Case Study as to the Effectiveness of Dispute Review Boards on the Central Artery/Tunnel Project

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Abstract: The most prevalent use of the Dispute Review Board (DRB) process in the United States to date is the central artery/tunnel project located in Boston. A DRB is a three-member panel jointly chosen by the contractor and owner that is present throughout the course of the contract, and whose responsibility it is to hear disputes contemporaneously with their occurrence. This paper reviews the efficacy of the DRB on the central artery/tunnel project answering such questions as to whether or not (1) there was any discernable bid savings between DRB and non-DRB contracts; (2) the DRB was successful in resolving all disputes prior to contract completion; (3) there were any barriers to the DRB’s effectiveness, concerning bid savings; and (4) the DRB reduced the costs of resolving disputes. The questions are timely and important in an industry that looks for new ways to reduce construction costs and values timely prevention and resolution to disputes.

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Introduction

The most prevalent use of the Dispute Review Board (DRB) process in the United States to date is the Central Artery/Tunnel (CAT) project located in Boston. A DRB is a three-member panel jointly chosen by a contractor and an owner that is present throughout the course of the contract. When a dispute occurs it hears both parties’ presentations concerning the dispute at hand and then issues a nonbinding recommendation as to the disposition of the dispute.

The CAT project, fondly called by its nickname “the Big Dig,” is considered one of America’s foremost megaprojects; it is the largest and most complex urban transportation project in United States history. Its relative magnitude is compared with the pyramids and Panama Canal in both cost and scope (Bechtel/Parsons Brinkerhoff 2006; Bechtel 2007; Coughlin and Strahinich 1993; Grunwald 2006; Pacheco et al. 2004). The CAT’s project actual construction work operations spanned from 1991 to substantial completion in December 2005 with the full opening of I-93 South, Dewey Square tunnel, I-90/I-93 interchanges, and Leonard P. Zakim Bridge (Amorello 2005).

Central Artery/Tunnel Project History

The original elevated central artery was constructed in 1950 and completed in 1959 (Angelo 2006; Flynn 1998). The elevated central artery carried approximately 75,000 vehicles a day and was originally intended to work with the inner belt, which circled downtown Boston from the south end and back bay across the Charles River to Cambridge and Charlestown (Background 2006). However, the construction had unintended consequences in that it separated Boston’s north end and water front from its downtown thereby cutting off economic development in the north end and waterfront areas (Background 2007). The elevated Central Artery was reported to carry more “cars per lane than any other highway” in America (Flynn 1998, p. 47), with traffic jams lasting 8–10 h a day and an accident rate four times the national average for urban interstates (Background 2007).

In 1972, a report was prepared by the Boston Transportation Planning Review suggesting to demolish the existing elevated central artery and reconstructing it below ground (Boston Transportation Planning Review 1972). The economic impact of such a plan was projected to revitalize Boston’s waterfront and remove the visual “eyesore” of the original central artery. The new underground highway system would optimize opportunities for increased tourism as well as enhance land values (Boston Transportation Planning Review 1972; Grunwald 2006, p. B02). However, federal funding was needed to make the project a viable one, and in 1987 it was secured covering 90% of the costs for a new, underground central artery and a new Boston Harbor tunnel connecting to Logan Airport (Massachusetts State Auditor’s Office 2002).

Construction of Central Artery/Tunnel

The Massachusetts Department of Public Works (MDPW) hired the joint venture of Bechtel/Parsons Brinkerhoff as management consultant in 1985 (Massachusetts State Auditor’s Office 2002). Bechtel/Parsons Brinkerhoff was contracted to provide design services, coordination among and between designers, contractor administration and coordination, safety monitoring, project over-

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sight, cost and schedule reporting, inspection services, and providing recommendations to enable the owner to make informed decisions (Bechtel/Parsons Brinkerhoff 2006; National Academy 2003; Miller 2002). The MDPW retained the authority to actually make decisions (National Academy 2003). Ultimately, in 1997 the Massachusetts Turnpike Authority (MTA) (or owner) was designated to be the owner of the project. Bechtel/Parson Brinkerhoff’s project’s role ended in December 2005 when all administrative and project functions were turned over to the MTA. At that juncture, Bechtel/Parson Brinkerhoff provided support services to the MTA (Bechtel/Parsons Brinkerhoff 2006).

Central Artery/Tunnel Project

As constructed, the CAT project spans 7.8 miles of highway, 161 lane miles in all, about half in tunnels, and was designed to carry 245,000 vehicles/day. The CAT project has two major components. The first is replacing the six-lane elevated highway with an 8–10-lane underground expressway directly beneath the existing road, culminating at its northern limit in a 14-lane, two-bridge crossing of the Charles River. The second is the extension of I-90 (the Massachusetts Turnpike) from its former terminus south of downtown Boston through a tunnel beneath South Boston and Boston Harbor to Logan Airport (Background 2007).

The initial cost estimated in 1982 U.S. dollars was $2.6 billion, which was based on a preliminary concept without technical studies being performed (Bechtel/Parsons Brinkerhoff 2006; Ginsburg 2004; Micciche 2001; National Academy 2003; Pacheco et al. 2004). It originally was to be completed in 1998 (National Academy 2003; Pacheco et al. 2004). The project’s eventual cost was $14.625 billion (or $8.0 billion in 1982 U.S. dollars) (Amorello 2005; National Academy 2003; Pacheco et al. 2004), with federal contributions capped at $8.5 Billion (Micciche 2001). Substantial completion was achieved in 2005 (Angelo 2006; Bechtel/Parsons Brinkerhoff 2006), $12 billion over the original budget and seven years later than planned.

There is some dispute as to the causes of the cost growth. According to Bechtel/Parson Brinkerhoff (2006), the cost increase was the result of many events, not the least of which were escalation, scope changes, design issues, and the like (Bechtel/Parson Brinkerhoff 2006). However, the MTA (or owner) noted cost increases also were the result of acceleration and contractor claims for schedule extension, overhead costs, and impact costs (Amorello 2002), all within Bechtel/Parson Brinkerhoff’s purview (Sullivan 2003a, b, 2004). Further discussion on cost growth is beyond the scope of this paper.

Dispute Review Boards—History

The DRB is a unique, nonadversarial project management technique that is a proactive, dispute prevention and resolution method utilized during the course of construction seeking to resolve a dispute contemporaneously (Harmon 2003a). DRBs are based on the premise that early attention to a conflict generally will lead to its prevention (ASFE 1988) or to its timely settlement (Jones 1995). The success of a DRB is defined as resolving all disputes contemporaneously during the construction of the project with no unresolved disputes at contract completion (Harmon 2003a, b).

