Emerging Options in Project Delivery and Finance: Tren Urbano and Massport's Intermodal Transit Connector

by

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B.S., Civil Engineering
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Submitted to the Department of Civil and Environmental Engineering
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Abstract
As funding becomes increasingly scarce for public infrastructure development, it will become difficult to complete large scale projects. The future of such projects will be dependent upon an increase in private sector involvement, particularly the investment of capital. The presently preferred procurement method relies heavily upon the private sector to complete a number of functions, including design and construction, but necessitates complete funding from the owner. Further involvement by the private sector will require an increase in the use of alternative delivery methods. These methods utilize the private sector to varying extents, from the traditional method most often used today to involvement in nearly everything from conceptual design through operation.

This thesis explores emerging methods and their applicability to large scale projects. The first section describes a number of methods, including the traditional method, and includes information on their individual strengths and weaknesses. It also looks at a number of issues that are central to the selection of an appropriate procurement strategy.

Two case studies are included as examples of how these strategies can be utilized and how the issues surrounding the projects have an impact on the selection process. The first case study involves Tren Urbano, a new rail transit system presently under construction in San Juan, Puerto Rico. This case study is especially illustrative when attempting to understand the manner in which external issues surrounding a project can dictate the final selection of the delivery method. The second case study is focused on the Intermodal Transit Connector at Logan Airport in Boston, Massachusetts. This is a preliminary study that explores the financial feasibility of the proposed system. This case study is provided as a means to explore and capitalize on external involvement throughout development of the system.

The case studies are structured such that the overall projects are separated into sections. Each section is treated as its own project and the complete system is viewed as a portfolio of projects rather than a single large project. This combined analysis of the entire portfolio provides increased flexibility for procurement options. It is this increase in flexibility that allows for greater private sector involvement, the ultimate goal of future infrastructure development.

Thesis Supervisor: John B. Miller, Asst. Prof. of Civil and Environmental Engineering

Acknowledgments

I would like to thank all those that have supported me throughout my graduate experience and the preparation of this paper. The time I have spent learning here has expanded my horizons and provided me with renewed vigor and enthusiasm for my profession. The task of preparing my thesis has been arduous at times and I would especially like to thank my wife, Celia, for her never ending encouragement, help with revisions and showing me how to really use a computer. Her support and ability to make me smile have been tremendously important.

I would like to thank my mother and father for their support and educational assistance throughout the years, with whom I would not be in this position today. Their complete support of my endeavors has meant a great deal. My grandparents also deserve recognition for their dedication to higher education and constant support throughout the years.

My thesis would not be where it is today without the help of John Miller. His ability to teach and inspire thought has provided the basis for much of my work. I hope that I can continue to improve my abilities through his ideas. My sincere thanks for his assistance and guidance throughout my graduate experience.

Finally I would like to thank those involved with Tren Urbano, Massport's IMTC project and the Department of Civil and Environmental Engineering for their help and access to information and ideas. Rather than risk omitting someone, I would like to thank them all. Suffice to say they have all been of great help. Without my involvement with these individuals, the process would have been filled with obstacles and considerably more difficult.

Table of Contents

List of Figures

1. Introduction

1.1 Present Preferred Method

The historical method of completing civil works construction projects in the United States used what is termed the traditional procurement method. This method, also known as design-bid-build, relies upon an engineer or architect to design the project, a competitive, sealed bid for construction services and construction by the lowest bidder. The process requires the owner to have the financial means to make all the necessary payments throughout the design and construction process. The process has been extremely effective at cutting construction costs using a low bid process. However, a number of trends have begun to develop that do not support the continued use of this method as the only means to complete construction projects.

1.2 Recent Trends

1.2.1 Lack of Capital

As pressure builds inside the public sector to provide additional entitlement programs and other services, the amount of capital available for construction has diminished. As the nation's infrastructure continues to deteriorate and require additional development at the same time, it is clear that the resources available are insufficient to meet present and future demand. One of the requirements of the presently preferred, or traditional method is that 100% of the required funding comes from the owner - often the government. With dwindling capital resources, this requirement may prohibit a number of potential revenue generating projects from ever being completed. Fortunately, additional procurement methods exist that rely less heavily on complete owner funding.

1.2.2 Private Involvement

The key to most alternative delivery strategies is increased private sector involvement on the finance side. The private sector already provides essentially all the design services, equipment, and construction services supplied in public infrastructure development. The degree to which the private sector and owners inter-relate is dependent upon the chosen delivery method and the amount of control the owner is willing to relinquish. The private sector has become increasingly interested in participating in additional phases of the construction process, particularly finance and operation. Private sector entities recognize the lack of government funding and understand its implications on their work - fewer projects, increased competition and lower margins. Potential involvement by the private sector is certainly driven by economic motive, but provides an additional source of capital with which to complete additional projects.

Because the private sector is obligated to its share holders to provide a positive return, every construction project will not be attractive. Only those projects where a steady revenue stream exists will be seriously considered. The attractiveness of a project depends both on the potential for profit and the risks associated with it. A project with a high potential return, but tremendous risk, may not be a good candidate for private sector investment unless some minimum performance guarantees can be attached. It is therefore important to understand what makes a project attractive to the private sector and how best to involve potential investors. Much of this understanding is based upon knowledge of alternative procurement strategies.

1.3 Thesis Structure

1.3.1 Quadrant Framework

The quadrant framework that I will be using as a guideline for defining procurement strategies was developed by Professor John Miller of MIT. This method provides a quick means of understanding the major variables of project procurement.

The quadrant analysis looks at projects in two manners; how is the project developed and completed, and from where does the funding come. The project completion method could range from an entirely segmented process where each task is completely separated from all others and provided by separate entities, to a systematized approach where the tasks are all interwoven and provided through a single entity. This variable is placed upon the horizontal axis. The funding method ranges from direct (i.e. completely provided by the owner or public funding sources) to indirect, where the project is funded entirely by external, usually private sector sources. This second variable is placed upon the vertical axis to create a two dimensional graph. Any project can successfully be placed somewhere upon these two axes.

The quadrants created by these axes are labeled I through IV. (Figure 1-1) Because each project must fall within one of these four quadrants, it is possible to easily characterize projects by their location. Historical analysis of projects by Professor Miller using this framework has provided interesting results regarding the trends of public infrastructure investment.

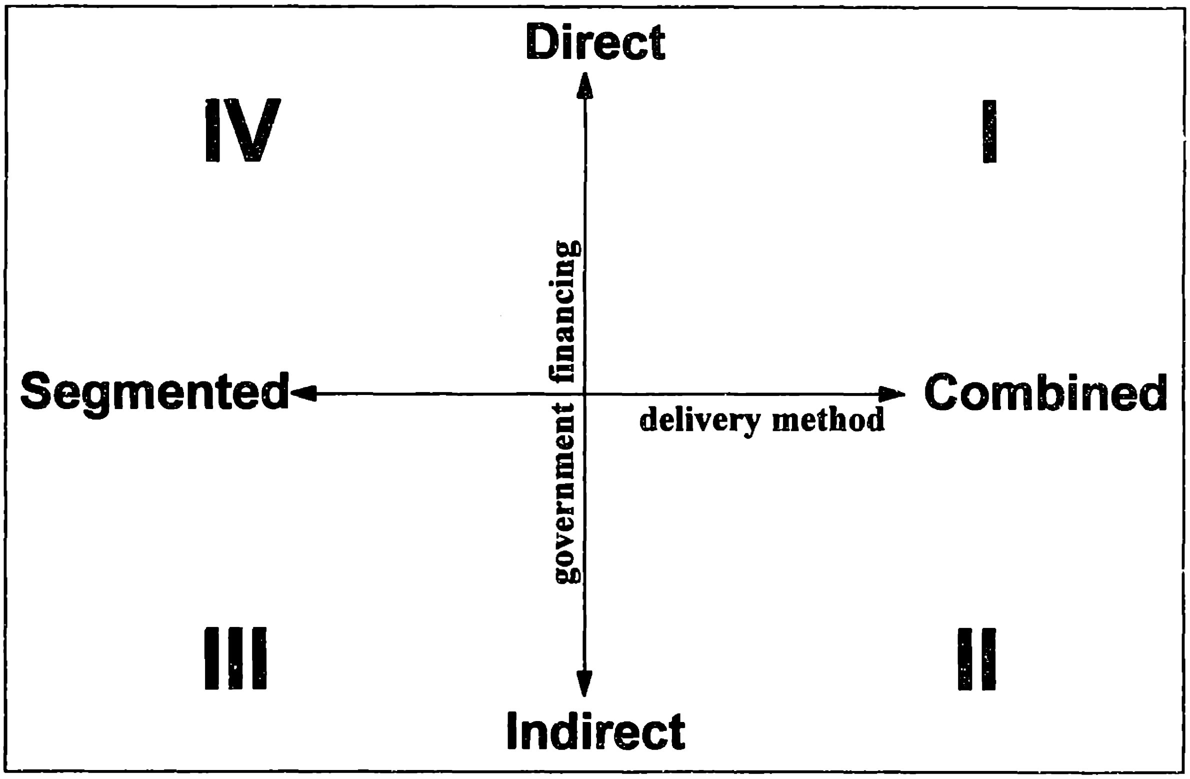


Figure 1-1 Quadrant Analysis

1.3.2 CHOICES

CHOICES is a modeling tool developed by Roger Evje. The model requires various inputs for a project, including method of procurement, construction cost, start of construction, duration of construction, discount rates, interest rates, inflation and bond rates. Additional parameters are also required that allow for sensitivity analysis and the exploration of options. These include sources of funding for construction, revenues from operation, construction overruns, increases in annual operation and maintenance costs and projections for annual revenue increases. CHOICES requires that a project be broken down into smaller components, each treated as its own project. Based upon the above data, the model uses a stretcher program to fit the cash flows to the desired construction period. Each procurement method has a generic cost curve which provides a first fit of expected cash flow, much like the generic cost curves used by large public construction organizations. The curves used in CHOICES arise from an extensive review of projects using a variety of procurement vehicles. A program function, called the stretcher, compresses or elongates the standard curves to fit the expected conditions with scheduled start and end dates. The cash flows are then converted to present values for more accurate analysis. A final function, termed the chooser, combines all the individual projects into a single portfolio, with discounted cash flows assigned accurately as they would be over time. This process allows analysis of a portfolio of projects rather than one large project. It is possible to quickly change the parameters or assumptions on a single portion of the overall project to understand the associated implications to the entire project. This is especially useful when uncertainty regarding projected revenues exists.[1]

The CHOICES model has been used to prepare financial pro-formas for each delivery method that might apply to each project, and for the entire portfolio, in order to better understand the associated cash flows and anticipated capital funding issues of alternate configurations of the project in the portfolio. Results from the modeling are represented both in graphic form in the main analysis and in the appendices in the form of individual contract data.

1.3.3 Procurement Options

An infinite number of minutely differing procurement strategies exist. However, they can be broken down into six general types; Design-Bid-Build or the traditional method, Design-Build, Turnkey, Design-Build-Operate, Build-Operate-Transfer and pure Operation and Maintenance. Each of these methods requires a different involvement by each of the participating parties. The relationships that are created and the manner in which they are designed, constructed, operated and funded differ from one strategy to the next. These differences are extremely important when the overall goal is to locate additional sources of capital for investment in civil construction projects. Each of the general methods, including their advantages and drawbacks, is defined and discussed as a background for understanding the case studies.

1.4 Case Studies

The case studies are intended to illustrate how the choice of procurement method can have an impact on the success or failure of a project. Each case study involves a major public sector civil works project.

1.4.1 Tren Urbano

Tren Urbano is a new urban transit system presently under construction in San Juan, Puerto Rico. The initial phase is a 12 mile heavy rail system that will connect several of the major residential and economic centers in and around San Juan. The overall cost will be in excess of $1.2 billion. This case study is provided to show how the selected procurement method is dependent upon the conditions that surround the project. These conditions are not limited to just those associated with capital resources, but also timing, control and operation.

1.4.2 Massport

This case study involves a project that is partially under consideration by the Massachusetts Port Authority. One of the properties Massport controls is Logan Airport. The manner in which traffic presently circulates among the airline terminals and public transportation systems is inadequate. The severity of the condition will only be exacerbated as the demand for air travel increases. The project included in this case study is the proposed by a group of students at MIT. It is intended to provoke thought and explore potential. It provides a forum for exploring the potential of such a system and methods that might ensure its construction in the future. The analysis of this system focuses on the present lack of capital for construction, potential sources for additional capital and analysis of a large program not as a single project, but rather as a portfolio of smaller, individual projects.

1.5 Summary

Present conditions regarding capital available for infrastructure development and the desire for greater financial participation by the private sector make it reasonable that non-traditional procurement strategies should be pursued with more vigor. The acceptance of these alternative delivery methods is growing. It is important to note that each alternative method must be understood and applied judiciously. In many cases, the design-bid-build method may provide the highest quality and the most effective manner with which to complete a project. Each of these methods has a deserved place in the infrastructure development process. The selection of method will be the challenge. Perhaps more appropriately, it will be combinations of all these methods that will provide the most effective procurement of large infrastructure projects.

2. Procurement Delivery Methods

To better understand how to use emerging strategies for procurement, each of the major delivery formats needs to be defined. This section does so, using the quadrant framework developed by Miller.[2]

2.1 Design-Bid-Build

The most common delivery method is Design-Bid-Build (DBB), in which each element is a separate activity related only loosely to the others. The process is sequential, in that design is followed by a bidding process and then construction. This format is often referred to as the traditional method.

When a need is identified, the plan to construct a project is typically developed in stages. The initial phase is typically a conceptual plan for the project. Based upon this conceptual plan, the owner must create a financial plan that produces cash flows that fit the budget, both in total amount and in time. This may entail the use of cash reserves or financing from independent, non-owner sources. When a feasible financial plan is created, the conceptual plan is developed in further detail. This is usually done through a design consultant selected by the owner or through competition. Public sector competition is generally based first upon qualifications and second on price. The selected consultant has a contract directly and only with the owner. The relationship between owner and consultant is fiduciary, in that the consultant is working in the best interest of the owner. The firm selected for this work then completes the plans to the 100% design level, including detailed specifications and drawings, and presents it to the owner.

The next step is to select a contractor who will construct the project. The usual process is to provide the contractual documents to the bidders and then the bidders respond with their price to complete the work as designed. Assuming the specifications are met, the project is awarded to the low bidder. The consultant utilized for design is often retained to oversee the bidding process and ensure that the specifications are met by the bidders, but this firm generally has little bearing on who is selected. The low bidder then signs a contract with the owner.

The contractor is responsible for the construction of the project as specified in the contract documents, including completion by a specified date. The responsibilities of each party are delineated in Figure 2-1. Each participant is required to completed the elements in the associated box. These elements are listed by letter and correspond to the activities below. Design changes are typically only requested by the contractor when the contractor would benefit; either by reducing costs and supplying a comparable product or by increasing the contract amount. The owner is responsible for oversight of the construction process and any difficulties, disputes and/or changes that occur during the life of the project. Often the consultant is retained to ensure that the contractor meets the specifications, but all directives must come directly from the owner. There is no contractual relationship between the design consultant and the contractor. Upon completion, the contractor turns the project over to the owner for operation.

Design-Bid-Build Procurement Strategy Responsibilities

Owner	Architect/Engineer	Contractor
A C H I K	B D F G	D J

A Identification of Need
B Schematic Design (3-5% Design)
C Financing Package
D Design Development (30% Design)
E Value Engineering
F Alternative Development
G Construction Documents (100% Design)
H Bidding/Proposals
I Construction Financing
J Construction
K Maintenance and Operation

Figure 2-1 Design-Bid-Build Procurement Strategy Responsibilities

The financial constraints of this process are straight forward: the funding for the subsequent phase must be available before the next phase can proceed. For instance, unless the owner has the money for the design, the consultant will not finish the project as they are typically paid for their efforts through progress payments. In the public sector, unless the funding is available for construction the project will certainly not be awarded and local laws may prevent it from being bid. The process is dependent upon having secure cash, grants, bonding or other loan mechanisms in place.

Although the owner and consultant may be present during all phases of the project, design, bidding and construction, each phase is a separate activity dependent upon the results of the prior activity. The nature of this sequential process requires that each activity is completed in full, including the assurance of available funding, prior to embarking on the next activity.

Using the procurement strategy framework, because the owner is 100% responsible for funding, either through cash, bonds of available public moneys, it is considered a direct method of funding. The approach is highly segmented due to the sequential nature of the work. Therefore, this strategy would fall in Quadrant IV. (Figure 2-2)

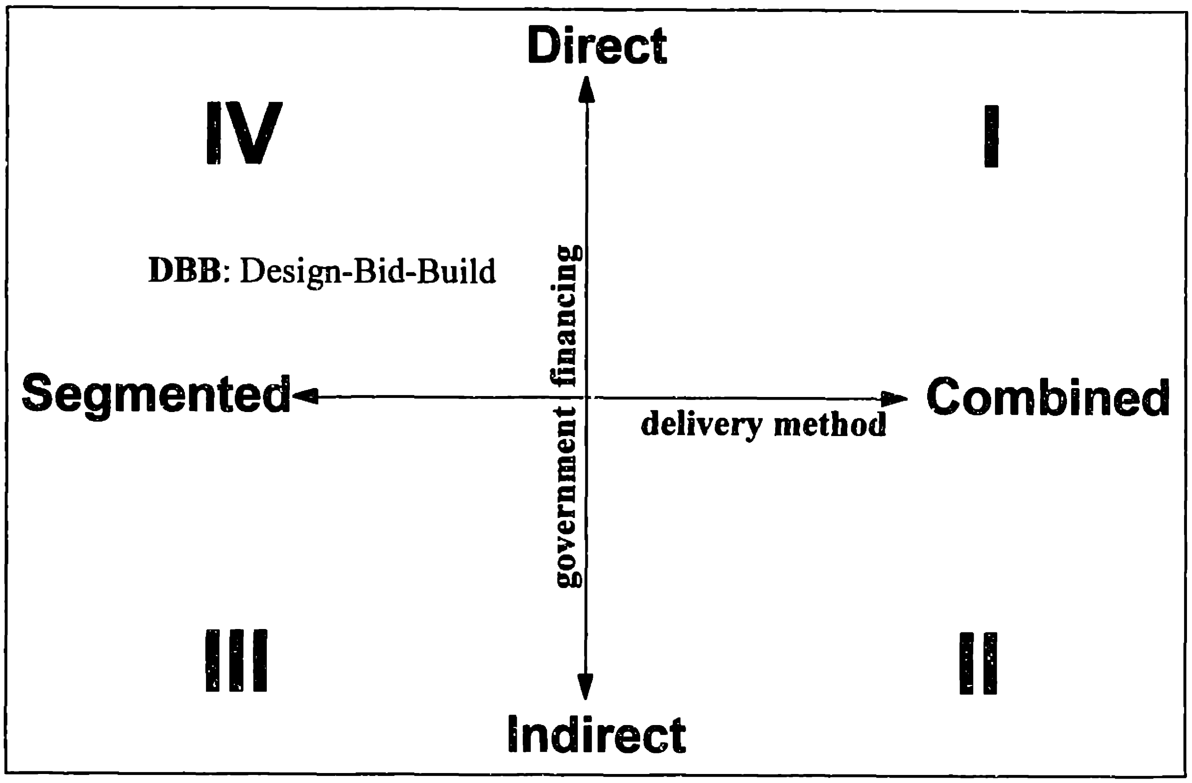


Figure 2-2 Quadrant Analysis: Design-Bid-Build

2.1.1 Design-Bid-Build Benefits

The most used contracting method has become so because of its many advantages. The bidding process for construction is understandable and theoretically places each bidder on an equal level. This is only one of the many reasons this type of contracting has become the standard in both the public and private sector.

Because the selection of the design professionals is not restricted by price alone, the owner has tremendous latitude with which to select the engineer/architect. In the public sector in the United States this process was made law by the Brooks Act of 1972.[3] Should the owner feel that a particular designer has a greater understanding of the project, a better vision or just a prior working relationship, the decision can be made to hire that designer on the basis of qualifications. Price is of secondary importance.

One of the most important advantages of the design-bid-build format is the relationship between the owner and the design professionals. The designer works directly for the owner with the owners interests in mind. This relationship is termed fiduciary, as the designer holds the trust of the owner. The owner can assume that the decisions made during design would be beneficial to the project, as the designer has nothing to gain by serving interests other than that of the owner.

During the design phase the owner has the ability to make changes and explore options that will not cause substantial changes during the construction process. This is especially important if the owner is unsure what the preferred method or design would be. This advantage may also be the determining factor in choosing a procurement method when the project is to be a civic or cultural landmark.

When design is 100% complete, the project is put out for bid. This completion of design should provide the owner with an accurate figure for construction. Barring major change orders from the owner or a major defect in design, the accepted bid should be a reliable figure. The risk of completion and price are shifted from the owner to the contractor when the contract is signed.

A final advantage is created by the general understanding of this process within the industry. Owners, engineers and contractors are all intimately familiar with the process, as is the judicial system and its many associated participants. There is tremendous experience among the parties involved and precedent has been established regarding most issues that may arise.

2.1.2 Design-Bid-Build Disadvantages

The process is drawn out and therefore is the most lengthy of procurement methods. Because each step is dependent upon the previous one, fast-track construction is not reliable. In the public sector, the time required from the advertisement for bids to the bid itself is often regulated.

The requirement for separate design and construction places a great deal of reliance on the designers knowledge and experience. Any knowledge that the contractor may possess regarding constructibility and/or value engineering is only revealed after the contract is awarded. Should savings result from a proposed value engineering change, the owner does not benefit.

