Lessons Learned

An Assessment of Select Public-Private Partnerships in Massachusetts

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A Pioneer Institute White Paper

by Dr. John B. Miller

PIONEER INSTITUTE
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Contents

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Executive Summary

Public-private partnerships are a much-misunderstood and still-evolving innovation in transportation infrastructure. Viewed with great suspicion by some as a 'selling off' of public goods, it is viewed with great enthusiasm by others as a source of additional revenues. In Massachusetts, we see public-private partnerships through the lens of recent projects that used private sector participation. This study seeks to examine several of those recent projects to learn about the private sector's role and its impact on the project.

First, the term "public-private partnership" should be defined. A companion volume to this study, *Life Cycle Delivery of Public Infrastructure: Precedents and Opportunities for the Commonwealth*, provides an in-depth overview of the different types of project delivery and finance mechanisms for public infrastructure. For our purposes, "public-private partnerships" means one of three broadly defined project delivery methods in which (i) design, (ii) construction, and (iii) long-term operations and maintenance are all combined into a single procurement (and a single contract) with government and funding for these three phases of the project is provided either: (a) entirely by the public sector, (b) entirely by the private sector (at risk), or (c) a combination of the two.

From this perspective, we examined four major recent projects in Massachusetts – the expansion of Route 3 North, the MBTA Commuter Rail Operating Agreement, the Big Dig Management structure, and the North East Solid Waste Compact (NESWC). These case studies assess the structure of each transaction, the extent of private sector involvement, and the outcomes, then draws several lessons from each experience.

Each case study, except for NESWC, does not meet our definition of a public-private partnership. Only the 20-year NESWC pact involved a contract sufficiently long in duration to permit the private-sector contractor to price and deliver an infrastructure facility on a life cycle delivery basis. Yet the procurement practices followed on the NESWC facility produced horrific results for its member communities.

The Route 3 North project demonstrates how the combination of design with construction (design-build) in a single procurement, when appropriately used, can produce clear savings in the cost and time of initial delivery.

Proven models exist for the competitive, transparent procurement of public insfrastructure using all of the project delivery and financing methods that have been successfully applied across the United States and the world.

The agreement between the Massachusetts Bay Transit Authority (MBTA) and the Massachusetts Bay Commuter Rail (MBCR) shows how a public entity can contract with the private sector to substantially reduce the amount of deferred maintenance within an infrastructure network, and use a pure operations and maintenance contract approach to position the network for better future technical and life-cycle cost performance.

The Big Dig project, which temporarily added hundreds of private-sector engineers and construction managers to the staff available to manage one of the largest and most complex construction projects in history, is an excellent example of how a public entity can adjust its internal capacity to manage projects over short periods of time.

NESWC provides the clearest lessons for future public-private partnerships in Massachusetts. Because the service agreement contained an unconditional obligation on the part of the member towns to pay all of the contractor's development, financing, operations, repair, and maintenance costs, there was no financial risk transferred to the contractor.

The NESWC project is a classic situation in which the Commonwealth commanded others (the member communities) to take risks with an emerging technology in circumstances under which the Commonwealth, rather than the towns, should have done so. The scope of the project had not yet developed to a point that allowed a competitive, transparent competition to take place. Instead, an extremely "soft" competition was conducted to select an entity to build the plant, without obtaining a simultaneous commitment from the bidder as to what precisely would be built and what precise charges would be paid by member towns. Because the procurement was so poorly planned and executed, the pricing terms were based on recovery of costs, overhead, and profit – essentially a cost-plus arrangement that most public procurement officials would be wary of over a 20-year term. The terms of the service agreement were negotiated by the Commonwealth on behalf of the member towns after the contractor had been selected.

Best procurement practices require competitive procurement of specific work, under known terms and conditions, for a price (cost). Unbundling these elements, as was done here, takes the competitive pressure off in negotiating terms and conditions.

The Commonwealth made one further, very significant mistake in this procurement: it permitted the contractor to keep the plant at the end of the term, even though all the costs of designing, building, repairing and operating the plant were fully amortized over the 20-year term. Although communities had paid high service fees over the 20-year period and had completely reimbursed the contractor for its development costs and its cost of capital upgrades, the facility remains in MRI hands, and is now processing trash to energy for its own account.

The NESWC project is an example of how poor procurement practices, lack of preparation, and lack of head-to-head competition, can produce unacceptable results with respect to any infrastructure facility.

As the Commonwealth considers whether and how to use alternative methods for delivering public infrastructure services in the future, including "public-private partnerships," the project delivery structures employed for Route 3 North, NESWC, the MBTA/MBCR, and the Big Dig projects provide valuable lessons. The companion report, *Life Cycle Delivery of Public Infrastructure: Precedents and Opportunities for the Commonwealth*, provides a more thorough discussion of the full range of proven project delivery and financing methods available for delivering infrastructure projects, including public-private partnerships.

As the Commonwealth considers whether and how to restructure its processes to renew, rehabilitate, and replace its infrastructure networks, it is time to move away from "one-off" experimental processes to a durable set of proven, legislatively established project delivery methods available for use on all of the Commonwealth's infrastructure projects.

Project by project experimentation by the Commonwealth in procurement processes for very large infrastructure projects – with high initial expense and long operations and maintenance tails – has not been a success. In the NESWC project, the Commonwealth conducted an experiment with 20 cities and towns in which a procurement strategy created from scratch failed miserably. The results fell disproportionately on the citizens of these 20 cities and towns.

In the Route 3 North project, the Commonwealth created a different procurement strategy for what was called a Design-Build-Finance-Operate

(DBFO) contract, again from scratch. The strategy succeeded in producing a facility that was designed and built by a single entity, but the project did not result in private financing (for which the Commonwealth was not responsible) or in private operations and maintenance of the facility at reduced costs. The desire to be innovative is certainly admirable, but the special legislation for Route 3 North did not provide a blueprint for future DBFO projects in the Commonwealth.

Proven models exist for the competitive, transparent procurement of public infrastructure using all of the project delivery and financing methods that have been successfully applied across the United States and the world – including the ABA 2007 Model Code for Public Infrastructure Procurement. As the Commonwealth considers whether and how to restructure its processes to renew, rehabilitate, and replace its infrastructure networks, it is time to move away from "one-off" experimental processes to a durable set of proven, legislatively established project delivery and financing methods available for use on all of the Commonwealth's infrastructure projects.

Introduction

The Commonwealth of Massachusetts is beginning to consider whether the use of "Public-Private Partnerships" might be an appropriate mechanism to quicken the timing of and increase the level of investment in the state's infrastructure – including roads, rail, water and wastewater. The purpose of this report is to provide some practical assistance to legislators, public policy makers, and stakeholders in understanding how previous infrastructure projects in Massachusetts should inform the debate.

This report first presents a basic framework for public officials to apply when considering the two basic questions that arise when the Commonwealth organizes the provision of public infrastructure assets: "who pays" and "who contracts with government." This framework is applied as a tool to characterize public infrastructure projects in a simple, useful, and repeatable fashion, including a graphical presentation of how well-known infrastructure projects in the Commonwealth have been delivered over the past 200 years within this framework.

A companion report, entitled *Life Cycle Delivery of Public Infrastructure: Precedents and Opportunities for the Commonwealth*, expands on this basic framework and provides a more thorough discussion of project delivery and financing methods, including public-private partnerships.

This report focuses on detailed case studies of four infrastructure projects recently delivered in Massachusetts: the Route 3 North Transportation Improvement Project, the MBTA Commuter Rail Operating Contract, the initial "Big Dig" Management Structure, and the North East Solid Waste Committee (NESWC) "trash to energy" Plant. Each case study focuses heavily on an examination of how the project was financed ("who pays") and how the project was delivered

("who contracts with government to do what"). The purpose is to determine whether any of these cases provide relevant experience that public officials and policy makers should consider in the effective use of "public-private partnerships" in the Commonwealth.

"Life-cycle" delivery mechanisms allow and encourage a designer to design for ease of construction, ease of operation, and ease of maintenance.

The term "public-private partnerships" has been applied to a wide range of procurement practices, a fact that generates substantial misunderstanding and confusion among public officials and stakeholders. To avoid this confusion, this report equates "public-private partnerships" to a collection of project delivery methods in which (i) design, (ii) construction, and (iii) long-term operations and maintenance are all combined into a single procurement (and a single contract) between the private sector and government. This is a life-cycle approach to the provision of infrastructure facilities and services.

Why should the Commonwealth carefully consider adding "life-cycle" mechanisms for infrastructure facilities and services? To attract additional private sector investment is surely one reason. This is because public resources for infrastructure are scarce. Success with so-called "public-private partnerships" – for example, transit – is hoped to have a positive effect on available appropriations for other infrastructure classes – for example, schools – by allowing the Commonwealth to make relative shifts of limited public funds toward those classes of infrastructure assets that cannot attract private sector investment.

But, much more importantly, "life-cycle" delivery mechanisms allow and encourage a designer to design for ease of construction, ease of operation, and ease of maintenance. Properly structured by the Legislature, a transparent, competitive procurement mechanism for "life-cycle" delivery of infrastructure will permit governments to provide better infrastructure for better value, while encouraging quicker delivery of badly needed infrastructure, along with high-paying skilled jobs. Improving the Commonwealth's infrastructure networks, the platform on which the state's economy runs, has exponential effects.

Many high profile recent projects, like the Big Dig and Route 3 North, are not actually public-private partnerships and their success or failure should not color consideration of the concept.

I. Delivery and Financing of Infrastructure Projects

As the options and approaches for infrastructure delivery and finance grew more complex in the 1990s, researchers began to look carefully into the history of infrastructure project delivery and finance in the United States. The goal of the research was to develop a simple, yet useful way to compare project delivery and financing methods, and for public officials and policy makers to think systemically about how the nation might move from its current focus on initial delivery to one that incorporates both initial delivery and life-cycle delivery of public infrastructure.

Two questions repeatedly crop up in the provision of public infrastructure: (i) who pays for infrastructure services and (ii) who contracts with government as it arranges to deliver the three key elements of every infrastructure project – design, construction, and long-term operations and maintenance. To organize a logical discussion of how infrastructure projects are delivered and financed, two different, basic strategies are

described below in answer to each of these two questions.

A. Who Pays (At Least Initially)?

Figure 1 (p. 5) assumes that governments can choose one of two basic strategies in answer to the question "who pays". The first, described as "Direct," is for government to pay for infrastructure projects with cash it raises for these purposes. Governments raise their own funds through sales and/or income taxes, user fees, or other charges, and frequently borrow funds in private-sector capital markets in order to have sufficient cash on hand to pay for ongoing obligations, such as health care, education, and public infrastructure.

For more than two centuries, governments have also, on occasion, chosen a second answer to the same question. This second approach, described as "Indirect" in Figure 1, is for government to position a public infrastructure asset in such a way that the private sector agrees to pay for design, construction, and long-term operations and maintenance in exchange for a realistic opportunity to recover this investment plus a

Figure 1
How Are Project Costs Paid?

Direct

Government pays for projects with public resources.

This includes monies obtained by:
(i) collecting taxes, user fees, or other funds;
(ii) borrowing funds (typically bonds or bond anticipation notes; and
(iii) receiving grants of money from other governments.

Funds are borrowed based on the credit-worthiness of the government. Grants received are available through taxes or charges by other governments.

Indirect

Government attracts the private sector to pay for projects with private sector resources. This is typically done by ceding specific, limited, control over a public infrastructure asset to create a revenue stream that the private sector will use to earn a return on capital invested anda profit.

"Indirect" includes monies obtained by:
(i) charging user fees;
(ii) borrowing funds; and
(iii) raising equity.

Funds are typically borrowed for design and construction based on the credit-worthiness of the project to produce sufficient revenue to repay the borrowed funds (with interest), to pay for long term O & M, and a profit.