The first DRB was the second bore of the Eisenhower Tunnel at Loveland Pass, CO (Silberman and Battelle 1997). The project was built between May 1975 and open to traffic on December 21, 1979, at a cost of $106 million (Coffee 1998; Eisenhower Tunnel 2007; Smith 1997), two years late, and 117% over the original contract cost (Denning 1993, p. 43; Eisenhower Tunnel 2007; Mathews 1997). Not willing to repeat past mistakes, in the contract documents for the second bore, the Colorado Department of Highways required a review board to make nonbinding recommendations concerning disputes that arose during the course of the project. Although the contract for the second bore did not require organization of the DRB until it was needed, the parties agreed to organize the board at the beginning of the project. The project had four disputes heard by the DRB and all were resolved prior to the contract closeout and without litigation (Bramble and Cipollini 1995; Mathews 1997). With this and subsequent successes, DRBs are now utilized in virtually every area of commercial construction, from tunnels and bridges, to airports, buildings, cogeneration plants, roadways, etc., in the United States, Europe, India, China, Great Britain, and Australia.

DRB Process and Procedures

The DRB is included in the contract terms and organized before construction began. The contractor selects one member and the owner another with each approving the other’s choice (Division I Subsection 7.16 of the General Conditions). A third member is selected by the two chosen DRB panelists. Members of the DRB are highly qualified with substantial engineering or construction experience. The project documents require DRB panelists to have at least 10 years experience in their respective professions and substantial experience in the type of construction involved in the contract, as well as experienced in contract interpretation and construction claims (Perini versus MHD 2005). The Each DRB panelist serves a term of one year, which could be renewed automatically unless either party elected otherwise. The costs of the DRB are shared jointly by the owner and contractor.

The DRB was to hear disputes and issue a nonbinding recommendation as to how the dispute should be resolved. This recommendation would then be referred to the MTA’s project director, who would accept or reject all or part of the recommendation. If the contractor disagreed with the project director’s decision, it would appeal such a decision to the Massachusetts Highway Division Board of Contract Appeals or file suit in Superior Court. There is a defined period of time to appeal or file suit in the contract. If the contractor does not file on appeal within the prerequisite time, the project director’s decision shall be final and binding, and further judicial review is barred (MHD versus Perini, 2001).

DRB during Construction Operations

The DRB receives copies of the contract documents, makes a project inspection tour, meets periodically at the site, and is kept informed of project developments. In the event a dispute occurs that the owner and contractor cannot settle on their own, the DRB schedules a hearing where both sides of the dispute can be argued, and produces a written recommendation for its suggested resolution of the dispute. The process allows the parties to have an opportunity to be heard, and they recognize that the DRB members have technical expertise and a firsthand understanding of the project, allowing for a realistic determination as to the disposition of the dispute. Although the decision is not binding, statistics
reveal that the parties usually defer to the judgment of the board in settling the dispute; essentially, to do otherwise would defeat the purpose of having a DRB (DRBF 2007).

Case Study

Data for this study were gathered from 2002 to 2006 from many sources, including, but not limited to, the Big Dig website (2002–2006), Central Artery/Tunnel field staff, construction contract detail reports, published reports, audits, hearing testimony, etc. A full list of sources is included in the Appendix.

This study was limited only to construction contracts on the Central Artery/Tunnel Project, excluding design and procurement contracts. This study reviewed data on 86 construction contracts that had notice to proceed issued during the period of February 1990 (C21A3) to 2004 (C08A8) (see the Appendix for a full listing). Of the 86 contracts, 46 contracts had DRBs (DRB contracts) included as a dispute resolution mechanism in the bid and contract documents. The remaining 40 projects did not include DRBs (non-DRB contracts) in either the bid or contract documents. The combined value of the construction portion of these contracts had an original contract value of $6.758 Billion. (Flagging costs, provided by the police, and other third party costs are not included.) The actual costs expended on these 86 construction contracts, including executed change orders, as of December 21, 2004, was $8.9 billion (see the Appendix).

The final contract amount of DRB contracts (as of December, 2004) is $8,399,743,956, ranging from $10,987,579 (C01A21) to $408,199,892 (C17AB). The final contract amount of non-DRB contracts is $481,172,247, ranging from $374,010 (C21AB) to 19,983,533 (C13A1) (see the Appendix). The project achieved substantial completion in 2005 (Angelo 2006; Bechtel/Parsons Brinkerhoff 2006), although work continued into early 2006. Nevertheless, many of the individual contracts achieved substantial completion prior to 2005.

Study’s Purpose

Some authors (Denning 1993; “Dispute” 1991; “Hope” 1987) assert that having a DRB as a dispute resolution mechanism in the contract documents reduces bid prices due to reduced contingency loadings resulting from the risk sharing between contractors and the Owner. However, it has been opined, bid prices are generally not reduced as a result of the DRB inclusion into a contract (Harmon 2004a,b). Because of this conflicting information, the question still begs to be asked; does having a DRB provision on this project result in lower bid prices? Can the “bid savings” be quantified? Is there a significant difference in bid savings between DRB and non-DRB projects? (For comparison, see Fig. 1)

Additionally, some authors (e.g.; Bramble and Cipollini 1995; Chapman 2001; CII 1995) have asserted that having a DRB reduces and/or eliminates the escalation of conflicts. Does the fact that a project has a DRB almost “guarantee” that all change orders, conflicts, and disputes on a project will be resolved as some have asserted? These are important questions, considering the fact that both owners and contractors desire cost efficiency when determining whether or not to initialize any new product or idea.

In reviewing the data and literature for this case study, four overall questions are addressed:

1. Does the use of DRBs reduce bid prices?
   a. Is there a significant difference in bid savings on a DRB contract versus a non-DRB contract?
2. Was the DRB successful?
   a. Were all change orders/claims resolved for all disputes prior to contract close out?
3. What were the barriers to the DRB’s effectiveness?
4. Does the use of DRBs reduce the cost of resolving conflicts?

Does Use of DRBs Reduce Bid Prices?

Engineer’s Estimates and Contractor Bids. At the planning stage of a project, the engineer’s estimate is used to set aside funds for the construction of the project as well as the evaluation of contractor bids for the project (Bledsoe 1992). The engineer’s estimate must be as accurate as possible since it represents the money that will be spent when the project finally is constructed. Contractors competing for work submit firm bids using the same information as in the engineer’s estimate, which are the plans, specification, and contract documents prepared by the owner’s
design team.

Therefore, it could be argued that both the bidding contractors and Bechtel/Parsons Brinkerhoff had similar knowledge and information that should result in contractor bids roughly akin to the engineer’s estimate. Although the scope of the contract was unique for each and every contract, the main variables: the owner, nature of the work, location, work environment, etc., were similar. The main variable, outside the uniqueness of each contract, was that some 46 contracts had DRB provisions in the contract as opposed to 40 that did not. So, if all else is similar, e.g., the owner, nature of the work, individual project variables, etc., does the presence of a DRB provision in the contract influence the contractor’s bid pricing? Are there bid savings on DRB contracts versus non-DRB contracts? If both DRB and non-DRB contracts experience bid savings, then is there a statistical significance between the bid savings on those contracts with DRBs as opposed to those without DRBs? Essentially, does the owner reap a financial reward for having a DRB provision in its contract influence contractors to submit lower bid amounts? While the results of one study (Harmon 2004a) indicated that most contractors did not reduce their bids because of a DRB contract provision, there have been limited empirical data to indicate whether or not a DRB contract provision is a factor in having reduced bid prices.