Changes to the project, including design and additions, are usually expensive and often difficult to complete. The separation of design and construction and the individual contracts awarded to the designer and the contractor creates an adversarial relationship. The fixed price contract creates a zero sum game. Any changes gained by the owner is a loss to the contractor and visa versa.[4]

2.2 Design-Build

The design-build (DB) form combines the two functions. The design and construction are completed by the same entity. A single organization or conglomerate is responsible for taking the conceptual design through completion and final construction. A single contract is awarded for the project.

The owner is responsible for creating and delineating the conceptual design. A competition is held to select the design/build team. This process is generally based upon a two part process. Initially firms or cooperative teams are screened for their ability to complete the work to the desired level of quality. This is usually done through a Request for Qualifications (RFQ) issued by the owner. The owner then must select the firms that appears to be the most capable and responsive. A Request for Proposals (RFP) is then issued to these selected firms. Based upon this Request for Proposals each firm will submit a package that covers the design. From these proposals a team or company is selected and the design is developed more fully. At some point during the design, usually between the 10 % (conceptual design) and 30% (schematic design) level, a construction price will be negotiated until an acceptable, agreeable figure is reached.

The firm awarded the contract is then responsible for completing the project under the terms of the contract. (Figure 2-3) Although a single contract is awarded, the firm may not necessarily be required to perform all the tasks themselves. Four general forms are widely recognized; 1) the consultant is the lead (with construction subcontracted), 2) the contractor is lead (with the engineering subcontracted), 3) a joint venture between an engineer/architect and a contractor or 4) a design-build specific organization. In each form, a single entity is responsible for the completion of the project.

Design-Build Procurement Strategy Responsibilities

Owner	Designer/Contractor
A B C H I K	**D E F G J**

A Identification of Need
B Schematic Design (3-5% Design)
C Financing Package
D Design Development (30% Design)
E Value Engineering
F Alternative Development
G Construction Documents (100% Design)
H Bidding/Proposals
I Construction Financing
J Construction
K Maintenance and Operation

Figure 2-3 Design-Build Procurement Responsibilities

When construction is completed, the project is turned over to the owner for operation. Beyond any warranty issues or included start-up, the design/build team's commitment is completed.

The financing commitments are nearly identical to that of sequential design-bid-build. Before the project can proceed, the owner must have all the funding secured. The owner is responsible for payment if the project is delivered and the specifications are met. The payment terms could be based either on progress throughout the job or on a lump sum, where one payment would be made upon completion.

This strategy is less segmented than the traditional design-bid-build method, yet operation and project financing are still provided by segmented means. The funding is direct, as the owner is responsible for the entire project. Design-build also falls in Quadrant IV, but further to the right on the horizontal axis than design-bid-build as it is more systemized. (Figure 2-4)

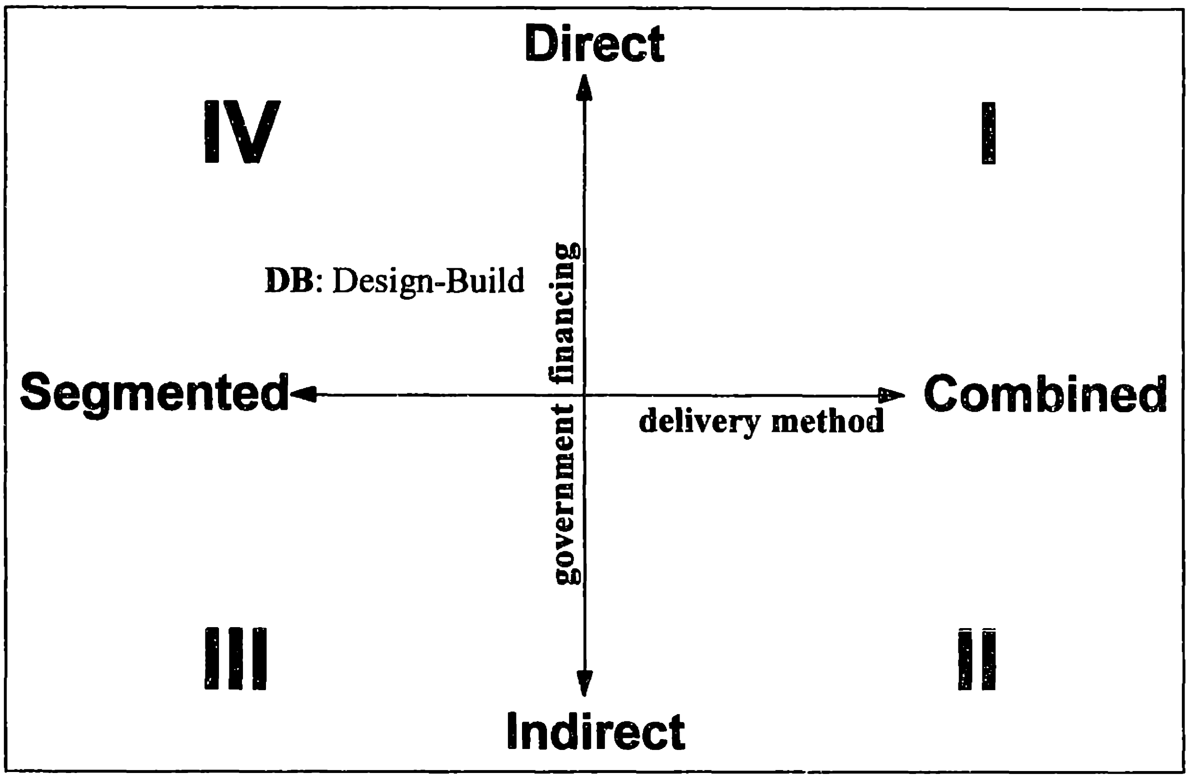


Figure 2-4 Quadrant Analysis: Design-Build

2.2.1 Design-Build Benefits

The design-build format provides different opportunities for the owner. The most encompassing of these advantages is a single source for all design and construction. This simplifies owner oversight and coordination, as less paperwork is produced and theoretically less man power is required.

Because project construction is awarded with the design, the construction schedule and total cost of the project is either known at award, or quickly there after. The separate step for bidding the construction phase is eliminated and a single entity is responsible for design and completion. This responsibility includes costs and schedule. Additionally, once the price and schedule of the project are determined, the owner has relieved himself of the liability of change orders required as a result of defective design - unless changes are made by the owner in the project scope or the site conditions differ from what was expected.

Because the costs are controlled by one entity or team, it is possible to fast-track construction, that is, begin construction before the design reaches 100% completion. Along with the elimination of a construction bid, this allows for an earlier start date and earlier completion of the project. In cases where revenue generation or the commencement of a service is particularly important, this early completion can produce very tangible benefits.

Perhaps the most important benefit of design-build contracting is the increased cooperation between the designer and contractor. The process provides incentives to communicate throughout the project and to innovate throughout the construction process. Difficulties that arise must be addressed collectively, and the incentive to seek change orders for the purpose of increasing the construction price has been removed.

2.2.2 Design-Build Disadvantages

Because the entire project is awarded early in the design process, changes in design are often difficult to accommodate. This is either true because the designer/contractor is not contractually bound to these changes without remuneration, or because under a fast-track schedule construction based upon preliminary design has already begun. Therefore, difficulty accompanied with design changes is usually accompanied by substantial cost increases.

The owner must be rather sophisticated and knowledgeable about both the project and the entire design and construction process. Because the designer and contractor are on the same team, the owner no longer has a fiduciary relationship with the designer. The owner has also lost some control in the design process. Decisions made during design may be made with cost savings in mind during the construction process. Even when these decisions may not necessarily benefit the owner, the owner may be unable to prevent their occurrence or dictate the direction of these decisions. Therefore it is crucial that the owner understand the project and be able to create effective specifications prior to award of the project.

Another area of concern is the sole source of the design and construction. Even though having one entity to interact with can be a substantial benefit, it can also become a tremendous problem. Should difficulties arise, the owner has no one else associated with the project upon which to rely. The other potential pitfall of the single source exists in the risk of financial trouble by the designer/contractor. Should this occur, the project may not be completed.

2.3 Turnkey

Turnkey contracting is an alternative form of design-build where the selected firm provides not only design and construction, but also additional services. The most common and important of these is construction financing, but such services could also include site selection, real estate purchase, obtaining permits, start-up services, etc. The procurement process is similar to that used for design-build. The name is derived from the lack of owner involvement up until the builder hands the project to the owner to just "turn the key."[4]

The financial requirements are substantially different with turnkey procurement because the owner needs to have the required funding upon completion of the project. (Figure 2-5) Since construction financing is provided by the contractor, until design and construction are completed. Besides the initial costs of developing a conceptual design and selecting an entity for completion of the project, only a final payment, upon completion, is required.

Turnkey Procurement Strategy Responsibilities

Owner	Turnkey Builder
A B C H K	**D E F G I J**

A Identification of Need
B Schematic Design (3-5% Design)
C Financing Package
D Design Development (30% Design)
E Value Engineering
F Alternative Development
G Construction Documents (100% Design)
H Bidding/Proposals
I Construction Financing
J Construction
K Maintenance and Operation

Figure 2-5 Turnkey Procurement Responsibilities

The turnkey strategy is slightly more of a combined delivery approach than design-build because construction financing is included. Because only the infrastructure is provided, not long term operation, it is positioned to the left of the vertical axis in Miller's framework. The provision of construction financing keeps the project above the horizontal axis. Ultimately the owner is still providing the funding for the project. This strategy falls in Quadrant IV. (Figure 2-6)

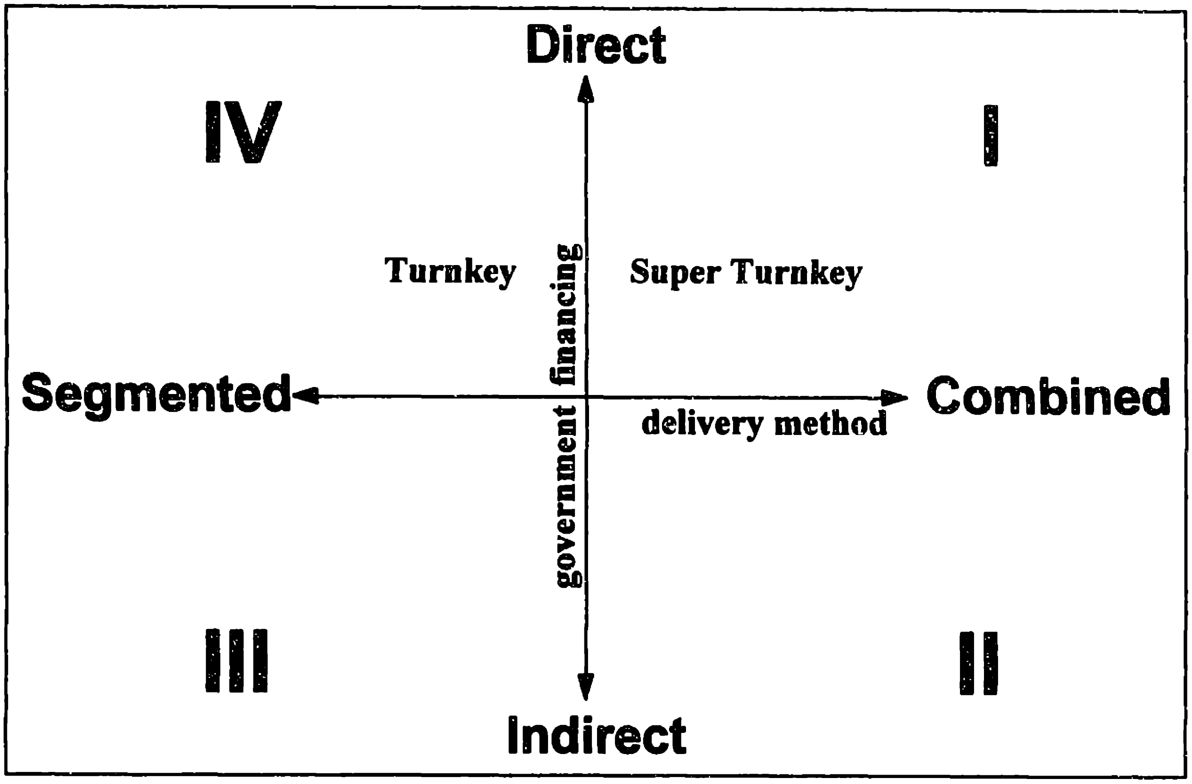


Figure 2-6 Quadrant Analysis: Turnkey

2.3.1 Turnkey Benefits

Because the turnkey form is essentially a design-build with the additional responsibility of construction financing, the advantages are similar to that of design-build. The added benefit is that associated with project financing. This financing can be beneficial in a couple different ways. An owner who cannot provide the capital required for construction, either because of the risk associated with construction or the timing of the project, but has the ability to secure long term financing based upon plant operations, can use the turnkey team to meet this extended cash flow. The second advantage comes primarily to the private sector. It is often the case that the turnkey team can secure funding at a much lower rate than that available to the owner. In this second instance, the owner could actually save money by using the turnkey team for construction financing.

A third benefit to turnkey construction is the incentive for the turnkey team to complete the project early. This works only with a fixed price contract, but the additional savings to the contractor can be substantial.

2.3.2 Turnkey Disadvantages

The disadvantages of the turnkey method are similar to those presented by design-build with the added risk of construction financing. Like design-build and design-build operate, the owner is dependent upon a single entity. Should this designer/contractor team have difficulties during construction, the risk that the project will never see completion exists. The owner must be extremely knowledgeable to understand the ramifications of the award of the contract and be able to properly develop preliminary specifications.

Because the design-build team is also providing the construction financing, the cost of the project to the owner may be increased. The cost of capital to the design/build team may be higher than that of the owner and some type of premium will certainly be charged for the extra service (i.e. construction financing) provided.

2.4 Design-Build-Operate

The design-build-operate (DBO) format takes the design-build form and adds the responsibility of operation to the contract. This form is identical in its development and execution, except that at the same time that franchisee commits to the design and construction phases, the franchisee also commits operate the facility, all for a competitively determined price. (Figure 2-7) When the project is accepted by the owner at the end of construction, the franchisee (i.e. the designer, contractor, operator team) is responsible for operation of the facility for the duration specified in the contract. The owner is typically responsible only for oversight of the project and quality assurance.

Design-Build-Operate Procurement Strategy Responsibilities

Owner	Designer/Contractor/Operator
A B C H I	**D E F G J K**

A Identification of Need
B Schematic Design (3-5% Design)
C Financing Package
D Design Development (30% Design)
E Value Engineering
F Alternative Development
G Construction Documents (100% Design)
H Bidding/Proposals
I Construction Financing
J Construction
K Maintenance and Operation

Figure 2-7 Design-Build-Operate Procurement Responsibilities

The financial constraints are similar, in that the owner must obtain secure funding for the design and construction portions of the project prior to its commencement. The franchisee receives payment for design and construction either throughout the process or upon completion. Operation costs can be covered by; a) appropriations just like design and construction, b) revenues collected by the operator, or c) combinations of the two. The design-build-operate format also includes other methods that are substantially similar, such as design-build-operate-maintain (DBOM). DBOM is so named because the operator is responsible for operation and maintenance of the system or facility. Most DBO requirements would require the same results.

Design-build-operate demonstrates a substantial shift toward a system type delivery strategy. The funding is still provided directly, but this procurement strategy falls to the right of the vertical axis in Quadrant I. (Figure 2-8) Everything but money is provided by a single entity.

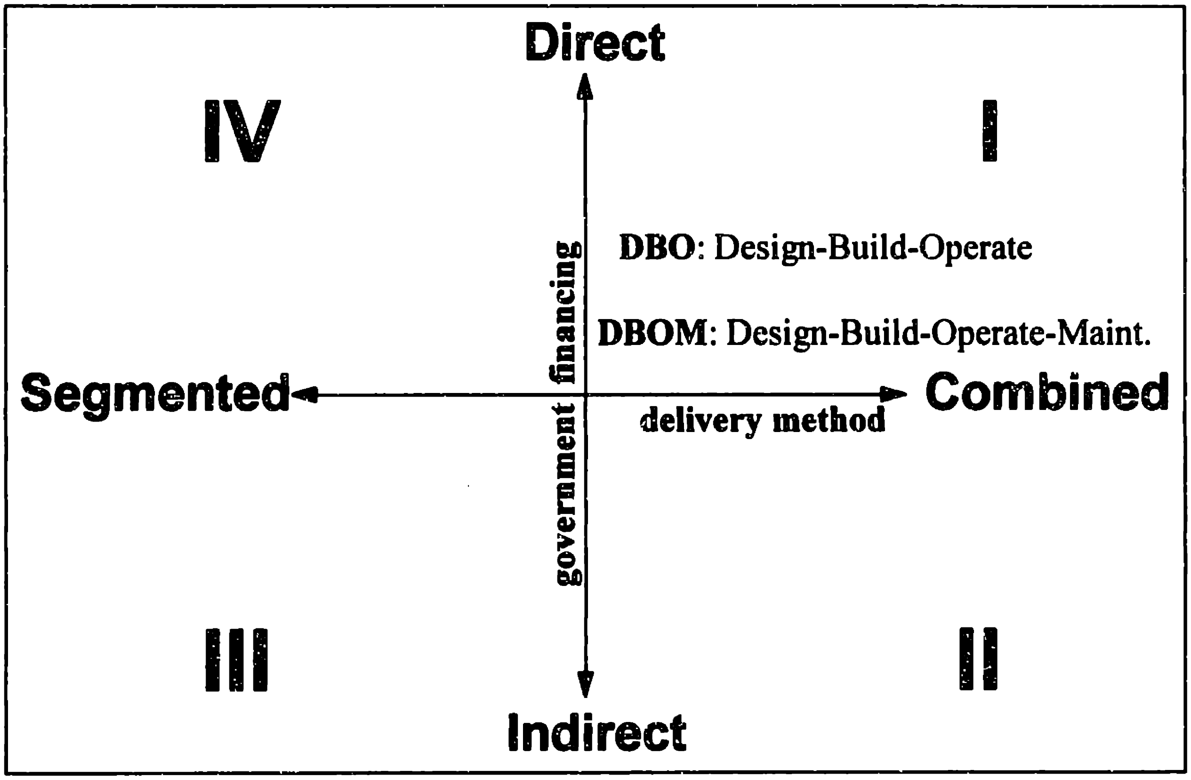


Figure 2-8 Quadrant Analysis: Design-Build-Operate

2.4.1 Design-Build-Operate Benefits

The added advantage of design-build-operate contracts beyond that of design-build is the stronger influence of life-cycle costs on overall performance of the DBO franchisee. Because the single entity is also responsible for operations and maintenance, including repair and replacement costs during the operations period, there are strong incentives for the designers to carefully consider higher quality components and to make decisions based on the cost of long term construction and operations. The increased cost of an inferior or traditional technology during operation may actually be more expensive than the increased initial cost of an improved or enhanced technology. If the costs or other operational benefits of a new process or methodology show the potential for substantial savings, the franchisee is likely to contract with the suppliers of such processes. Other scenarios, such as DBB and DB, do not provide incentive for the designer to take this risk.

There should be an improved level of cooperation and communication between all parties, including the operators of the system. These improved relationships should result in a higher quality project as everyone can be involved in the design of the project.

2.4.2 Design-Build-Operate Disadvantages

The disadvantages of this format are like the disadvantages of the design-build method in the fact that everything comes from a single source that is contractually bound with the owner. The risk associated with financial distress is amplified, especially if the owner does not have the capability of operating the project. Further more, the designers understand explicitly the ramifications of their decisions upon operation. A disincentive to install quality equipment may exist if they do not anticipate problems during the operational portion of the contract.

2.5 Build-Operate-Transfer

The Build-Operate-Transfer format is a further extension of the DBO methods. The entire contract for design, construction financing, construction, operation and long term financing is given to a single franchisee. This single entity is responsible for all aspects of the project from conceptual design through a specified operational period.

What is unique about this project delivery method is how the franchisee is remunerated. The franchisee will retain the revenues, or a portion there of, from the facility or service as payment over a period of time. Essentially, the franchisee provides not only design, construction operation and initial and long-term financing, but does so at its own risk. (Figure 2-9)

Build-Operate-Transfer Procurement Strategy Responsibilities

Owner	Franchisee
A B	**C D E F G I J K**

A Identification of Need
B Schematic Design (3-5% Design)
C Financing Package
D Design Development (30% Design)
E Value Engineering
F Alternative Development
G Construction Documents (100% Design)
H Bidding/Proposals
I Construction Financing
J Construction
K Maintenance and Operation

Figure 2-9 Build-Operate-Transfer Procurement Responsibilities

Depending upon the timing of the transfer of the property back to the owner, this strategy may be called a number of things, all of which are functionally the same; build-operate-transfer (BOT), build-own-operate (BOO), design-build-operate-transfer (DBOT), or build-own-operate-transfer (BOOT). In general, they all provide similar functions that differ dramatically from the other procurement methods in that the financial risk that project revenues are sufficient to operate the facility and pay off debt is the franchisee's risk, not the owner's.