Figure 2

How Are Project Elements Delivered?

The three (3) key elements of infrastructure projects are delivered separately from each other – "Segmented."

Distinctions remain between capital budgets for the initial delivery of projects and the operating budgets for long term repair, operations, and maintenance.

Combining Design with Construction (Design-Build) is included here, as is Operations % Maintenance.

Design

Construction

Design-Build

Operations & Maintenance

Segmented

The three (3) key elements of infrastructure projects are delivered together – integrated with each other – "Combined."

Distinctions are eliminated between capital budgets and operating budgets for these projects.

All "Public Private Partnerships" use combined delivery methods.

Design-Build-Operate-Maintain
(including all combinations of public and private sector funding)

Combined

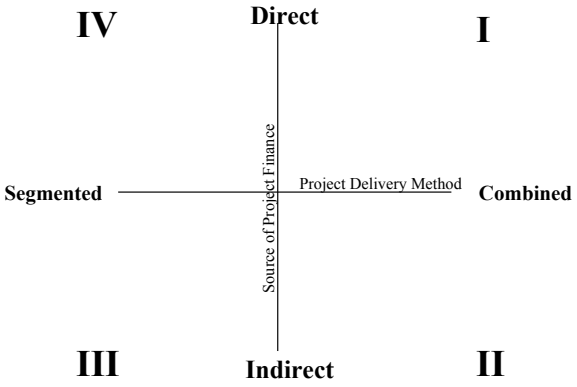
reasonable return through the collection of tolls and/or user charges. The private sector typically provides these funds through contribution of equity and by borrowing funds in private-sector capital markets. For the purposes of this report, where the timing, amount, and sufficiency of the revenue stream from tolls and/or user charges is at the private sector company's risk, the answer to "who pays?" is the private sector, and the financing approach is "indirect."

Of course, in reality, the "cost" of infrastructure facilities that are provided through an "indirect" financing approach is paid by the people and firms that pay tolls and/or user charges. From the consumer's point of view, the consumer is always paying – through gasoline, sales, and/or income taxes or tolls paid to government that permit direct financing or through tolls and user fees paid to private sector companies that permit indirect financing. So, practically speaking, unless a project being paid for "indirectly" provides better service and higher value, and/or at a lower cost to users, indirectly financed projects will continue to be viewed as an additional "tax" burden on consumers.

Note that where the government assures the private sector that the revenue stream from tolls, user charges, or government payments will be sufficient to provide a return on investment, including profit, this government commitment amounts to "direct" funding.

Figure 3

The Quadrant Framework



Source: *Principles* Text, Miller 2000, Kluwer.

B. Who Contracts With Government to Deliver What?

To a large extent, which professions and firms contract with government to provide public infrastructure is influenced by the structure of the construction industry in the United States. Architects and engineers must be professionally registered under state statutes that also require them to play specified roles in the design of public infrastructure facilities. General construction contractors are also typically licensed under local statutes, and generally provide construction services in accordance with a complex set of local, state, and federal statutes and regulations relating to labor, safety practices, and the environment. Since the Great Depression, government has typically arranged and provided for long-term operations and maintenance of infrastructure facilities out of public operating budgets.

Since 1929, the U.S. construction industry has been restructured in the image of these historical trends, and procurement models have been established to support contracts between the government and separate segments of the industry.

Professional designers typically contract directly with governments to provide design through a qualifications-based selection (QBS) process – meaning that the designer must demonstrate technical qualifications first, followed by the ability to do the work at a reasonable price. General contractors typically contract directly with governments to build the specified design for a lump-sum fixed price. Governments most often maintain and operate the infrastructure facilities delivered by designers and construction contractors, at public sector expense.

Figure 2 (p. 6) assumes that governments can choose one of two basic strategies in answer to the question "who contracts with government". The first, described as "segmented," is for government to provide for three key elements (design, construction, O&M) on a "piecemeal" or segmented basis – by separately hiring designers and construction contractors to deliver infrastructure. For the purposes of this report, the combination of design and construction (design-build) is considered to be a segmented process.

For more than two centuries, governments have also, on occasion, chosen a second answer to this question. This second approach, described as "combined" in Figure 2, is for government to combine design, construction, and long-term operations and maintenance into a single contract between government and a single private sector entity. That single entity will perform one or more of these functions itself, and subcontract with one or more designers, operators, and construction contractors to deliver the complete project over the life-cycle. In this report, projects delivered through a combined or life-cycle strategy are the equivalent of so-called "public-private partnerships."

C. Characterizing Infrastructure Projects

Figure 3 (p. 7) combines Figures 1 and 2 into quadrants that distinguish between direct and indirect financing strategies, and segmented and combined delivery strategies. The horizontal axis represents the degree to which the design, construction, and long-term operations and maintenance of an infrastructure facility are segmented into multiple contracts or combined in a single contract. The vertical axis represents the degree to which funds to pay for capital and operating costs are direct or indirect. Figure 4 (this page) shows delivery methods by quadrant.

D. Massachusetts Projects In the Quadrant Framework

Figure 5 (p. 9) places a number of well-known Massachusetts infrastructure projects into the Quadrant Framework. The circles in Figure 5 represent time. Early projects, shown in the inner ring, are all life cycle delivery projects in Quadrants I and II. These projects include the privately funded railroads, a proposed Boston to Albany canal that was authorized but never built, the Middlesex Canal between Boston and Lowell, and numerous post roads (which were built in the private sector in exchange for the right to collect postal revenues as the mails passed). Figure 5 also shows several well-known

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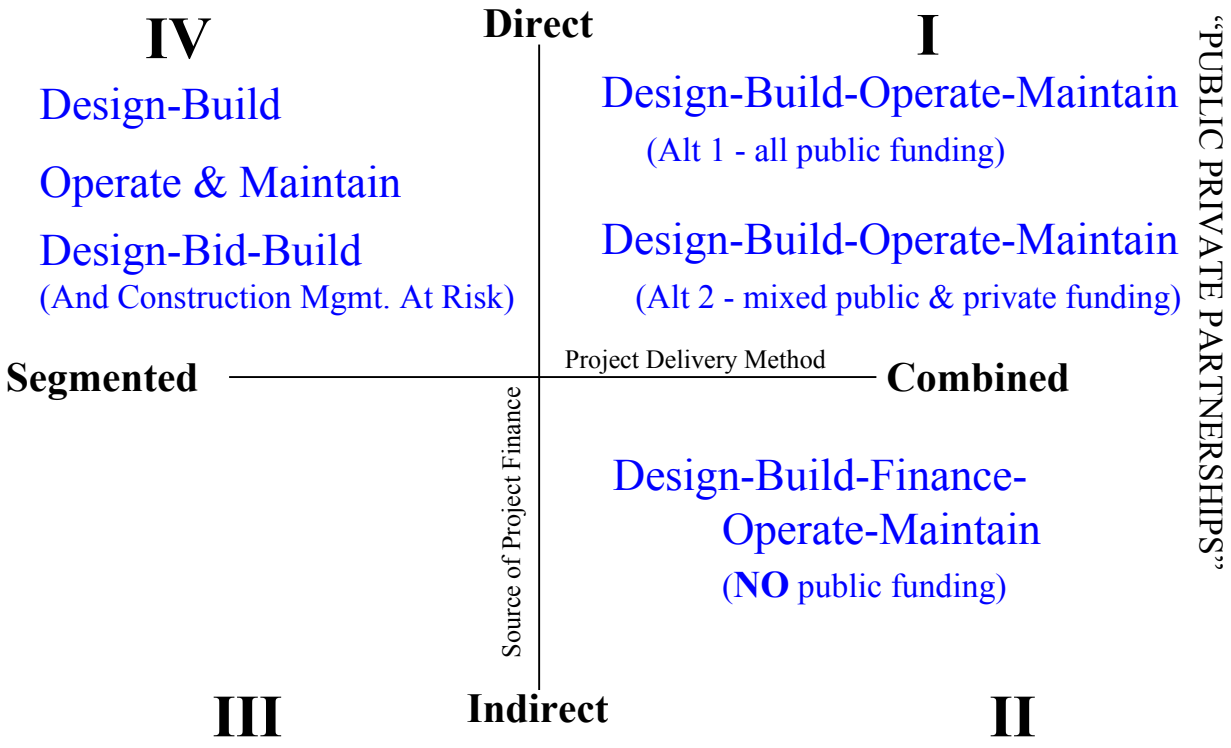
Figure 4
Six Key Delivery Methods



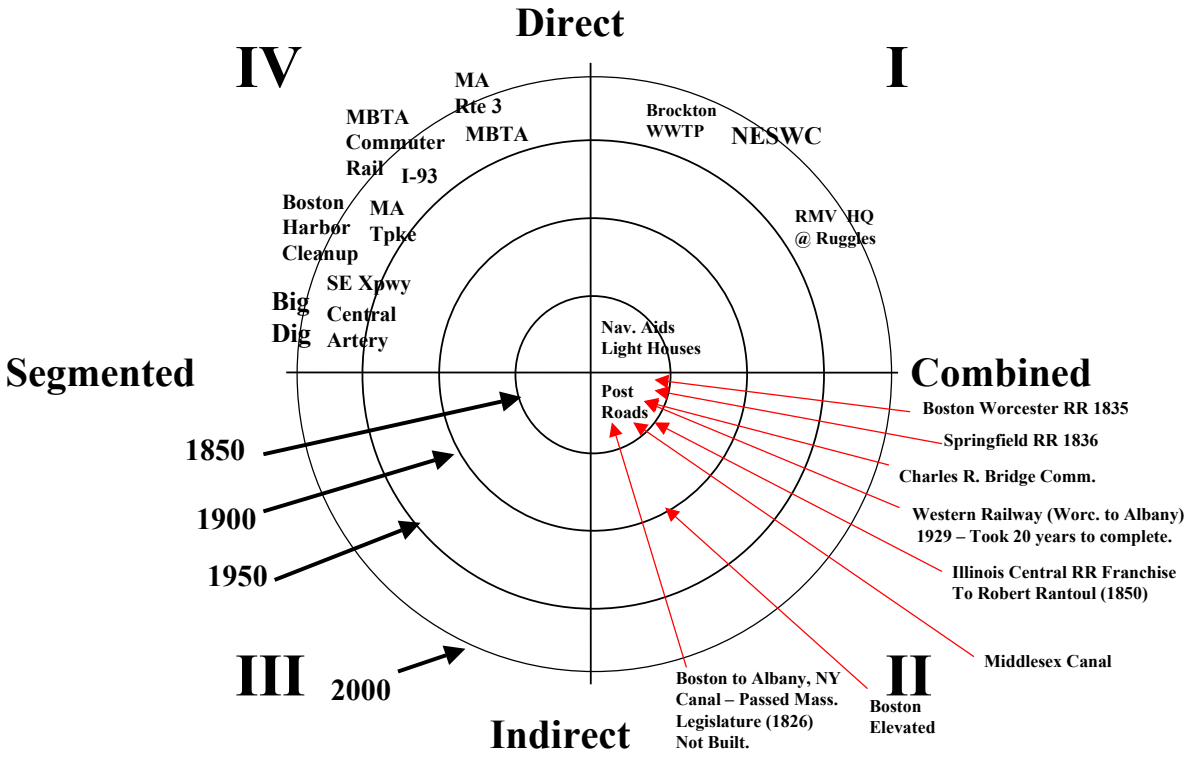
Massachusetts projects that were delivered using design-bid-build as the delivery method in the last half of the 20th century. These include the old Central Artery, the Southeast Expressway, the Massachusetts Turnpike, Interstate 93, the various extensions and refurbishments to the MBTA subway system, and the Boston Harbor Cleanup. All of these projects reside in Quadrant IV of the framework.

