performed in the first instance, it will almost certainly be more costly to negotiate the same work later during the construction phase, because the price is then obtained through negotiation with a

single contractor, rather than through a competitive procurement process. An AWO could also be more expensive to perform than an equivalent amount of work in the base contract if the contractor needs to tear down or rework an installation already completed, or the project schedule is delayed. At a minimum, NYC Transit incurs costs to process the AWO.

This audit by the Office of the MTA Inspector General (OIG) is a continuation of its work on the MTA capital program.<sup>1</sup> Although we cannot put a precise dollar figure on the financial risks associated with misclassified AWOs, it is clear that strengthening the classification process will improve the quality of work, reduce delay, and minimize cost increases on future construction projects.

### Summary of Findings

NYC Transit procedures already provide direction on how to process an AWO caused by a design error or omission in order to avoid similar mistakes on future projects. Of course, that process relies on accurate classification of AWO causes. As our findings make clear, however, NYC Transit must improve its classifications of design errors and omissions.

- Our analysis of 46 AWOs shows that 11 of them actually resulted from a design error or omission, but were incorrectly classified as to cause by CPM managers. During our interviews, the managers frankly agreed with us that according to CPM's own definitions, six of these 11 should have been classified as having been caused by a design error or omission. While managers disagreed with our assessment of the remaining five, they did not provide adequate explanations to support their own assessments.
- A designer who agreed that an AWO for \$1.1 million was due to a design omission, candidly noted that she had been unaware of her omission on the contract until we contacted her during the audit. She said that she will now know to look for these issues when working on future projects.
- CPM often "bundles" additional work of differing types and causes in a single consolidated AWO. However, this bundling sometimes has the effect of obscuring design errors and omissions. While bundling may have a valid business rationale, the appropriate chief engineer or chief architect is not alerted that the design error or omission had occurred when the consolidated AWO carries some other classification.
- Some CPM construction managers do not properly classify error and omission AWOs because they are reluctant to confront CPM designers, with whom they may work on future projects. Additionally, some managers are reportedly deterred from properly

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<sup>1</sup> See MTA/OIG #2008-16 Value Engineering at MTA New York City Transit; MTA/OIG #2009-8 Assessing the Effectiveness of the MTA All-Agency Contractor Evaluation (ACE) Program; MTA/OIG #2009-15 Program Deficiencies in the MTA All-Agency Contractor Evaluation (ACE) Program; MTA/OIG #2010-1 Assessing the MTA Contractor Safety Incentive Program (CSIP); and MTA/OIG #2010-04 Governance Assessment of MTA Capital Program Mega Projects.

classifying the AWO because of the resulting increased paperwork. Consequently, the appropriate chief engineer or chief architect does not pursue the lessons-learned procedure because he or she is not alerted by the construction manager that a design error or omission is involved.

The design error and omission category is particularly meaningful because it provides a means of avoiding future mistakes, while promoting better work, fewer delays and lower costs. And yet, that category is rarely utilized. It is troubling, therefore, that our findings indicate that a significant number of design error and omission AWOs are misclassified, meaning that NYC Transit is at risk of repeating its mistakes.

### **Summary of Recommendations**

1. Senior CPM managers should re-instruct managers on the importance of properly classifying the causes of AWOs and retrain them on how to do so
2. CPM's Quality Management group should perform compliance audits of AWO classifications utilizing independent engineering expertise.
3. In order to ensure that design errors and omissions in bundled AWOs are identified and addressed, the construction manager should clearly indicate on the internal AWO reports that some of the additional work was caused by an error or omission, and send copies of these reports to the responsible chief engineer or chief architect.

We presented our findings and recommendations to the Senior Vice President of CPM, and he agreed that the improvements recommended by OIG are warranted.

### **Summary of Agency Response**

NYC Transit accepted all three recommendations and is in the process of modifying its procedures to comply with the recommendations. Once the procedures are finalized, the agency plans to train its employees and then implement the procedural changes. We note that while NYC Transit does not plan to implement recommendation #2 above in the manner we put forth, the agency does plan to institute an alternative approach to accomplish the same result. Most important, NYC Transit agrees that it must correctly categorize design errors and omissions. As such, we will continue to monitor its progress toward fulfilling this commitment.