This procurement strategy provides a drastic shift when using the Quadrant analysis. This type of project is highly systematized, with nearly every service provided by one source. Except for initial planning costs incurred by the owner in structuring the project and awarding the franchisee, funding is 100% indirect. All the project funding comes from external, private sector sources. This shift places the build-operate-transfer method in Quadrant II. (Figure 2-10)

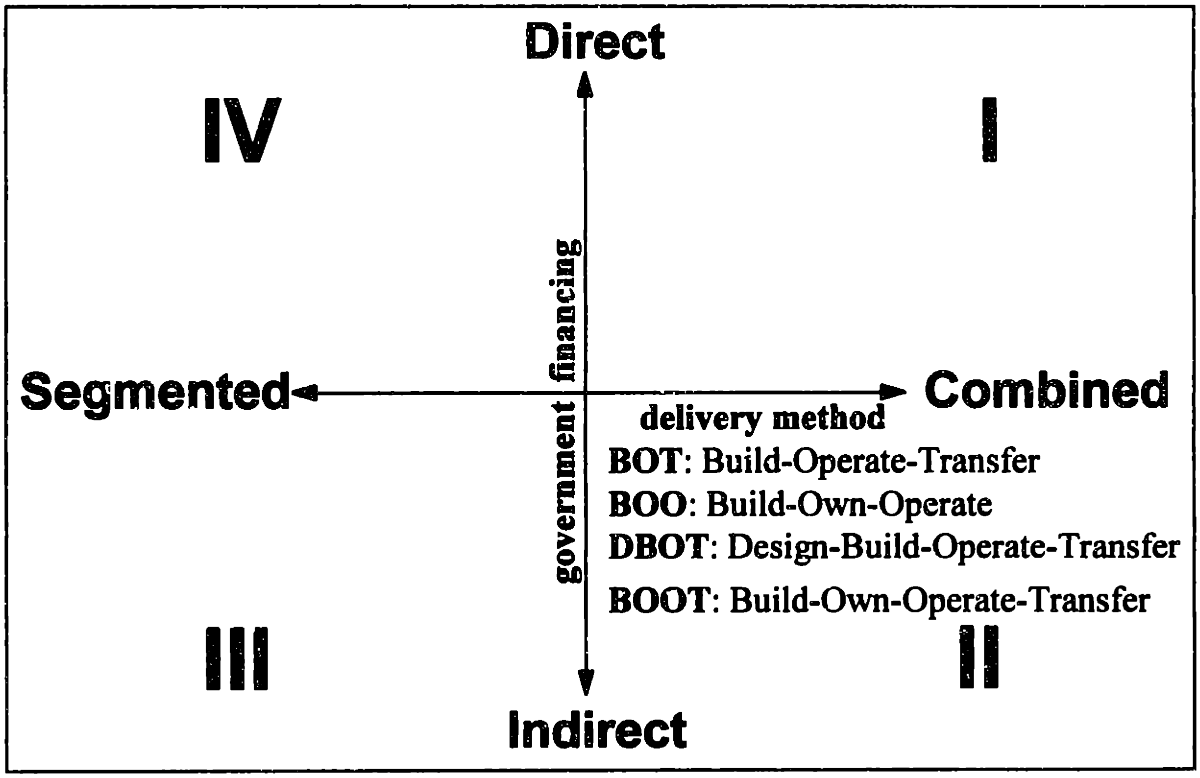


Figure 2-10 Quadrant Analysis: Build-Operate-Transfer

2.5.1 Build-Operate-Transfer Benefits

Build-operate-transfer is in many ways like a design-build-operate arrangement. Most notably an operational period is included in the contract. The major addition to the process being the inclusion of financing throughout the entire life of the project, including operation. Like design-build-operate formats, it allows for fast-track construction and theoretically produces a higher quality design through increased communication, cooperation and life-cycle costing.

The major benefit however, is the financial support provided by the designer/contractor/operator entity. Often owners cannot muster the financial means to construct a project, or must choose one project over another. Because payment for the project comes from operating revenues, the owner can still manage to complete a project without the normally required financial means. Certain private sector owners can also use this financial tool when their cost of capital is higher than that of the build-operate-transfer franchisee.

Another benefit of this procurement method is the ability to introduce new technologies or techniques to a project or area that lacks the ability to produce it on its own. Most proprietary technologies fit into this category. For example, in order to acquire Hughes ETC AVI technology, the only present source is Hughes. Local designers and contractors may not possess the required expertise to complete a project that relies upon new technologies. The franchisee in this contractual arrangement can bring the required knowledge with them and subsequently train and educate the local residents.

2.5.2 Build-Operate-Transfer Disadvantages

Because the owner has awarded the project to a single entity, the owner has lost the benefits of a fiduciary relationship with the engineer. A loss of control over the detailed design is often lost as a result. To properly establish initial parameters and specifications, the owner must be knowledgeable about the specific project and the process that will ensue.

Similar to design-build and design-build-operate, the owner may have difficulty making changes after the project has been awarded. Certainly these changes will produce additional expense.

Like turnkey procurement, build-operate-transfer includes construction financing. The cost of capital to the franchisee may be greater than that of the owner. The process probably also includes long-term financing after completion of the project. The cost of capital issue regarding long-term financing is similar to that of construction financing. Additionally, franchisee will have to charge a premium for both of these services.

Because the decision to use build-operate-transfer as a means to complete a project generally hinges on a lack of available funding, there is an additional risk. Should a project become a greater revenue producer than anticipated, the owner might not realize the tremendous earning potential of the new facility or service. Therefore, an owner must fully comprehend the intricacies of the process and understand the risks and potential rewards during the project development process.

2.6 Primary Concerns/Issues

When selecting a procurement strategy, it is important to understand that each method has advantages and disadvantages. To effectively choose a method that will complete a project as desired, the primary concerns must be understood and explored.

2.6.1 Financing

Financing is probably the most important factor in completing a project simply because some mechanism must exist to pay for the costs of the project. No matter how well the project is planned, designed, constructed, or operated, if it cannot be paid for, it will not be completed. When planning, it is important to understand how the financial structure interacts with other aspects of the process and how it can control the entire project. The two major items in the financial plan concern 1) how much will the project cost and 2) how will it be paid for.

2.6.1.1 Construction Costs

If costs are not understood, it is impossible to envision a financial package. The costs must be estimated, including those required for development, acquisition, design, construction and operation. The sum of these costs is crucial, but the timing of different expenses is also important.

2.6.1.2 Revenue Stream

Once costs are established, the potential sources of revenue need to be identified. These include existing and future budgets, sources of annual profit and financial markets. Another potential source is revenues that will be produced from the operation of the project. The financial plan begins to take shape when these revenues and their timing can be matched with costs. The issue of revenues is particularly important when an owner lacks the capability to complete a project, yet the project may produce substantial revenues upon completion. Under this scenario, the project would be a candidate for a build-operate-transfer procurement strategy.

2.6.2 Risk and Control

Risk and control is of particular importance. The allocation of risk and the amount of control that the owner either desires or actually requires will have a tremendous impact on the strategy that is chosen and how potential bidders will respond to the project.

2.6.2.1 Owner Control

The degree in which the owner feels the need to control the design and the process is an important issue. The selection of a strategy may be based upon this issue alone. The owner may have such complex issues regarding politics, local needs, the ability to remain flexible, ownership of the project, etc. that any combination of design and construction or operation would be unable to produce the required results. An arrangement that utilized a design professional in a fiduciary relationship with the owner might be the only acceptable choice.

Control over the schedule is another factor that becomes extremely important. The necessity for an early completion may drive the project away from the traditional method towards one that can facilitate fast-track construction. The start of the project may be equally important. The window of opportunity to begin a project, and thus dedicate a portion of the budget to the project or secure outside funding, may be narrow. A strategy that ensures quick commencement of the process might be the only option.

Owner drivers[5], may shape the form that best suits the project. Does the owner have the ability to use a form that relies on substantial knowledge of the process for successful completion? Often an owner will be unwilling to add the required in-house staff to utilize one or more strategies.

The topic of risk requires meticulous analysis. The accepted axiom is that risk should only be accepted by those who are best able to control it. Each delivery method implicitly assigns risk based upon the incentives inherent to the contractual form. Identification of the risks and the proper assignment of these risks using the available procurement strategies is essential for conflict and avoidance.

2.6.3 Sensitivity Analysis

The manner in which the variables in a project are inter related is an issue on multiple levels. The role of the sponsoring agency or owner can play a critical role in the selection process. The ramifications of this role can be manifested in the process that is chosen. The niche that an owner occupies will determine the motives of the project. Is profit most important? Is the provision of a service the ultimate concern? These motives will be reflected in final form of the contract.

The project itself will have internal variables; completion date, construction cost, cost of capital, discount rates, etc. Sensitivity analysis of the project (changing the numbers to see the impact of each variable) helps to show how these variables are related to one another and their relative importance. If the project is most dependent on completion dates and the commencement of operation, hence revenues, decisions will be based upon quick completion. If the cost of construction or operation is the primary concern, a different decision might be reached. Understanding the individual variables of the project becomes essential in the assignment of risk and the selection of the procurement strategy.

2.6.4 Quality of Design

The requirements of the design are a factor in the selection process that can easily be ignored. A landmark civic project or one that requires certain aesthetic qualities might necessitate the use of a prestigious architect. A plant for manufacturing might rely upon technology that is constantly changing and the design could be best completed using the input of the vendors and contractors. Each procurement strategy will provide a different emphasis regarding the required design quality. Warehouses have dramatically different design characteristics than museums and this must be accounted for in level of control afforded the owner, designer and contractor.

2.6.5 Operation

A key component in the procurement selection process is the decision to include or exclude operation and maintenance. This apparently simple decision can have a profound effect on how the design is completed and maintenance is conducted. The direct effect is in life-cycle costing. However, the length and terms of the operations portion of the contract are equally important. A period that is insufficiently short will not create the intended incentives. A period that is too long may lock an owner into service that can become outdated, or costs become impossible to predict. Should a project cease to be profitable for the operator, maintenance and operation may suffer through cost cutting measures.

3. Tren Urbano

3.1 Background

Tren Urbano is a new urban transit system for the metropolitan San Juan area of the island of Puerto Rico. The tremendous postwar growth in the San Juan area has exerted extensive pressure upon the existing highway and surface transportation system. This increased need for transportation services, along with the reliance upon the automobile as the primary means of transportation, has created overwhelming roadway congestion. Part of the solution in the San Juan metropolitan region is a public transit system - Tren Urbano.

3.1.1 General Description

Puerto Rico is an island in the Caribbean located between the Dominican Republic and the U.S. Virgin Islands. (Figure 3-1) Although a Commonwealth of the United States, it retains a characteristically Caribbean demeanor. According to the 1990 U.S. Census, the total population of the island was approximately 3.7 million people.[6] The topography of the island is distinctly volcanic. The historic development of the island has thus been limited to the coastal plains, a narrow band of tenable land around the island. The bulk of this development has centered around San Juan. (Figure 3-2) The Spanish colonial port and settlement of Old San Juan is now only a small portion of the growing metropolitan area. The development originally centered around the deep water port provided by San Juan Bay.

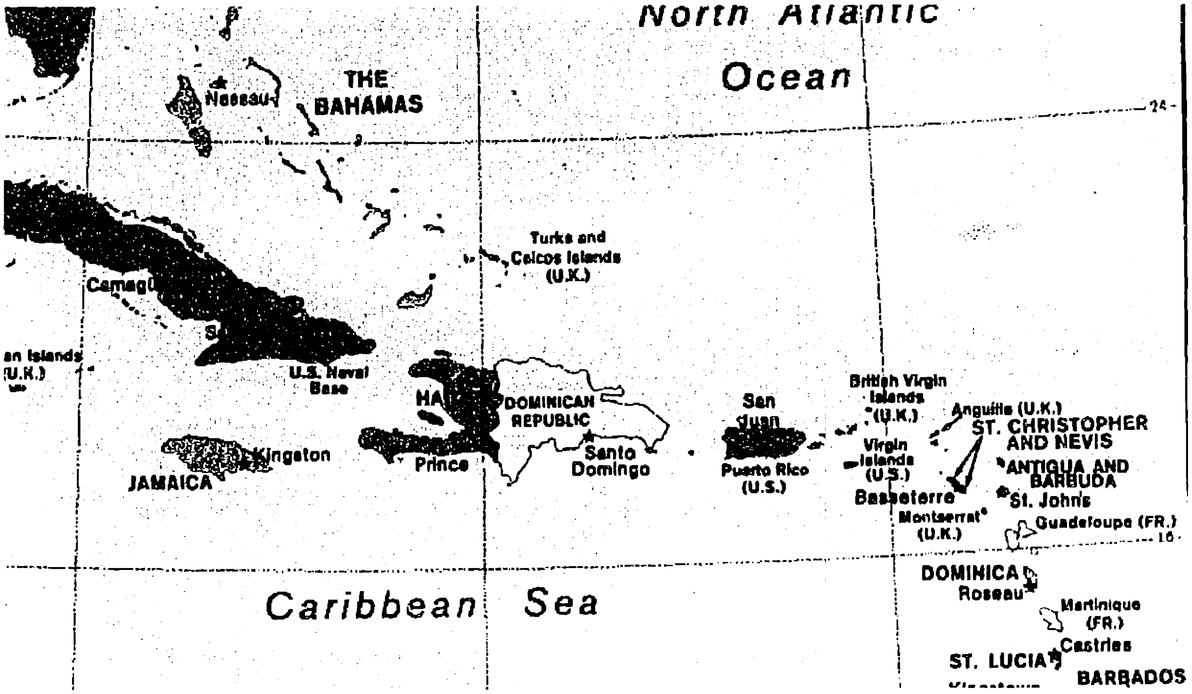


Figure 3-1 Caribbean Map

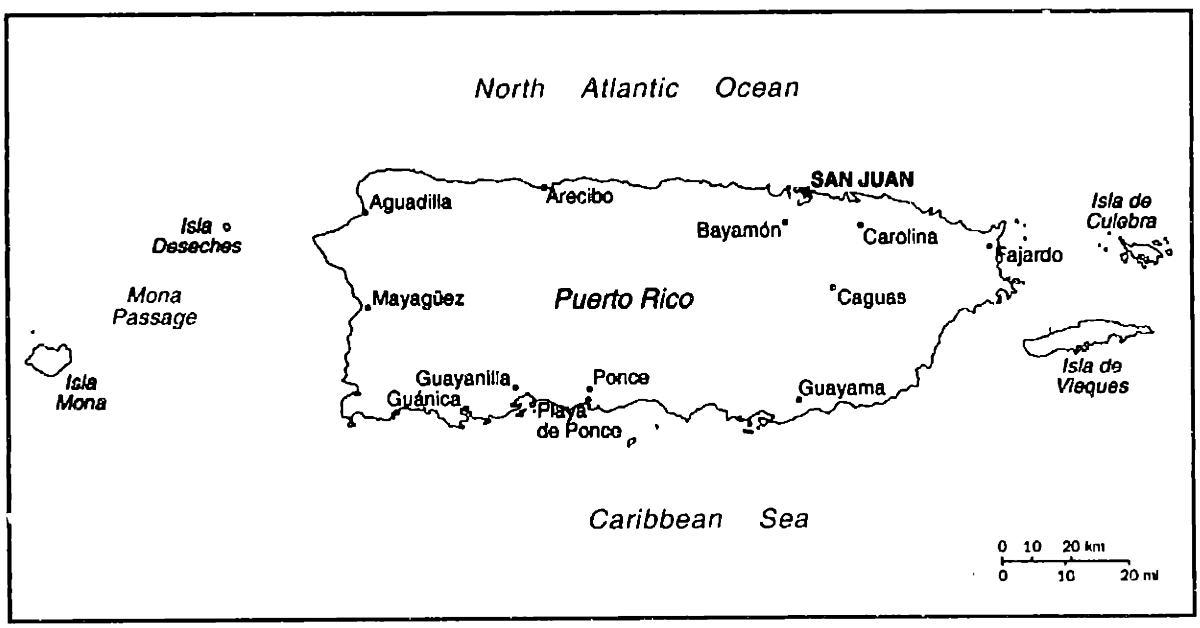


Figure 3-2 Puerto Rico

A large portion of the Puerto Rican population resides in the San Juan Metropolitan Area. Results from the 1990 U.S. Census estimate the total to be 1.3 million people, or 37% of the total island population. The associated population density ranks with the highest in the United States.[6]

Along with this tremendously dense center of population is a heavy dependence upon the automobile as the primary means of transportation. Estimates from 1990 indicate that more than 90% of all work related (commuting) trips were made in personal automobiles. The result, during the morning and evening commute, is extreme congestion. The existing public transit systems, buses and publicos, is entirely dependent upon these same surface roads. With the exception of a few bus routes with dedicated lanes, they are also subject to gridlock.

Associated with the dependence upon personal automobiles is the relative amount of money spent on an automobile by the average Puerto Rican family. Because the per capita income is substantially lower than that of the mainland United States and the cost of a car is similar in both locales, the percentage of income spent on transportation in Puerto Rico is staggering. Data from the 1990 census shows this figure to be nearly 40% [6]

The development of the area has resulted in what now can be viewed on two axes. The first runs from north to south in the city of San Juan; Old San Juan to Rio Piedras through Santurce and Hato Rey. The other axis runs in an east-west direction from Carolina to

Bayamon through the Torrimar, Centro Medico and Villa Nevarez areas. Within these three municipalities, San Juan, Bayamon and Carolina, reside 60% of the population of the region. Just as importantly, 83% of the regional jobs are found in the same area.

With the already limited capability of the highways and streets and projections of increasing demand, the proposed solution is a fixed guideway, heavy rail system to service the area.

3.1.2 Project History

The process that created Tren Urbano Began 30 years ago. To date, a number of regional planning studies have been conducted regarding transportation in the San Juan metropolitan area. The general conclusion of each of these studies was that a regional transit system would be required.

The first of these studies, the 1967 San Juan Metropolitan Plan, was completed by Wilbur Smith, Inc. The resulting recommendations called for a fixed rail system with two alignments. One north-south alignment in the Santurce - Rio Piedras area and one east-west alignment in the Bayamon - Hato Rey - Carolina area. A number of additional studies were completed as a result of these initial recommendations. One of these was Transit Alternatives for Metropolitan San Juan, completed in 1979. This report looked at several options for both fixed guideway and bus systems. Again, the result was the recommendation of a fixed rail system in the Santurce - Rio Piedras - Bayamon area. This alignment became known as the Bayamon Crescent route.

Another study was conducted in 1993 that resulted in the San Juan Regional Transportation Plan. The major emphasis of this report was that along with strategic highway improvements, the key to an improved regional system was the construction of a high frequency rail system in the Bayamon Crescent. From this plan, the Draft Environmental Impact Statement (DEIS) for Tren Urbano was developed.

The project detailed in the DEIS is Phase I of the entire Tren Urbano project. This first phase will operate in the Bayamon Crescent from Bayamon to Hato Rey. (Figure 3-3) A proposed Phase Ia would continue on to Santurce. Phase II would be east to Carolina, Phase III from Santurce to Old San Juan, and Phase IV from Santurce to the airport. (Figure 3-4)

Figure 3-3 Tren Urbano: Phase I Alignment

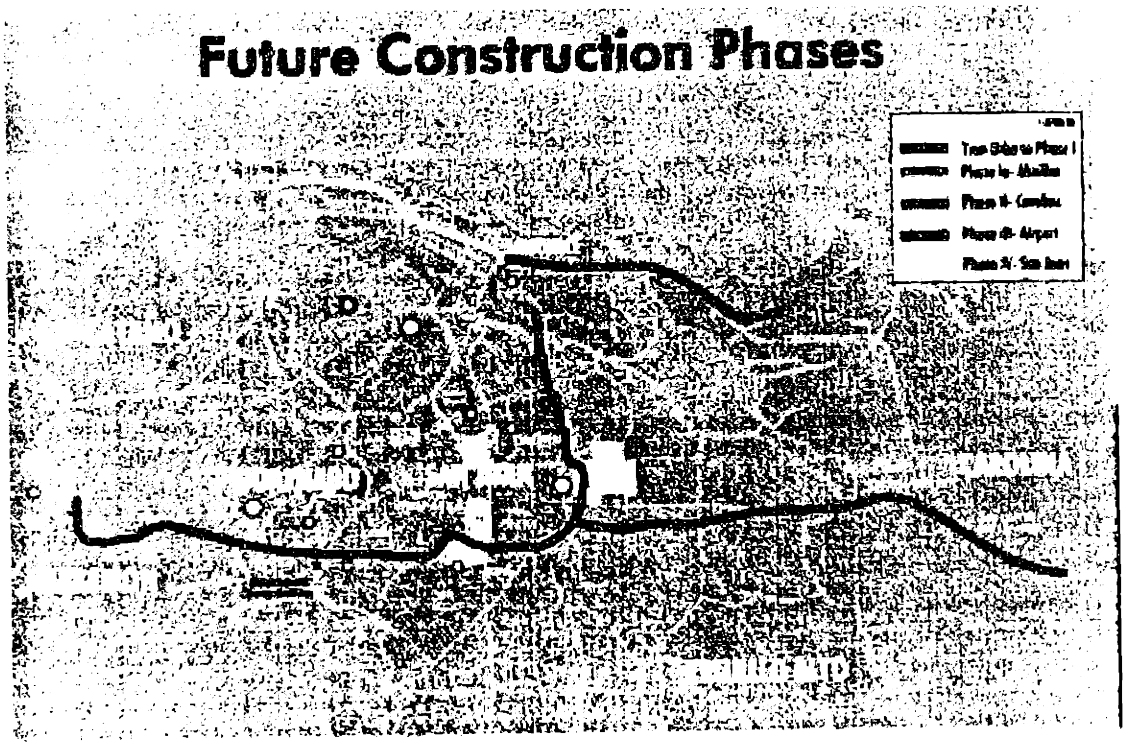


Figure 3-4 Tren Urbano Alignment: Future Phases

Further refinement of the Phase I system plan, including financial considerations and design, produced the Final Environmental Impact Statement (FEIS), upon which the existing procurement strategy was implemented.