In Quadrant I, the Brockton Wastewater Treatment Plant is an example of a long term design-build-operate-maintain contract in the water field. Also listed is the long term leasing arrangement between the Registry of Motor Vehicles and Metropolitan Structures, Inc., which provided for the delivery of a new headquarters building at Ruggles Station for the Registry pursuant to a long term DBOM lease. The project was built and the Registry moved in, but moved out following a "sick-building" dispute with the landlord. This project is an example of a long-term, build-to-suit arrangement properly characterized as DBOM.

As Figure 5 indicates, there have been very few recent projects in Massachusetts that qualify as public-private partnerships under our definition. Yet a number of high profile recent projects have involved the private sector more aggressively than the standard design-bid-build procurement process and have entered the public consciousness as public-private partnerships. The case studies below examine four of these projects to determine what lessons can be learned for future public-private partnership efforts.

Figure 5

Project Examples from Massachusetts



II. Four Infrastructure Projects Recently Delivered in Massachusetts

A. Summary

This section presents detailed case studies on the following projects:

· the Route 3 North reconstruction project from Burlington to the New Hampshire line;

· the five-year operations contract between the MBTA and Massachusetts Bay Commuter Rail, Inc. (MBCR), which has now been extended for an additional three years;

· the Big Dig Management Structure; and

· the North East (MA) Solid Waste Committee (NESWC) contract for the disposal and recycling of solid waste.

Only one – the 20-year NESWC pact – involved a contract sufficiently long in duration to permit the private-sector contractor to price and deliver an infrastructure facility on a life cycle delivery basis. Only one – the NESWC facility – could fairly be described as a public-private partnership, yet the procurement practices followed on the NESWC facility produced horrific results for its member communities.

The Route 3 North project demonstrates how the combination of design with construction (design-build) in a single procurement, when appropriately used, can produce clear savings in the cost and time of initial delivery. The agreement between the MBTA and MBCR is an excellent example of how a public entity can contract with the private sector to substantially reduce the amount of deferred maintenance within an infrastructure network, and use a pure operations and maintenance contract approach to position the network for better future technical and life-cycle cost performance. The Big Dig project, which temporarily added hundreds of private-sector engineers and construction managers to the staff available to manage one of the largest and most complex construction projects in history, shows how a public entity can adjust its internal capacity to manage projects over short periods of time, but has little relevance for future consideration of the use of PPPs.

B. Route 3 North

Although some have said so, in no sense was the reconstruction and widening of Route 3 North a "public-private partnership". Rather, the Route 3 North project (which was delivered between 2000 and 2005) is a clear example of how design-build – the combination of design with construction in a single contract – can produce savings in both cost and time in the delivery of major public infrastructure projects.

The Route 3 North project demonstrates how the combination of design with construction in a single procurement can produce clear savings in the cost and time of initial delivery.

Prior to this project, Route 3 North was highly congested during work-day peak hour periods. Previously, Route 3 consisted of a four-lane (two each in the north and south directions) parkway-type facility with more than two dozen attractive – but narrow – bridge structures which prevented easy expansion to three lanes in each direction. The project consisted of a complete makeover of the 21-mile corridor, with the addition of: a median shoulder, 30-foot clear zones, 13 replaced interchanges, 29 replaced bridges and structures, and the reconstruction of major interchanges at the Drum Hill Rotary and at Concord Road.

Neither the project, nor the procurement approach used, can be easily replicated in Massachusetts, because this was a "one-off" project specifically authorized by the Legislature as a departure from "regular" processes by Section 6 of Chapter 53 of the Acts of 1999, which authorized the Massachusetts Secretary of Transportation to award a contract for "design, construction, operations and maintenance, finance, and joint development" of the project following a competitive process outlined in the statute. The uniqueness of this process – one that is unlikely to be exactly repeated – had only one significant drawback: the process undoubtedly raised the cost of competing for the bidders, and the cost of managing the competition for the state, and lengthened the procurement process. The design-build and O&M concepts embedded in Section 6 of Chapter 53 of the Acts of 1999 are neither new nor experimental. The Legislature could quickly adopt procurement models (that already exist) to expand the use of techniques so successfully used on Route 3 North. The 2007 ABA Model Code for Public Infrastructure Procurement (MC PIP), which contains source selection language already adopted by the Legislature for the procurement of goods and supplies, provides a ready legislative model.

1. The Request for Proposals

The Request for Proposals (RFP) for the project was issued in three volumes. Volume 1 contained instructions to proposers, and Volumes 2 and 3 contained the forms of the various agreements that the successful bidder would be required to sign following the submission, evaluation, and award of the project, pursuant to evaluation criteria set forth in the RFP. These included a development agreement, operations and maintenance agreement, ground lease, and sublease.

The RFP provided a detailed description of the proposed work, how the project would be funded, and described the potential for "joint development" along the corridor. The developer was required to "arrange for financing of the project based on a future stream of payments under the development agreement", which payments were "subject to annual appropriation by the Massachusetts Legislature." The various agreements drafted by the Commonwealth and included in the RFP basically provided for the developer to borrow sufficient funds to design and build the project on the schedule set forth in the RFP. These same agreements provided that the Commonwealth would arrange for the following payments in exchange:

a. During construction – the Commonwealth would make "interest-only" payments until the scheduled date for final acceptance [if the developer was "late", the developer would pay this interest as liquidated damages until final acceptance was achieved];

b. After construction – the Commonwealth would make payments under the sublease sufficient to both retire the developer's debt (principal and interest on the sum borrowed) and to pay for operations and maintenance expenses under the O&M agreement.

The agreements attached to the RFP were carefully structured to place the risk (and cost) of late completion of the design and build portion of the project on the developer – while putting the full faith and credit of the Commonwealth behind the debt incurred by the developer to design and build the facility.

The RFP set forth a very aggressive schedule for the competitive process, and specified that the owner was looking for substantial completion of the work within 42 months of the notice to proceed. The procurement schedule from the RFP is set forth in Table 1 (next page).

The RFP also included a detailed base technical concept (BTC) for the project. Also included were two acceptable alternatives for the Route I-95/128

Table 1: The Procurement Schedule Set Forth in the RFP for Route 3 North

Date	Event
December 17, 1999	Request for Proposals Issued
February 22, 2000	Last Requests for Clarification from Private Sector
March 16, 2000	Proposals Submitted by Private Sector
Week of April 3, 2000	Owner Requests for Proposal Clarifications
Week of April 10, 2000	Oral Presentations
May 15, 2000	Selection Announced
May 22, 2000 (on or after)	Development Agreement Awarded and Executed
May 15 to July 2000	Value Engineering Process, Finance Process, Ground Lease and Sublease Executed, Finance Closing, Notice to Proceed
42 months following Notice To Proceed	Substantial Completion of the Project

interchange. The owner confirmed that, with stated exceptions, it expected to have acquired all of the real property necessary to construct the BTC by September 15, 2000.

The RFP permitted and encouraged proposers to submit alternative technical concepts ("ATCs") that would result in cost savings without reducing functionality, provided that the alternatives were based on deviations from the technical RFP requirements that had been successfully used elsewhere. ATCs were subject to a "blind" pre-approval process, which provided additional transparency by confirming which technical alternatives would be acceptable prior to the final competition. The RFP authorized the state to use any of the design concepts submitted by proposers in the final design of the project, and provided for compensation to unsuccessful bidders whose concepts produced savings used in the final project design.

2. Competition, Evaluation, and Award

The RFP contained all the information needed by potential proposers to consider the base technical concept established by the Commonwealth, to consider whether alternative technical concepts were appropriate, to decide whether to participate, and to submit qualifying proposals. The RFP clearly stated how the Route 3 North project would be awarded on that combination of technical content and price that the Secretary of Transportation decided represented "best value" to the Commonwealth. The evaluation process began with a series of pass-fail tests that verified the proposers' "responsibility" to move forward to technical and price evaluation. Technical and price evaluations were conducted separately, and the relative technical and price weights were not disclosed. Comparison on pricing was objective, and based on the required submittal forms, but the RFP clearly advised competitors that the evaluation committee would recommend which proposal represents "best value" to the Commonwealth. Where the recommended proposal was not also the lowest cost proposal, the evaluation committee was required to present a written explanation of the reasons why the Secretary should accept the evaluation committee's recommendation. The RFP included the typical performance and payment bonds required for public works projects, and similar payment and performance bonds adapted for the O&M phase of the project.

Modern Continental Construction Co., Inc. was selected as the "developer" of the project. Modern's total D-B contract price was $375,140,312. In August 2000, the development agreement between the Commonwealth and Modern was executed, and a special purpose, tax exempt ("63-20") entity, the Route 3 Transportation Improvement Association, Inc., (the "Route 3 TIA") was established. The Route 3 TIA issued $394.5 million in tax-exempt lease revenue

bonds in August 2006. The monies received from the sale of the bonds in the public marketplace provided the cash used by Modern Continental for the design and construction of the Route 3 project. The development agreement, the ground lease, the sublease, and the various associated bond-related documents required the Commonwealth to lease the "project" for 34 years, in exchange for the payment of rent sufficient to pay principal and interest on the bonds and pay for ongoing repair and maintenance of the facility.

3. Modern Continental's Performance

Modern Continental broke ground on the Route 3 North project in October 2000, and completed the work, late, at the end of the calendar year 2004. Near the end of the Route 3 project, Modern Continental found itself in financial difficulties, and its assets were acquired by another firm. At the time, liquidated damages were being assessed by the Commonwealth, which had barred Modern Continental from competing for further major highway contracts.[1] Three lanes were open in each direction on the full length of the project in October 2004. Work was substantially completed in 2005. The operations & maintenance agreement between the Route 3 TIA and Modern Continental was never executed. Although the Route 3 TIA continues to exist, and continues to collect rent from Mass Highway for repayment of the 2000 bonds[2] issued by the Route 3 TIA, ongoing repairs, maintenance, and operations of Route 3 North are now being provided directly by the Massachusetts Highway Department.

4. Analysis

The rehabilitated Route 3 represents a remarkable upgrade in transportation service between Burlington (Routes 128 and I-95) and the New Hampshire border. Daily traffic volume on the route has increased by 15% to 25%, depending on locations, while travel speeds have increased and travel times have decreased.[3]

The Route 3 North project fits into the Quadrants as a Design-Build project in Quadrant IV. Design was fully integrated with construction and, although the Commonwealth obtained an option to contract with Modern Continental for long-term operations and maintenance, the Commonwealth did not award it, and Modern Continental did not survive to perform it. Funding was "direct," not "indirect," because the state, not Modern Continental, kept the obligations to repay both the principal and interest on $395 million of debt incurred by the Route 3 TIA to design and build the project.

The rehabilitated Route 3 represents a remarkable upgrade in transportation service between Burlington and the New Hampshire border.

There is much to admire in the way the Route 3 expansion project was packaged, bid, awarded and implemented. The project achieved its goal of chronic congestion relief along Route 3 North. The scope of the project was clearly defined in advance, and environmental reviews and clearances had already been handled in a Final Environmental Impact Report (FEIR). The competition was head to head – ensuring that the Commonwealth acquired initial delivery (design and construction) at a competitively derived fair price. The procurement was transparent – in that reliable, clear, relevant information was made available in a timely way to potential bidders, actual bidders, the public, and to public officials. The Commonwealth received the benefits of lower cost and earlier completion – benefits that a design-build strategy can typically provide in the initial delivery of public infrastructure, and in particular horizontal public infrastructure. The road was designed and built by a Massachusetts-based consortium of engineering and construction firms, at prevailing wages for construction workers. The new facility already includes

bridges wide enough to support additional north/south travel lanes in the future.