## BACKGROUND

Once a contract for a capital construction project has been agreed to by NYC Transit and a contractor, any change in the scope of the contract must be processed as an Additional Work Order. AWOs can add significantly to the cost of construction primarily because the price of the work is obtained through negotiation with the existing contractor only, rather than through a competitive procurement process. Typically, NYC Transit, will have little leverage in these negotiations, because it needs the work to be done, and alternatives to working with the existing contractor will likely be even more costly. Additional costs also result from the engineering and administrative work required to process the AWO. NYC Transit Capital Program Management adds 5 percent to the budgets of its construction projects in order to cover anticipated AWOs. This figure is slightly below the 5.7 percent average (or \$344 million) of AWO payouts reported by the NYC Transit Capital Planning and Budget department for CPM projects closed between years 2001-2010.

### Classifying Design Errors and Omissions

AWOs result from a variety of causes, which NYC Transit has classified into nine separate categories.<sup>2</sup> For tracking purposes, CPM requires that construction managers complete a summary form and classify each AWO using these categories. Additionally, each quarter, construction managers are required to submit a list of AWOs on all open projects to their respective supervisors, again with each AWO classified by category.

As shown below (in Chart 1 on page 6), the most common classification of AWO is the “field condition,” which CPM defines technically as “an unforeseen condition discovered during construction.” CPM managers further explained, however, that this definition actually means conditions at the project site that could not have been identified by reasonable inquiry or inspection at the time the project was designed.

By comparison, when a condition should have been identified and properly addressed in the design phase, the AWO should be classified as a “design error or omission (E/O).” According to NYC Transit procedures, a design error is a “change in work attributed to a mistake in judgment or work incorrectly done during design.” For example, if the designer applies the wrong standard when designing a fire suppression system, a design error has occurred. A design omission is an “oversight in the design that results in additional work that should have been included in the original contract document.” A room designed without provision for a second access point where necessary is an example of a design omission.

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<sup>2</sup> For a complete list of how NYC Transit categorizes and defines causes of AWOs, see Appendix A.

## CPM's Lessons-Learned Procedure

When a CPM construction manager evaluates a proposed AWO and concludes that a design error or omission was involved, CPM Project Management Procedure (PMP) 335 requires that he (or she) verbally obtain concurrence with his determination from the appropriate CPM design manager before finalizing the AWO summary form. Once the parties agree that the cause of an AWO is a design error or omission, the construction manager must send the completed form to either the CPM chief engineer for the associated engineering discipline or to the chief architect, as appropriate.<sup>3</sup> Each quarter the construction manager also sends a listing of all AWOs and their causes to these same senior managers.

After examining the error and omission, the responsible chief engineer or the chief architect is required to take the following actions:

- Prepare a one-page Lessons-Learned document, including actions to be taken to prevent similar E/Os. Actions to be considered include revisions to standards, guidelines, master specifications, standard drawings, checklists and procedures. Individuals assigned to complete these actions are to be included together with required completion dates.
- Distribute the Lessons-Learned document to each design Project Engineer/Architect, Design Manager and Principal Engineer within CPM, who are to discuss it with all of the engineers/architects in their respective offices.
- Meet with the relevant designer, Project Engineer/Architect and Design Manager to discuss the E/O. The purpose of this meeting is to ensure that these individuals fully understand the cause of the E/O and how to prevent a recurrence in the future.
- Submit to the Deputy Vice President of Engineering Services, who oversees all chief engineers and the chief architect, a copy of each Lessons-Learned document initiated during the quarter. Each document must indicate if preventative action was completed in the quarter or if action is still outstanding.

While NYC Transit has established a lessons-learned procedure to prevent design E/O's from recurring on future contracts, in order to realize its benefits CPM construction managers and their supervisors must ensure that E/O AWOs are correctly classified. If that process fails, NYC Transit risks repeating costly and avoidable mistakes.