3.2 Local Conditions

The circumstances in which the Tren Urbano project was developed are unique. The majority of construction projects, especially large civil works projects, cannot be replicated. The conditions that surround the projects, in this case Tren Urbano, determine how the projects will be designed, constructed and financed. Following are the concerns that faced the Puerto Rico Highway and Transportation Authority as they deliberated on procurement selection.

3.2.1 Political Climate/ Timing

Although not explicitly identified as such, perhaps the most important factor in the strategy selection process for Tren Urbano was the existing political framework. Previous attempts to initiate the process required to undertake such an ambitious project had failed for various reasons. Because Puerto Rico has a definitively Caribbean flavor, the political landscape can be extremely inflammatory. The present Governor, Pedro Rosello, and his administration supported Tren Urbano, but there was concern that any opposition might not look as favorably on the project. Therefore, it was imperative that a major portion of the construction contracts be awarded before the next election. Any strategy that prolonged the award of the project might leave the door open for substantial changes or even cancellation. Should the governor not be reelected, the new administration could conceivably cancel the project based upon its support from the previous administration. This polarization of politics could engulf the project, rather than force its continuation based on its merits. Thus, timing of the design and contractor selection process was critical to the overall success of the project. The tentative schedule looked to begin construction immediately upon certification of the Final Environmental Impact Statement and Record of Decision, mid 1996. This schedule would allow initial operation of the system to begin in 2001.

3.2.2 Funding

One of the crucial aspects of the plan was the manner in which the project would be funded. The Puerto Rico Highway and Transportation Authority (PRHTA) had at its disposal a substantial budget. The bulk of these revenues were derived from gasoline taxes, motor vehicle license fees and toll receipts. When coupled with existing commitments to other ongoing highway and transportation projects, these revenues would be insufficient to cover the all construction costs without raising additional funds through new or increased taxes. Based upon the failure of other major new transit systems in Honolulu and Houston that had relied upon an increase in taxes, the government decided additional taxation would not be a feasible source of funding. The Puerto Rico Highway and Transportation Authority was familiar with the bond market as a method for raising needed capital and intended to take out bonds as necessary as a secondary funding source. According to the Final Environmental Impact Statement, the bonding capacity is limited. Because the PRHTA must maintain a debt to service coverage ratio of 1.50, the project would fall approximately $300 million dollars short of the total required amount of $1.1 billion.[6] It was hoped that this money would be made available through the Intermodal Surface Transportation Efficiency Act (ISTEA). This discretionary fund was appropriated by Congress to help support projects of this nature. Earlier negotiations with the Bush administration had not resulted in any guaranteed funding. The general assumption was that as the project became more probable, this situation could change. Under the current administration, an understanding was reached, indicating that this funding would in fact become available. There was also an interest in utilizing private funding, provided by the contractor, to bridge the gap between what was locally available and what would be required. The manner in which the private sector might be included however would be based upon the risk associated with the project and its potential returns.

Another consideration was funding for operation of the system. Whether it were to be done internally or through contract with a private entity, the risks associated with ridership were considerable. At an estimated fare of $.50 per trip, the total daily traffic was anticipated to be 114,492 riders in the year 2010.[6] Assuming this traffic would be consistent, 365 days per year, this projects to a yearly revenue of $20,894,790. Certainly ridership will increase steadily over the first years of operation. With a ten percent annual increase, the daily number of riders would be 48,556 in the first year of operation. With the same fare structure or $.50 per trip, the annual revenue generated by these riders would only be $8,861,470. This revenue would definitely fall short of operating costs during the initial few years of operation. If the forecasted numbers for the are accurate and the proposed fare structure is used, the system will have an annual operating deficit of nearly $8,000,000 in the year 2010. Because San Juan has no recent urban transit history, there is an added risk associated with the ridership projections. It would be difficult, if not impossible to entice private investment without certain monetary concessions relating to the actual number of passengers carried.

3.2.3 Control

Control can be characterized in two distinct manners for Tren Urbano. The first is owner control regarding design, financing and interaction with the community. It was believed to be critical that the Puerto Rico Highway and Transportation Authority have complete control of the alignment of the system. This would include where the guideway should pass and where the stations should be located. Control over these aspects was important because it would determine who would be served and theoretically how they could best be served. These decisions were considered to be the role of the government and could only best be addressed through public entity means. The quality of the design was equally important. The major decisions, regarding the type of system, the controls for the system and the aesthetic character of the system, that would have a dramatic impact on the overall success or failure of the project needed to be made through the existing government agencies, or at least indirectly through their guidance. Another area where owner control was important was in cost control and finance. To ensure that the government's money was being spent efficiently, it was desired that the lowest cost of capital be realized and that cash flow management was done in accordance with other existing capital spending programs.

The other area of concern regarding control, dealt with the contractual form that was selected. It would be essential that the method effectively allowed for the control of contract interfaces. It would be important to understand who would be responsible for the oversight of these interfaces and how any potential problems should be addressed.

3.2.4 Quality

The overall quality of the project was the most important factor in the selection of a procurement strategy. Any method would have to provide the desired level of efficiency and quality to create a useful service. This would include not only the physical components that would be installed, but the manner in which the system would be operated subsequent to the completion of construction. The decisions made during the design portion of the project would have lasting implications upon the system. It was determined that an importance should be placed upon life-cycle costing so the decisions to include or preclude certain elements would be fully understood. If the future cost implications of design decisions were better known, it would be possible to create a product that would be easier and more economical to operate.

3.2.5 Technology Transfer

Puerto Rico possessed little, if no experience in designing or operating a fixed guideway transit system. All design, construction expertise would have to come from external sources. It was realized early in the process that the project would provide a tremendous opportunity to introduce new technologies to the island. In fact, it was desired to maximize the transfer of these technologies to local firms and personnel so that Puerto

Rico could become a leader in the Caribbean in future transit system construction. Specifically, the objectives were as follows:

- To develop the skills and know-how of Puerto Rican professionals, technicians, workers and businesses in urban rail transit
- To develop Puerto Rican experts in rail transit to offer their services to Latin America and other countries of the hemisphere.
- To transmit the technological, administrative, financial, environmental, legal, and procedural knowledge to Puerto Rican professionals in order to be able to design, construct, operate and maintain an optimal system for Tren Urbano.[7]

Whichever procurement method would be used, it would need to allow this transfer to occur.

3.2.6 Local Involvement

With an infrastructure investment of this magnitude, the project was viewed as an economic stimulus. Because the technology was not native to Puerto Rico, it was understood that the primary contract would probably not be awarded to a local firm. However, it was important to make sure that a substantial portion of the money would remain in the coffers of Puerto Rican owned and operated businesses. There was intense pressure to ensure that the profit from the design and construction would not be solely enjoyed by foreign enterprises. It was envisioned that Puerto Rican companies possessed the skills required to complete substantial portions of the work on a subcontracted basis. The skills and equipment required for engineering and construction of large civil works had developed locally in the decades after World War II.

3.2.7 Political and Legal Feasibility

With the passing of the Brooks Act in 1972, the design-bid-build procurement strategy had in fact become law in the United States when public funds were to be used. Alternative delivery systems are in fact precluded by DBB legislation in many states. In Puerto Rico, however, this was not the case. According to PRHTA officials, a portion of the Puerto Rico Act explicitly legalized the use of alternative delivery systems on the island of Puerto Rico. Since its passage, several projects have been completed using government funding, including the Teodoro Moscoso Bridge. (Figure 3-5)[8] This project was completed using the build-transfer-operate format in only 20 months after award of the contract. In Puerto Rico, the legality of any alternative process was never an issue. Moreover, a precedent already existed to utilize these newly rediscovered strategies and attract private investment.

Teodoro Moscoso Bridge

A toll bridge across the San Jose Lagoon,
Linking the Hato Rey financial district and the Airport

Length:	2.1 miles
Construction Cost:	$109,500,000
Franchisee:	Autopistas de Puerto Rico
Opening Date:	February 23, 1994
Period of Concession:	35 years
Toll Rate:	$1.50

To date traffic has been at much lower volumes than anticipated and the franchisee is not turning a profit.

Figure 3-5 Teodoro Moscoso Bridge

Issues of legality also existed regarding the operational phase of the system. If Tren Urbano were operated by the Puerto Rico Highway and Transportation Authority, the project would be straight forward. However, if a contract were to be awarded for long term operations, limitations existed through the form of Internal Revenue Service regulations. Essentially, because tax exempt bonds would be used to finance the project, although indirectly, any operational period associated with the construction project would be limited to three years plus two one year renewals. Any deviation from these limits would effectively eliminate the benefits accrued through the use of tax exempt bonds. These restrictions meant that a five year operation obligation would be the maximum allowable. The Internal Revenue Service regulations were subsequently changed in 1997 (after award of the project) so that operation contracts may extend up to 30 years.[9]

Another legal hurdle existed in federal legislation that prohibited direct requirements for local participation. In fact, the use of local participation cannot even be used as an evaluation criteria.[10] Therefore, the contractual form itself must be formulated in such a way that local participation becomes a logical and economical solution.

3.3 Financial Model

To better understand the manner in which the project will be funded, it is useful to look at a financial pro-forma. The sources of revenue will be balanced with the costs of design and construction and assigned chronologically as can best be envisioned. The figures used will all be discounted back to 1997 to obtain the net present value of the project.

3.3.1 Revenues and Available Funds

For this project the sources of funding have been identified as PRHTA budget funds, PRHTA bonding, gate receipts from Tren Urbano and Intermodal Surface Transportation Efficiency Act (ISTEA) allotments from the Federal Transit Administration. Because the project is only one of many transportation infrastructure projects that will be completed by the PRHTA and has not been separated from these projects, it is difficult to gain a clear understanding of the budget/bond arrangement. The ISTEA money has been estimated at $300 million and would come in the form of a full-funding grant agreement. The gate revenues from the operation of the system are based upon the projected daily ridership in the year 2010. The initial toll rate is projected to be $.50.

3.3.2 Engineering, Construction and Operation Costs

Construction costs are estimated to be $1.2 billion. These costs will be incurred beginning in late 1996 and will continue through the beginning of operation in 2001. The majority of the construction activity will occur between 1998 and 2000.

Total engineering costs will be approximately $47 million. Engineering began in 1994 and will continue through the beginning of operation in 2001. Engineering costs to Tren Urbano consist of preliminary planning and design, development of design through the 30% level required for the Final Environmental Impact Statement and procurement, project management of contract interfaces and quality assurance.

It is unclear what right of way costs will be, but they have been estimated at $20 million. The majority of the system will be constructed either on an existing highway right of way that is owned by the Commonwealth of Puerto Rico, underground or elevated above existing structures. Therefore it is reasonable to assume that additional right of way costs will be minimal.

The operational costs for the first five years are estimated to be between $28 million and $29 million. It can be assumed that these costs could be extended for an additional five year period and they would remain reasonably accurate. Operation by the Puerto Rican Highway and Transportation Authority or a private consortium would likely produce similar results regarding total costs to Tren Urbano.

3.3.3 Financial Options: Sensitivity Analysis

Preparation of a financial pro-forma from the point of view of the Puerto Rican government leads to some interesting conclusions. (Figure 3-6) The most striking of these is the relatively small amount of revenue generated through ridership. When the assumed fare of $.50 per trip is coupled with the anticipated ridership during the first five years of operation, the operational portion alone will not produce a profit. Not only will the overall period provide negative income, but a profit will not be realized in any single year. If it is assumed that operational costs do not increase and the fare does not increase, solely relying on increased ridership, even in the tenth year of operation system revenues are insufficient to cover even operating costs.

Tren Urbano
FINANCIAL ANALYSIS **BASE CASE**

Given:

Pre construction cost	47,000,000
Construction Costs	1,211,000,000
Other Miscellaneous costs	20,000,000
Right of Way	20,000,000

Assumptions	
10% increase in riders	
Per trip cost of $.50	
114,492 Daily riders in year 2010	
Initial Daily passengers	48514
Initial Annual Passenger	17707610
Fare rate	0.5
Annual % Increase in fare revenu	10
Annual % increase in O&M Cost	0
Initial Fare Revenue	8,853,805
O&M Costs in the first year	28,760,000
Discount Rate	0.08

Schedule of Expenses % tage of respective total		
Year	Preconstruction	Construction
1994	5	
1995	12	
1996	20	1
1997	20	9
1998	15	25
1999	10	35
2000	10	20
2001	8	10

		Preconstruction		Construction		Other	O&M	Tolls	Profit	Pr. Value	Cum Pr. Val
Year	Index	% tage	Actual	% tage	Actual	Costs					
1994	0	5	2,350,000		0				-2,350,000	-2,350,000	-2,350,000
1995	1	12	5,640,000		0				-5,640,000	-5,222,222	-7,572,222
1996	2	20	9,400,000	1.00	12,110,000	20,000,000			-41,510,000	-35,588,134	-43,160,357
1997	3	20	9,400,000	9.00	108,990,000				-118,390,000	-93,981,799	-137,142,156
1998	4	15	7,050,000	25.00	302,750,000				-309,800,000	-227,712,248	-364,854,404
1999	5	10	4,700,000	35.00	423,850,000				-428,550,000	-291,663,929	-656,518,333
2000	6	10	4,700,000	20.00	242,200,000				-246,900,000	-155,588,881	-812,107,214
2001	7	8	3,760,000	10.00	121,100,000		28,760,000	8,853,805	-144,766,195	-84,469,684	-896,576,898
2002	8	0	0	0	0		28,760,000	9,739,186	-19,020,815	-10,276,354	-906,853,253
2003	9		0	0	0		28,760,000	10,713,104	-18,046,896	-9,027,941	-915,881,194
2004	10		0	0	0		28,760,000	11,784,414	-16,975,586	-7,862,981	-923,744,174
2005	11		0	0	0		28,760,000	12,962,856	-15,797,144	-6,775,124	-930,519,299
2006	12		0	0	0		28,760,000	14,259,141	-14,500,859	-5,758,490	-936,277,789
2007	13						28,760,000	15,685,056	-13,074,944	-4,807,630	-941,085,419
2008	14						28,760,000	17,253,561	-11,506,439	-3,917,494	-945,002,913
2009	15						28,760,000	18,978,917	-9,781,083	-3,083,405	-948,086,318
2010	16						28,760,000	20,876,809	-7,883,191	-2,301,028	-950,387,347

Figure 3-6 Tren Urbano Pro-Forma: Base Case

When the Federal Transit Administration grant contributions are input during the construction period, 1996 - 2001, as negative costs, the total net present value becomes more favorable, but remains at nearly $675,000,000 in the negative after ten years of operation.(Figure 3-7) Because the costs of operation are greater than the revenues received, the net present value decreases each year. Until the revenues increase this condition will remain.

To assess the possibility of using a build-operate-transfer type strategy it is important to understand the revenues generated during operation and the risk associated with these revenues. In this case it is quite clear that a build-operate-transfer contract for the entire system would not be attractive to private investors. If it were assumed the federal grant money would still be available for a privately designed, constructed and operated facility, the fare would have to be quadrupled and ridership would have to increase at an annual rate of 37% to create a positive net present value in year ten.(Figure 3-8) Considering the presently anticipated rate and ridership, these increases cannot be considered reasonable. The risk associated with these assumptions would be greater than any private investor would be willing to assume. Therefore a build-operate-transfer strategy for the entire system is not feasible given the present circumstances.

Tren Urbano
FINANCIAL ANALYSIS **BASE CASE**
Given:

Pre construction cost	47,000,000
Construction Costs	1,211,000,000
Other Miscellaneous costs	20,000,000
Right of Way	20,000,000

Schedule of Expenses % tage of respective total		
Year	Preconstruction	Construction
1994	5	
1995	12	
1996	20	1
1997	20	9
1998	15	25
1999	10	35
2000	10	20
2001	8	10

Assumptions	
10% increase in riders	
Per trip cost of $.50	
114,492 Daily riders in year 2010	
Initial Daily passengers	48514
Initial Annual Passenger	17707610
Fare rate	0.5
Annual % Increase in fare revenu	10
Annual % increase in O&M Cost	0
Initial Fare Revenue	8,853,805
O&M Costs in the first year	28,760,000
Discount Rate	0.08

Year	Index	Preconstruction % tage	Preconstruction Actual	Construction % tage	Construction Actual	Other Costs	O&M	Tolls	Profit	Pr. Value	Cum Pr. Val
1994	0	5	2,350,000		0				-2,350,000	-2,350,000	-2,350,000
1995	1	12	5,640,000		0				-5,640,000	-5,222,222	-7,572,222
1996	2	20	9,400,000	1.00	12,110,000	12,500,000			-34,010,000	-29,158,033	-36,730,316
1997	3	20	9,400,000	9.00	108,990,000	-13,000,000			-105,390,000	-83,661,980	-120,392,295
1998	4	15	7,050,000	25.00	302,750,000	-45,000,000			-264,800,000	-194,635,905	-315,028,200
1999	5	10	4,700,000	35.00	423,850,000	-97,000,000			-331,550,000	-225,647,359	-540,675,559
2000	6	10	4,700,000	20.00	242,200,000	-120,000,000			-126,900,000	-79,968,526	-620,644,085
2001	7	8	3,760,000	10.00	121,100,000	-140,000,000	28,760,000	8,853,805	-4,766,195	-2,781,029	-623,425,114
2002	8	0	0	0	0	-1,600,000	28,760,000	9,739,186	-17,420,815	-9,411,924	-632,837,038
2003	9		0	0	0		28,760,000	10,713,104	-18,046,896	-9,027,941	-641,864,979
2004	10		0	0	0		28,760,000	11,784,414	-16,975,586	-7,862,981	-649,727,960
2005	11		0	0	0		28,760,000	12,962,856	-15,797,144	-6,775,124	-656,503,084
2006	12		0	0	0		28,760,000	14,259,141	-14,500,859	-5,758,490	-662,261,575
2007	13						28,760,000	15,685,056	-13,074,944	-4,807,630	-667,069,204
2008	14						28,760,000	17,253,561	-11,506,439	-3,917,494	-670,986,699
2009	15						28,760,000	18,978,917	-9,781,083	-3,083,405	-674,070,104
2010	16						28,760,000	20,876,809	-7,883,191	-2,301,028	-676,371,132

Figure 3-7 Tren Urbano Pro-Forma: FTA Grant

Tren Urbano

FINANCIAL ANALYSIS **BASE CASE**

Given:

Pre construction cost	47,000,000
Construction Costs	1,211,000,000
Other Miscellaneous costs	20,000,000
Right of Way	20,000,000

Schedule of Expenses % tage of respective total		
Year	Preconstruction	Construction
1994	5	
1995	12	
1996	20	1
1997	20	9
1998	15	25
1999	10	35
2000	10	20
2001	8	10

Assumptions	
10% increase in riders	
Per trip cost of $.50	
114,492 Daily riders in year 2010	
Initial Daily passengers	48514
Initial Annual Passenger	17707610
Fare rate	2
Annual % Increase in fare revenu	37
Annual % increase in O&M Cost	0
Initial Fare Revenue	35,415,220
O&M Costs in the first year	28,760,000
Discount Rate	0.08

		Preconstruction	Construction			Other	O&M	Tolls	Profit	Pr. Value	Cum Pr. Val
Year	Index	% tage	Actual	% tage	Actual	Costs					
1994	0	5	2,350,000		0				-2,350,000	-2,350,000	-2,350,000
1995	1	12	5,640,000		0				-5,640,000	-5,222,222	-7,572,222
1996	2	20	9,400,000	1.00	12,110,000	12,500,000			-34,010,000	-29,158,093	-36,730,316
1997	3	20	9,400,000	9.00	108,990,000	-13,000,000			-105,390,000	-83,661,980	-120,392,295
1998	4	15	7,050,000	25.00	302,750,000	-45,000,000			-264,800,000	-194,635,905	-315,028,200
1999	5	10	4,700,000	35.00	423,850,000	-97,000,000			-331,550,000	-225,647,359	-540,675,559
2000	6	10	4,700,000	20.00	242,200,000	-120,000,000			-126,900,000	-79,968,526	-620,644,085
2001	7	8	3,760,000	10.00	121,100,000	-140,000,000	28,760,000	35,415,220	21,795,220	12,717,302	-607,926,783
2002	8	0	0	0	0	-1,600,000	28,760,000	48,518,851	21,358,851	11,539,523	-596,387,261
2003	9		0	0	0		28,760,000	66,470,826	37,710,826	18,864,802	-577,522,459
2004	10		0	0	0		28,760,000	91,065,032	62,305,032	28,859,285	-548,663,174
2005	11		0	0	0		28,760,000	124,759,094	95,999,094	41,172,366	-507,490,808
2006	12		0	0	0		28,760,000	170,919,959	142,159,959	56,453,676	-451,037,132
2007	13						28,760,000	234,160,344	205,400,344	75,525,280	-375,511,852
2008	14						28,760,000	320,799,671	292,039,671	99,428,130	-276,083,721
2009	15						28,760,000	439,495,549	410,735,549	129,480,975	-146,602,747
2010	16						28,760,000	602,108,902	573,348,902	167,355,079	20,752,333

Figure 3-8 Tren Urbano Pro-Forma: Increased Fare

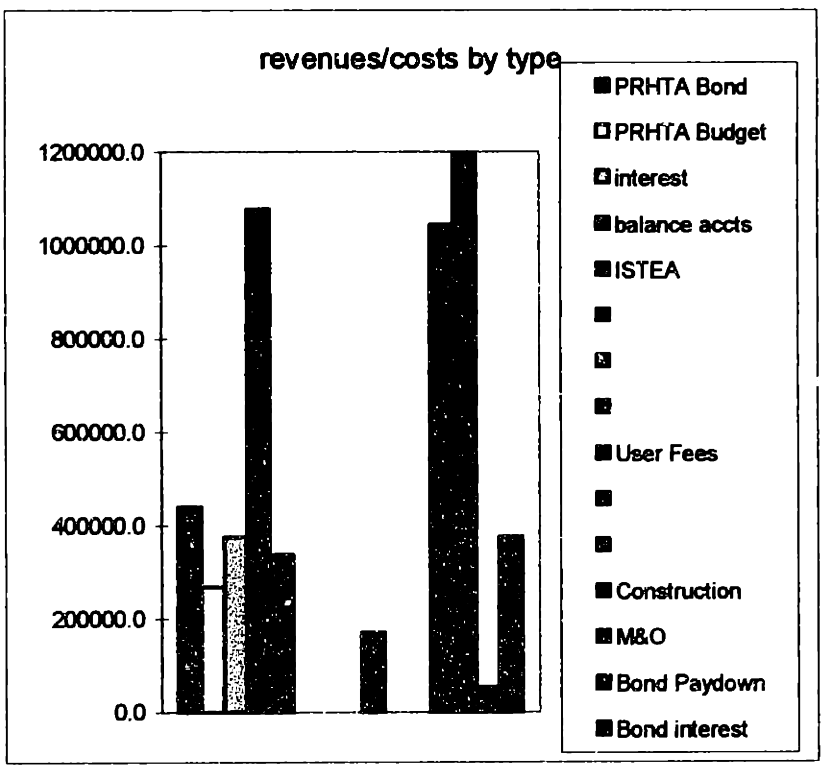
Additional revenue generating activities, including station development, could provide opportunities to improve cash flow of the system. However, it is difficult to properly estimate the extent of these potential revenue sources. All revenue streams are based upon ridership numbers to some extent. Any commercial ventures would be dependent upon the number of people or buyers visit the stations and commercial real estate options are also tied to the demand for prime property. If demand projections are questionable, then all associated revenues carry additional risk. Because San Juan does not have a recent urban transit system history, the existing ridership estimates are associated with a certain degree of risk. To assume that the development of reliable revenue streams from these associated sources could substantially change the profitability of the system would be unwise.