5. Lessons Learned

The Route 3 North project is a 34-year commitment by the Commonwealth (through a special purpose tax entity) of future federal highway grant money in which the cost incurred by the private sector in financing the lease has been included in the lease payment committed by the Commonwealth. The amount of the lease payments to which the Commonwealth is committed was intended, and was calculated, to be sufficient over the 34-year term to amortize the capital cost of designing and constructing the project. In essence, the Commonwealth put its credit, and its credit worthiness, behind the payment of this capital lease. The analogy to a home mortgage – while imperfect – is this: the Commonwealth agreed to pay both the principal and interest associated with 100% of the cost of designing and constructing the project. Future federal highway grants are likely (but not guaranteed) to exceed this expense, but the Commonwealth's credit stands behind the repayment of the Route 3 TIA debt.

The state made this commitment in order to obtain the benefits of the Route 3 North project in 2004, that is, at a time much earlier than it otherwise would have received federal aid specifically directed to a widening of Route 3 North.

The road itself was never intended to generate toll revenue. While the project included the prospect of revenues for the developer (and, in turn, the state) through "joint development," the RFP contained little comfort to proposers that any such revenues would materialize. No such revenues have been generated.

The procurement process did not conclusively package design and construction activities with long-term operations and maintenance services. Instead, O&M services were priced separate and optional. As it turned out, the Route 3 O&M agreement was never executed, and its extensive contractual commitments for repair and maintenance by a private O&M contractor were not established. The rehabilitated Route 3 is now competing, along with other state road projects, for an adequate share of state funds for repair and maintenance.

The Commonwealth made a 34-year lease commitment in exchange for a significant improvement in transportation service through what amounts to a straightforward design-build road project along one of the state's major transportation corridors. The Commonwealth committed a portion of its future federal grant receipts (and a portion of its own credit worthiness) to do so. By using prospective revenues to fund infrastructure improvement now, the state exchanged some flexibility in the use and application of future revenues for the delivery of a significantly higher level of service decades earlier along the Route 3 North corridor.

6. Questions Raised

The Route 3 North Project raises basic policy questions. How deep into future federal highway grant revenues should the Commonwealth be willing to reach in exchange for transportation improvements now? The Commonwealth could easily commit all its future federal highway grant revenues in exchange for still more immediate transportation improvements. At some point, though, is this simply a generational transfer of taxpayer burden? How much of the burden of replacing capital transportation projects should be borne by current and by future generations? The answers require delicate balancing by public policy makers between "pay as you go" and "pay later" strategies – the same balancing that governments have been considering throughout American history.

C. MBTA Commuter Rail

After a competitive procurement process conducted by the MBTA in 2002, the Authority entered into a five-year operations and maintenance contract with the Massachusetts Bay Commuter Railroad Company, LLC (MBCR) on February 19, 2003 to provide commuter rail service along the Authority's 702 miles of commuter rail track in eastern Massachusetts. The MBCR serves more than 140,000 passengers each work day on 465 trains, operating on 13 lines that extend as far north as Newburyport and Rockport, as far west as Worcester and Fitchburg, as far east as Kingston and Middleboro, and as far south as Providence, Rhode Island.[4]

The MBCR contract with MBTA to operate and maintain the region's commuter rail lines was structured not as a "public-private Partnership," but as a pure operations and maintenance contract. Although this "O&M" contract contains some capital replacement and capital repair activities, the central obligations of the contractor are to maintain and operate existing assets, wear and tear excepted.

On December 10, 2007, the MBTA Board of Directors voted to extend MBCR's contract for an additional three years. The Board had the additional options of a one or five year extension. MBCR will be paid roughly $224 million per year, plus an inflation adjustment.[5]

1. MBCR's Operations and Maintenance Contract

Broad, All-Inclusive Structure To Required Services

The services MBCR is obligated to provide under the O&M contract include essentially all maintenance and repair required to keep the commuter rail service up and running, with a variety of special arrangements relating to long-term capital repair and replacement, and long-term capital planning for the commuter rail network. The payment structure, described in more detail below, is essentially cost reimbursement, with penalty provisions for deficient performance of the services assigned to MBCR in the agreement.

MBCR's obligations under the operating agreement are set forth in a number of general scopes of service with very specific exhibits supporting each of these. In short, the agreement contains exceptionally detailed requirements and obligations covering the details of virtually all aspects of the operation of the commuter rail network by a third-party contractor.

Exhibits to the contract include specific information on required services to be delivered in the areas of customer service, engineering, mechanical performance, and, obviously, transportation. A key element of the Transportation Scope of Services creates on-time performance requirements and on-time performance reports, which are the basis for penalties for untimely or cancelled service.

2. Payment for Services

MBTA retains control, and ultimate responsibility, for both the capital and maintenance expenditures made by MBCR in operating the commuter rail network. Funds paid to MBCR are independent of revenues arising from commuter rail operations, and the MBTA retains the authority to make its own decisions as to the amount, timing, and allocation of capital, repair, and maintenance funds across the commuter rail system. There are three components of the payments to MBCR under the contract: (i) the annual fixed price, which includes compensation for all services detailed in the agreement, the exhibits, and the scope of services; (ii) compensation for force account work; and (iii) payment of the revenue growth incentive, if it is applicable. Force account work is reimbursed as direct costs billable to the MBTA.

Table 2: Annual Fixed Price Paid to MBCR

Annual Fixed Price Other Than Force Account Work for Base Commuter Rail Services (Does not include: Special Trains, Maintenance. Of Unused right-of-way)

Year 1	$206.0 million
Year 2	$209.1 million
Year 3	$205.5 million
Year 4	$209.2 million
Year 5	$215.4 million
Total, Years 1-5	$1,045.3 million

Price for Greenbush Service

Year 3	$7.0 million
Year 4	$7.3 million
Year 5	$7.8 million

Table 2, above, sets forth the annual fixed price (other than for force account work) that the MBTA agreed to pay MBCR to provide base services on the commuter rail network.

Absence of Performance Metrics

One curious aspect of the MBCR operating agreement is the absence of overall metrics for evaluating the "big picture" performance of MBCR over the first five years of the operating agreement. Upon reading the operating agreement, one would expect to find historical statistics on ridership (by line and train), on-time performance (by line and train), and fare revenue (by line and train). None of this information is provided in the operating agreement with respect to the period prior to 2003, and is simply not used as a baseline for comparing MBCR's performance after 2003. Basic questions cannot be asked about Amtrak's prior performance of these services and whether MBCR's operation of commuter rail has improved service, increased ridership, or increased net revenue.

· What were ridership statistics prior to 2003, when Amtrak operated the service, and how has ridership evolved over each of the past five years, by line, and in total?

· What was fare revenue prior to 2003, and how has revenue evolved over each of the past five years, by line, and in total?

The contract does require that MBCR generate and maintain on-time performance statistics for its own operations after 2003, and these statistics have not only been kept, but have been used to assess penalties against MBCR for "late" and "cancelled" trains, as defined in the operating agreement. While internal comparisons of MBCR may be useful in evaluating whether service levels are changing (upward or downward), and for evaluating the causes thereof, i.e. deteriorating capital equipment, improper maintenance, or human error (or mistake), more basic questions about the long-term health and future of the commuter rail system might be better addressed through the combination of solid ridership, fare revenue, and on-time performance data.

The performance of the commuter rail network over the past 10 years is not transparent to outside observers. Fare revenue is apparently obscured by the Authority's fare collection and transfer policies, which do not permit accurate allocation of monthly pass revenue among the MBTA's rail, subway, and bus modes. Ridership data is similarly skewed. The new Charlie card system does not establish origin/destination information that might assist in the development of more accurate commuter rail revenue information.

3. Contract Creates Future Opportunity

While the lack of historical metrics is a hindrance to analyzing MBCR's performance, the Operating Agreement does offer several useful items that will improve future contracts and provides an opportunity to contract for design-build-operate-maintain services on portions of the network.

The first item is an embedded series of long term capital improvements that MBCR is committed to make to the commuter infrastructure. The Operating Agreement requires MBCR to:

· conduct Sperry rail tests on all continuous welded rail ("CWR") and on jointed rail;

· spend $300,000 per year on a Rail Grinding Program to minimize the premature replacement of rail, and to avoid rail grinding during dry months;

· purchase, weld, and install 5 track miles of CWR in the first six months of each Agreement year;

· renew all cross-ties as required for maintenance, and to purchase and install 35,000 new crossties each Agreement year;

· replace or upgrade 15 grade crossings in each Agreement year, and to replace six culverts per Agreement year; and

· overhaul up to 21 Head End Power units each Agreement year as part of the Annual Fixed Price.

The development of historical data over the eight years of the MBCR contract should put the MBTA in a position to make better decisions regarding long term capital and maintenance budgeting for commuter rail.

The services described above represent capital improvements to the commuter rail network that, though incidental to the entire capital stock in any single year, are intended to allow the MBTA and MBCR to improve service levels and lower ongoing maintenance costs through the judicious expenditure of funds on capital replacements under the Operating Agreement. Next, the Operating Agreement contains a provision that specifically obligates MBCR to properly maintain commuter rail assets, saying "[c]ontractor shall maintain the infrastructure assets of the MBTA and *shall not defer maintenance of these assets so as to reduce Contractor's costs*, or for any other reason."[6]

Lastly, the Operating Agreement requires MBCR to enter historical maintenance data to the extent it is electronically available, and to enter ongoing maintenance into the Authority's Management Information Systems throughout the term of the Contract. It also requires the generation of a number of management and engineering plans, as well as annual recommendations for capital and productivity improvements that are necessary for the MBTA to make long term capital v. maintenance budgeting decisions.

Each of these efforts requires substantial data collection, engineering analysis, and careful planning. As these plans are delivered over the course of eight years of commuter rail operations, the rate of deterioration of capital stock, trends in required maintenance, repair, and capital expenditures will become increasingly apparent, and the long term costs (both capital and maintenance) of operating the commuter rail network on a sustainable basis will be better and better understood. The Operating Agreement includes extensive requirements for MBCR to produce as-built drawings in formats which permit detailed record-keeping of conditions throughout the network.

The term of the MBCR (five years or eight years) is much too short for the MBTA to transfer long term capital and maintenance decision-making to MBCR. However, the development of historical data over the eight (8) years of the MBCR contract should put the MBTA in a position to make better and better decisions regarding long term capital and maintenance budgeting for commuter rail based on solid historical experience.

Table 3: Operating Expense Per Passenger Mile (MBTA Commuter Rail)

COMPARISON OF U.S. COMMUTER RAIL SYSTEMS Source: 2006 Public Transportation Fact Book, American Public Transportation Association, based upon Data from FTA's National Transit Database, FY2004			
		Operating Expense / Passenger Mile	Rank
Dallas, TX	Dallas Area Rapid Transit (DART)	$1.13	1
Anchorage, AK	Alaska Railroad Corp	$0.93	2
Hartford, CT	Connecticut DOT (CDOT)	$0.89	3
Seattle, WA	Central Puget Sound Regional Transit Authority	$0.67	4
Dallas, TX	Fort Worth Transportation Authority (the T)	$0.59	5
Philadelphia, PA	PENNDOT	$0.55	6
New York, NY	MTA Long Island Rail Road (MTA - LIRR)	$0.45	7
San Francisco, CA	Peninsular Corridor Joint Powers Board (PCJPB)	$0.45	8
Philadelphia, PA	SEPTA	$0.43	9
Stockton, CA	Altamont Commuter Express	$0.38	10
San Diego, CA	North County Transit District (NCTD)	$0.35	11
Washington, DC	Virginia Railway Express	$0.35	12
New York, NY	Metro North Commuter RR Company	$0.34	13
Baltimore, MD	Maryland Transit Administration	$0.34	14
New York, NY	NJ Transit	$0.33	15
Chicago, IL	Northern Indiana Commuter Transportation District	$0.32	16
Miami, FL	South Florida Regional Transp. Authority	$0.30	17
Chicago, IL	NE Illinois Reg'l Commuter Rail Corp	$0.29	18
Boston, MA	MBTA	$0.28	19
Los Angeles, CA	Southern California Regional Rail Authority (Metrolink)	$0.27	20

4. MBCR Performance

During the first four years of MBCR's service, trains posted a 90 to 95 percent record for on-time performance.[7] On-time performance of commuter rail trains was the subject of criticism by passengers during the summer of 2007 and during the period prior to the MBTA's decision to extend the operating agreement at the end of that year. Riders reported noticeable degradation in the on-time performance of trains in and out of Worcester, for example, and MBCR has promised to make improvements in on-time performance.[8] There has been little discussion of MBCR's performance regarding capital upgrades to equipment, rail, ties, and crossings over the first five-year period.