Data Analyzed—Engineer’s Estimates. On September 2, 2003, engineer’s estimates for 64 (74%) out of the 86 construction projects were accessed from the World Wide Web (http://www.bigdig.com/html/contlist-a.htm) (see the Appendix). The engineering estimates for the 64 projects totaled $6,214,422,600. The contract award amounts for these contracts totaled $5,433,836,227. Bid savings, characterized as the difference between the engineer’s estimate and the contract award amount totaled $780,586,372.76 (for an average savings of 12.56%). Of the 46 DRB contracts, engineers estimates were available for 37 contracts (80%). The average bid savings for DRB contracts was 13.4%. The total bid savings for the DRB contracts were $725,955,110. Of the 37 DRB Contracts, $5,433,836,227. Bid savings, characterized as the difference between the engineer’s estimate and the contract award amount totaled $780,586,372.76 (for an average savings of 12.56%). Of the 46 DRB contracts, engineers estimates were available for 37 contracts (80%). The average bid savings for non-DRB contracts was $34,946,564 (C15AA) higher. The average bid savings was 12.25%. Of the 27 non-DRB contracts, 17 (63%) had bid savings while 10 (37%) non-DRB contracts had contract awards over the engineer’s estimate. The mode was 53% (Fig. 2).

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<th>Average savings (%)</th>
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<td>DRB projects</td>
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Discussion. While there was a substantial bid cost savings for both DRB and non-DRB contracts, there was no statistical significance between the bid savings of DRB versus non-DRB contract. In other words, having a DRB provision did not influence the contractors to submit a lower bid price than they would have submitted had the provision not been included in the contract documents. While there are many factors in estimating the cost of a project, whether or not a DRB provision is included in the contract is not one of them.

Was DRB Successful? Were All Issues (Change Orders/Claims) Resolved prior to Contract Completion? The data received consisted of the construction contract detail reports generated by the owner’s field personnel and project consultants and made available to this researcher from September 2005 to April 2006 (see the Appendix).

As of April 2006, 28 issues were presented to the DRB panels on 12 projects. Contractor claim amounts totaled $169,263,570, ranging from $16,255 (C04A2) to $54,000,000 (C11A1). Of the total contract claims of $169 million, the DRB issued recommendations suggesting payout amounts totaling $42,408,564 (Larry Delmore, personal communication).

Of the $42 million recommended payout amount, the owner paid out $7,462,000, essentially 4% of the total claim amount, or 18% of the recommended payout amount.

Unresolved Issues as of April 2006. CAT project members define a claim as a change order request whether or not it is unresolved or uncontested (National Academy 2003). In this paper, we define a dispute as an unresolved issue, change order, and/or claim.

As of April 2005, 3,640 claims/disputes were unresolved, with
a contractor’s claimed value of $441.6 million contractor’s value (Amorello 2005, p. 12). A year later, in April 2006, a total of 1,735 claims/disputes remained unresolved. Of these claims/disputes, 34 (74%) were on DRB contracts (amounting to $57,569,773) (see the Appendix). As previously noted, the project’s substantial completion was in December 2005. However, four months after the project’s substantial completion and months and/or years after each individual contract’s substantial completion (see the Appendix), change orders/claims amounting to $57 million were still unresolved, whereas out of the 40 non-DRB contracts, only six projects (15%), amounting to $794,366, had unresolved claims/disputes.

Discussion. The reasoning behind the exceptional number of claims/disputes on the project was investigated by an independent project review team (National Academy 2003). It was their determination that the exceptional number of changes/claims were due to the fact that many of the contracts had completed civil design but required modifications to accommodate project wide systems that were designed in later contracts (National Academy 2003). The National Academy opined that the incomplete designs were the cause of the “high rate of claims and changes” (National Academy 2003, (p. 16) experienced by the project.

Essentially, although the majority of issues were resolved on the entire project, $57 million (1,735) claims/disputes were left unresolved at the entire project’s substantial completion. Moreover, a greater percentage of DRB contracts as opposed to non-DRB contracts had unresolved claims/disputes.

More importantly, some of these claims/disputes languished unresolved for years. The Appendix lists the number of unresolved issues as well as the individual contract’s substantial completion dates. As can be seen, the claims/disputes remained stagnant from between one month to over eight years (see the Appendix). Information as to the number of open issues at each contract’s substantial completion was not made available to the researcher. However, it is noteworthy to mention that as early as 2003 unresolved change orders/claims in the amount of $188 million, some between two and seven years old (Mead 2003) existed. Therefore, having claims/disputes languishing into 2006 seems to be in keeping with the backlog of unresolved claims experienced throughout the project’s duration. Clearly, having a DRB did not achieve its ended end, to wit, to resolve all claims/disputes prior to contract completion. Of the DRB contract claims/disputes, a total of $56,775,407 was unresolved as of April 2006. However, this figure must be kept in perspective, while $56.8 million in claims/disputes is significant, it is a mere 0.64% of the total $8.9 billion in construction contract payments and only 2.68% of the total executed change order amount of $2,122,226,871.

Therefore, if having a DRB was intended to bring an expedient and contemporaneous resolution to unresolved issues/claims, why were so many issues left unresolved for such extended periods?

What Were Barriers to DRB Effectiveness?

Given the fact that DRBs are purported to reduce or eliminate disputes prior to contract completion and more DRB versus non-DRB contracts had many unresolved issues months/years after substantial completion, why were DRBs underutilized? Moreover, why were so few disputes brought before the DRB? As noted previously, as of April 2006 only 28 issues were brought before the DRB for a formal hearing. The majority of the disputes, change orders, and claims were resolved by other means. However, Shipley (1999, 2000) attributed the low level of presentation of claims/disputes to the DRB as evidence of the success of the project’s partnering efforts. Nevertheless, this opinion was not borne out by the excessive number of unresolved issues as of April 2005 and April 2006.

Not one factor appears to be the sole factor in the underutilization of the DRB, but several appear to have influenced the owner as well as the DRB contractors to ignore the benefits of the DRB process. These are as follows:

- Elongated dispute resolution process;
- DRB process viewed as adversarial;
- Preparation for the hearing was time consuming;
- Issue with the recommendations—they were not convincing; and
- Recommended settlement amounts below historical average.

Elongated Dispute Resolution Process. One barrier is the elongated dispute resolution process in the contract. As admitted by the (MTA 2001) the contract contained an “extensive multilayered evaluation process…to deal equitably with claims by contractors.” This extensive process required the contractor to present its claim to progressive levels of senior management for review prior to being allowed to request a hearing before the DRB. Another factor extending the settlement process and adding a large delay was that change orders over $250,000 were requested to be forwarded to the CAT’s legal staff (Angelo 2006). Although a stepped process generally is advisable, disputes that travel through an elongated process risk having positions harden because of the psychological investment individuals make in the development and arguing merits of the dispute.