3.3.4 CHOICES Modeling

Use of the CHOICES Model confirms the operational deficit and indicates the capital required to subsidize operations on a net present value basis. Two scenarios were developed. The first assumes that maintenance and operations spending will mirror the present contract and increase only slowly based upon inflation. The second assumes that operation and maintenance will have to increase substantially upon conclusion of the ten year period covered in the present contract.

3.3.4.1 Present Maintenance and Operation Spending Structure

This model assumes the present maintenance and operation costs of $28,760,000 per year for the first ten years of operation. After that point operation and maintenance costs are estimated to increase slowly to mimic costs affected by inflation. The results on a net present value basis are presented below both graphically and quantitatively in Figure 3-9. Summarized in the graph are the total costs and revenues for a period that extends to 120 quarters (30 years) from the beginning of the construction period.



Class	
PRHTA Bond	438739.7
PRHTA Budget	268466.9
interest	375854.7
balance accts	1078675.7
ISTEA	337411.7
	0.0
	0.0
	0.0
User Fees	169994.5
Subtotal revenue	2669143.3

Figure 3-9 CHOICES: Tren Urbano Revenues and Costs, Present Conditions

Over the lifetime of the system under this model, approximately 25 years, the maintenance and operation costs exceed the cost of construction. Because user fees are not sufficient to cover operational expenses, additional funding will be required to ensure proper operation and maintenance over the lifetime of the system. The amount required is represented above by the balance accounts number. Using net present value analysis, if the Puerto Rico Highway and Transportation Authority had to have this money available now, it would have to total nearly $1.08 billion dollars. According to the Final Environmental Impact Statement, a cash flow analysis was conducted through the year 2006, the first five years of operation. This was done to confirm the Puerto Rico Highway and Transportation Authority's ability to cover not only construction expenses, but also those of operations. If this is assumed to be accurate, it would follow that this operational deficit will be adequately covered through annual budgetary funds.

Additional insight regarding the quarterly requirements of the construction and operation program are provided in Figure 3-10. This graph shows annual net present costs over the 120 quarter period. Sources of revenue for construction and operation are shown above the horizontal axis and costs are indicated below the axis. One of the important accounts to observe is what is termed balance accounts. This represents the additional funding that will be required during the operational portion to cover losses. If the system revenues could cover the costs of operation, this annual balance accounts number would be zero.

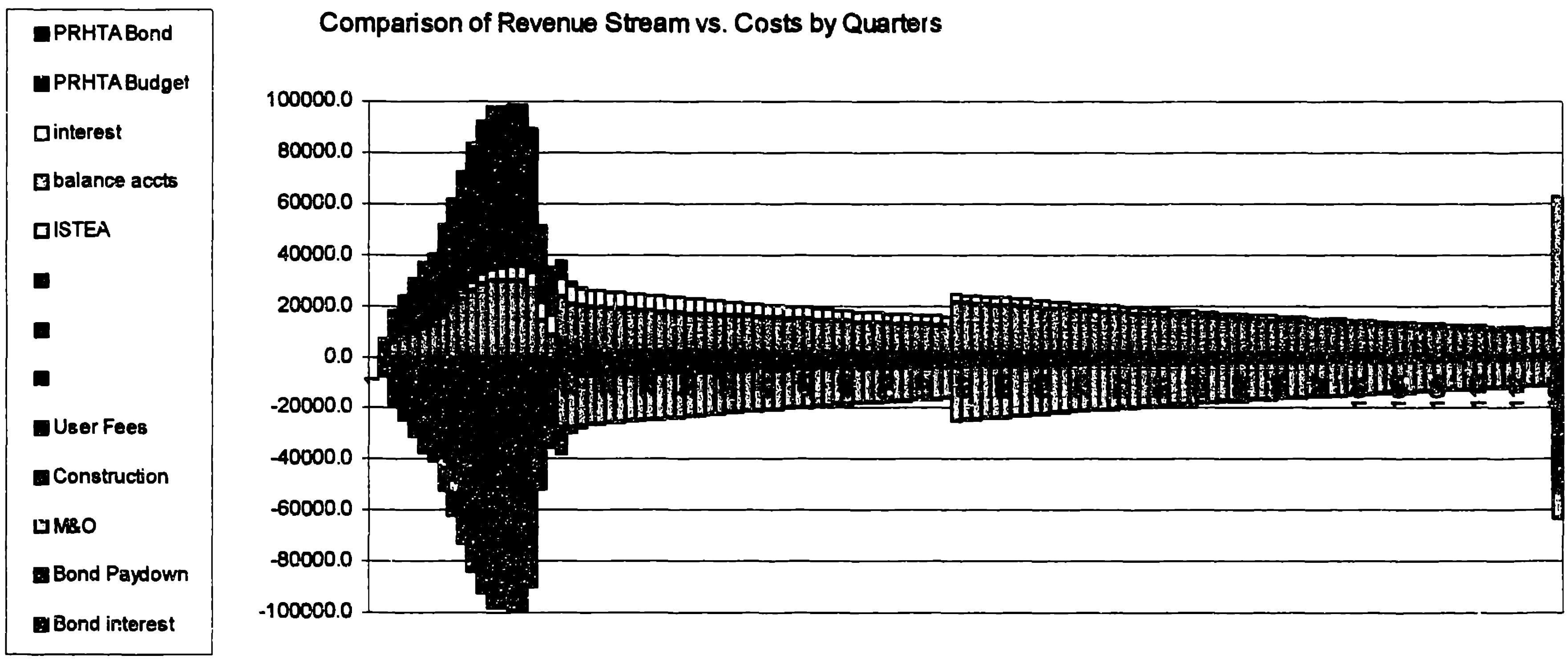
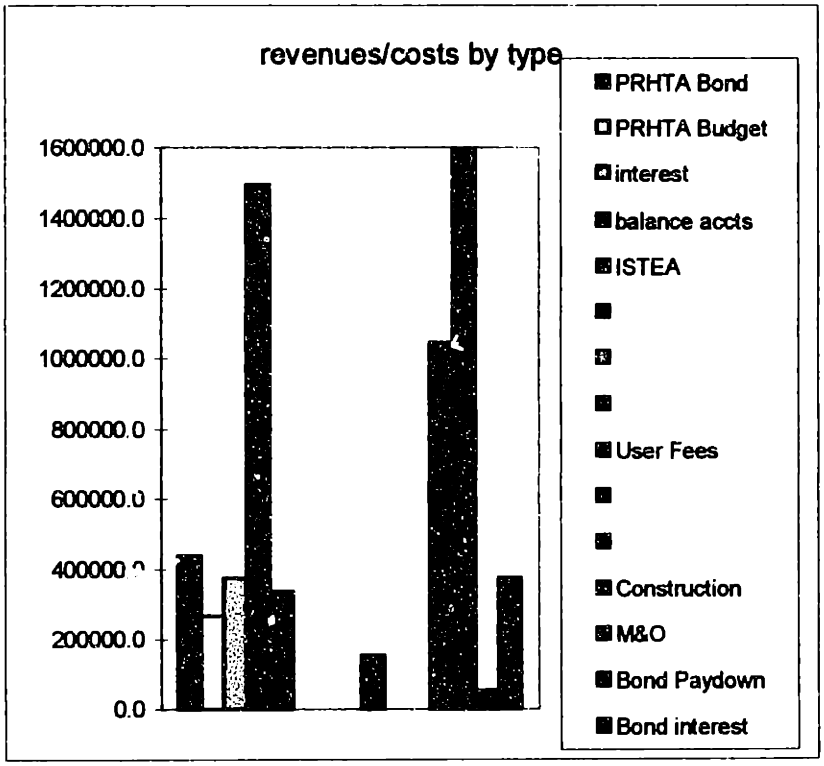


Figure 3-10 CHOICES: Tren Urbano Quarterly Data, Present Conditions

3.3.4.2 Increased Maintenance and Operation Spending

The second scenario looks at the system with increased maintenance and operation spending after the first ten years of operation. During the first ten years, the contract amount of $28,760,000 annually is utilized. After this date however, spending is increased to reflect an annual rate of 15.5% of the total cost of construction. This number may more accurately reflect current maintenance and operations spending on large infrastructure projects that are completed using design-build-operate procurement methods. Private infrastructure developers use this number as a rough estimate to adequately cover long term maintenance concerns.

The results (Figure 3-11) again indicate that maintenance and operation spending exceeds the cost of construction. The graph represents the same period examined previously, only the funding required for maintenance and operation has been increased. The amount required for maintenance and operation is in fact substantially greater. In fact, the required amount in the balance accounts column is over $415 million in present value dollars greater. This is an increase of 38.5%. Should maintenance and operation costs actually require a similar increase, the Puerto Rico Highway and Transportation Authority may not be prepared financially to handle such conditions.



Class	
PRHTA Bond	438739.7
PRHTA Budget	268466.9
interest	375854.7
balance accts	1494167.3
ISTEA	337411.7
	0.0
	0.0
	0.0
User Fees	154137.4
Subtotal revenue	3068777.9

Figure 3-11 CHOICES: Tren Urbano Revenues and Costs, Increased Maintenance and Operation

Additional information regarding the timing of this required deficit funding is included in Figure 3-12. The balance accounts category is particularly illustrative, as it graphically shows the deficit created through operation. Appendix A includes individual project data on a present value basis.

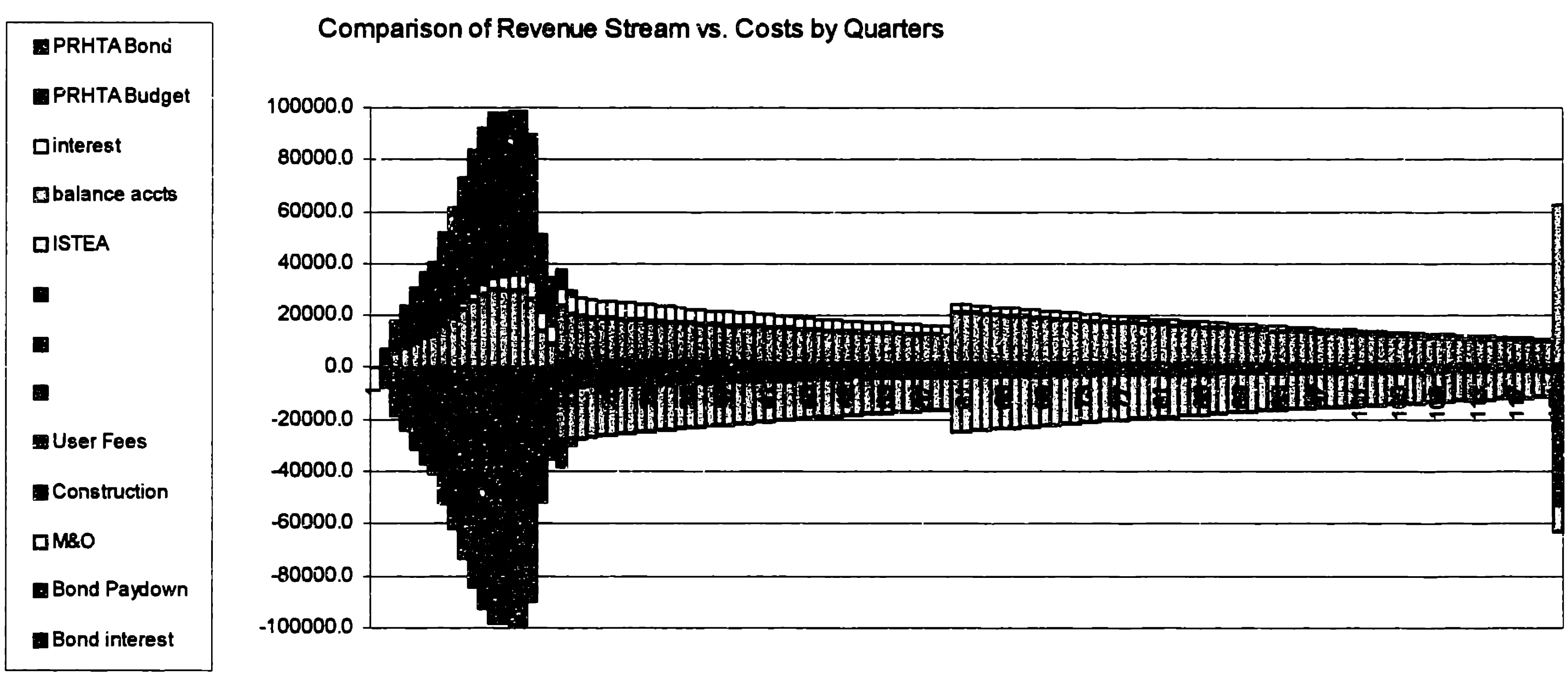


Figure 3-12 CHOICES: Tren Urbano Quarterly Data, Increased Maintenance and Operation

3.4 Choice of Delivery Method

Based upon the conditions surrounding the project and the financial risks and drivers, the procurement strategy that was selected is in the form of a design-build-operate contract. This strategy was selected based upon its ability to deliver a quality project using a fast-track schedule. To oversee the project and complete initial design, a number or consultants were hired. This group of designers is collectively known as the General Management Architecture and Engineering Consultant (GMAEC).

3.4.1 Contractual Form

The selected method utilizes multiple contracts in an attempt to meet a variety of objectives. The overall method is termed turnkey, or a derivation thereof, but is in fact a design-build-operate contract with six associated design-build contracts.

The use of the turnkey designation has roots that stem from the Federal Transit Administration's liberal definition of turnkey procurement. In fact, using the Federal Transit Administration's interpretation, almost any project using a procurement strategy that does not follow the traditional design-bid-build format could potentially qualify as a turnkey project.[11] The significance of this somewhat twisted definition becomes important however to Tren Urbano. Tren Urbano was selected as a one of four projects in the United States for a Federal Transit Administration sponsored Turnkey Demonstration Program. This program was established under the Intermodal Surface Transportation

Efficiency Act (ISTEA). The other three projects are Baltimore's Light Rail Extension, the San Francisco BART Airport Extension and the El Segundo Del Norte Station in Los Angeles. [12] (Figure 3-13) Inclusion in this program was not a guarantee of federal funding, but according to FTA personnel, the additional exposure provided through the associated Turnkey Demonstration Program Workshops probably led to the eventual award of a full funding grant agreement in the amount of $300.1 million from the Federal Transit Administration.

Federal Transit Administration's Turnkey Demonstration Program

Baltimore's Light Rail Extensions
  3 extensions totaling 6.3 miles
  $106 million

San Francisco BART Airport Extension
  extension of 6.2 miles and 3 stations
  $1.3 billion

Los Angeles' Union Station Gateway
  intermodal transit station joint development
  $295 million

San Juan's Tren Urbano
  new start, 12 mile transit system
  $1 billion

Figure 3-13 FTA Demonstration Program

Using the Federal Transit Administration's loose definitions, the PRHTA decided to use a Turnkey strategy primarily because of the ability to secure construction contracts based upon 30% design, thus effectively fast-tracking the project.[10] Another early decision was to include operation as a part of the contract. The desire to encourage life-cycle costing was the impetus. It was felt that the design would be of higher quality and the system would be more efficient and functional if the operators had some input in the design process. Several options were explored in order to best satisfy all the concerns surrounding the project. Two of these are a single large contract that would contain all elements of design and construction and a small turnkey contract that would include the system wide elements and operation, coupled with several civil construction contracts. All options assume that any included operation would be for up to a five year period because of the IRS tax exempt rules. Following is a description of these two variations of turnkey and their specific concerns related to Tren Urbano as perceived by the Tren Urbano Procurement Task Force.[13]

3.4.1.1 Single Turnkey

The first of these options was a single turnkey contract. This would mean that the entire project would be let as a single job to one entity or consortium in the form of a design-build-operate contract with potential private sector financing options. This schedule would probably have allowed construction to begin in late 1996 assuming procurement were to proceed as estimated. Because of the sheer scope of the project, the bidders would require additional time to complete their bid packages and the start of construction could be slightly delayed when compared to other methods.

The greatest advantage of the single turnkey method is the lack of interfaces. The designer/contractor would be responsible for essentially everything, including schedule and cost overruns. The Puerto Rico Highway and Transportation Authority would have a single source with which all matters would be addressed. This franchisee would be liable for virtually any problems other than unforeseen conditions that might be encountered during construction. Because a sole entity would be responsible for all aspects of the project, it would certainly encourage operations driven design.

Another advantage of the single turnkey method would be the potential access to favorable financial markets and cost savings. Cost savings could come in multiple forms, either through volume buying discounts or through access to private sector capital. Any consortium that could put this type of package together would certainly have access to funding with a somewhat lower cost of capital. This capital could either come directly through lines of credit from banks or through external debt markets. Additionally, costs could be reduced by using their substantial balance sheets to support completion guarantees and liquidated damages.[10]

The biggest concern with the single turnkey is the impact that it may have on local participation and technology transfer. The firms or consortia that will have the technological and financial capabilities required to complete such a project would not be led by local enterprises. The sheer size of the project would attract potential bidders worldwide. Should the project be awarded to a group that did not intend to utilize local companies, there would be no recourse or further opportunity for the local firms. Without local involvement in the design, construction or operation, effective technology transfer would be extremely difficult. Associated with the bidders that would be attracted to the project, is the issue of competition. Although there could be cost savings, due to the size of the project, the competition may be limited to a select few. The lack of bidders would be caused by two factors. The size of the project would preclude many mid-size firms, but more importantly there are only several vehicle manufacturers who could produce the required train cars. This lack of qualified, capable bidders may not produce an optimal cost structure.

The issue of owner control is not well addressed using a single turnkey strategy. Once the 30% design phase is passed on to the contractor, the owner retains little input beyond design reviews at pre-arranged design points. Should the owner wish to make a change, it would have time and cost impacts that would result in costly change orders. With a large project of this nature, it can be assumed that certain aspects of design will need to be modified as people gain a better understanding of its impacts. The single turnkey method provides no incentive for the contractor to be sensitive to these newly discovered needs.

3.4.1.2 Mini-Turnkey Plus Civil

The second type of contract looks at the project as a portfolio of smaller projects rather than one large project. A turnkey contract would be awarded that would include system wide elements such as track, controls, vehicles, maintenance facilities, operation and a short section of track with its associated stations. Additional contracts would be issued for civil works sections. These could be done either design-bid-build or design-build. The master contract would have some interface and oversight responsibilities to ensure all designs and sections would be compatible. A separate contract could also be awarded for the fare collection system when it was decided which technology would be most appropriate.

This type of format would require only minimal design work, as the additional civil contracts could be awarded later. This would allow award of the system wide elements contract by the mid July deadline.

The mini-turnkey plus civil format creates a number of contract interfaces. Because the contracts would all be awarded directly by the Puerto Rico Highway and Transportation Authority, the mini-turnkey contractor would not be responsible for the construction schedule of these sections. The risk associated with delays on the individual alignment sections and the fare collection system would have to be accepted and controlled by the owner. The mini-turnkey contractor would need to be involved in review of the other contract designs, but would be placed in a somewhat difficult position, in that they could not directly mandate changes.

With inclusion of operation with the system wide elements, life-cycle costing would be addressed as accurately as possible. The additional civil sections would probably not be influenced as much through this interaction as items such as controls, maintenance facilities and vehicles. Volume discounts and access to lower cost capital might be less available when compared with a single turnkey, but could still lead to substantial cost savings. Competition however, could be improved through this type of contractual arrangement. The mini-turnkey contract would only attract a few bidders, for the same reasons as the single turnkey, but the additional civil contracts could draw considerable interest from prospective bidders and subsequently drive down bid prices.