Because of thoughtful preparation of the contract, the MBTA has been able to realize meaningful capital expenditures by MBCR and to build an asset management system upon which to build future contracts.

Recent statistics published by the American Public Transit Association seem to indicate that operating expense per passenger mile for the commuter rail network in Boston is relatively low, when compared to other commuter rail systems in the US. See Table 3.

5. Analysis and Conclusions

The commuter rail operating agreement between the MBTA and MBCR is, in many ways, the most interesting of the experiments with infrastructure project delivery in the Commonwealth. While the press has reported difficulties with service, MBCR is, by contract, implementing a capital replacement and improvement program that addresses those fixed assets within the commuter rail network that are in most urgent need of capital replacement. MBCR is also implementing a much smaller capital repair program for rolling stock, but this portion of the agreement is not

structured – by either party – to provide for continuous, steady replacement of rolling stock and locomotives over time.

The MBTA seems to have made a very wise strategic decision to use the contract arrangements with MBCR as a means to gain a substantially better understanding of rates of degradation of its capital facilities, rolling stock, and consumables.

As the MBTA and MBCR move toward the end of the current eight-year arrangement for operating the commuter rail network, the MBTA should be in a better position (than before the MBCR contract) to incorporate historical metrics for ridership, fare revenue, ongoing maintenance, and ongoing capital expense in the next competition for a commuter rail operator. The MBTA seems to have made a very wise strategic decision to use the contract arrangements with MBCR as a means to gain a substantially better understanding of rates of degradation of its capital facilities, rolling stock, and consumables, while at the same time substantially expanding and upgrading the information systems that identify and track assets and associated capital, maintenance, and repair costs. There is a fundamental tension between a five-year operating contract awarded to a private entity like MBCR and the MBTA's longer term interest balancing maintenance versus replacement of capital assets such as rolling stock and rail. With eight years of data, information, and experience in digital and written report form, the MBTA should then have substantially improved its options by the end of the MBCR contract to either move to: (a) a comprehensive design-build-operate-maintain model, (b) a more competitively priced pure O&M model, or (c) the re-establishment of a fare structure that fully or partially supports a publicly operated commuter rail system in the Commonwealth.

D. The "Big Dig"

The Central Artery – Third Harbor Tunnel (CA/T) Project, when built, was the largest civil engineering project in the history of the United States. The depression of the Central Artery and the construction of a new connection from the previous eastern terminus of the Massachusetts Turnpike to Logan International Airport has become part of Massachusetts lore over more than a decade of design and construction in the heart of the City of Boston. Traffic congestion on the old Central Artery, designed to carry 75,000 cars per day, but which had reached 200,000, was legendary. The annual cost of delay to users was estimated at $500 million.[9] The solution implemented was the CA/T project to replace the six-lane elevated highway with an 8- to 10-lane underground expressway directly beneath the existing road, with a 14-lane, two-bridge crossing of the Charles River at the north end of the project. This was to be coupled with the extension of I-90 from downtown Boston through South Boston and under Boston Harbor (the Ted Williams Tunnel) to Logan Airport.

The Big Dig project was structured not as a "public-private partnership," but as a collection of traditional design-bid-build projects, with many inter-connected pieces and interfaces, but essentially delivery was to be made in the traditional fashion in which design is first completed, followed by competitive lump sum bidding for construction. The Commonwealth originally planned to receive the completed project for operations and maintenance by its Massachusetts Highway Department, a plan that changed near the end of the project, as described below. This case study is about one aspect of the Big Dig – its management structure, that is, how the Commonwealth arranged for these otherwise "traditional" processes to be managed by the Commonwealth on behalf of the public.

1. Background

At the inception of the project, the Massachusetts Highway Department[10] needed additional engineering and construction management help for the duration of the proposed CA/T project. This help could be obtained by hiring additional staff at MassHighway or by retaining assistance from consulting firms in the private sector. The decision taken by then-Secretary of Transportation Fred Salvucci and Governor Michael Dukakis was to conduct a procurement for a design and construction management firm (or firms) who would temporarily, during the term of the CA/T project, serve as an extension of MassHighway staff, under its direction and control.

Another decision taken by cognizant state officials early in the project was to break the CA/T project's design and construction up into smaller "contract packages" ("Sections") the intent of which was to encourage smaller, local designers and builders to be in a position to compete for contracts. The project was eventually carved into more than 20 sections, creating numerous contract and design interfaces to be coordinated and managed by MassHighway and by its management consultants.

Following a public procurement for professional services under the applicable Massachusetts law, a joint venture of Bechtel Corp. and Parsons Brinckerhoff, Inc., was selected to serve in this capacity. The competition included strong proposals from other reputable firms, including a combination of DeLeuw Cather, Inc. (based in Washington, DC) and its parent, the Parsons Corporation (based in Pasadena, California). The agreement between the Commonwealth and the Bechtel-Parsons Brinckerhoff joint venture followed the basic strategy described above – Bechtel-Parsons Brinckerhoff would be retained to provide additional professional design review and construction management expertise to MassHighway, under the latter's direction and control. The US Department of Transportation reviewed, approved, and funded this arrangement.

The December 9, 1987 Agreement between MassHighway and the B/PB JV (Work Program 4) explicitly confirmed these arrangements. Section IV of the Agreement incorporates a Scope of Work that was attached to the Agreement as Exhibit A. In the Definition of Services, the term "management" was defined to mean all services described in the scope of work, subject to the Department's (MassHighway's) "direction and approval." Throughout the Agreement, various provisions confirmed that the Management Consultant was to act as an agent of the Department, an extension of its employees, without actual or apparent authority to bind the Department.

Section III of the Agreement, at Section E, at Subsection 3, includes a release by the Department of the Management Consultant (and a Covenant Not to Sue by the Department in favor of the Management Consultant) for any liability in excess of available insurance proceeds plus 200% of the Management Consultant's portion of the Net Fee under the Agreement, except to the extent that any claim is attributable to the willful misconduct, gross negligence, . . . fraud, or active concealment of the Management Consultant.

Subsection 6 confirms that the Management Consultant "shall be deemed to be acting as the Department's agent in its dealing with third parties..., provided however, that the Management Consultant shall have no real or implied authority to bind the Department in contact or by declaration or admission.

In section M, the support relationship of the B/PB JV to the Department was again confirmed. To be paid, B/PB JV's work was required to be with full knowledge of the Department, and was to be approved in full. Work not authorized and approved was not to be paid under the

Agreement.

The 1987 agreement was clear: the B/PB JV's work was to be done under the oversight and approval of MassHighway.

2. Changes to the "Integrated Project Organization"

In 1997, the Legislature of the Commonwealth created the Metropolitan Highway System, designated the Massachusetts Turnpike Authority as the future owner and operator of the Central Artery/Third Harbor Tunnel facilities, and transferred day to day management of the Big Dig from MassHighway to the Mass Turnpike.[11] The December 2004 report of the Senate Committee on Post Audit and Oversight suggests that one consequence of this transfer (apparently unintended) was that it allowed the CA/T organization to be converted to the so-called Integrated Project Organization, in which "state employees were integrated with employees of Bechtel/Parsons Brinckerhoff with the goal of creating a more seamless project management structure."[12] The Senate Committee notes that prior to the legislative transfer of the Project to Mass Turnpike, MassHighway was prohibited under M.G.L. c. 29, Sec. 29A from allowing a private contractor to supervise state employees assigned to manage and oversee the project. The IPO was "to be a dynamic flexible and harmonious whole [to enable state employees and B/PB employees to work together cooperatively, without duplication of efforts] designed to match staff members' technical skills to jobs without regard for the organization paying their salaries.'"[13]

In its 2008 press release describing its settlement of claims by the Commonwealth and the US Attorney for the District of Massachusetts on the CA/T, Bechtel acknowledges the creation of the IPO in 1999, "just as construction activity was peaking".[14] The press release goes on to acknowledge what the Senate Report concluded in December 2004.

Although adopted for the stated purpose of streamlining the management structure and trimming costs, it also had the effect of blurring accountability and responsibilities, and discouraging proactive project management.[14]

An independent review of the project by the Board on Infrastructure and the Constructed Environment ("BICE") of the National Academy of Sciences in 2003 offered mixed results on the IPO, citing several examples in which the IPO reported savings and improvements in the project, but noting situations in which the IPO proved to be weak.[15]

The implementation of the IPO has complicated the control of expenses for the B/PB management-consultant team. MTA personnel, including the director of finance, review and approve invoices from the consultant. Annually, the staffing of the B/PB management consultant team is reviewed, with the expectation that time commitments will be reduced as the CA/T project concludes more contracts and moves toward completion. (BICE Report, p. 28.)

3. Effect of the IPO on Overall Project Performance

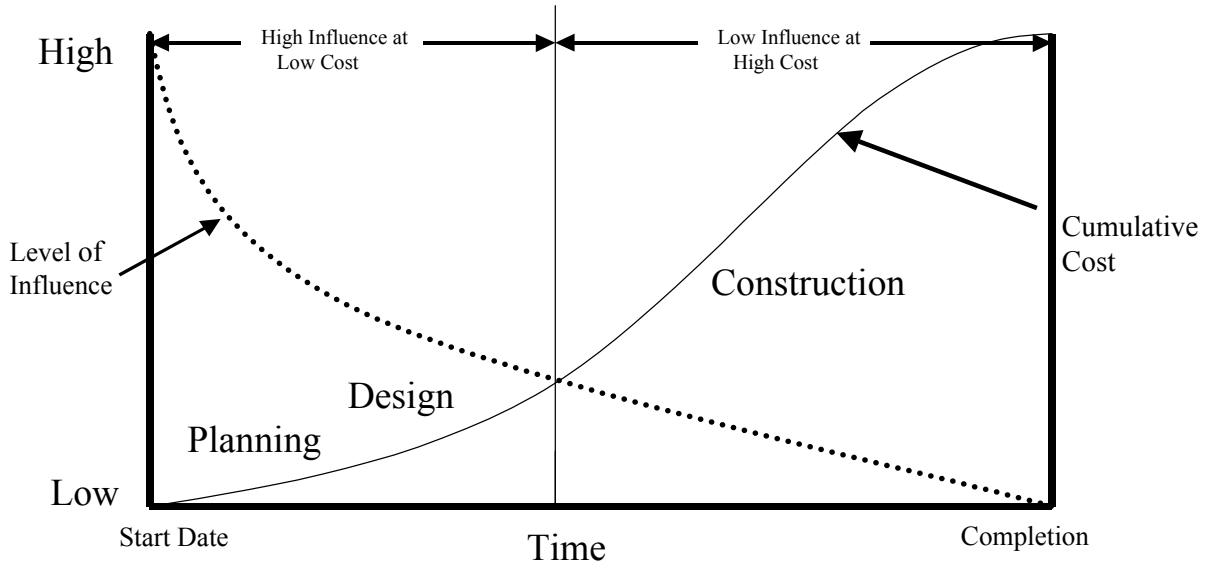
In retrospect, the Integrated Project Organization is now perceived to have created more problems than solutions with respect to the completion of the Project, and it certainly seems to have affected the results of settlement discussions among the parties, the Attorney General of the Commonwealth and the U.S. Attorney. There is little doubt that the IPO increased costs and time for project completion because it blurred responsibility and accountability between the public and private sectors. However, for two principal reasons, it is difficult to conclude that the creation of the IPO at the height of construction of the CA/T in 1999 was the root cause of the increase in project cost and delays in completion.