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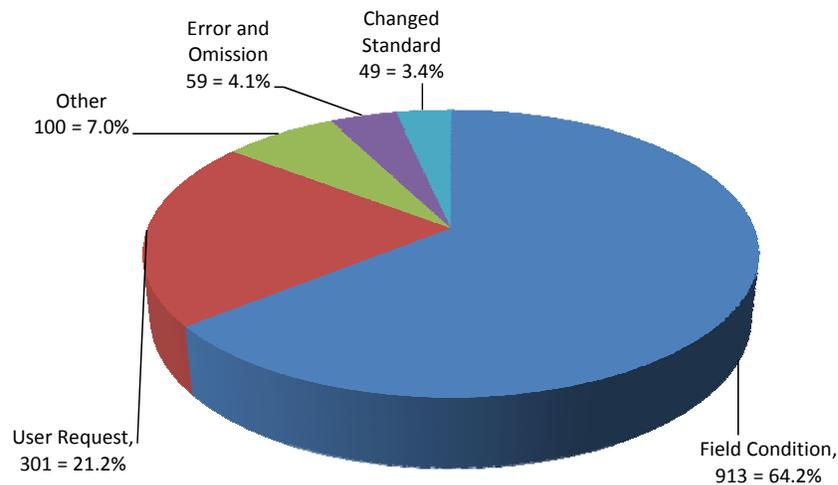
<sup>3</sup> See PMP 335, section 3.0. CPM has a matrix organizational structure whereby designers report to their respective chief discipline engineer or to the chief architect for technical oversight and to a design manager who coordinates their work for each project. Note that besides architectural, CPM's structure included five engineering disciplines at the time of our audit. CPM has since expanded its structure and now has seven engineering disciplines, including Structural, Electrical, Communications, Signals, Mechanical, Environmental, and Systems.

## AWOS ARE RARELY CLASSIFIED AS DESIGN ERRORS AND OMISSIONS

Of the 131 construction contracts that were modified in 2009 and 2010, NYC Transit finalized negotiations on 1,422 AWOs with a net value of \$64.8 million.<sup>4</sup>

As shown in Chart 1 below, 913 (64.2 percent) of these 1,422 AWOs were classified by CPM managers as caused by field conditions, but only 59 (4.1 percent) of them were classified as caused by errors or omissions.

**Chart 1:**  
**2009-2010 AWOs by Cause<sup>5</sup>**



Approximately 80 percent of the design work on capital construction projects at NYC Transit is actually performed in-house; the remainder, while performed by outside firms, is closely overseen by agency personnel.<sup>6</sup> Correctly classifying AWOs that are caused by errors and omissions is a critical and necessary first step in correcting problems and applying the lessons learned to future projects. Therefore, the initial assessment and classification of cause must be accurate and withstand scrutiny. OIG tested the initial classification and, as described in the following sections, concluded that a significant number of design errors and omissions were incorrectly classified by CPM managers.

<sup>4</sup> The net AWO value of \$64.8 million represented 4.2 percent of all CPM construction payments in these two years.

<sup>5</sup> For purposes of simplicity, this chart consolidates the following NYC Transit-defined categories into "Other": Contractor Request, Design Enhancement, Dispute Determination, and Other.

<sup>6</sup> NYC Transit guidelines require that reimbursement be sought from private design firms for design E/Os costing over \$250,000. However, none of the 59 E/O AWOs met that requirement. (Case Study 1 discussed below involved work done in-house rather than by a private firm.) This reimbursement threshold and process were not subjects of the present audit.

## MISCLASSIFICATION OF DESIGN ERROR AND OMISSION AWOS

To ascertain if CPM managers were correctly classifying design errors and omissions, the OIG reviewed seven contracts that had a high frequency of AWOs or had AWOs where the cost represented a large percentage of the base contract amount. After reviewing basic information for each AWO on these seven contracts, we selected 46 AWOs with a net value of \$9.4 million to study further because they appeared to be vulnerable to misclassification.<sup>7</sup> We interviewed the construction and design managers, senior engineers and architects, and procurement officials who were responsible for the design, construction, and procurement of these projects. We also reviewed the design, construction, and procurement files for the AWOs.

We applied CPM's own definitions to the facts of each of these 46 AWOs and concluded, as shown in Table 1 below, that 11 should have been classified as design errors or omissions but were incorrectly classified by CPM managers as resulting from an unexpected field condition or, in one case, a user department request.

**TABLE 1: Misclassified AWOs: AWOs Caused by a Design Error or Omission but Incorrectly Classified by CPM Managers as Resulting from Some Other Cause**