The whole purpose of a DRB is to resolve disputes contemporaneously. Disputes should be taken to the DRB when either party recognizes that a negotiated settlement is unlikely (“Dispute” 1991). For reasons discussed below, this did not happen. While hope springs eternal, those experienced in the industry know that the longer a change order/claim sits and awaits resolution, the more positions harden and cost grows. Essentially, the older the claim, the harder it is to resolve.

The experience with DRBs on this project and the timing of when issues can be brought to hearing was in sharp contrast to the Corps of Engineer’s use of DRBs. In these projects the COE process allowed factual disputes to be resolved at the contracting officer level and a DRB hearing was held prior to the contractor filing an appeal to the contracting officer’s decision to the Board of Contract Appeals (Libbey 2000). The timely use of DRBs was shown to reduce delays, claims, and cost overruns (“Dispute” 1991). But its untimely use negated the positive attribute of the DRB process and resulted in the experience encountered on this project.

DRB Process Viewed as Adversarial. As commented on by the CAT staff, the DRB process itself resembled arbitration in that a contractual tribunal conducts the hearing and renders a decision. This observation is not new and has been commented upon in court decisions (e.g., Schulster versus Traylor 2003) and in other literature (e.g., Denning 1993; Genton 1999). The DRB process, wherein a formal presentation is made by the parties, generally with the assistance of outside counsel and/or consultants, was viewed by some CAT staff as adversarial by its very nature. Although cross examination was not allowed, allegations were responded to and questions of witnesses by the DRB were common. Moreover, Thibaut and Walker (1975, 1978) demonstrated that disputants prefer procedures that mirror the traditional trial system, such as the process of having witnesses testify, hearing evidence, and rendering of a legal decision. Lind and Tyler have
claimed that “people react more favorably to procedures that give them considerable freedom in communicating their views and arguments” (Lind and Taylor 1988, p. 9). The fact that the DRB hearing is trial-like does not, in and of itself, make it adversarial. The fact that the parties after traveling through an elongated dispute resolution process still could not resolve the dispute among themselves likely was to be the genesis of the adversarial attitude of the parties.

**Preparation for Hearing is Time Consuming.** An additional issue prohibiting the effectiveness of the DRB was that in preparing for the hearing, virtually “no stone was left unturned,” in that both field and contract administrative staff developed “briefing books, charts and graphic displays, schedule analyses and other exhibits” (Shipley 1999, 2000, p. 5). It seems apparent that the DRB process took on the same “scorched earth” characteristics as currently exists in arbitration. Again, the psychological investment in terms of effort as well as the financial investment in terms of consulting and legal fees may have contributed to the decision not to bring unresolved issues before the panel.

**Issues with Recommendations.** As noted by Genton (1999), in utilizing the DRB, the parties have obliged themselves to act in good faith and be ready to “reconsider their position in light of the DRB recommendation” (Genton 1999, p. 68). In fact, ignoring or refusing to accept a well-argued recommendation basically defeats the purpose of a DRB. The recommendation that does not adhere to contractual terms and conditions but attempts to make a “fair” determination acts as another barrier to the DRB’s effectiveness. The party’s relationship is structured within the “four corners” of the contract. This defines not only the scope of the work, but also other responsibilities including the expectations, such as notice, delay, payments, etc. If the recommendation does not adhere to the terms and conditions of the contract, no matter how “unfair” they appear to the DRB, then it is likely that the recommendation will be rejected by one party.

Also influencing whether or not an issue is settled is the written recommendation itself. The main purpose of the recommendation is to “convince the parties of the ‘wisdom’ of the panel’s” (Harmon 2004b, p. 291) proposed settlement. The recommendation is the way the DRB demonstrates its knowledge of the project; understanding of both sides of the dispute, as well as the analysis of the solution to the disputes, the recommendation itself. A well-crafted, well-argued, recommendation was not always developed by the panel. The owner’s project director is the final decision-making authority. His decision is based on many factors, not the least of which is the written recommendation of the DRB. The owner’s project director does not have any first-hand knowledge of the dispute and may not know the DRB panel members themselves, so the main representation the project director has in evaluating the value of the DRB’s suggested settlement is the written recommendation. If the recommendation is neither well crafted nor well argued, it is unlikely that its suggestion as to the disposition of the matter will be accepted without modification by the project director.

The following is illustrative of one recommendation:

1. **DRB merit entitlement summary:** The claim elements reviewed by the board and the board opinion on the merit are as follows:
   a. Direct cost of added scope: partial merit of contractor’s claim.
   b. Impact to contract work: partial merit of contractor’s claim.
   c. Field support costs: partial merit of contractor’s claim.
   d. Subcontractors’ extended overhead: no merit to contractor’s claim.
   e. Contractor’s extended overhead: no merit to contractor’s claim.

There is no discussion of the issue, the parties’ arguments, the contractual support of the arguments or counterarguments, nor what was or was not convincing to the panel. There is a one line monetary amount recommendation with no description on how that amount was calculated. A well-crafted, well-detailed, and fully explained recommendation can be an invaluable “wake up call” to upper management as to the likely disposition of the dispute, but if the recommendation is poorly argued, lacking the recitation of the parties’ claims and rebuttals, lacking a demonstration that the panel understood the messages the parties attempted to convey, and failing to demonstrate a “solid understanding of facts and issues” (Harmon 2004b, p. 291) and/or the appropriate contract language to support the panel’s recommendation is missing, then the wake up call is not heard.

But, how does the DRB convince the disputants as to the equitable solution to the dispute without the above-mentioned discussions? If the recommendation is the “tool for settlement” (Harmon 2004b, p. 294), then it should be crafted as a stand alone document enabling a final decision maker, in this case the project director, to have a full, but pithy understanding of the issues and be convinced as to the logic and reasoning behind the suggested settlement. The manner in which the recommendations were crafted may have influenced the owner’s reduction of the $42 million in recommended settlements to $7.5 million.

**Recommended Settlements below Historical Averages.** Historically, contractor claims (which included change order) that totaled over $2.9 billion have been settled for approximately $1.4 billion (49.9%) of the contractor’s initial requested amount (Massachusetts State Auditor’s Office 2002, p. 6; National Academy 2003, p. 21). If the 49.5% payout held true for the issues brought before the DRB, then the $169 million in claims argued would have been settled for approximately $84.3 million. However, the DRB recommendation suggested a payout of $42 million or 25% of the contractor claim amount. Additionally, of this $42 million recommended payout, the owner paid out $7.5 million or 4% of the claimed amount (Larry Delmore, personal communication). Both these percentages were significantly less than the average claim/change order payout noted in the aforementioned reports (Massachusetts State Auditor’s Office 2002, p. 6; National Academy 2003, p. 21).

It is likely that the contractors were dissatisfied with this result. The concept of customer satisfaction has been studied widely (e.g.; Hunt 1977; Taylor and Baker 1994; Westbrook 1980). These studies indicate that when a customer is satisfied with a product or service, (s)he is more likely to repeat the service and recommend it to others (Martinez-Tur et al. 2006). People expect consumption experiences to be fair, and negative reactions occur when they believe they have been subject to unjust outcomes or procedures (Clemmer and Schneider 1996). Contractors have a justice motive and judge their relationships with institutions using fairness as a fundamental base (Martinez-Tur et al. 2006). In other words, by the mere fact that DRB quantum recommendations were far below average settlement rates may have influenced contractors in believing the outcome was unfair even if the process required to obtain the recommendation was considered fair.