First, the original contract arrangements between MassHighway and B/PB already established B/PB as essentially the agent of the Commonwealth, subject to the direction and control of the State, with very limited liability as either the designer or the constructor of the Big Dig. B/PB were managing the design and construction on behalf of the state, pursuant to a contract arrangement in which the risk associated with design was primarily on the Section Design Consultants and the risk associated with construction was primarily on the contractors. The conversion to the IPO did not help in 1999, but B/PB was never directly responsible for the performance of independent contractors engaged directly by the Commonwealth to both design and build the Big Dig.

Second, at the point in the project when this change was made, the die was largely cast – there was very little opportunity in the middle (or at the height) of construction to influence how the project performed during the construction period that remained. Figure 6 (this page) illustrates the rationale underlying this conclusion, based on research conducted by Prof. Boyd Paulson at Stanford University. The Cost Influence Curve, generated as a result of Paulson's research, describes the dwindling ability to influence project results as projects move into the construction phase. The much more likely sources of cost and schedule increases against budget on the Big Dig are inadequacies in early planning, procurement, and design. By the time the project moved fully into the construction phase, there was very little opportunity to influence cumulative cost.

Figure 6

Cost Influence Curve



Source: Boyd Paulson, *Professional Construction Management*, first published in 1978.

4. The Completed Big Dig Project

While the cost overruns associated with the Big Dig are now legendary, and have affected transportation spending across the Commonwealth, its impact on traffic and congestion is undeniable.

Dan Baxter, ITS Director of North America with Stantec (a design and consulting firm), in Denver, Colorado, has concisely summarized the effect of the completed Big Dig project on congestion in metropolitan Boston:

· Daily average traffic speed on the new Central Artery northbound rose from 10 mph to 43 mph.

· The average speed in Boston's Harbor tunnels tripled from 13 to 36 mph.

· Daily hours of vehicle delay in these facilities went down by 66%.

· The 1990 environmental projection of an improvement in traffic flow by 2010 has already been exceeded, while overall traffic volume grew by 23.5% since 1995.

Improvements to environmental conditions following the completion of the Big Dig are contended to be more impressive. For example, the Economic Development Research Group, in a study funded by the Massachusetts Turnpike Authority, projects:

· (in the year 2010) a 2,123-ton projected reduction in the emission of carbon monoxide;

· an estimated 25-33% reduction in traffic-related noise in nearby neighborhoods; and

· reductions for 2005 VOC emissions in the CA/T study area (based on an analysis by CA/T staff and Central Transportation Planning staff).

5. Summary and Conclusions

The Big Dig was clearly delivered as design-bid-build in Quadrant IV. Each of the sections was essentially procured as separate design-bid-build projects, with separate design, followed by bidding, awarded on the basis of lowest sealed bid, and construction. The project was traditional design-bid-build – which may have appeared differently because of the presence of the B/PB JV as a management consultant to MassHighway, and, ultimately, when the project was transferred to the Massachusetts Turnpike Authority, as a consultant to it.

In no way can the Big Dig be seen as a public-private partnership or life cycle delivery project, executed in either Quadrant I or II of the Quadrant Framework. There is no ongoing private sector involvement in long-term operations and maintenance of the combined project. All of the financing for the initial delivery of the project came from public sources – state appropriations and federal grants. Funding for ongoing maintenance and operations comes from the Turnpike.

Improvements to environmental conditions following the completion of the Big Dig are contended to be more impressive.

To some, the Bechtel-Parsons Brinckerhoff joint venture agreement may appear (with 20-20 hindsight) to have been a mistake, to have been poorly conceived or poorly drafted. But, the situation back in 1987 clearly favored proceeding with the project as was decided by Secretary Salvucci and Governor Dukakis. Through the extensive influence of the Massachusetts Congressional delegation, and in particular Speaker Thomas P. "Tip" O'Neill, Massachusetts had an opportunity to gain a substantial federal subsidy that was originally projected to be 90% of project costs. Of course, the project's history of cost overruns and various Federal actions resulted in the actual number being approximately 60% of project costs.[17]

The project required an intense, but temporary, increase in MassHighway Department staffing.

The project involved complex tunneling in an urban area, through 300-year-old sea walls whose precise location was not known, while finding, moving, and replacing 300 years of water, sewer, steam, electrical and telephone utility lines beneath the heart of the city. The project was to be completed while the elevated Central Artery remained in operation, and without disturbing ongoing MBTA service on the Blue and Red lines, which it crossed, and without disrupting commercial establishments on either side of the project.

While the cost overruns associated with the Big Dig are now legendary, and have affected transportation spending across the Commonwealth, its impact on traffic and congestion is undeniable.

Should other delivery and financing strategies have been considered? The project might have been moved to design-build-operate-maintain (with full state and federal funding) if public officials had been willing to pay a "shadow toll" or an "availability payment" to a single contractor over a 25- to 35-year period sufficient to amortize the developer's cost for designing and building the project and for operating it over a similar concession period. But, this seems impractical given the extraordinary level of uncertainty where 300 years of utilities were located, and further, where a series of sea walls that previously divided the harbor from land were also located. How would such a procurement be structured to fairly compensate the contractor for the probable performance of a significant amount of changed underground work other than on a time and materials basis? The difficulty of asking the private sector to firmly (and fairly) price the construction work through downtown Boston would have likely precluded this approach.

The project might have been moved to design-build-finance-operate-maintain, a privately funded life cycle delivery. But a privately financed version of the Big Dig would have required a tolling structure that repaid the initial delivery cost of the project, financing costs, and ongoing O&M costs. The privately funded version would face the same difficulty described above – how would a privately funded procurement be structured (where significant underground risk cannot be firmly and fairly priced) without the private sector including a substantial contingency in their proposal which would unfairly pass this contingency on to users through higher tolls?

Given the technical difficulty of the project,[18] and the uncertainty over underground conditions, it is difficult to imagine a scenario in which the Big Dig project might have been positioned as a life cycle delivery procurement in either Quadrant I or II, without paying a substantial premium for extensive changes in the scope of work caused by differing underground site conditions. The project might have been broken up into a smaller number of sections, which would have made the coordination efforts easier, but the decision to carve the project up as it was can be debated endlessly.

With the passage of time, the Big Dig should, and will be seen, as one of the most successful congestion relief projects ever built, despite its poor track record of estimating costs and meeting cost projections. With the January 2008 settlement of remaining disputes between the Commonwealth and Bechtel-Parsons Brinckerhoff, the extraordinary improvements in transportation service that the completed Big Dig now brings to the City of Boston will hopefully become the legacy that lasts, not the decade and a half of construction.

E. The North East Solid Waste Committee

The North East Solid Waste Committee (NESWC) is a group of 23 Massachusetts cities and towns that formed an informal association of public officials meeting in the 1970s to explore solutions to the emerging problem of declining landfill space for the disposal of solid waste.[19] With the benefit of hindsight, and the perfect vision it provides, the issues and the proposed solutions related to the disposal of solid waste seem to be in the distant past, but in the 1970s, the problems facing public authorities were pressing, important, and very real. The Oil Embargo of 1973 had created a fuel crisis in the United States, and had driven prices up. Public landfills were filling, were viewed as a source of pollution, and, with the passage of CERCLA (or "Superfund") in the last few days of the Carter Administration, were suddenly converted to a potentially stunning liability for local communities throughout the Commonwealth. The protection of groundwater and aquifers as reliable sources of drinking water was emerging as a pressing environmental need, and the concept of "resource recovery," along with an entirely new industry to recycle and reuse waste materials, was in its formative years. New approaches and improved technologies were being tested and applied to recover paper, metal, glass, and energy from solid waste.

Two basic approaches were being considered by Massachusetts communities – burn waste to create steam, which in turn would generate electricity, or process waste into a fuel that could subsequently be burned. The Commonwealth stepped forcefully into the emerging problem of solid waste by legislation passed in 1973,[20] which "required the Commonwealth's Bureau of Solid Waste Disposal (BSWD) to designate solid waste disposal districts throughout the state and authorized the BSWD to lease land to private persons or firms for construction, operation, and maintenance of private resource recovery facilities."[21] The Commonwealth then contracted with the MITRE Corporation to analyze the feasible locations and sizes of resource recovery projects around the Commonwealth.[22]

The phrase "public-private partnership" was not yet in the U.S. vocabulary. The logic behind involving the private sector in solid waste disposal was quite simple: attract new technology and know-how to improve the quality and lower the price to the public sector. By combining design, construction, maintenance, and operations into a single contract (then described as a design-build-operate-maintain contract), the public sector put the responsibility for properly disposing of solid waste squarely on its private-sector contractor – an approach that worked on the technical side, but, as discussed below, was a miserable failure on the cost side to those communities that joined NESWC.

The NESWC project was initially identified by the Commonwealth as one of at least five statewide regional resource recovery projects. NESWC was the first such project to be actively pushed by the BSWD, and as it turned out, was the only resource recovery project that was actually constructed.[23]

The idea was a simple one: (i) consolidate a reliable stream of solid waste to be incinerated in a "trash-to-energy" plant, and (ii) sell the energy produced at the new plant to the electrical grid through a power purchase agreement with New England Power. The cost of incineration would be lower for a group of cities and towns than each could achieve alone because of economies of scale. The cost would further be reduced through the sale of generated power to the grid. The situation should have been a win-win for the environment, for the participating towns, for taxpayers, and for the private operator.

In later investigations, the Inspector General found that, throughout the 1970s, the Commonwealth aggressively pushed the NESWC project on communities in the northeast section

of the Commonwealth. For example, in a January 1979 letter to the Andover town manager's office, the Commissioner of Environmental Management warned of increased costs and "crisis management" if Andover and other communities did not sign on promptly with the NESWC project:

"Stricter requirements will eliminate many landfills and increase the costs of those that remain. *If municipalities do not make timely decisions now to assure the availability of the NESWC facility, many municipalities . . . can be expected to enter a period of crisis management...I urge each and every municipality to recognize this problem for what it is and to realize the immediacy of the need for a positive decision on the NESWC contract.* . . . It is important that each city and town in the Northeastern Massachusetts area have this item on its agenda, at town meetings or in city council."[Emphasis added.]

The Inspector General also found that in April 1979, as the *Lawrence Eagle-Tribune* reported, the Governor had sent letters to communities in the greater Lawrence area, warning that many of their landfills violated state regulations. A January 1981 article in The Boston Globe quoted the Secretary of Environmental Affairs as stating that 45 out of 59 landfills in use in northeastern Massachusetts were in violation of state environmental regulations, and that the landfills serving 50 of 74 communities expected to be served by the NESWC plant were projected to be full by 1985.

The Inspector General found that while some communities objected to the Commonwealth's pressure to participate in the NESWC project,[24] after the Commonwealth announced its intention to close 45 of the 59 operating landfills in the region, 23 communities agreed to join the NESWC project, which the towns understood would produce a guaranteed volume of trash large enough to create a single combined revenue stream sufficient to design, build, finance, operate, and maintain a trash-to-energy plant that would meet the solid waste needs of the participating communities for the next 20 years. With the state closing three-quarters of the region's landfills, the participating towns believed that there was little choice but to join NESWC.

1. Premature Procurement Actions

The Commonwealth of Massachusetts' consultant prepared the Request for Proposals (RFP) from the private sector to design/build/finance/operate/maintain the NESWC project. In the RFP and at a pre-bid conference in January 1975, potential bidders were advised that the Commonwealth would organize the regional structure of the project after selecting the contractor and advised that 53 communities in northeastern Massachusetts and New Hampshire were potential users of the project.