<i>Contract Title</i>	<i>AWO #</i>	<i>Description</i>	<i>AWO Cost</i>	<i>AWO Cause as per Quarterly AWO Report</i>
<i>8th Avenue Tunnel Rehab (C33814)</i>	2	<i>Catwalk Replacement</i>	<i>\$1,100,000</i>	<i>Field Condition</i>
	7	<i>Reduced Quantities of Curb Repair</i>	<i>-\$99,000</i>	<i>Field Condition</i>
	15	<i>Reduced Quantities of Wall Tiles</i>	<i>-\$218,000</i>	<i>Field Condition</i>
	20	<i>Electrical and Communication Work</i>	<i>\$98,900</i>	<i>Field Condition</i>
<i>Brighton Line Stations Rehab (A35870)</i>	10	<i>Platform Edge Repair Work</i>	<i>\$420,000</i>	<i>Field Condition</i>
<i>Charleston Bus Annex (C40419)</i>	31	<i>Bird Screens</i>	<i>\$17,750</i>	<i>Field Condition</i>
<i>Corona Yard Signal System (S32726)</i>	39	<i>Electrical, Plumbing, and Mechanical Work</i>	<i>\$80,000</i>	<i>Field Condition</i>
<i>Dyckman Substation (P36248)</i>	27	<i>Re-route Electrical Conduits</i>	<i>\$4,600</i>	<i>Field Condition</i>
<i>Grand Avenue Bus Depot (C40418)</i>	44	<i>Valves, Underground Tanks, &amp; Diesel System</i>	<i>\$61,200</i>	<i>User Request</i>
<i>Joralemon Tunnel Rehab (C33293)</i>	1	<i>Clean Debris from Track</i>	<i>\$80,000</i>	<i>Field Condition</i>
	8	<i>Additional Track-level Signs</i>	<i>\$40,000</i>	<i>Field Condition</i>
<b>7</b>	<b>11</b>		<b>\$1,585,450</b>	

We asked the responsible CPM design managers whether they agreed that the 11 AWOs above should have been classified as having been caused by design errors or omissions, as per CPM's

<sup>7</sup> The information that we reviewed included a general description of the AWO, the cost of the AWO and the AWO cause.

own definitions of AWO causes.<sup>8</sup> If the design manager was no longer employed at NYC Transit, we interviewed the design engineer who performed the work. In six of the 11 cases, either the responsible design manager or design engineer agreed with our determinations.<sup>9</sup>

The 8<sup>th</sup> Avenue Tunnel Rehabilitation is an example of an AWO incorrectly classified as a field condition that a CPM designer later agreed should have been classified as a design omission. However, since it was originally misclassified, the designer was unaware of the AWO until we contacted her during our review.

### Case Study #1

Contract: 8th Avenue Tunnel Rehabilitation (C33814)  
AWO #: 2  
Amount: \$1.1 million  
Date: September 2008  
Description: Catwalk Replacement

The contract's specifications did not include any work to repair catwalks in the tunnel. This work, which ended up costing \$1.1 million as an AWO, was missed by the CPM structural designer because she surveyed the tunnel from the walkways, rather than from the track level. While the drawings on file did not indicate the type of walkways in the tunnel, she had assumed that the walkways were the tops of solid concrete structures – a common tunnel feature. Instead, the walkways turned out to be catwalks, which are concrete slabs on pillars, with nothing underneath the slabs.

When the project was awarded, the CPM construction manager and the project manager for the contractor jointly surveyed the site and discovered that major portions of the catwalk undersides were deteriorating, necessitating full replacement of the concrete slabs. Since catwalk repair was not in the contract, NYC Transit needed to issue an AWO.

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<sup>8</sup> At NYC Transit, the design manager is responsible for managing all aspects of a design project and ensuring that all required design processes are performed.

<sup>9</sup> In two of the six cases, the design manager agreed with our determination. In three cases, the design engineer who was responsible for the design work that led to the AWO agreed with our judgments. In one instance, the design manager had retired, and we were unable to identify the responsible design engineer. In this case, we discussed our finding with the CPM official who was the responsible program manager when the AWO was finalized, and he agreed with our determination. A program manager is more senior than a design manager, because he/she is responsible for all project work, including design, in a specific programmatic area (e.g. signals and train control, station rehabilitation, systems and security).

The construction manager noted in the internal AWO summary that “an in-house Error and Omission is not involved,” and classified the AWO as an unanticipated field condition in his quarterly report. This classification was clearly erroneous, however, because the condition would have been readily apparent during the design phase upon inspection from the track level. Indeed, the problem was actually discovered during a subsequent survey conducted by CPM and the contractor. As such, the facts here did not fit CPM’s definition of a field condition.

The CPM designer who had surveyed the tunnel agreed that it was a design omission. She also stated that she had not gone down to the track level much during the survey because the length of tunnel to inspect was particularly long, the multi-disciplinary inspection group was large, and the inspection was conducted during continuous train traffic. As a result, she did not realize the structures were catwalks and that there were numerous significant defects on the catwalk undersides. In fact, the designer had been unaware of the true nature and condition of the structure until we contacted her during the audit. She said that she will now know to survey tunnels from the track level, and look out for defects in the catwalks during future tunnel inspections.