The most important advantage of the mini-turnkey plus civil contracts option is its ability to include local participants. The nature of the associated civil contracts would not require sophisticated skills or technology that must be imported. The size of the section contracts would also be manageable for a number of local construction firms. In fact, because of the high costs associated with mobilization to the island, local firms may have an advantage on these additional section contracts. With greater local participation, it can be assumed that some of the technology will be transferred during the design and construction process.

With the increased interfaces also comes an opportunity for increased owner control. Because each civil section contract will be awarded separately, the owner should be able to control, or at least better understand, the cost structure of the project. Because the design on each individual section would be advanced to approximately the 30% level required for the Final Environmental Impact Statement, the PRHTA would play a much greater role in local design decisions. This would provide an opportunity to be more sensitive to community needs and localized conditions. Where the single turnkey could potentially alienate communities through indifference, the mini-turnkey plus civil option could provide an opportunity to be much more dynamic and responsive.

3.4.2 Actual Contractual Form

The final contract that was awarded is in the form of a mini-turnkey for the central portion of the project plus civil sections format. The primary contract is termed Systems and Test Track Turnkey (STTT). This contract includes most of the system wide elements. Design, procurement, installation start-up and operation of the track, train control systems, vehicles, communication systems, power distribution systems, escalator and elevator systems and the fare collection systems is all included in this contract. The test track designation refers to an alignment section that is included as a portion of this contract. The included section also contains two stations, Torrimar and Los Lomas, and the maintenance facility.

Six other alignment section contracts were developed, ranging in size from $37 million to $226 million. These sections are Bayamon, Rio Bayamon, Centro Medico, Villa Nevarez, Rio Piedras and Hato Rey. (Figure 3-14) Each of these contracts was packaged as a design-build civil works package. They vary in scope, but all contain similar elements, primarily the guideway and stations. The alignment section contracts, as they are referred to, were arranged so that each section contained similar types of construction. For instance, Contract 1, Rio Bayamon will operate mostly on an elevated guideway. In contrast, Contract 5, Rio Piedras, will be primarily underground and will require the use of substantially different construction methods.

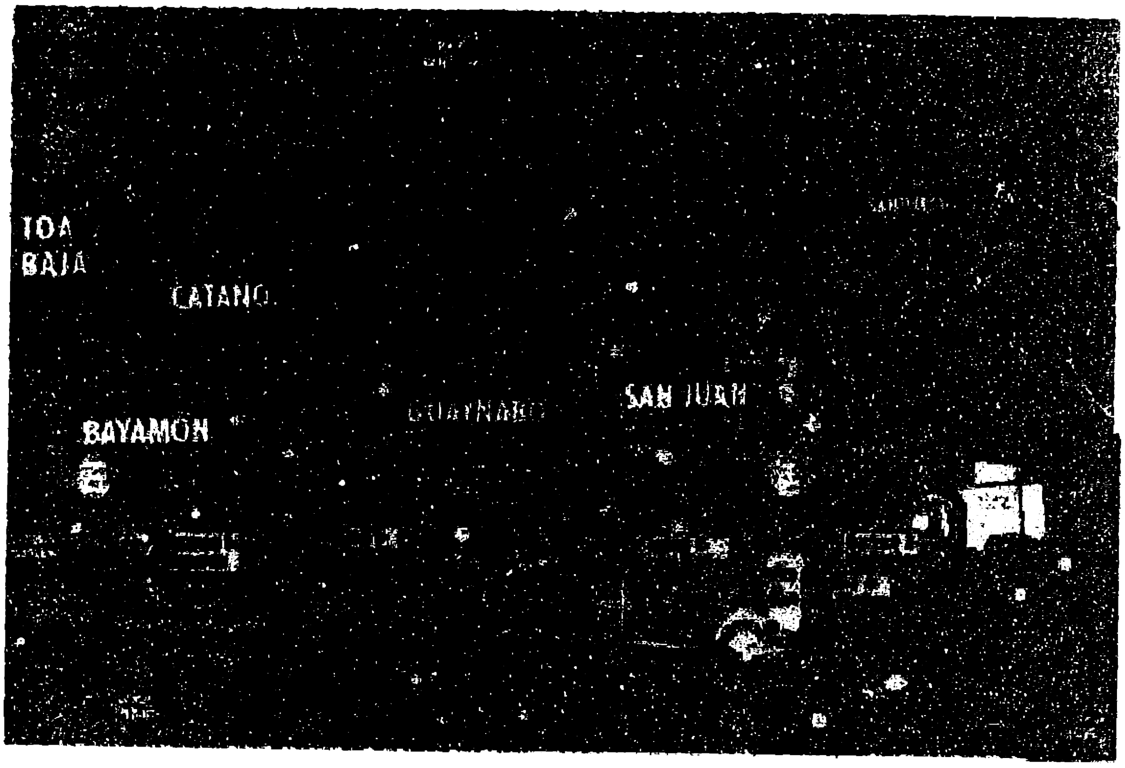


Figure 3-14 Tren Urbano: Alignment Section Contracts

It was ultimately decided that private sector capital would not be used as a source of construction financing. Because the Puerto Rico Highway and Transportation Authority was able to raise sufficient capital to cover construction costs through the issuance of tax exempt bonds and a full funding agreement with the Federal Transit Administration, additional sources of funding were not required. The cost of private capital would have been substantially higher than the cost of capital actually obtained. The annual rate of return on bonds issued will be 7.75%.

The Systems and Test Track Turnkey contract was awarded to Siemens Transportation Partnership, Puerto Rico, a group headed by Siemens Corporation. Other important partners include Parsons Brinkerhoff Quade & Douglas, Inc. (quality assurance, construction services and coordination), Alternate Concepts, Inc. (operation & maintenance), Lord-Mass Joint Venture (communication, control and power systems), Juan R. Requena & Assoc. (architectural & engineering services) and Redondo - Perini Joint Venture (facilities construction).

3.5 Conclusions

Because the project is only in its infancy, it is difficult to accurately assess the total success or failure of the project or the manner in which it was procured. However, a number of critical milestones have already been achieved that reflect the manner in which the project was secured. Although unwittingly, the manner in which the system was broken into smaller projects allows for portfolio analysis and an increase in the potential delivery method solutions.

3.5.1 Successes

The most important success to date is the fact the contracts for construction have been awarded and the design/construction process has begun. The first contract, the Systems and Test Track Turnkey (STTT) was signed on July 15, 1996. The original goal was to have the first of these contracts awarded by July 1996, so this objective was met. The first of the alignment section contracts, Bayamon, was signed on August 1, 1996. These contracts were awarded and signed before the election in late 1996. The project had been started and it would be difficult to stop the process, regardless of which administration were elected. Since then, the remainder of the contracts have been awarded and construction has proceeded as planned.

System design includes input from the operational portion of the STTT contract team. The GMAEC has been pleased with this input and the consideration given to suggestions generated through this interaction. The hope continues that life-cycle costing will have an impact on the long term operation of the system.

Various studies have been completed attempting to determine the impact of alternative delivery systems on cost and schedule. The results of these studies vary, without out any conclusive results. Estimates by the Department of Public Works, of which the PRHTA is a major portion, based upon their own construction costs and estimates, indicate that the chosen method will result in cost estimates of approximately 30% and a time savings of two years.[7] This aspect of the decision making process appears to have produced tangible results.

The amount of work to be completed directly by local, Puerto Rican firms is substantial. The majority of the construction work included in the Systems and Test Track Turnkey contract will be completed by Redondo, Inc., a large civil construction firm located in Puerto Rico. Much of the engineering and management has also been subcontracted to Puerto Rican firms. Of the alignment section contracts, several have been awarded to consortia that consist of primarily Puerto Rican companies. Another has been awarded to a Mexican company, ICA. Although the primary system wide element engineering will be performed mostly by foreign companies, a large portion of the civil & structural engineering will be completed by local professionals.

The financing plan that was crucial to the success and timing of the project was in fact implemented, with approximately $415 million to come from the federal government.

Most of this aid comes from the Federal Transit Administration in the form of a full funding agreement in the amount of $300.1 million. The remainder comes from flexible grant moneys provided for more general highway and public transportation improvements. It is anticipated that $540 million in debt proceeds will be used directly for Tren Urbano. The remainder of the required capital and funding required for operation will come from annual Puerto Rico Highway and Transportation Authority budgets.

Most important to the integrity of the system is its quality. It is too soon to accurately determine the quality of the system and the experience provided by this new means for public transit. However, during the selection process a decision was made to award the Systems and Test Track Turnkey contract not just on price alone, but on the quality and experience offered by the entire proposed package.[14] It was believed that the level of quality would be sufficient for the success of the system.

3.5.2 Potential Problems

Although it appears that the primary objectives have or will be met, there are a number of potential problems and substantial risks exist that could prevent Tren Urbano from being a success. These range from physical completion of the project in a timely manner to actual ridership numbers.

3.5.2.1 First Potential Problem

The issue of life-cycle costing may not be properly addressed. The short time period associated with operation is not long enough to have a significant impact on the design process. The difference in quality between components will probably not be felt in a five to ten year period. As time increases the difference will become more apparent, but at that time the design-build-operate consortium may not be involved. Should the Siemens Transportation Partnership actually be involved in the operation at such a date in the future, only the operational portion handled by Alternate Concepts would be active in the operation and decision making process. The other players in the partnership, particularly the contractor, Redondo, may not have any further enforceable obligations. The priorities of the separate interests in the partnership will probably differ. Even though the contract is held by Siemens, it may be difficult to elicit the proper response through the existing subcontract arrangements. To date, the participation of the operator's personnel has been viewed as highly beneficial. Their input and interaction with the GMAEC has resulted in minor changes that should improve the overall usability of the system. The interaction of the contractor however has not been viewed in a positive manner. There has generally been a lack of cooperation and willingness to create long-term solutions. This can easily be explained through the manner in which the contracts are written. The contractor and operator both have subcontracts within the Siemens Transportation Partnership. In the case of Redondo, this contract is lump sum for constructed services. Any changes made are, by nature, not going to be advantageous to Redondo, unless an equitable adjustment in price and time is made. Yet, changes in prices to Redondo are likely to come from another team members pocket, not from Tren Urbano. Redondo would therefore be hesitant to be cooperative. The operator has incentives to make changes, as they will impact their responsibilities at a later date, presumably for the better.

Associated with the operational phase is the commitment from the Siemens Transportation Partnership. They could easily view this relationship as a manner through which to sell vehicles (i.e. train cars). Any maintenance that would be advised for long term use might be ignored or applied in a stop gap measure. They may have every intention of ending their relationship with Tren Urbano at the conclusion of the first five year period. Should they prescribe to this view, they would have no incentive to make required or advised repairs that have any relationship to operation in any year past the fifth.

3.5.2.2 Second Potential Problem

A severe under funding of maintenance could also occur. Information from study of design-build-operate contracts shows annual maintenance and operation costs typically fall in the range of 15% - 16% of total construction costs. (insert footnote) The numbers accepted in the Systems and Test Track Turnkey contract for the operation of Tren Urbano are 18.9% of the Systems and Test Track Turnkey contract, but only 2% to 3% of the total cost of Phase I construction. Realistically costs will increase as facilities age and this is a brand new operation, but this type of investment is substantially lower than the norm. Were maintenance spending to continue to lag, the facility would experience premature degradation. As the quality of the system is tantamount to its success, and one of the primary objectives established early in the project, a lack of true commitment to the system could produce inferior long term quality.

3.5.2.3 Third Potential Problem

The contractual arrangement of all the sections provides design up to the 30% level. The remainder of design must be completed by the designer/contractor teams. This level of design has already determined the majority of the systems that will be used. The tasks that remain deal with details, structural issues and other areas where only a minor impact can be made. The 30% design level generally refers to what would be 30% of the billings for design. At this point however, all the real design decisions that have any meaningful impact on the system or its cost structure have been made. The true benefits of design-build-operate construction and involvement of a potentially innovative private sector are minimized by the relative finality of the system design. Unfortunately, the federal process, requiring complete Environmental Impact Statements, of which 30% design is a requirement, and Major Investment Studies (MIS), precludes the capture of these benefits. Until these federal requirements are changed to allow substantial, meaningful decisions to be made by the design-build teams, all alternative delivery methods will only achieve partial success.

3.5.2.4 Fourth Potential Problem

A less significant potential problem related to the relationships created by the contract is the access to information and personnel. In the Systems and Test Track Turnkey contract, Siemens is the primary contact and all negotiations, changes, and requests must proceed through Siemens to the GMAEC. The contractor, Redondo would not normally have the ability to communicate directly with the engineer to lobby for what it felt would be most favorable. That responsibility would lie only with the primary general contractor, in this case Siemens. However, because Redondo also has contracts directly with the owner, they have direct access to the GMAEC decision makers. This relationship could cause problems when Redondo experiences difficult negotiations with Siemens in the Systems and Test Track Turnkey contract. During meetings regarding issues for the alignment section contract, Redondo could bring up issues they are trying to resolve with Siemens. Redondo could potentially refuse to make changes in the alignment section contract unless they get what they desire with Siemens. They could also try to have the GMAEC exert pressure on Siemens to resolve the problems on the Systems and Test Track Turnkey contract with Redondo. In either case, they could place Siemens in an awkward position that could produce additional tension. This back door access may place either Siemens or the GMAEC in a difficult situations.

3.5.2.5 Fifth Potential Problem

The risk associated with ridership is perhaps the most important to the overall success of the project. Because the anticipated numbers cannot immediately cover operational expenses, the government was correct to assume this risk. Should the ridership not increase, the system will constantly require additional spending to cover costs. The costs of this operation could become critical over a 25 to 30 year period. The desire to include operations as part of the contract was in part based upon the ability of the private sector to operate more efficiently that the public sector. If the private sector has no interest in participating in the operation of the project, or is not given the ability to have an impact upon its success, then this potential advantage is negated. Through the acceptance of risk of ridership by the Puerto Rico Highway and Transportation Authority also comes the responsibility of increasing passenger numbers. Although the private sector may have innovate ideas and methods to effectively increase ridership, there is no incentive for the operator to participate in these activities. Payment for operation is based upon meeting certain operational incentives. These incentives are based on the timeliness and cleanliness of the system, not on the number of passengers using Tren Urbano. Without private sector involvement, the system may always operate at a substantial loss. Even with innovative ideas and substantial increases in ridership, the system may never be a money generator, but the cost of operating the system could potentially be minimized with the help of the private sector.

3.5.3 Possible Design-Build-Operate Scenario

One possible way in which to minimize the long term effects of one potential problem would be to pique the interest of the private sector toward operation of the system. As the existing contract cannot be re-negotiated due to potential legal ramifications, this option could be explored for operation of the system after the first five years. Given the circumstances, it would not be reasonable to expect the private sector to embrace the project and its operational shortfalls. However, if Tren Urbano were to offer some minimum level guarantees, the outcome could be quite different. A guarantee in this instance could be in the following form. The franchisee would be responsible for the long term operation and maintenance, for a period of twenty five to thirty years, and would collect all the tolls. Fares would be determined through a negotiation between the franchisee and the PRHTA and would be based upon a break even plus a profit scenario. The franchisee would keep all the revenue as partial payment. If this revenue did not meet minimum requirements, the Puerto Rico Highway and Transportation Authority would be responsible for direct payment of the difference between the revenue and the minimum amount. Should the revenues exceed the minimum, the franchisee would benefit. This system would reward the franchisee for increasing ridership, but the risk of poor ridership would be held by the owner. The government would in fact have little to lose should the minimum amount be accurately formulated. The government is already responsible for this amount under the present procurement strategy. The only risk would be if revenues were substantially higher than estimated. This increase would benefit the franchisee. However, if the goal is to increase investment by the private sector, increase operational efficiency through private sector innovation, or to develop a high quality, useful system, then public sector profitability must be secondary. The role of government is an entirely different argument for another forum. As government is faced with increasing infrastructure needs and limited funding sources to meet these needs, it can be argued that the minimization of operational expenditures would be advisable.

With the recent changes in the IRS regulations (February 1997) it may be possible to develop a new package for use after the existing contract has expired. These changes allow for the use of long term operational commitments of up to 25 to 30 years. With longer term contracts come increased incentives to properly investigate life-cycle costing and a potential increase in quality.

3.5.4 Applicability of Portfolio Analysis

The forum of Tren Urbano provides an excellent example of how the factors that influence procurement strategy selection need to be carefully balanced. Each decision throughout the selection process limits or expands the range of possibilities for later decisions. Typically no one factor is the only determinant in the process. Some factors may be given a higher priority, for instance schedule for Tren Urbano, but they are all inter dependent. These relationships need to be explored. Tren Urbano illustrates just how this process works.

Tren Urbano also provides an opportunity to look at the entire system as a portfolio of smaller individual projects. Because each portion is composed of similar elements and can be separated from the others, it is possible to analyze and select a procurement strategy that maximizes the benefits for the entire system. Although this was not the intention of the PRHTA during their selection process and analysis was not actually completed in this manner, it is possible to easily understand the potential of an increase in procurement strategy options. Inspection of the Tren Urbano circumstances illustrates the potential for utilizing several different procurement methods within the context of one large system.

4. MassPort's IMTC

4.1 Background

As a prelude to a description of the Intermodal Transit Connector (IMTC), it is helpful to understand how the project was initiated and how the following proposed development came to be. The Massachusetts Port Authority (Massport), who owns and operates Logan Airport, provided funding for a group of students and professors to review the existing plans developed as part of their Logan 2000 plan and attempt to identify funding options. This group, the Infrastructure Development Research Group (IDR) formulated the following ideas.

The Infrastructure Development Research Group reached the seemingly startling conclusion that if the Intermodal Transit Connector is to have a truly strategic impact on the importance and convenience of Logan, a corresponding strategic connection of Massachusetts Bay Transportation Authority (MBTA) lines and commuter rail lines to Logan (via the Silver Line) would be appropriate. The background leading us to this conclusion is important.

4.2 Conditions

4.2.1 On Airport

A number of existing conditions and recent developments must be analyzed to properly understand how the IMTC meets existing demands and meshes with existing systems.

Logan is an unusual airport with unique characteristics. It is located a mere 3 miles from downtown Boston, allowing the potential for quick access. (Figure 4-1) It is one of only seven United States cities with a direct rail transit link to its airport. Six percent of all passengers use rail as a means of access, giving it the fourth highest share among these airports. Approximately 88% of all Logan's passengers use the available ground transportation system. This figure corresponds with Logan's position as a gateway or terminus for travel, rather than a connecting hub.

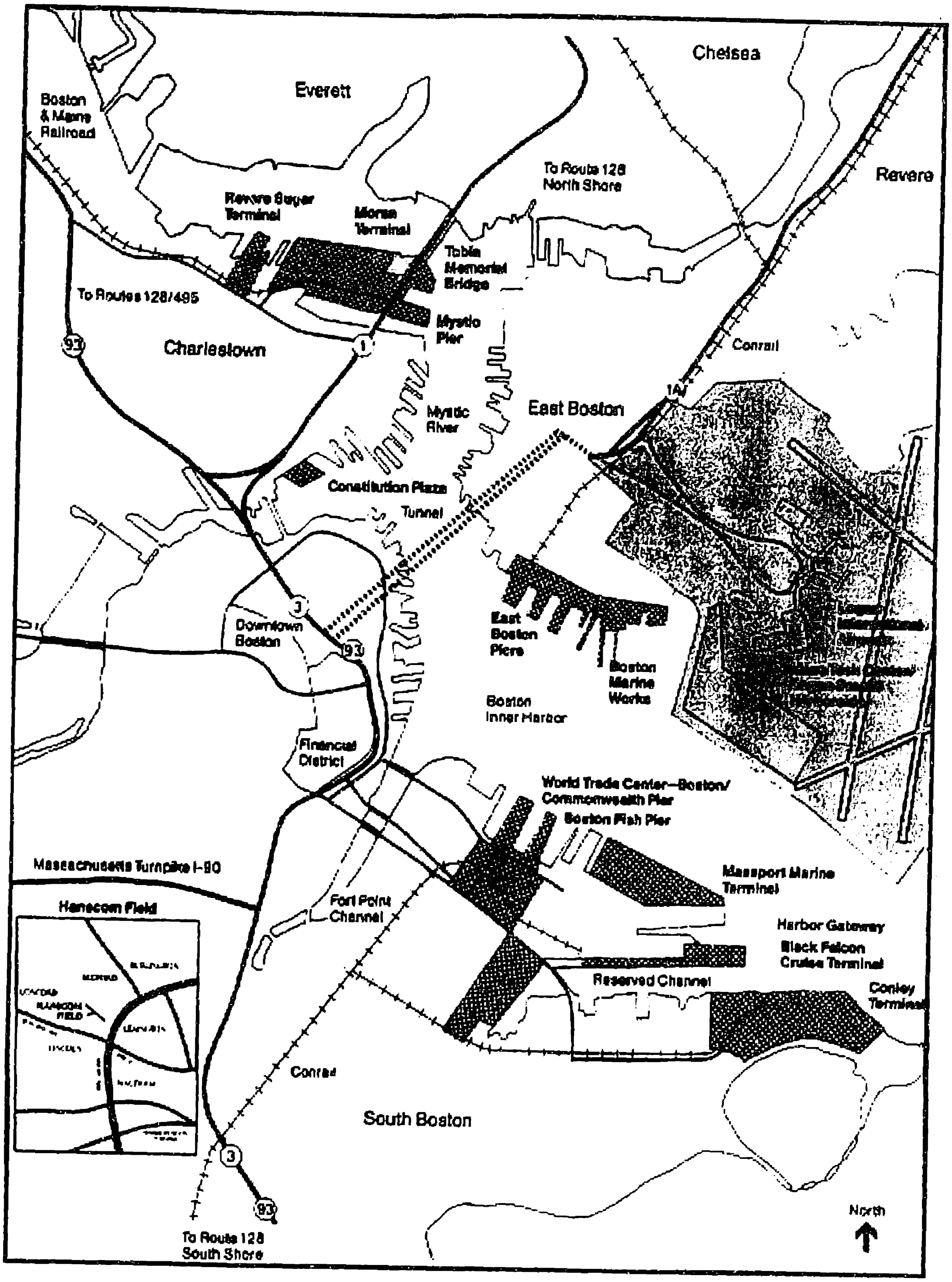


Figure 4-1 Boston's Logan Airport

Logan is presently the 16th busiest airport in the nation with 24 million passengers per year. Growth in the near future is predicted to be steady with approximately 45 million passengers by the year 2010. This perceived increase in use will provide additional challenges as the area available for airport use (3.75 square miles) is physically limited by the harbor on three sides and East Boston to the north. Presently, options to move services off the airport proper are being pursued. The number of parking spaces at the airport has been frozen to encourage High Occupancy Vehicle (HOV) use. In order to accommodate the number of passengers expected in the future, the HOV share must increase. MassPort has set an HOV share goal of 35% by 2010. The share of passengers arriving by HOV has risen steadily from 23% in 1987 to 31% in 1995. The majority of this increased percentage is attributable to private bus and rideshare van services. The rail transit share has not increased over this period.