The RFP was issued and the procurement process started:

(1) before the Commonwealth or affected towns knew who would ultimately join NESWC;

(2) before the Commonwealth could confirm expected volumes of solid waste from the affected towns; and

(3) before the Commonwealth made any firm commitment to close even one (1) of the 45 competing landfills that the Commonwealth had identified as in violation of existing environmental laws.

Rather than confirming these critical pieces of information before issuing an RFP, the Commonwealth solicited technical proposals and cost estimates for three alternative projects whose size and functional requirements varied significantly:

· a small facility serving a "core region" including Andover, Haverhill, Lawrence, Methuen, and North Andover that would burn up to 310,000

tons per year;

· a medium facility burning 527,000 tons of waste per year from 53 communities in northeastern Massachusetts and southern New Hampshire; and

· a large facility burning 930,000 tons per year from unspecified municipalities in northeastern Massachusetts and southern New Hampshire.

There was no head-to-head competition on the plant that was actually to be built, competition that would have forced bidders to sharpen their pencils, and be innovative and creative in how to integrate design with construction and with operations and maintenance in order to win the award.

The Commonwealth completed its procurement selection process and awarded a contract in August 1975 to Universal Oil Products (UOP) to design, build, finance, operate, and maintain the largest of the three facilities listed in the RFP. Because the specific design requirements were not known before the RFP was issued, the evaluation criteria set forth were weak, none specific, and primarily "qualifications" based. The four evaluation criteria were: (a) system reliability; (b) the financial and operational qualifications of the proposer; (c) environmental impact and aesthetics; and (d) the net disposal fee. The fourth criteria might have forced proposers to sharpen their pencils and compete head to head, but the Commonwealth asked proposers to address three differently sized potential plants – and the plant actually built was yet a fourth size. The procurement plan was a poor one, forcing the Commonwealth to conduct soft competition.

The disposal fee proposed by UOP was $4.70 per ton, which was calculated on the assumption that the largest of the three plants was built and on the further assumption that the region would produce the quantity of trash projected by the Commonwealth. The Commonwealth was still projecting that 53 towns, including Haverhill, Lawrence, and Lowell, would join the consortium. This "price" assumed that a facility capable of burning 930,000 tons of waste per year would be built, furnished with the expected quantity of trash, and that receipts from the sale of energy and recovered metals would be as projected by the Commonwealth.

The technical scope of the facility was not properly defined in the RFP. Without a firm understanding of which towns were "in" and which towns were "out," and developing reliable estimates of the expected volumes of solid waste that would actually be heading to the proposed NESWC facility, (a) the specific characteristics of that facility could not be established, (b) the design requirements could not be set forth in an RFP that called for head-to-head competition, and (c) a competitive solution could not be obtained through the procurement. There was no head-to-head competition on the plant that was actually to be built, competition that would have forced bidders to sharpen their pencils, and be innovative and creative in how to integrate design with construction and with operations and maintenance in order to win the award. The terms of the DBOM contract were not distributed with the RFP in advance. Without a common basis (i.e. the expected terms and conditions) upon which to compare the proposals, the procurement could not generate head-to-head competition on price and on quality.

After awarding the "trash-to-energy" plant to UOP in 1975, the Commonwealth negotiated with UOP on behalf of potential member towns as to the terms of their respective agreements. The negotiations dragged on and construction did not commence until 1981. The plant did not open until September 1985. The facility that was the basis for UOP's "competitive" selection was abandoned in favor of a plant less than half that

size – 465,000 tons per year. Twenty three towns became members of NESWC: Acton, Andover, Arlington, Bedford, Belmont, Boxborough, Burlington, Carlisle, Dracut, Hamilton, Lexington, Lincoln, Manchester, North Andover, North Reading, Peabody, Tewksbury, Watertown, Wenham, Westford, West Newbury, Wilmington, and Winchester.

2. Financing the NESWC Project

The agreements that the Commonwealth negotiated for the member towns required each town to sign a service agreement with UOP's operating subsidiary Massachusetts Refusetech, Inc. (MRI). Each town committed to send all of its (conforming) solid waste to the facility for disposal. In order to secure a steady cash flow to MRI (to demonstrate to MRI's financial investors that cash payments from the member communities would be made regularly and on time), each town was required to meet a certain minimum tonnage of solid waste "tipped" at the facility. Towns were required to "put or pay" for solid waste disposal, that is, to "put" the required tonnage into the facility at the established tipping price per ton, or to "pay" a tipping fee anyway, as established in the agreement, for any shortage in total tons "tipped" each week, month, and year.

All of this would have been great for the member towns if the $4.70/ton tipping price proposed by UOP (for the largest proposed plant) had turned out to be the actual price, or even a base price subject to escalation by the Consumer Price Index. Instead, the Commonwealth had negotiated agreements with MRI under which member towns were required to pay a Disposal Fee that fluctuated, based on numerous and complex factors. The amounts paid as a Disposal Fee by member towns were based on a formula that adds together a base payment, a supplemental payment based on tonnage tipped (with premiums for certain excess tonnage and penalties for certain short tipping tonnage), the cost of MRI's debt service on financing for the project, an operation and maintenance fee that is adjusted upward each year by the Consumer Price Index, taxes, insurance, bonds, and fee pass-through costs. From this total, 89.5% of the revenues received from power sales to New England Power, and 50% of the revenues received from sale of recovered ferrous metals were subtracted to calculate the final Disposal Fee payable by towns.

Many years after UOP was selected as the winning proposer, and after the plant opened, the actual volume of solid waste committed to be sent to the project, and the associated revenues, turned out to be vastly lower than projected by the Commonwealth at the time it encouraged the member towns to sign up. First, the three largest cities in the region, Haverhill, Lawrence, and Lowell all decided not to join NESWC, and instead participated in a competing solid waste disposal project proposed by Refuse Fuels, Inc. The absence of these major participants would have stopped the procurement process, except that the Commonwealth had already completed its selection process for the largest of three facilities, based on the erroneous assumption that these three cities would join NESWC. Second, the Commonwealth dramatically slowed its closure of the 45 landfills it had previously announced would be shut down. Suddenly, the economic rationale for NESWC and for the "trash-to-energy" plant was substantially different, and much, much worse.

Figure 7: The North Andover "Trash to Energy" Plant

The agreement provided that under these circumstances, MRI had the right to adjust the service fee to the communities "so as to restore equivalent financial conditions for the performance by MRI of its obligations under this Agreement." In the event of a disagreement with MRI's proposed change in the amount of the service fee, the agreement called for arbitration and required the arbitrator to put MRI in the same position it would have been in had the changes not occurred.

Everything now worked against the communities:

· The state didn't close competing landfills, which eliminated any pressing requirement for other towns to join NESWC.

· Instead of 53 towns, only 23 became members, and none of the big three – Lawrence, Lowell, and Haverhill – did. As a result, volumes were lower, and there were less economies of scale in the "trash-to-energy" process. There was also less power to sell to the grid, and lower credits to be earned against tipping fees.

· The state passed the MA Solid Waste Act of 1987, and in 1990, the U.S. Congress modified the Federal Clean Air Act, in response to which MRI spent $43 million dollars modifying the plant.

· The initial delivery cost of the "trash-to-energy" plant, when it opened in 1985 with a rated capacity of 465,000 tons of waste per year, was $197 million, so the $43 million dollar expense was a significant addition to MRI's overall capital costs.

· The price of oil dropped considerably between the time the Commonwealth was pushing the project in the mid 1970s to 1985, when the plant opened. Revenues from the sale of energy dropped from a projected $.10 per kilowatt hour to $0.015 per kilowatt hour in 1985.[26]

Against the projections used by the Commonwealth and by UOP in negotiating the various service agreements, the number of particpating communities was substantially lower, the volume of trash was substantially lower, the cost of building the plant was substantially higher, and the value of the energy produced by the plant, when sold to the grid, was lower by a factor of six.

The procurement process used by the Commonwealth on the NESWC "trash-to-energy" project provides numerous examples how not to structure projects for transparency and competitive pricing.

MRI's view was that it was still entitled, no matter what these various changes were, to the same economic deal, with complete recovery of the cost of its capital investment, with reimbursement for O&M costs, and with the same level of overhead recovery and profit MRI anticipated when the agreements were signed.

MRI adjusted the service fee to:

· amortize all of its capital expenses over the 20-year term of the agreement, including the $43 million in capital upgrades spent during operations (on a schedule much shorter than 20 years);

· be paid in full for all the other charges specified in the agreement, including the stipulated O&M charges, with CPI escalation; and

· be paid to cover the overhead and profit return expected by UOP (and MRI) at the time the agreements were signed.

Costs projected by the Commonwealth's consultant to be $4.70 per ton in 1975, when the Commonwealth selected UOP to build the largest proposed plant with the highest assumption of waste delivered and value of energy sold to the grid, were (in 1997) $95 per ton. MRI was largely

successful in raising the service fee to these levels throughout the NESWC communities.[27]

There was no escape for the Towns: Section VI, Clause 7 of the service agreement contains an "Unconditional Obligation to Pay" the Service Fee as adjusted.

3. Summary and Conclusions

The NESWC project was positioned as a design-build-operate-maintain project in Quadrant I of the Quadrant Framework. The term of operations and maintenance (20 years) was planned to be long enough for the contractor to fully recover all development and financing costs connected with the design and construction of the facility. Because the service agreement contained an *unconditional obligation* on the part of the member towns to pay all of the contractor's development, financing, operations, repairs, and maintenance costs, there was no financial risk transferred to the contractor in this situation. Provided it designed and built the facility, and was able to take trash in the minimum quantities specified, the towns had an irrevocable, unconditional obligation to pay for all of the contractor's costs.

The NESWC project is a classic situation in which the Commonwealth commanded others (the member communities) to take risks with an emerging technology in circumstances under which the Commonwealth, rather than the towns, should have done so. The Commonwealth prematurely wrote and issued a Request for Proposals before it had secured the trash and revenue streams necessary to properly support a 20-year design-build-operate-maintain project. It doesn't appear that the Commonwealth understood the risks it was transferring to those towns "commanded" to enter NESWC, and it certainly doesn't seem that the Commonwealth conducted any sensitivity analyses around key variables in the life cycle cash flow of this facility. Typically, project feasibility studies look at cash flow (revenue and expense) of a project over the life cycle, and then make a series of assumptions to test the long term effect of changes in these variables on the tipping fee charged to the towns.

The NESWC project is an example of how poor procurement practices, lack of preparation, and lack of head-to-head competition, can produce unacceptable results with respect to any infrastructure facility.

In the NESWC case, the situation was even worse, because the Commonwealth did not yet know which towns would join NESWC and which towns wouldn't, which landfills would be closed, and which wouldn't. The scope of the project had not yet developed to a point that would have allowed a competitive, transparent competition to take place. Instead, an extremely "soft" competition was conducted to select an entity to build the plant, without obtaining a simultaneous commitment from the bidder as to what precisely would be built and what precise charges would be paid by member towns. Because the procurement was so poorly planned and executed, the pricing terms were based on recovery of costs, overhead, and profit – essentially a cost-plus arrangement that most public procurement officials would be wary of over a 20-year term. The terms of the service agreement were negotiated by the Commonwealth on behalf of the member towns after the contractor had been selected. Best procurement practices require competitive procurement of specific work, under known terms and conditions, for a price (cost). Unbundling these elements, as was done here, takes the competitive pressure off in negotiating terms and conditions.

The Commonwealth made one further, very significant mistake in this procurement: it permitted the contractor to keep the plant at the end of the term, even though all the costs of designing, building, repairing, and operating the

plant were fully amortized over the 20-year term. Although communities had paid high service fees over the 20-year period and had completely reimbursed the contractor for its development costs and its cost of capital upgrades, the facility remains in MRI hands, and is now processing trash to energy for its own account.