While CPM managers disagreed with our assessment of the remaining five AWOs, they did not provide adequate explanations to support their own assessments. One of those five is used as an example in case study 2 below. The other four are discussed in Appendix B,

### Case Study #2

Contract: 8th Avenue Tunnel Rehabilitation (C33814)  
AWO #: 20  
Amount: \$98,900  
Date: October 2009  
Description: Electrical and Communication Work

This AWO was comprised of four components including, in our view, one caused by a design error and one caused by a design omission. The contract specifications called for installation of electrical receptacles every 90 feet on the central columns of the tunnel that would be accessible to both tracks. However, during a pre-construction inspection the contractor and MTA construction manager found that instead of columns, there was a solid wall from 200<sup>th</sup> Street to 207<sup>th</sup> Street. Therefore, additional conduits and receptacles had to be installed so that they would be accessible to both tracks along this length of tunnel.

Since the responsible design manager had retired, and we were unable to identify the design engineer who was responsible for this project, we interviewed the CPM program manager for this project. The program manager told us that the

designers could not conduct a full inspection because they did not have access to the tunnel during design. He was apparently misinformed, though, given that the designers actually inspected the tunnel. And the solid wall should have been obvious during the tunnel inspection. Because OIG could not interview the designers, we could not ascertain why they missed this condition. Nevertheless, the corrective work fit CPM's definition of a design error, i.e., a change in work attributed to a mistake in judgment or work incorrectly done during design. The situation did not fit the definition of field condition, i.e., a situation at the project site that could not have been known at the time the project was designed.

Similarly, within this contract there was a new communications room at the 190<sup>th</sup> Street Station for which the contract drawings did not show needed lighting fixtures. Although classified as a field condition, this missed work is an obvious design omission, which was then added to the contract as part of this AWO.

### **Bundled AWOs**

In analyzing our case studies, we found that additional work of differing types and causes is sometimes bundled together, negotiated, and issued as a single consolidated AWO. For example, the summary form for the AWO in Case Study #2 (as well as the related quarterly AWO list) states that the AWO was caused by a field condition. However, this AWO contains multiple elements, each potentially caused by different circumstances. While bundling may have a valid business rationale, it can also have the effect of obscuring additional work necessitated by a design error or omission and result in a misclassified AWO, because according to CPM's procedures the consolidated AWO is assigned only one cause.

Therefore, the construction manager should clearly indicate on the AWO summary form that some of the additional work was caused by an error or omission, and forward the form to the responsible chief engineer or chief architect. CPM should also add a column to the existing quarterly AWO listing requiring the construction manager to indicate whether any AWO includes at least one element caused by an error or omission.

### **CPM Needs to Improve its Procedures for Ensuring that AWOs are Properly Classified**

We note that CPM had identified incorrect classification of AWO causes as a problem back in 1998. In August 1998, CPM completed a review of all 360 AWOs approved during the first quarter, and found that construction managers had misclassified 13 E/O AWOs (3.6 percent). To correct this problem, CPM modified its procedures for processing AWOs to require that construction managers send copies of all approved AWOs to the responsible chief engineer or chief architect, who is then to "verify that the stated reason for the AWO is correct."

However, two of the five chief engineers and the deputy to the Chief Architect at CPM told us that copies of approved AWOs are often not forwarded to their offices by the responsible construction manager. As a result, the causes assigned by construction managers to many AWOs

are not verified. Thus, some design errors and omissions are not caught and then studied in order to prevent them from recurring. For example, as noted in Case Study #1 (see page 9), the design engineer responsible for the structural design of the 8th Avenue Tunnel Rehabilitation had been unaware of the \$1.1 million AWO needed to correct deficiencies in the catwalk until we contacted her during the audit.

Furthermore, while we could not determine precisely why the individual AWOs included in our sample were misclassified, CPM employees made some candid observations during our interviews. For example, one manager told us that some construction managers are reluctant to draw attention to the mistakes made by design engineers, because they often need to work with them on future projects. Two other managers told us that the increased work load that results from designating an AWO as having been caused by an error or omission can be a deterrent. These observations indicate that there may be inherent disincentives for construction managers to identify problems with design work.