MassPort has developed a plan, Logan 2000, to address the immediate needs of the airport and the distribution of passengers to the terminals. Terminal expansion and modifications, roadway reconfiguration and an automated people mover are all addressed in this plan. The International Gateway (Terminal E) and Terminal A are scheduled for major redesign and subsequent construction to improve passenger flow under increased usage. The airport roadway system is also being reconfigured in conjunction with the nearby central artery project. Access and egress to Route 1A North, the Sumner Tunnel and the Ted Williams Tunnel will be improved. An upper and lower roadway will be added at the International Gateway along with other modifications that should allow improved access to both the terminals and garages. Elevated walkways with moving sidewalks will be added to provide fast, simple and direct movement between the garages and the terminals with the hope that terminal drop-offs and pick-ups will be reduced.

An automated people mover, the third major element of this plan, would provide high level, reliable service for passengers, employees and visitors. This system would be an asset in a number of areas as it would increase MBTA ridership to the airport, reduce environmental impacts (emissions) caused by the present bus system, decrease dependence upon private vehicles, reduce roadway congestion and provide a convenient transportation mode for passengers making inter-terminal transfers and connections to the rental car area.

Another on airport issue is the effective long term use of land. Although a fraction of the size of other major airports, there are a number of necessary functions that cannot be easily moved. These include airside operations (runways, taxiways and gates), check-in and baggage facilities and security, customs and immigration. There are also services that could be moved to another location such as maintenance, offices and car rental facilities. It is also important to recognize potential commercial opportunities that exist on the airport. Food, lodging, retail, parking, office space and transportation links were all identified as possible future sources of revenue.

4.2.2 Off Airport

Several areas surrounding the airport are either presently being developed, or have been targeted for major investment in the near future. This infusion of capital and the refurbishment of these areas could play an important role in the success of new airport projects, particularly those that involve transportation. The two areas of most obvious interest are those adjacent to the airport, South Boston and Chelsea.

4.2.2.1 Points North

The area just north of the airport is also likely to see changes that will affect airport access. The Wood Island MBTA station may soon become the access point for the airport, rather that the present Airport station. A joint Central Artery/Tunnel and MBTA plan has been developed that would close the Airport station at a savings of $35 million with the land given back to East Boston. The present Wood Island Station would require modifications to allow dramatically increased bus access. Two options have been explored; an on-grade figure eight layout ($1 million) and a grade separated system using a viaduct ($5 million). Options for future rail access to the station appear to be feasible with a cost for an at grade system of $10 million.

The Urban Ring is another project in the planning stages that could be integrated into Logan's transportation plan. This "Urban Ring" will provide access circumferentially around the downtown area and will serve as a link between those communities adjacent to Boston. (Figure 4-2) Two of the potential termination points are the Wood Island Station and either South Station or South Boston. The opportunity to create a true intermodal connection in the Urban Ring exists through the Wood Island station.

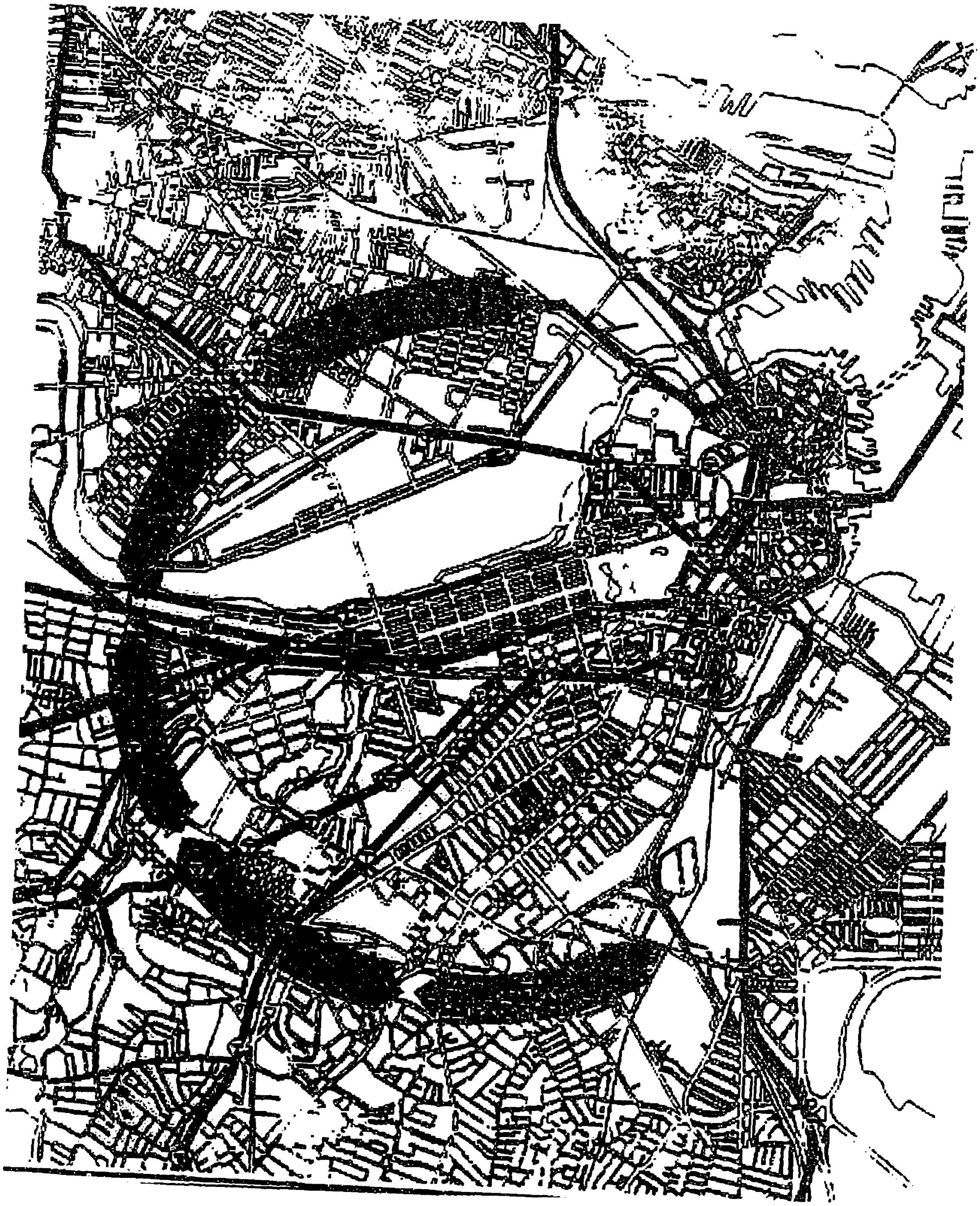


Figure 4-2 Urban Ring

Present planning options include the possible relocation of the bus maintenance facility from the airport into nearby Chelsea. Access is possible via an existing truck right of way which could be linked to the Urban Ring. The possibility of converting this facility to accommodate rail traffic offers additional flexibility in planning for a strategically significant IMTC at Logan.

4.2.2.2 South Boston

The South Boston piers area is poised for development. It is ideally located, has an extraordinarily low residential population and has never been fully developed since its heavy use in the late 1800's and early 1900's as a rail head and service area for the Port of Boston. It abuts downtown Boston, the airport, the waterfront and the central artery. There has been little development until recently, leaving several vacant parcels with commercial, industrial and/or civic value. MassPort has substantial holdings in the South Boston pier area, including the World Trade Center. Four major projects are scheduled to be under construction or completed by the year 2000.

The World Trade Center expansion is well under way with the construction of a new hotel and a subsequent office building. The hotel is scheduled for opening in the spring of 1998. The 427 room capacity is in addition to conference, meeting and function facilities and will be connected to the World Trade Center. A new office building will be constructed adjacent to the hotel with over 460,000 square feet of office space and 15,000 square feet of retail space. A second office building of similar scope is tentatively planned for a nearby parcel.

Other ongoing projects include the new Federal Courthouse, the already existing Children's Museum and the Boston Marine Industrial Park. The courthouse is expected to attract 2,200 visitors per day in addition to providing office space for 800 employees. The Children's Museum presently draws nearly 400,000 visitors per year and the marine industrial park is expected to add 1500 employees. Other projects that are scheduled for completion by 2010 include Fan Pier/Pier 4, the McCourt property, Fish Pier, the Summer St. Office and Industrial Park, a convention center and a cruise terminal. The area is slated for rapid expansion of commercial uses that will need transportation facilities and access to the airport in order to accommodate heavy daily movements of employees and visitors to the area.

The Massachusetts Bay Transportation Authority's Transitway is one manner in which this area will be served. This system will consist of an overhead catenary trackless trolley that will operate in a one mile long tunnel from Boston's midtown to South Boston at D Street. (Figure 4-3) The first phase of the system will initiate at South Station and proceed to the Federal Courthouse and the World Trade Center with additional street level stops in South Boston. The Transitway is presently under construction and is scheduled to begin operation in 2002. The total cost of the project is currently estimated to be $413 million, with the majority of costs ($330 million) being covered by the federal government.

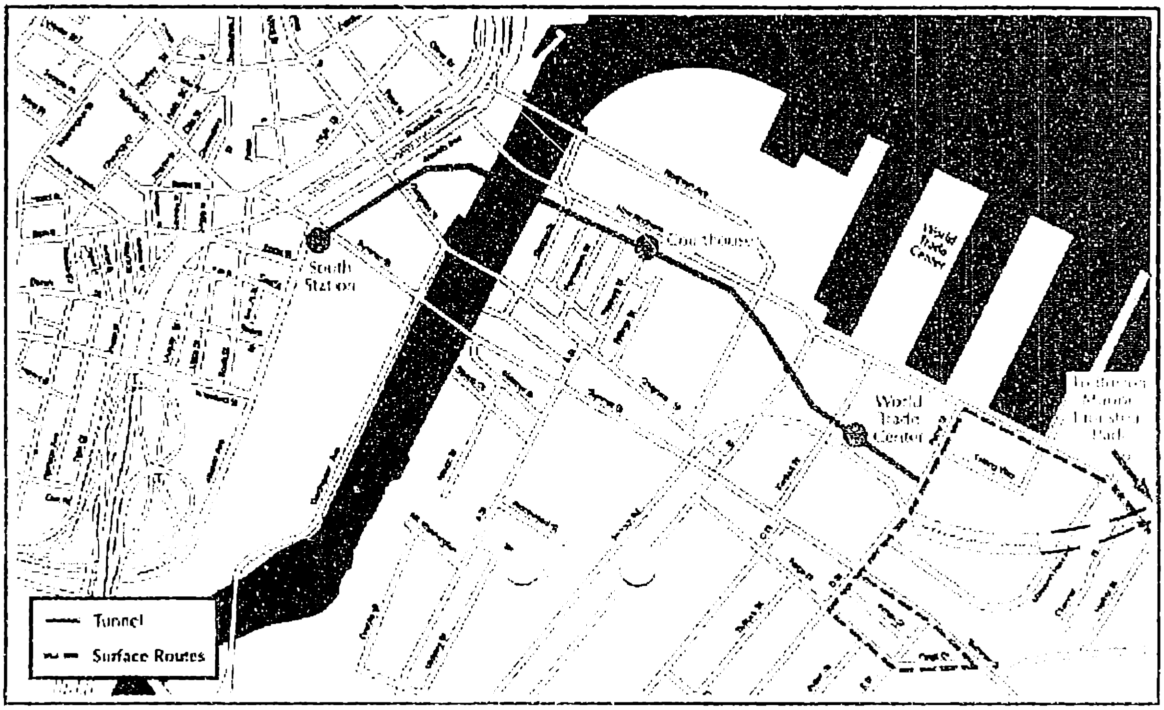


Figure 4-3 Transitway

Construction is in conjunction with the Central Artery/Tunnel project. Design capacity should provide access for approximately 60% of the peak hour trips to the Pier area. When completed the system is expected to have the ridership listed in Figure 4-4.

	Peak	Daily	Annual
Year 2002	6200	22000	6.4 million
Year 2012	10600	34100	10 million

Figure 4-4 Transitway Ridership

4.3 The Intermodal Transit Connector Vision

Based upon the current context in which issues and potential developments around the airport, we believe that any configuration of the IMTC should not be limited to airport facilities, but must include access to Boston through the South Boston Piers area to South Station and into the Transitway. The potential to link a new system with the number of already existing transportation modes is too great to ignore, both from a rational standpoint and in terms of tapping potential resources to fund and operate this system. We believe in a plan that could ultimately result in a new transit line - the Silver Line. In accordance with the development in adjacent areas and the difficulty presented by attempting to predict ridership, a phased approach, proving economic feasibility is advisable. We presently envision three phases that would each be contingent upon the success of the earlier phase.

4.3.1 Phase I Years 1997 - 2002 +/-

A South Loop bus service from Logan (all terminals) to the World Trade Center and South Station should be added immediately. (Figure 4-5) A Compressed Natural Gas (CNG) or better technology should be declared for all on-airport buses and should be effective no later than 2002. The system should acquire and operate a premium service that would be operated on a fare basis. Passenger information systems with advanced capabilities should be utilized to apprise riders of arrival, departure and travel times. It is anticipated that five buses would be sufficient to meet demand during this period and that a fare of $4 - 5 would be appropriate. This bus loop should be operated as a high quality, reliable service that could provide ridership information upon which future phases can be planned. The loop should be awarded under a Design, Build, Operate contract in which the franchisee would be responsible for a 15 to 20 year operational period.

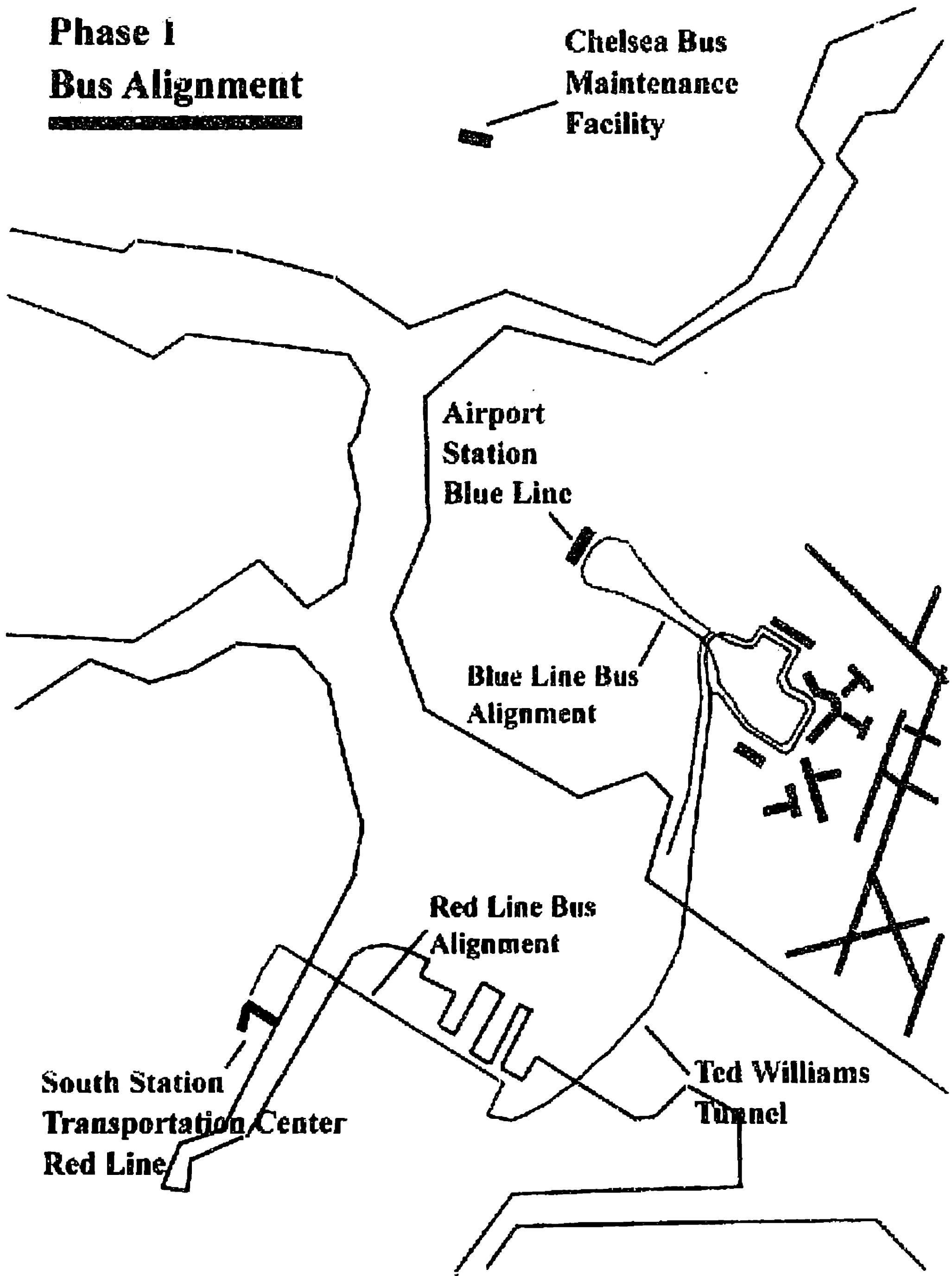


Figure 4-5 Phase I Bus Service

During this period a bus ramp should be constructed at D Street in South Boston to allow direct access to the Ted Williams Tunnel. Central Artery/Tunnel (CA/T) personnel have determined that this type of access is possible and plans are under development.

Potentially these modifications could be provided using CA/T budgets. The bus maintenance facility should be relocated to Chelsea and should be designed for the new CNG technology. The rental car operators and hotels should be induced to join this new service, eliminating their individual bus services, decreasing congestion and providing a potential source of revenue. Costs for Phase I are contained in Figure 4-6.

Buses	$1.5 million
Display Technology	$1.5 million
D Street Access Ramp	$3.5 million
Chelsea Bus Maintenance Facility	$0.8 million per year

Figure 4-6 Phase I Costs

4.3.2 Phase II Years 2002 - 2012 +/-

Should ridership exhibited under Phase I prove viable, Phase II would commence upon the opening of the Transitway. The bus service would move into the Transitway and would use the new ramp at D Street to gain access to the tunnel. (Figure 4-7) The service would be expanded to include a stop at the courthouse and additional buses would be purchased to meet demand. The system would continue to be operated by the franchisee as a premium, fare based service. The MBTA has unfortunately elected to use a catenary system inside the transitway. The acquired CNG buses will physically be able to utilize the transitway tunnels, but the ventilation of the system may require modification to accommodate these buses.