As revealed in earlier studies (Harmon 2003b, 2004b), procedural and interactional justice influences the success of the DRB
process. The fair process effect in procedural justice studies reveals that procedural justice positively influences reactions to unfavorable outcomes (Folger et al. 1979). Explained differently, it means that if the process is considered fair, even if the outcome is not what one expected or hoped for, the parties are satisfied with it. Of equal importance are studies that show that the fair process effect can be supported by the presence of social comparison information—because this information is a key reference point in the evaluation of the outcome (Van der Bos 1997, 1998). In other words, the fair process effect takes a back seat if there is a reference, such as the historical payout of change orders and claims, in evaluation whether or not the outcome was fair.

The fair process effect varies with the presence or absence of social comparison information (Van der Bos and Lind 2002). Therefore, when the average settlement of change order/claims was known to be approximately 50% (Massachusetts State Auditor’s Office 2002, p. 6; National Academy 2003, p. 21), contractors had a reference point upon which to judge the DRB recommended settlement amounts and/or the different settlement amount proposed by the project director. In the assessment on whether or not the settlement amount was “fair,” Thibaut and Kelly (1966) in their seminal study demonstrated that when individuals lack experience, other referent standards (for example, what other contractors were being paid) are likely to exert significant influence on the perception of fairness. Once individuals have a comparison benchmark, that benchmark will be the reference point as to whether or not the outcome, i.e., DRB recommendation and project director settlement figure, is fair (Goodman 1974; Masters and Keil 1987). Therefore, we can conclude that even if the DRB process was considered fair but the outcome unfair, the contractors have no incentive to utilize a process that will result in an unfair outcome.

The information concerning the average 50% settlement rate could have been accessed by published information (Massachusetts State Auditor’s Office 2002, p. 6; National Academy 2003, p. 21) or by word of mouth, which have been shown to be key factors that influenced the expectations and satisfaction of contractors (Oliver and DeSarbo 1988; Oliver and Swan 1989; Zeithaml et al. 1993). Basically, when the level of the recommendation and/or project director’s settlement offer falls below what contracts feel are their minimum acceptance level, the contractor feels dissatisfied and may opt out of utilizing the DRB (Zeithaml et al. 1993). In discussions with contractors concerning the use of DRBs, the National Academy report noted that “some contractors who participated in the [National Academies] roundtable discussion suggested the nonbinding nature of the [DRB] process serves only to the benefit of the owner” (National Academy 2003, p. 21). The fair process effect is unlikely to emerge when a reliable benchmark of fairness is present (Hui et al. 2007). The fact that DRB hearings resulted in payouts of 4% underscores previous research and gives credence to the hypothesis that contractors may have believed that unfair outcomes would result in the utilization of the DRB process and resist its use (FHwA 2007).

### Does Use of DRBs Reduce Cost of Resolving Disputes?

As Genton opines, the value of a DRB is not necessarily due to the parties being convinced by the suggested settlement, but because the parties believed that the DRB assisted them in avoiding a long and costly legal proceeding (Genton 1999, p. 70).

As noted previously on DRB contracts, not all disputes were resolved via the DRB process. The greater majority of the change orders/claims were resolved without DRB involvement. In addition to the formal DRB hearing, an advisory DRB process also was utilized. An advisory DRB is more informed than a DRB hearing in that presented documents are not as elaborate, oral testimony is abbreviated, and the DRB renders an oral opinion shortly after the informal presentation (Bastianelli 2001). The advisory DRB does not wait until all the formal dispute processes are exhausted before hearing a dispute, but hears it informally during a regularly scheduled site visit (Bastianelli 2001, p. 7). It was used after negotiations on the field level had reached an impasse but prior to bringing the issue to the senior partnering level. Both the owner and contractor agreed to use the advisory DRB prior to its implementation. Moreover, there was no risk to the parties since the oral opinion as to the disposition of the dispute was not admissible in any proceeding, nor was it documented in writing. The downside to an advisory DRB would be that the oral opinion of the panel may be ignored because all the facts and arguments would not be presented as a formal DRB hearing would be. Another downside is faced by the DRB itself because it would be asked to render an advisory opinion without all the facts, and a complete presentation, and in a short time (Bastianelli 2001). There is little information concerning the advisory DRB such as contract amounts of claim/dispute, DRB contracts that used them, etc. However, 30 advisory hearings were held on issues ranging from $100,000 to $10 million. All the issues brought forward for advisory opinions were settled and contract modifications were issued (Larry Delmore personal communication).

### Did Use of DRBs Reduce Cost of Resolving Disputes?

**DRB Fee.** The DRB fees paid for the 46 DRB contracts on the project totaled $1.8 million. This figure was 0.02% of the total project cost and approximately 1% of the contractor’s total claim amount. This amount covered not only the costs of the regularly scheduled meetings, but also the hearings, “study” time, and decision making as well. Regular meetings were scheduled quarterly and hearings were scheduled as needed. The average cost per meeting was $3,492; this falls within the industry range of between $3,500 and $5,000 per meeting.

If you combine the 28 formal hearings with written recommendations and the 30 advisory opinions, the “cost” of the DRB averaged $31,034 per dispute. This is basically the cost of one motion in a court case.

There were three contracts (C05A1, C01A6, and C11A1) that went to litigation with nine claims/disputes. While the full legal costs of these matters are unknown, an anonymous CAT member estimated that the parties have incurred over $10 million in legal fees. Basically, the nine claims/disputes involved in these three litigated contracts averaged approximately $1.1 million per dispute.

**Mediation Costs.** Mediation was also used as a methodology to settle claims. Project records reflect that mediation was used on six DRB contracts (C01A3, C01A6, C09A4, C19D1, C19E4, and C22A1). The mediation fees for the six contracts (C01A3, C01A6, C09A4, C19D1, C19E4, and C22A1) totaled $351,144, or an average of $59,024 per contract, whereas the DRB cost per contract was $39,130 ($1.8M + 46 DRB contracts). DRB costs averaged $20,000 less per claim/dispute.