Because misclassification was an issue in 1998 and, as evidenced by our more recent work continues to be a problem, CPM needs to initiate ongoing quality assurance review related to the classification process. Rather than require that construction managers send copies of all AWOs to the appropriate engineering discipline or chief architect to ensure that AWOs are properly classified, CPM's Quality Management group, which conducts CPM's internal audits, should perform compliance audits of AWO classifications. We recognize that the Quality Management group might not currently have all of the staff with the necessary engineering skills to perform these audits. CPM should therefore provide any needed staffing resources to assist in the review.

Senior CPM managers should also re-instruct construction managers on the importance of properly identifying the causes of AWOs, and highlight the benefits of a properly functioning lessons-learned process for future project designs. The design error and omission category is particularly meaningful because misclassifications of them are missed opportunities to better evaluate staff, hold them accountable for their actions, and help them learn from their mistakes. On the other hand, accurate classification promotes better work, less delay, and lower costs.

Therefore, CPM should emphasize that properly identifying AWOs is a necessary and important part of the job, not a task to be avoided. Senior managers should also explain that the process for identifying E/O AWOs can and should be handled by construction managers in a non-confrontational manner, in order to minimize potential conflicts with designers. For example, the task of identifying AWOs could be approached as an opportunity to improve future designs and to reduce the cost of future projects.

The Senior Vice President of CPM agreed with us that the procedural improvements we recommended above are warranted.

### **Financial Risks Associated with E/O Misclassification**

The misclassification of an AWO as something other than a design error or omission increases the risk that designers will repeat the same mistakes on future contracts. Notably, the E/Os that we found to be misclassified involved over \$2 million in payments for additional work or reductions in work that had to be negotiated with contractors. Indeed, regarding nine of the 11 E/Os we analyzed, NYC Transit agreed to pay the contractors \$1,902,450 for additional work.

Even if work to correct the design errors and omissions would have had to be performed in the first instance, it will almost certainly be more costly to negotiate the same work later during the construction phase, because the price is then necessarily obtained through negotiation with a single contractor, rather than through a competitive procurement process. And at a minimum, NYC Transit incurs engineering and administrative costs to process the AWO.

Other factors that could make additional work more expensive to perform when belatedly necessitated by a design error or omission include:

- The contractor may need to tear down or rework installations already completed in order to accommodate the corrected design.
- When the additional work necessitates an extension to the contract's duration, CPM's cost to manage the project increases because it would have to continue to staff the project. CPM may also be required to pay the contractor "impact costs" because of the time extension.

As noted above, sometimes an AWO involves a reduction in the scope of work and consequent credit to NYC Transit. For example, we reviewed two E/Os where the contractor agreed to pay NYC Transit \$317,000 because NYC Transit needed less tile and concrete repair than was planned on a tunnel rehabilitation contract. Nevertheless, there may still be a negative financial impact on NYC Transit associated with these credit AWOs because NYC Transit may not receive the full value of the deleted work, and there remains the additional cost associated with processing the AWO.

While we cannot put a precise dollar value on the financial risks associated with misclassified AWOs, it is clear that strengthening the classification process will improve the quality of work, reduce delay, and minimize cost increases on future construction projects.

## RECOMMENDATIONS

1. Senior CPM managers should re-instruct managers on the importance of properly classifying the causes of AWOs and retrain them on how to do so.

*NYC Transit accepted this recommendation. The agency will be modifying its Project Management Procedures by the end of December 2011 to emphasize the importance of correctly identifying and categorizing AWO causes. Senior CPM managers will also be providing training on the new procedures to all construction managers and personnel.*

2. CPM's Quality Management group should perform compliance audits of AWO classifications utilizing independent engineering expertise.

*NYC Transit accepted this recommendation but differed somewhat as to approach. Once the new Project Management Procedures are issued and the employees are trained, CPM's Quality Management group will conduct audits to ensure compliance with the new procedures. However, since the CPM auditors are not registered professional engineers and architects, CPM believes it would not be appropriate for the auditors to determine whether AWO causes are properly classified. Also, according to the Deputy Vice President in charge of the Quality Management group, CPM does not have enough engineers from other units to lend to the group for the purpose of assisting the Quality Management auditors nor does it have sufficient funds to hire outside engineers for this task. Instead, CPM will increase the initial oversight of AWOs by instituting a "construction change management procedure" whereby senior CPM managers will review all AWOs that (1) individually cost more than \$100,000 paid to the contractor; (2) result in a cumulative cost for that AWO of more than \$200,000 when in-house or other non-contractor costs are included; or (3) lengthen the project schedule. This process is to be put in place by the first quarter of 2012 and will include a review by the senior CPM managers to confirm that AWO causes are properly classified.*