The NESWC project is an example of how poor procurement practices, lack of preparation, and lack of head-to-head competition, can produce unacceptable results with respect to any infrastructure facility. The NESWC project highlights an important lesson for the Commonwealth and its subdivisions when considering life cycle delivery. Life cycle delivery projects need to be sufficiently long – at least as long as a typical mortgage (15 to 35 years) – for a contractor to arrange financing for construction and operations. Financing banks need to see a long concession period to be comfortable that project revenues can repay the money borrowed. The NESWC communities provided this comfort through an irrevocable, unconditional commitment to pay the (adjusted) service fee. The lesson is this: the consequences of poor procurement planning, lack of head to head competition, and lack of transparency when life cycle delivery methods are used will last for at least a generation.

III. Conclusion

As the Commonwealth considers the addition of public-private partnerships as a mechanism for quickening the pace and increasing the level of investment in infrastructure renewal, several lessons can be learned from the case studies.

First, many high profile recent projects, like the Big Dig and Route 3 North, are not actually public-private partnerships and their success or failure should not color consideration of the concept.

The Commonwealth should consider project delivery methods...that are focused...on the achievement of two goals: (i) better infrastructure service (ii) at competitively established lower life cycle costs to users.

The Route 3 North project was a design-build project, not a "life-cycle" project and not a public-private partnership. The project confirmed that combining design with construction can make practical sense on engineering projects, in which the timing and cost of initial delivery are important considerations. The Big Dig is often cited as an example of a "PPP" but the project clearly had none of the attributes of integrating of design, construction, and O&M functions into a single contract with the private sector. The CA/T project may provide a number of lessons in project packaging (the project was broken into dozens of pieces), fast tracking (the project commenced at the south end while schemes A through Z, literally, were still being analyzed for the Charles River crossing), and the use of private consultants to temporarily expand the capacity of state agencies to manage the design and construction of very large projects. But, the Big Dig really isn't relevant for consideration by the Commonwealth of project delivery strategies in which design, construction, and life-cycle

O&M are integrated into a single, competitively awarded, transparent contract with the private sector.

The MBTA commuter rail Operating Agreement is an example of an operations and maintenance agreement, rather than a public-private partnership. The MBTA commuter rail contract experiment continues, and will hopefully provide public policy makers with an opportunity to properly better balance operating and capital budgets for a large, aging, commuter rail system. Because of thoughtful preparation of the contract, the MBTA has been able to realize meaningful capital expenditures by MBCR and to build an asset management system upon which to build future contracts.

The MBCR contract has likely slowed the pace at which the commuter network degrades, because of the heavy emphasis on timely maintenance. For a transparent, competitive "Life Cycle" delivery method to be effective in the future, better information should be routinely generated as to ridership and commuter rail revenues. MBCR's performance, and that of its successors, should be measured against objective metrics that include ridership and revenues.

The procurement processes used by the Commonwealth on the NESWC "trash-to-energy" project provides numerous examples how not to structure projects for transparency and competitive pricing. The process failed to protect the public across multiple dimensions: it was not transparent; competitors did not compete head-to-head; and risk was allocated to those least equipped to bear it.

Going forward, the Commonwealth should consider project delivery methods, including carefully defined public-private partnerships, that are focused like a laser beam on the achievement of two goals: (i) better infrastructure service (ii) at competitively established lower life cycle costs to users. To accomplish these goals on large public infrastructure facilities, the integration of design with construction and with operations and maintenance over the life cycle of the facility is essential. Publicly financed, privately financed, and mixed alternatives for life cycle delivery of infrastructure services need to be legislatively established as permanent options readily available to public officials at both the state and local level in the Commonwealth. With competitive, transparent, yet flexible mechanisms in place to describe, compete, and award infrastructure work, both the public and private sectors can move from "talking" about PPPs to actually designing, building, and operating the projects required to meet the Commonwealth's infrastructure needs. Every citizen in the Commonwealth will benefit from increased mobility and from the opportunity to participate in this work.

Glossary of Terms

INFRASTRUCTURE. Infrastructure is used in a broad sense to mean collectively, (a) capital facilities such as building, housing factories, and other structures which provide shelter; (b) the transportation of people, goods, and information; (c) the provision of public services and utilities such as water, power, waste removal, minimization, and control; and (e) environmental restoration.

INFRASTRUCTURE FACILITY. Infrastructure facility means a building; structure; or networks of building, structure, pipes, controls, and equipment that provide transportation, utilities, public education, or public safety services. Included are government office buildings; public schools; courthouses; jails; prisons; water treatment plants, distribution systems, and pumping stations; wastewater treatment plants, collection systems, and pumping stations; solid waste disposal plants, incinerators, landfills, and related facilities; public roads and streets; highways; public parking facilities; public transportation systems, terminals, and rolling stock; rail, air, and water port structures, terminals, and equipment.

INITIAL DELIVERY. Initial delivery refers only to the design and construction phases of an infrastructure facility, that is, to the production of the initial facility itself. Long term operations and maintenance is not part of initial delivery.

LIFE-CYCLE DELIVERY. Life-cycle delivery refers to all the phases of an infrastructure facility, that is, to both the initial delivery of the initial facility and to the operations and maintenance of the facility throughout its useful life.

PROJECT. The term project is used to refer to discrete tasks performed in connection with part, or all, of an infrastructure facility, or service.

About the Author:

Dr. John B. Miller's career has spanned the legal and academic worlds, focusing on practical business, legislative, and contractual solutions to the world's burgeoning infrastructure needs. He graduated from MIT in 1974 with a bachelor's degree in Civil Engineering and a Master's degree in Soil Mechanics. In 1977, Dr. Miller received his J.D. from the Boston University School of Law and Master's in Law in Taxation from the same school in 1982.

After serving as Associate General Counsel and Patent Counsel to a Cambridge high tech firm for three years, Dr. Miller joined the Boston office of Gadsby & Hannah in 1981, where he built a national practice in construction law and government contracts. Dr. Miller was elected to the American College of Construction Lawyers in the Fall of 2005. In August, 2006, Dr. Miller joined Patton Boggs LLP as Of Counsel in its Construction Projects, Infrastructure, and Finance groups. In over 30 years of practice, Dr. Miller has represented clients with the full range of construction industry interests, including cities, towns, designers, contractors, suppliers, subcontractors, and construction managers. After Dr. Miller resigned his partnership at Gadsby & Hannah, the firm represented the Big Dig.

In 1992, Dr. Miller accepted a three-year fellowship in the Center for Construction Research and Education in MIT's Civil Engineering Department. He received his PhD in Infrastructure Systems in 1995, and joined MIT's Construction Management Faculty. At MIT, Dr. Miller was awarded a four-year NSF CAREERS grant to explore and develop the logic for a new area of engineering practice that applies the array of project delivery methods to American infrastructure networks. The goal of this research was to promote and attract new technology and more effectively deliver complex collections

of infrastructure assets – i.e., buildings, water, wastewater, and transportation.

His research at MIT produced a comprehensive history of America's 200 year experience with public-private partnerships. Miller's work with industry groups produced the 2007 ABA Model Code for Public Infrastructure Procurement, the intent of which is to re-establish a broad, competitive US marketplace for infrastructure and to balance public policy requirements of transparency and fairness. While at MIT, Dr. Miller taught several undergraduate and graduate level courses, including Law and the Construction Industry, Public Infrastructure Development Systems, and The History of American Infrastructure.

Dr. Miller's work at MIT produced theory, evidence, and practical new approaches for addressing long term infrastructure problems. He authored two textbooks on public-private partnerships, *Principles of Public and Private Infrastructure Delivery* and *Case Studies in Infrastructure Delivery*. His contributions to the ABA 2000 Model Procurement Code and the ABA 2002 Model Regulations produced a new project delivery model for state, district, and local governments. A condensed version of this model – the Model Code for Public Infrastructure Procurement (MC PIP) – was issued by the ABA Sections of Public Contract Law and State and Local Government Law in 2007.

About Pioneer:

Pioneer Institute is an independent, non-partisan, privately funded research organization that seeks to change the intellectual climate in the Commonwealth by supporting scholarship that challenges the "conventional wisdom" on Massachusetts public policy issues.

Endnotes

[1] "Problems Not New For Project's Largest Contractor", Boston Globe, Christopher Rowland, July 14, 2006.

[2] The Route 3 North Transportation Improvements Association, Inc., Commonwealth of Massachusetts Lease Revenue Bonds, Series 2000 (the "Bonds").

[3] Route 3 North Widening: Before and After – A Traffic Analysis, TransReport, November 2007, published by the Metropolitan Planning Organization, pg. 3.

[4] MBCR web site. http://www.mbcr.net/

[5] "MBTA Extends Rail Contract", Boston Globe, Bierman, Noah, December 11, 2007.

[6] Section 1.1(c) of Exhibit 3 of MBCR Operating Agreement.

[7] The Boston Globe, November 21, 2007.

[8] The Boston Globe, December 11, 2007.

[9] Mass Pike Web Site. www.masspike.com/bigdig/background/index.html

[10] The Massachusetts Highway Department ran the Big Dig through most of the duration of the project. The project was transferred to the Massachusetts Turnpike Authority late in the construction process by the Massachusetts Legislature.

[11] Mass. Gen. Laws. Chapter 81A.

[12] The Committee's Report may be found at http://www.mass.gov/legis/senate/bigdig.htm

[13] Senate Report, at page 11 of 24.

[14] Press Release by Bechtel, dated January 23, 2008.

[15] Completing the "Big Dig: Managing the Final Stages of Boston's Central Artery/Tunnel Project", the National Academies Press, 2003.

[16] A Future Vision: Safe and Reliable Surface Transportation on Managed Highways, Dan Baxter, P.E., presented to the International Bridge, Tunnel and Turnpike Association Annual Meeting in Vienna, Austria, October, 2007. Baxter's data sources including the February 2006 study, Economic Impacts of the Massachusetts Turnpike Authority and the Central Artery/Third Harbor Tunnel Project, by the Economic Development Research Group (EDRG); and Mr. Baxter's June 2007 article, "Big Believer" in Roads & Bridges, page 24. www.roadsbridges.com

[17] Commonwealth of Massachusetts Information Statement, page 83-84, August 14, 2008.

[18] "Soil freezing" and "deep soil mixing" were extensively developed as construction techniques for "jacking" the extension of the Massachusetts Turnpike to South Boston under the existing South Station rail yards, all without interrupting service. To extend the Massachusetts Turnpike over the Fort Point Channel, without disrupting (or destroying) the unlined Red Line subway tunnel toward Ashmont, the section designers detailed what amounts to an underwater bridge over the channel (but sunken below the water table) so that the highway portion of the project was fully supported on foundations bearing on firm soil on either side of the Red Line. The Fort Point Channel highway sections were built essentially as a series of water tight ships, in casting basins in the piers district that were floated out of the casting basins and placed onto columns above the Red Line.

[19] Much of the factual background for this case comes from a report prepared by Robert A. Cerasoli, the Inspector General of the Commonwealth of Massachusetts, issued in December, 1997. The full text of this report is available from the Office of the Inspector General. The North East Solid Waste Committee Project: Planning and Development of a Public Private Partnership, Report by the Office of the Inspector

General, Commonwealth of Massachusetts, December 1997, 43 pages.

[20] MGL c. 16 §18-24 (as amended by 1217 of the Acts of 1973).

[21] The North East Solid Waste Committee Project: Planning and Development of a Public Private Partnership, Report by the Office of the Inspector General, Commonwealth of Massachusetts, December 1997, pages 4-19.

[22] Ibid..

[23] Ibid..

[24] Ibid., at pages 18-19.

[25] Ibid., pgs. 9-10.

[26] Harvard Business School Case Study 9-801-067, June 29, 2001, page 5.

[27] One exception came out of Superior Court litigation, in which NESWC and MRI agreed to split a portion of the capital upgrade cost. In August 1999, the Legislature appropriated $3 million to further reduce the community share. Supplement 1, HBS Case Study 9-801-068 January 30, 2004, page 1.

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