### Conclusion

As noted by Yates and Duran, the use of DRBs is not a substitute for basic dispute prevention techniques (Yates and Duran 2006, p. 24).
The merits of the issue. As Altschuler aptly notes, "construction the conditions at the project site before rendering a decision on in a hearing in a timely manner would allow the panelists to view evolution of the dispute. Moreover, having the dispute presented spent considerable effort and money—contemporaneous with the tive when an issue is brought to the panel before the parties have should provide the panel with the information necessary to con- elists should be motivated to draft and write clear, well-reasoned think about the case. This presents both a challenge and opportu- benefit of a neutral third party’s opinion about what they really part, to the fact that it is nonbinding. The disputing parties get the recommendation will convince either side to settle. [42x462] Sullivan 2003a, b Arbittier 2006, p. 40, due to arbitrators failing to maintain control over the process as well as issuing awards without explanation. Paid daily and/or hourly, arbitrators welcomed postponements, lengthy cross ex-aminations, and the like, increasing the cost as well as the time to resolve a dispute (Arbittier 2006). Will the DRB process follow the same route? Has the DRB process become a victim of its own success? Has the increased popularity of the process also resulted in its problems and misuse? The benefit of the DRB process is that it can be superior to litigation, arbitration, or mediation, in that it is designed to be faster, cheaper, and better suited for construction disputes. The parties cherry pick the panel, who are respected; experienced in the type of project being constructed; understand its technicali- ties; and are able to read and understand the draw-ings, specifica-tions, and contract. This process can be far superior in taking a chance of an arbitrator or mediator having the same technical expertise. When significant time and money is spent investigating every aspect of a dispute it is not uncommon for the parties them- selves to convince themselves of the righteousness of their posi-tion. Once positions harden, it is unlikely a nonbinding, poorly crafted recommendation will convince either side to settle. Moreover, the current popularity in the DRB process is due, in part, to the fact that it is nonbinding. The disputing parties get the benefit of a neutral third party’s opinion about what they really think about the case. This presents both a challenge and opportu-nity for the proponents of the DRB process. Talented DRB pan-elists should be motivated to draft and write clear, well-reasoned opinions. The parties have an investment in the process by the very fact that the panelists’ time and effort cost money. Both sides should provide the panel with the information necessary to con- vince them their positions are correct. This process is most effec-tive when an issue is brought to the panel before the parties have spent considerable effort and money—contemporaneous with the evolution of the dispute. Moreover, having the dispute presented in a hearing in a timely manner would allow the panelists to view the conditions at the project site before rendering a decision on the merits of the issue. As Altschuler aptly notes, “construction professionals instinctively know how important it is to see the site in order to reach an informed decision on the issues” (Altschuler 2003, p. 37). Just as site visits can affect an arbitration award, too can observing the conditions surrounding the dispute as they occur, influence the recommendation by the DRB, as well as the positions of the parties. Timing of the hearing with the genesis of the dispute can be a powerful motivator for the panel to issue a convincing recommendation.

As noted previously, the small number of matters brought to a formal DRB hearing may be an indication that the owner and/or the contractors were dissatisfied with the DRB. Distributive jus-tice is based on equity/social exchange theory that assumes hu-mans are motivated to maximize gains and minimize costs. A study by Clemmer and Schneider (1996) revealed the predo-nminance of distributive justice (perceived fairness of the outcome, hence, outcome oriented) over procedural (perceived fairness that fair procedures were used to arrive at the outcome) and interac-tional justice (perceived fairness of interpersonal treatment). This was reaffirmed by the Martinez-Tur et al. study, wherein they observe that “[d]istributive justice was shown to be the most im-portant determinant of customer satisfaction, followed by interac-tional justice and finally by procedural justice” (Martinez-Tur et al. 2006, p. 111). Basically, customer (contractor) satisfaction is based primarily upon the degree to which the outcome was per-ceived as equitable (Martinez-Tur et al. 2006). While either party could bring a matter before the DRB, generally, it is the claiming party (contractor) that seeks a resolution. Therefore, this author postulates that the fact that contractor’s payments for matters not brought before the DRB (settled at an average of 50% of amount sought) rather than the 4% (in the settlement after the DRB hear-ing and recommendation) was perceived by the contractors as inequitable, thus leading to the decision not to bring forth issues to the DRB but to seek other avenues of recourse, such as mediation.

Finally, the amount of time it takes to reach a final resolution is a key component that, in the past, was the cornerstone of the DRB’s success (McMillan 2000). The fact that claims/disputes traveled through an elongated process prohibited the timely reso-lution of these disputes. As this case study illuminates, merely having a DRB provision in the contract does not guarantee its use. Unlike litigation, the DRB cannot force the parties to bring dis-putes to a hearing.

Moreover, scheduling hearings at the convenience of the par-ties seems to have contributed to the backlog of unresolved dis-putes. The DRB process can be effective if disputing parties are compelled to learn the facts and evaluate not only their position, but that of the opposition; when they do so contemporaneously the chances for settlement or resolution are far greater than if they waited a year or more. Settlement becomes practical when the parties understand and focus on their cases. This happens only with the pressure of an imminent hearing. Perhaps a clause in the contract compelling the parties to bring the unresolved issue to the DRB after, say, 30 days, would convince the disputants to resolve the issue among themselves—or bring it, warts and all, to the DRB for a formal hearing.