### *MTA OIG Comment:*

*While we remain concerned that the Quality Management group will not determine as part of its audits whether AWO cause classifications are accurate, we recognize the potential benefit of increased senior level oversight of AWOs through the planned "construction change management procedure" and expect that this will improve the accuracy of AWO categorization. We will continue to monitor these efforts as appropriate.*

3. In order to ensure that design errors and omissions in bundled AWOs are identified, the construction manager should clearly indicate on the AWO summary form and the quarterly AWO listing that some of the additional work was caused by an error or omission, and send copies of these reports to the responsible chief engineer or chief architect.

*NYC Transit accepted this recommendation. The changes to the AWO summary form and the quarterly AWO listing will be incorporated into the new Project Management Procedures as well as into the new training for construction management staff. Additionally, the Deputy Vice President in charge of the Quality Management group informed us that his group will perform audits to help ensure that the AWO forms and listings are sent to the responsible chief engineer or chief architect.*

## CONCLUSION

Additional Work Orders add significantly to the cost of construction primarily because the price of the work is obtained through negotiation with the existing contractor only, rather than through a competitive procurement process. Typically, NYC Transit, will have little leverage in these negotiations, because it needs the work to be done, and alternatives to working with the existing contractor will likely be even more costly. Additional costs also result when the contractor needs to tear down or rework an installation already completed, or the project schedule is delayed. At a minimum, NYC Transit incurs engineering and administrative costs simply to process the AWO.

Certainly, some AWOs are unavoidable, as when work is needed to address unforeseeable conditions or changes in technical standards that arise after the contract was awarded. On the other hand, AWOs caused by design errors and omissions are clearly avoidable and should not be repeated in future contracts. The first step in preventing repetition is for NYC Transit construction managers to accurately classify additional work caused by design errors and omissions.

As our review has revealed, though, some managers are reluctant to properly classify error and omission AWOs because they are hesitant to confront designers, with whom they may work on future projects, or because of the extra paperwork that these classifications entail. Given that nearly 25 percent of our sampling of AWOs were caused by design errors and omissions but had been misclassified, it is clear that NYC Transit must change its ways or face a significant and continuing risk of repeating design mistakes. While we cannot now put a precise dollar value on the financial risks associated with misclassified AWOs at NYC Transit, it is clear that strengthening the classification process will improve the quality of work, reduce delay, and minimize cost increases on future construction projects.

Importantly, though not part of our audit, it seems clear that the risks associated with misclassification of design errors and omissions naturally extend to the other agencies within the MTA, including the Long Island Rail Road, Metro North Railroad, the Capital Construction Company and MTA Bridges and Tunnels. Indeed, the benefits of our findings and recommendations could be even greater for those agencies that have a higher percentage of design work performed by outside consultants, who could be financially liable to the agency for their mistakes. With this in mind I have discussed our report with the MTA's Office of Construction Oversight and have forwarded copies to the presidents of the MTA agencies, asking them to carefully consider our findings and recommendations in the context of their own operations. By doing so, we believe, the agencies can further improve work and reduce delay throughout the MTA and, over the long term, may well save millions of dollars in the process.

## APPENDIX A: CPM DEFINITIONS OF AWO CAUSES

<b>AWO Cause</b>	<b>Definition</b>
Design Error	Change in work attributed to a mistake in judgment or work incorrectly done during design.
Design Omission	An oversight in the design that results in additional work that should have been included in the original contract document.
Field Condition	An unforeseen condition discovered during construction that was not known or not reflected in the contract documents.
Changed Standards	Technical requirements that have been revised and not reflected in the contract documents.
User Request	Work requested by user/sponsor department in order to improve safety, functionality, or operations.
Dispute Determination	Additional work or adjustment to the contract as a result of disagreements between contractor and NYC Transit that were found to have merit.
Contractor Request	A change to the scope recommended by outside parties determined at NYC Transit's discretion to have merit.
Design Enhancement	Change to the contract initiated by the Resident [Engineer], Construction Manager, or Design Manager that improves the design with regard to life cycle cost, maintenance or operability. No design error or omission is involved in the change.
Other	Other than an established justification listed here.