Appendix

Table 1 shows unresolved issues and Table 2 shows an analysis of contracts done on October 9, 2007 of the Central Artery Tunnel Project.
<table>
<thead>
<tr>
<th>Contract number</th>
<th>Name</th>
<th>Contractor</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>DRB</th>
</tr>
</thead>
<tbody>
<tr>
<td>C01A2</td>
<td>South Boston Phase I Surface Detour Roadways</td>
<td>Modern Continental Construction Co.</td>
<td>10,987,579.50</td>
<td>12,658,618.00</td>
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<tr>
<td>C01A3</td>
<td>I-90 South Boston Interchange</td>
<td>Kiewit/Atkinson/Cashman</td>
<td>280,120,000.00</td>
<td>253,353,938.00</td>
<td>289,718,113.00</td>
<td>(17,945.00)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C01A4</td>
<td>Temporary ramps at World Trade Center</td>
<td>Modern Continental</td>
<td>5,293,000.00</td>
<td>4,659,035.10</td>
<td>4,952,957.00</td>
<td>49.00</td>
<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>C01A6</td>
<td>I-90 South Boston Interchange (West)</td>
<td>DeMatteo/Flaiton/Interbeton</td>
<td>192,500,000.00</td>
<td>179,531,211.00</td>
<td>225,865,942.00</td>
<td>(8,888.00)</td>
<td>1</td>
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<tr>
<td>C01A7</td>
<td>South Boston Surface Streets and D Street Separation Roadways</td>
<td>Roads Corporation</td>
<td>11,349,305.00</td>
<td>13,354,085.00</td>
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<td>2</td>
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<td>C01B1</td>
<td>Ventilation Building No. 5 Superstructure</td>
<td>Walsh Construction Company of Illinois</td>
<td>31,097,700.00</td>
<td>42,831,170.00</td>
<td>28,500.00</td>
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<td>1</td>
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<tr>
<td>C02A1</td>
<td>South Boston Haul Road</td>
<td>Modern Continental Construction, Inc.</td>
<td>14,811,462.00</td>
<td>8,817,534.00</td>
<td>10,822,646.00</td>
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<td>2</td>
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<tr>
<td>C04A1</td>
<td>South Boston Railroad Relocation</td>
<td>Modern Continental</td>
<td>2,693,909.00</td>
<td>1,747,829.00</td>
<td>1,747,829.00</td>
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<td>2</td>
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<tr>
<td>C04A2</td>
<td>Boston Marine Industrial Park Tunnel/Ventilation Building</td>
<td>Kiewit/Perini/Atkinson/Cashman</td>
<td>210,003,529.00</td>
<td>179,149,600.00</td>
<td>247,808,906.00</td>
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<td>C04A3</td>
<td>Ventilation Building No. 6</td>
<td>Walsh Construction Company of Illinois</td>
<td>15,240,840.00</td>
<td>16,706,343.00</td>
<td>20,701,549.00</td>
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<tr>
<td>C04A4</td>
<td>Permanent Sewage Pump Station</td>
<td>RDA Construction Corporation</td>
<td>2,500,000.00</td>
<td>2,553,120.00</td>
<td>2,704,724.00</td>
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<tr>
<td>C05A1</td>
<td>I-90 Immersed Tube Tunnel</td>
<td>J.F. White/Morrison–Knudsen/Interbeton</td>
<td>237,609,657.42</td>
<td>226,896,824.00</td>
<td>250,840,631.00</td>
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<tr>
<td>C05B1</td>
<td>I-90 Tunnel Finishes</td>
<td>Walsh Construction Company of Illinois</td>
<td>56,587,987.00</td>
<td>49,495,000.00</td>
<td>78,996,472.00</td>
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<tr>
<td>C07A1</td>
<td>Bird Island Flats Tunnel/Ventilation Bldg 7</td>
<td>Modern Continental/Obayashi</td>
<td>227,573,229.00</td>
<td>245,964,000.00</td>
<td>321,984,373.00</td>
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<td>C07A4</td>
<td>Ventilation Building No. 7</td>
<td>M. DeMatteo Construction Company</td>
<td>17,082,628.00</td>
<td>19,165,637.00</td>
<td>23,529,857.00</td>
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<tr>
<td>C07A5</td>
<td>East Boston Electrical Substation—Emergency Response Station</td>
<td>Modern Continental Construction</td>
<td>7,482,628.00</td>
<td>6,737,000.00</td>
<td>7,959,163.00</td>
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<tr>
<td>C07B1</td>
<td>Porter Street Outfall</td>
<td>J. M. Cashman, Inc.</td>
<td>35,361,078.64</td>
<td>20,358,616.00</td>
<td>35,114,750.00</td>
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<tr>
<td>C07C1</td>
<td>I-90 East Boston Toll Plazas and Facilities</td>
<td>Barletta Engineering Corporation</td>
<td>7,500,000.00</td>
<td>3,492,193.00</td>
<td>14,535,383.00</td>
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<tr>
<td>C07D1</td>
<td>I-90 Logan Airport Egress Ramps</td>
<td>Perini Corporation</td>
<td>31,400,189.00</td>
<td>27,392,820.00</td>
<td>36,355,888.00</td>
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<td>C07D2</td>
<td>I-90 Logan Airport Interchange</td>
<td>M. DeMatteo/Flaiton</td>
<td>178,000,000.00</td>
<td>144,058,100.00</td>
<td>184,775,817.00</td>
<td>2,093,000.00</td>
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<tr>
<td>C08A1</td>
<td>I-90 Route 1A Interchange</td>
<td>Barletta Heavy Divisor</td>
<td>215,000,000.00</td>
<td>190,611,547.00</td>
<td>203,853,570.00</td>
<td>19,373,169.00</td>
<td>323</td>
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<td>C08A5</td>
<td>Advanced Detour Roadways</td>
<td>J. F. White/Morrison–Knudsen/Interbeton</td>
<td>11,950,500.00</td>
<td>7,553,455.00</td>
<td>8,733,583.00</td>
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<tr>
<td>C08A7</td>
<td>Bremen St. Park Pavilior</td>
<td>W. T. Rich Co., Inc.</td>
<td>1,469,000.00</td>
<td>1,733,201.00</td>
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<td>C08A8</td>
<td>Rt. 1A/Neptune Rd.</td>
<td>Barletta Heavy Div.</td>
<td>8,420,227.00</td>
<td>9,692,230.00</td>
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<tr>
<td>Contract number</td>
<td>Name</td>
<td>Contractor</td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
<td>V</td>
<td>VI</td>
<td>VII</td>
<td>DRB</td>
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<tr>
<td>C09A3</td>
<td>Ventilation Building No. 1 and Emergency Station No. 4/Electrical Substation</td>
<td>M. DeMalteo Construction Co.</td>
<td>Sept. 9, 2003</td>
<td>Sept. 30, 2005</td>
<td>31,249,006.00</td>
<td>48,680,826.00</td>
<td>7,000.00</td>
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<td>C09A4</td>
<td>I-93/I-90 Interchange, I-93 northbound</td>
<td>J. F. White/Slattery/Interbeton/Perini</td>
<td>Mar. 4, 2003</td>
<td>Oct. 19, 2005</td>
<td>375,000,000.00</td>
<td>482,715,055.00</td>
<td>(57,669.00)</td>
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<td>C09A7</td>
<td>Excavation Support, I-90 Tunnel/Fort Point Channel</td>
<td>Cashman/Kiewit/Perini/Atkinson</td>
<td>Jun. 8, 2000</td>
<td>Jan. 4, 2001</td>
<td>195,000,000.00</td>
<td>152,422,783.00</td>
<td>236,897,202.00</td>
<td>19,830.00</td>
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<td>C09A8</td>
<td>Broadway Bridge, Partial, Ramp L, and utility relocation</td>
<td>Kiewit/Cashman</td>
<td>Jun. 25, 1999</td>
<td>Nov. 26, 1999</td>
<td>67,335,000.00</td>
<td>45,196,145.00</td>
<td>77,865,054.00</td>
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<td>C09A9</td>
<td>Fort Point Channel Main</td>
<td>Modern Continental Construction</td>
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<td>2,118,100.00</td>
<td>2,035,987.00</td>
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<td>C09B1</td>
<td>I-90 Fort Point Channel Crossing</td>
<td>Modern Continental/Obayashi</td>
<td>May 14, 2002</td>
<td>Sept. 30, 2005</td>
<td>301,377,284.00</td>
<td>423,949,450.00</td>
<td>2,850,134.00</td>
<td>19</td>
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<td>C09B2</td>
<td>I-90 Seaport Access Tunnel Finishes</td>
<td>Modern Continental Construction</td>
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<td>95,000,000.00</td>
<td>64,137,639.00</td>
<td>91,192,453.00</td>
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<td>C09B3</td>
<td>I-90 Fort Point Channel Casting Basin and Material Testing and Transportation</td>
<td>Modern Continental Construction</td>
<td>Jan. 12, 1998</td>
<td>May 9, 1999</td>
<td>112,000,000.00</td>
<td>76,778,000.00</td>
<td>155,753,865.00</td>
<td>(301,073.00)</td>
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<td>C09C1</td>
<td>I-93/I-90 Interchange, I-93 southbound and I-90 Main</td>
<td>Modern Continental Construction</td>
<td>Sept. 22, 2001</td>
<td>Mar. 5, 2005</td>
<td>134,330,000.00</td>
<td>108,576,515.00</td>
<td>133,450,934.00</td>
<td>(250,906.00)</td>
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<tr>
<td>C09C2</td>
<td>I-93/I-90 Interchange Ramps and restoration at Albany St.</td>
<td>Modern Continental Construction</td>
<td>Feb. 1, 2005</td>
<td>Sept. 22, 2005</td>
<td>179,407,143.00</td>
<td>191,324,031.00</td>
<td>2,879,500.00</td>
<td>69</td>
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<td>C09C4</td>
<td>I-93/I-90 Interchange, ramps and surface restoration at Albany St.</td>
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<td>McCourt Construction</td>
<td>Mar. 18, 2005</td>
<td>Mar. 18, 2005</td>
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<td>I-93 Northbound Tunnel (Atlantic Avenue)</td>
<td>Perini/Cashman</td>
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<td>430,693,559.00</td>
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<td>New East Side Interceptor/I-90/I-93 interchange area</td>
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<td>Utility Relocation—Hanover/Sudbury Streets</td>
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<td>Perini Corporation</td>
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<td>McCourt Construction</td>
<td>Oct. 11, 1996</td>
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<td>17,608,633.00</td>
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<td>I-93 Central Artery—North Street to Chardon street</td>
<td>J.F. White/Slattery/Perini</td>
<td>Dec. 11, 2001</td>
<td>Aug. 3, 2003</td>
<td>369,100,000.00</td>
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<td>I-93 Centraxy Artery Chardon Street to Charles River</td>
<td>Cashman/Kiewit/Adkinson</td>
<td>Feb. 26, 2001</td>
<td>Jun. 30, 2005</td>
<td>260,000,000.00</td>
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<td>Ventilation Building No. 4 and Parking Garage</td>
<td>Walsh Construction/Daniel O’Connell’s Sons (JV)</td>
<td>May 26, 2000</td>
<td>Oct. 27, 2005</td>
<td>106,600,000.00</td>
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<td>W.T. Rich Company</td>
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<td>C17A1</td>
<td>Central Artery northbound, Congress to High Street, Southbound High to Oliver St.</td>
<td>Modern Continental Construction</td>
<td>Apr. 21, 2001</td>
<td>Mar. 3, 2003</td>
<td>257,366,800.00</td>
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<td>I-93 Central Artery—State St. to North St.</td>
<td>Modern Continental/Ohabashi</td>
<td>Oct. 28, 2000</td>
<td>Oct. 5, 2000</td>
<td>172,000,000.00</td>
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<td>Ventilation Building No. 3</td>
<td>Walsh Construction Company of Illinois</td>
<td>Aug. 19, 2000</td>
<td>Nov. 13, 2005</td>
<td>73,408,520.00</td>
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<td>C17A6</td>
<td>I-93 Kneeland Street to Charles River—tunnel construction, viaduct demolition and surface restoration</td>
<td>Modern Continental Construction</td>
<td>Mar. 14, 2005</td>
<td>Jan. 8, 2006</td>
<td>408,199,892.00</td>
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<td>I-93 Tunnel—High to State Street/MBTA Aquarium Station</td>
<td>Modern Continental/Ohabashi</td>
<td>May 11, 2004</td>
<td>Jan. 1, 2006</td>
<td>298,225,070.00</td>
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<td>McCourt/Obabashi</td>
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<td>Nov. 1, 2005</td>
<td>12,308,120.00</td>
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<td>Dewey Square tunnel control building electrical modifications</td>
<td>Suffolk electrical Company</td>
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<td>Dec. 7, 1997</td>
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<td>J. Cashman</td>
<td>May 15, 2004</td>
<td>Nov. 6, 2005</td>
<td>4,013,878.00</td>
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<td>Ramps north of Gilmore Bridge</td>
<td>J.F. White Contracting Company</td>
<td>Apr. 15, 1999</td>
<td>Jul. 26, 2004</td>
<td>51,200,000.00</td>
<td>50,420,621.00</td>
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<td>Ancillary highway facilities/north of Gilmore Bridge</td>
<td>Barletta Heavy Division</td>
<td>May 15, 2004</td>
<td>Nov. 6, 2005</td>
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<td>C19BA</td>
<td>1-93 demo viaduct/const ramp SA-CN demo/Charles River</td>
<td>J.F. Whit Contracting Company</td>
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<td>Mainline bridge over the Charles River</td>
<td>Atkinson/Kiewit</td>
<td>Jul. 15, 2002</td>
<td>Jan. 1, 2005</td>
<td>77,000,000.00</td>
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<td>Storrow Drive connector bridge</td>
<td>Daniel O’Conel’s Sons</td>
<td>Mar. 21, 1999</td>
<td>Jul. 31, 2000</td>
<td>22,000,000.00</td>
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<td>I-93 Leverett Circle/Storrow Drive connectors</td>
<td>Modern Continental Construction</td>
<td>Feb. 3, 2003</td>
<td>Sept. 23, 2005</td>
<td>140,000,000.00</td>
<td>145,541,764.50</td>
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<td>Walsh Construction Company of Illinois</td>
<td>Aug. 23, 2001</td>
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<td>14,600,000.00</td>
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<th>II (US$)</th>
<th>III (US$)</th>
<th>IV (US$)</th>
<th>V (US$)</th>
<th>VI (US$)</th>
<th>VII (US$)</th>
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<td>Residual Ramps S-N and LC-N</td>
<td>Modern Continental Construction</td>
<td>Sept. 5, 2005</td>
<td>Mar. 5, 2006</td>
<td>38,177,939.00</td>
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<td>Initial Leverett Circle connectors</td>
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<td>50,100,000.00</td>
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<td>Mass. Electric Construction Company</td>
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<td>Fisherbach &amp; Moore, Inc.</td>
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<td>Memorial Tunnel fire ventilation test program— site preparation and facility modifications</td>
<td>Kiewit Eastern Company</td>
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<td>Robert McAlpine, Ltd.</td>
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<td>Material disposal system</td>
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<td>Dec. 2, 1996</td>
<td>Oct. 26, 2008</td>
<td>130,675,000.00</td>
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<td>Spectacles Island off-shore boring</td>
<td>Guild Drilling Company, Inc.</td>
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<td>The Middles Corp. &amp; Affiliates</td>
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<td>The Middles Corp. &amp; Affiliates</td>
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<td>374010</td>
<td>358,835.00</td>
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<td>R. Zoppo Corp.</td>
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<td>Water Transportation Docking Facility— Russia Wharf</td>
<td>Jay Cashman, Inc.</td>
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</table>

Note: Symbols in the column head of the table indicate as I=original contract completion data; II=revised contract completion date; III=engineer estimate (US$); IV=contract award amount (US$); V=final contract amount (US$); VI=amount unresolved issues as of April 2006 (US$); and VII=number of open issues. Sources include Engineer’s estimate accessed from the World Wide Web on September 2, 2003, at http://www.bigdig.com/thtml/contlist-a.htm; contract award and contractor names accessed from the World Wide Web on September 2, 2003, at http://www.bigdig.com/thtml/origin.html; and construction contract details dated September 2, 2005, made available from the Central Artery Tunnel field staff. Unresolved Issue data from Construction Contract Summary dated April 2006 made available from CAT field staff.

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