### APPENDIX B: AWOS THAT CPM DISAGREES ARE MISCLASSIFIED<sup>10</sup>

<b>Contract Title</b>	<b>AWO #</b>	<b>AWO Description</b>	<b>Cost of AWO</b>	<b>Date Issued</b>	<b>AWO Cause as per Quarterly AWO Report</b>
Brighton Line Stations Rehabilitation (A35870)	10	Additional platform edge repair work at Newkirk Station	\$420,000	4/9/2010	Field Condition

**Description:** The station's platforms are concrete slabs resting on concrete pillars. The design was based on a survey conducted about ten years before construction, and the CPM designers had not completely inspected the undersides of the platforms. The design only included repairs of the platform edges. During a pre-construction inspection, the contractor saw that sections of the platforms needed full replacement, not just edge repair. NYC Transit managers have stated that the designers could not view the undersides of the platforms. However, as noted on the AWO summary form, the contractor was able to view the undersides during the pre-construction inspection.

<b>Contract Title</b>	<b>AWO #</b>	<b>AWO Description</b>	<b>Cost of AWO</b>	<b>Date Issued</b>	<b>AWO Cause as per Quarterly AWO Report</b>
Grand Avenue Bus Depot (C40418)	44	Valves, ladders in underground tanks, and changes to diesel system	\$61,200	8/9/2006	User Request

**Description:** This AWO is comprised of three elements. The first element required the installation of a new type of valve. The designer used an older engineering standard that had been superseded. The second element required a change in manhole design, because the designer had again used an older standard that had been superseded. These two elements should have been classified as a design error, because the designer should have been aware of the revisions that had occurred in NYC Transit's requirements prior to the completion of the design. The third element required the removal of an access ladder that had been installed in an underground tank in accordance with the contract. The ladders were in the way of a mechanical measuring device in the tank, and had to be removed. In our view, this element should be classified as a design error, because it involved an error in judgment. The designer should have

<sup>10</sup> As described in the text, OIG concluded that 11 of the 46 AWOs we reviewed were misclassified by CPM. Of those 11, CPM managers agreed with us that six were misclassified. Although these managers disagreed with our assessment that the remaining five AWOs were also misclassified, they did not provide adequate explanations to support their own assessments. For the benefit of the reader, we discussed one of those five AWOs as an example in case study 2 (on page 9). The other four disputed AWOs are discussed here.

foreseen that the ladder would block access to the measuring device. While CPM managers did not agree with our assessments, they did not provide clear reasons as to why our conclusions were incorrect.

<b>Contract Title</b>	<b>AWO #</b>	<b>AWO Description</b>	<b>Cost of AWO</b>	<b>Date Issued</b>	<b>AWO Cause as per Quarterly AWO Report</b>
Joralemon Tunnel Rehabilitation (C33293)	8	Additional "No Clearance" signs	\$40,000	11/17/2006	Field Condition

**Description:** During construction it became apparent that additional replacement "No Clearance" signs were needed in the tunnel. (No Clearance signs warn workers that there is no room on the side of the tracks when a train passes.) The program manager stated that it is difficult to survey a tunnel since it is necessary to stop continuous train traffic in order to perform the survey.

However, as seen in Case Study #1 (Page 8), designers do survey the tunnels during the design stage of the project without stopping train traffic. In addition, each year NYC Transit's Maintenance of Way (MOW) Division inspects each subway tunnel, and it too performs this work without stopping train traffic. In fact, several managers told us that CPM coordinates its design surveys with the MOW inspections. Though it is not clear from the project file why the designers did not coordinate with MOW in this instance, we emphasize that such coordination is essential to make the process efficient as well as effective. In any event, the designers here could certainly have determined how many signs needed replacement and not omitted this work from the design. Given that the condition was clearly foreseeable, it did not qualify as a "field condition."

<b>Contract Title</b>	<b>AWO #</b>	<b>AWO Description</b>	<b>Cost of AWO</b>	<b>Date Issued</b>	<b>AWO Cause as per Quarterly AWO Report</b>
Dyckman Substation (P36248)	27	Re-route battery & control conduits to positive duct bank	\$4,600	9/25/2008	Field Condition

**Description:** Positively charged battery and control cables (and the conduits they run through) were originally designed to be placed within ducts containing negatively charged cables – an arrangement that would increase the likelihood of a short-circuit. Although during construction, as evidenced by project records and our interviews, managers realized the flaw in this design and issued this AWO to run these positively charged cables and conduits through separate ducts, the AWO cause was nonetheless classified as a "field condition." Significantly, CPM managers did not provide us with clear reasons justifying this classification and explaining away the evidence establishing that the AWO resulted from a design error.