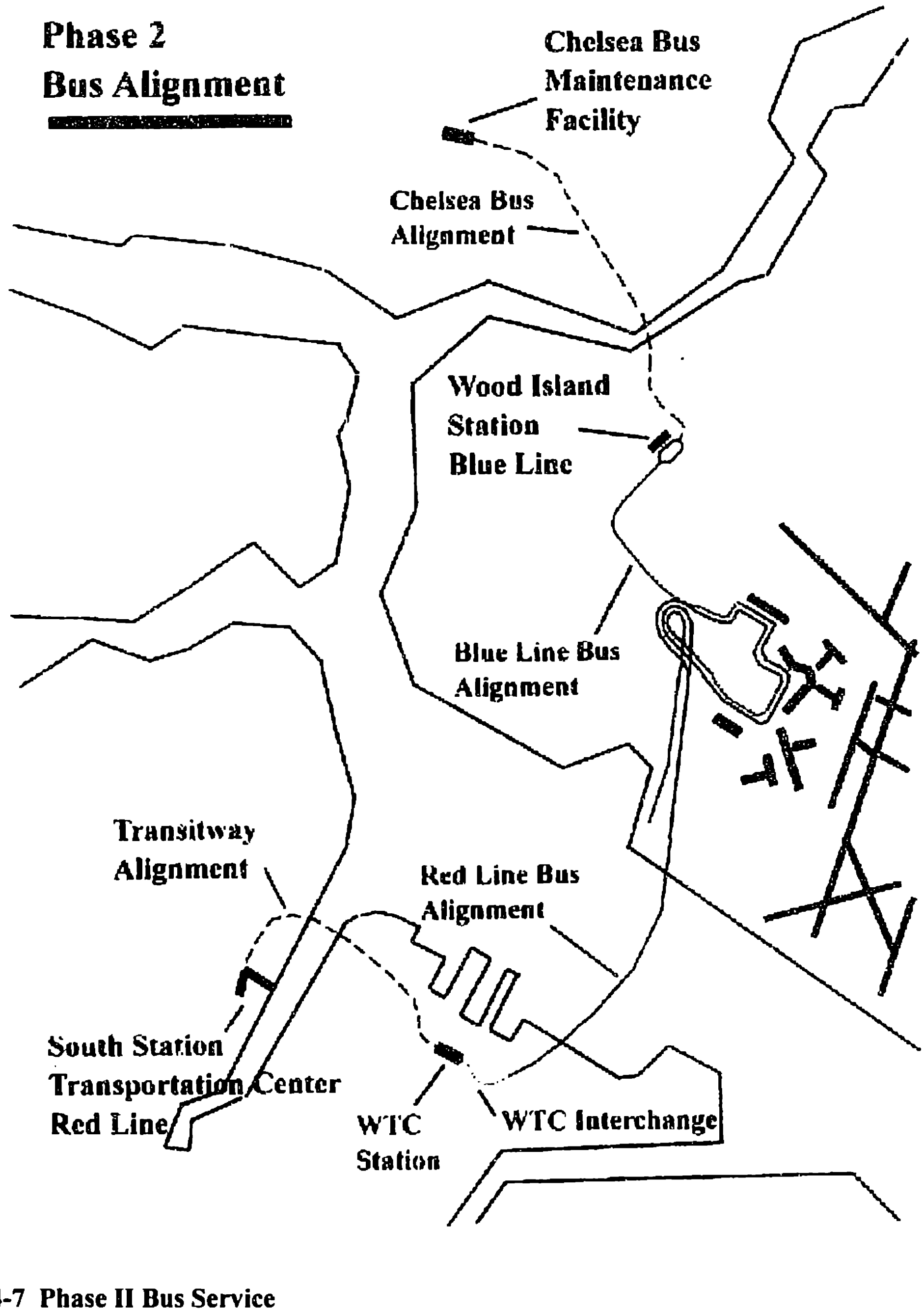


Figure 4-7 Phase II Bus Service

The evaluation period, from 2002 - 2008, will be critical in determining whether future phases will be economically justifiable. Actual data from the operational period will be compiled to evaluate and predict ridership and revenue trends for this type of high quality, premium transportation service to the airport. Several questions need to be asked. Will ridership & revenue streams justify the major capital expenses under Phase III? Has South Boston developed as anticipated? Has the Transitway been completed under the original full-build scenario to the Boylston Street station? Should indications be favorable, Phase III would follow. Should the numbers dictate otherwise, the bus service could continue to operate for an indefinite period of time until ridership/revenue figures prove adequate to proceed to Phase III.

4.3.3 Phase III Years 2012 and Following

The full-build system would include an upgrade to a fixed rail system from Boylston Street, through the Transitway, to the World Trade Center. An additional rail tunnel would be constructed beneath the harbor to the airport. Stations would be constructed at the Logan Hyatt and rental car areas, Terminal A/B, Terminal C, Terminal E, Wood Island and Chelsea. The system would utilize fixed rail vehicles with the system wide elements yet to be determined. (Figure 4-8)

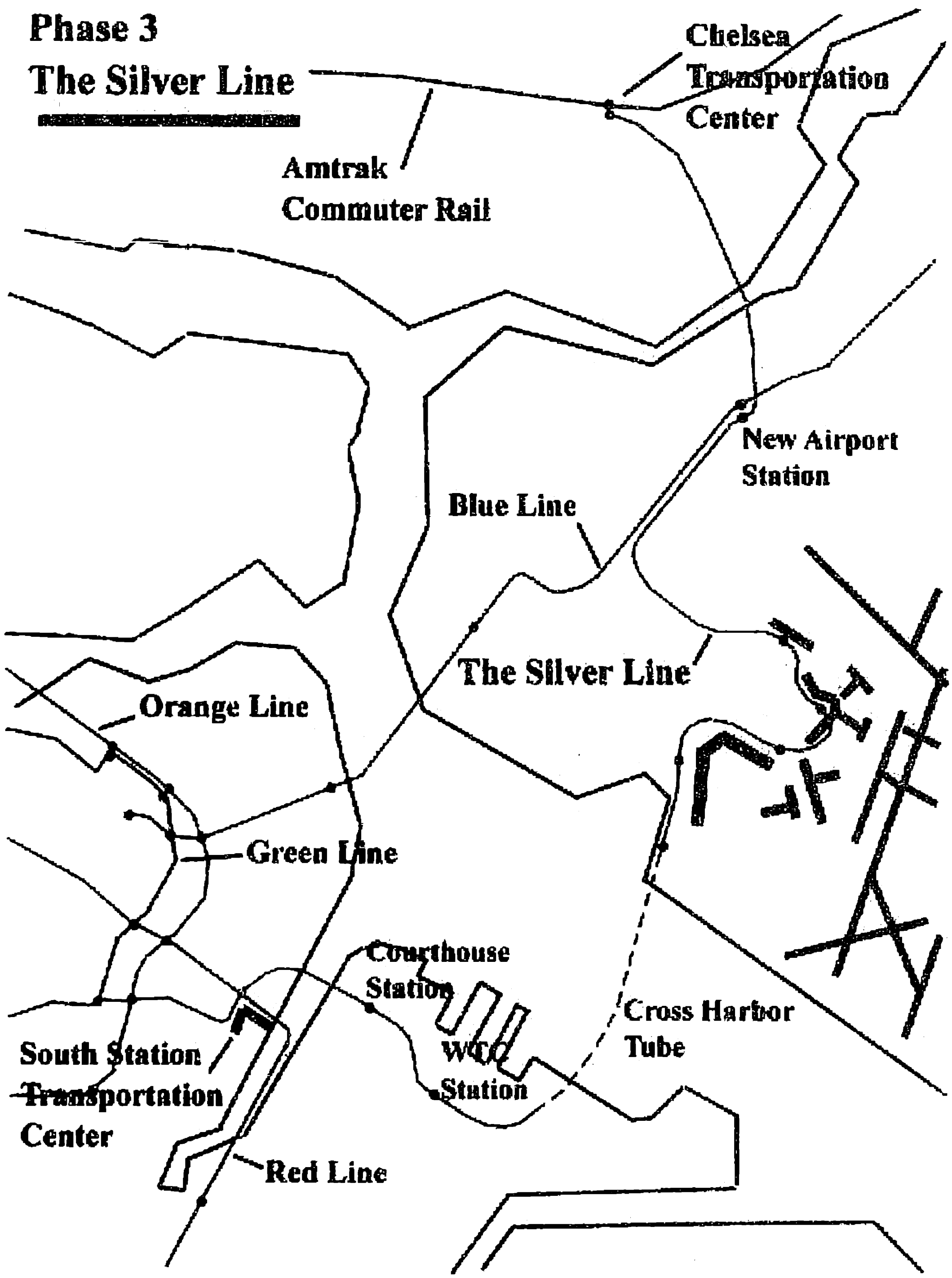


Figure 4-8 Phase III Fixed Guideway

Each terminal has specific circumstances that present challenges when attempting to understand how the stations will provide the access that will be required. Terminal A is presently out for qualifications for a design/build contract. Its proximity to Terminal B and the Ted Williams Tunnel provide space restrictions, but otherwise there is ample room for a station. Terminal E likewise has plenty of room to provide a proper station and will be redesigned and renovated in the near future. The opportunity exists to ensure that provisions for stations are made during the redesign of these two terminals. Terminals B and C appear to have little available space for a station and the access area is restricted. Another issue is how to get passengers close to the gates. The layout of these terminals does not provide one convenient location for a station. The design issues associated with these existing structures are complex, but it is necessary to understand the restrictions that present construction will place upon future design. (Figure 4-9)

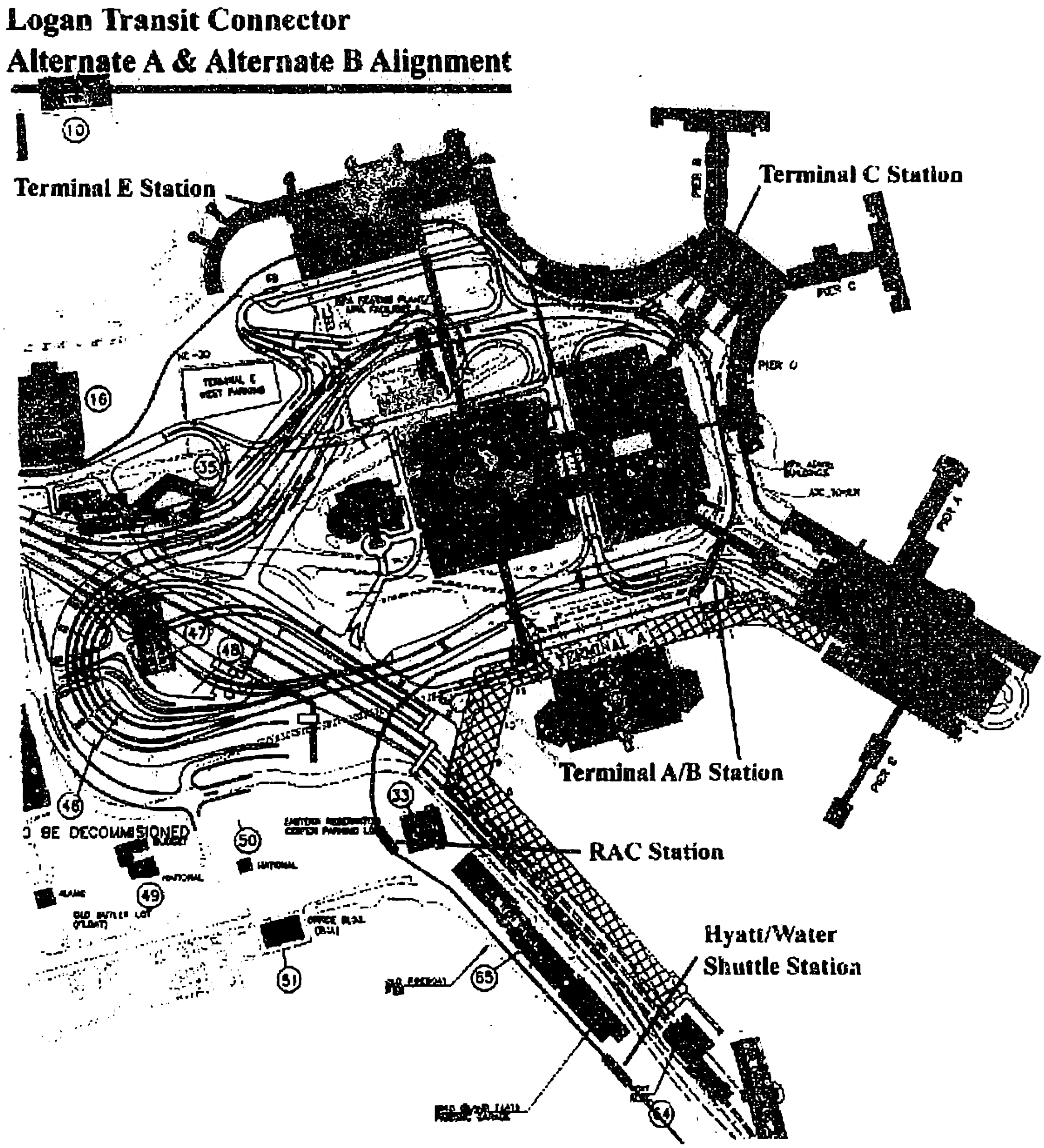


Figure 4-9 Terminal Station Alignment

Recent proposals developed by Logan 2000 include above grade, elevated stations at all terminals. We have termed this Alternative A. Alternative B would be to put all the terminal stations below grade, incorporating them into the new terminal designs.

Costs for Alternative A are estimated below. (Figure 4-10) The figures were primarily extrapolated from Logan 2000, MBTA Transitway and CA/T data.

Guideway	$352 million
Stations	$ 36 million
Vehicles and Systems	$ 74 million
Maintenance Facility and Equipment	$ 30 million
Cross Harbor Tube	$180 million

Figure 4-10 Phase III Alternate A Costs

Because of the increased costs of underground construction, Alternative B would have additional costs for the guideway ($20 million) and the stations ($72 million). The added benefits of having a below grade system include removal of the system from the effects of weather, it could provide a more convenient system for passengers that would deposit them directly at the terminals and it would preserve space and options for future development and/or modifications. Total estimated costs for all phases are included in Figure 4-11. The key elements of construction required to complete Phase III and potential funding sources are detailed in Figure 4-12.

Phase I	$ 9.4 million
Phase II	$ 5.4 million
Phase III - Alternative A	$928 million
Phase III - Alternative B	$1.02 billion

Figure 4-11 Preliminary Costs for the Intermodal Transit Connector

Project	**Possible Funding**	**Contract Type**
Guideway - Boylston to WTC	MBTA	DBB
Guideway - Wood Island to Chelsea	MBTA, NexTEA	DBB
Guideway - On Airport	MPA	DBB
Tunnel/Tube - WTC to Hyatt	Private Sector	BOT
Trains, Controls & Maintenance Facility	Private Sector	DBO or BOT Franchise
Stations at Terminals, WTC	Private Sector	DB or DBO

Figure 4-12 IMTC Possible Funding Sources

4.4 Intermodal Transit Connector Conclusions

The review of the conditions at Logan Airport and developments surrounding it, along with the preliminary design of a system led us to develop the above phased approach. From our study we have determined the following:

1) Cheap, high frequency bus service is available now and can be used to generate ridership data.
2) The connection through Logan to South Boston is vital for the development of MassPort properties.
3) The Intermodal Transit Connector could be a central feature of a regional transportation system.
4) Tying all MBTA lines directly to Logan (the Silver Line) is of strategic significance to Boston and the region.
5) Ridership and revenues must be tested prior to a major capital investment
6) Inter-agency cooperation (MassPort, MBTA, MHD & CA/T) is critical to the success of the project

4.5 Financial Modeling

To understand how this project could be completed it is necessary to understand the financial package that would be required. A financial pro-forma has been prepared to better illustrate the financial machinations of the project. All the numbers used in this financial analysis come either from external sources or are creations of the Infrastructure Development Group. A detailed breakdown of these estimates is provided in Appendix B. They are only meant to be an approximation, developed for use as a demonstration on project procurement through portfolio analysis. Because the difference in cost between Alternate A and Alternate B are minimal when compared to the overall cost of the system, only one alternative, Alternate A has been fully developed.

Because of the sheer scope of the project, and a lack of complete funding from Massport for the total amount, procurement of the project as a single large civil works project would not be feasible. When the project is viewed as a portfolio of smaller projects, it is possible to understand where additional funding could be found. Each portion of the project could be procured utilizing a different method.

4.5.1 Single Large Project

When the project is packaged as a single, large civil works project, it is not only a daunting project in scope, but more importantly, it may not be prudent. The strength of the Infrastructure Development Group's vision is based upon a phased approach and the interaction of numerous government agencies. The phased approach would provide a more accurate means for predicting demand, and thus the potential revenues associated with the project. Should the bus service provided under Phases I and II meet any expected demand and prove profitable, the full build scenario might be unwarranted. However, the forecasts developed through this service might indicate higher ridership and revenue potential than originally anticipated. Should this happen, then the conditions would be even more favorable for the construction of the Phase III system.

Even with a phased approach and a single final project, the Intermodal Transit Connector will be a nearly $1 billion project. Although Massport may possess the capital required for this type of investment, it could probably not allocate this much money to a single project. The scope of their overall operations requires that numerous projects are continually underway across all areas of their operations. The success of the Phase III system will depend upon outside sources of capital. With a single large project, it is difficult to solicit funding from other agencies. Typically when money is made available, it is linked to specific actions or projects. Without differentiation, any funding would go towards the overall costs of the project. This apparent flexibility might thwart efforts to entice others to help fund the project. Associated with the linking of funding is control. Those providing the capital would surely want some control over the portions with which they were involved. A large project would not provide many interfaces where this could be accomplished without tremendous friction.

4.5.2 Portfolio of Projects

When the Intermodal Transit Connector is viewed as a portfolio of smaller projects, it is much easier to understand how potential funding sources can be incorporated into the project. A number of local, state and federal groups and agencies could have the potential to be of assistance. The largest of these is the federal government through the Department of Transportation, specifically the Federal Transit Administration. Currently funds are available through the ISTEA legislation and future funding will most likely be available through some similar appropriations legislation. The Massachusetts Bay Transportation Authority (MBTA) is intimately involved in transportation issues in Boston and is presently constructing the Transitway, a potential link in the system. The Central Artery/Tunnel project presently has a tremendous impact on local construction and transportation and some changes could be incorporated into their work. Another public sector source could be the Massachusetts State Highway Department, either for temporary road construction or for maintenance activities. The final source could be the private sector. If viable, stand alone packages could be produced that had reliable revenue streams, there might be the potential for private sector investment. When the project is broken down into more manageable parcels, potentially these other entities could be associated with particular sections. If they recognized their importance and could envision the role they could play through their interaction, these additional sponsors could become vital to the success of the overall project.

4.5.3 One Potential Package

The financial pro-forma was prepared using the CHOICES Model. To successfully utilize the program, the entire Intermodal Transit Connector project was broken down into several smaller packages. Each of these was then input as a separate project with its own schedule and funding sources. In all, thirteen packages were put together that pertained to the overall success of the IMTC. These packages and their total present day (1997) costs are contained in Figure 4-13.

Intermodal Transit Connector Projects

Project #	Project	Strategy	Cost
1	Phase I - Smart Bus Acquisition	DBB	$ 1,560,000
2	Phase I - Smart Tech. Displays	DB	$ 1,240,000
3	Phase I - Bus Maint. Facility Operation	DBB	$ 800,000 /year
4	World Trade Center Tunnel Access	DBB	$ 3,000,000
5	Phase II - Additional Buses	DBB	$ 2,400,000
6	Phase II - Smart Tech. - Wood Island	DBB	$ 200,000
7	Phase II - Bus Maint. Facility Operation	DBB	$ 800,000 /year
8	Transitway Extension	DBB	$ 153,000,000
9	Phase III - Guideway	DB	$ 204,000,000
10	Phase III - Fourth Harbor Tunnel	DB	$ 180,000,000
11	Phase III - Stations	DBO	$ 190,000,000
12	Phase III - Maintenance Facility	DBO	$ 5,000,000
13	Phase III - System Wide Elements	DBO	$ 372,410,000

Figure 4-13 IMTC: One Possible Package

Each of these projects was assigned an anticipated construction start date and a corresponding completion date. Operation of each phase was assumed to commence immediately upon completion or procurement of construction activities. Phase I was assigned a start date in the first quarter, or immediately, and would continue through quarter 18, to approximately 2002. Phase II would begin immediately thereafter and would continue for approximately ten years, until quarter 58. Phase III construction activities would be timed such that completion and the first operation of the full build system would be in quarter 59, or approximately 2012. The earliest activity in Phase III would be the installation of the Fourth Harbor Tunnel, to accommodate later guideway construction. The pro-forma analysis was completed through 120 quarters, 30 years from now.

4.5.3.1 Assumptions

A number of funding assumptions were made in an attempt to capitalize on the involvement of these other entities, particularly the public agencies. These assumptions have been made in an attempt to show the potential that may exist and do not represent any existing commitments. Each project was developed with outside funding in mind and should be viewed only as an attempt to attractively package similar components. Bundling in this manner would provide the opportunity for capital investment and an opportunity for each agency to be involved in the design and control of certain aspects of the entire construction program. Figure 4-14 shows the funding assumptions that have been made and the potential commitment from all participating agencies.

Intermodal Transit Connector - Funding Source Commitments

Project #	Project	% Construction	% Operation
1	Phase I - Smart Bus Acquisition		
	Massport Budget	20%	100%
	ISTEA	80%	
2	Phase I - Smart Tech. Displays		
	Massport Budget	20%	100%
	ISTEA	80%	
3	Phase I - Bus Maint. Facility Operation		
	Massport Budget		100%
4	World Trade Center Tunnel Access		
	Central Artery/Tunnel	100%	
	Massachusetts Highway Department		100%
5	Phase II - Additional Buses		
	Massport Budget	20%	100%
	ISTEA	80%	
6	Phase II - Smart Tech. - Wood Island		
	Massport Budget	20%	100%
	ISTEA	80%	
7	Phase II - Bus Maint. Facility Operation		
	Massport Budget		100%
8	Transitway Extension		
	MBTA	100%	100%
9	Phase III - Guideway		
	Massport Bond	25%	
	Massport Budget		100%
	MBTA	25%	
	ISTEA	50%	
10	Phase III - Fourth Harbor Tunnel		
	Massport Bond	25%	
	Massport Budget		100%
	MBTA	25%	
	ISTEA	50%	
11	Phase III - Stations		
	Massport Bond	25%	
	Massport Budget		100%
	MBTA	25%	
	ISTEA	50%	
12	Phase III - Maintenance Facility		
	Massport Bond	50%	
	Massport Budget		100%
	ISTEA	50%	
13	Phase III - System Wide Elements		
	Massport Bond	25%	
	Massport Budget		100%
	MBTA	25%	
	ISTEA	50%	

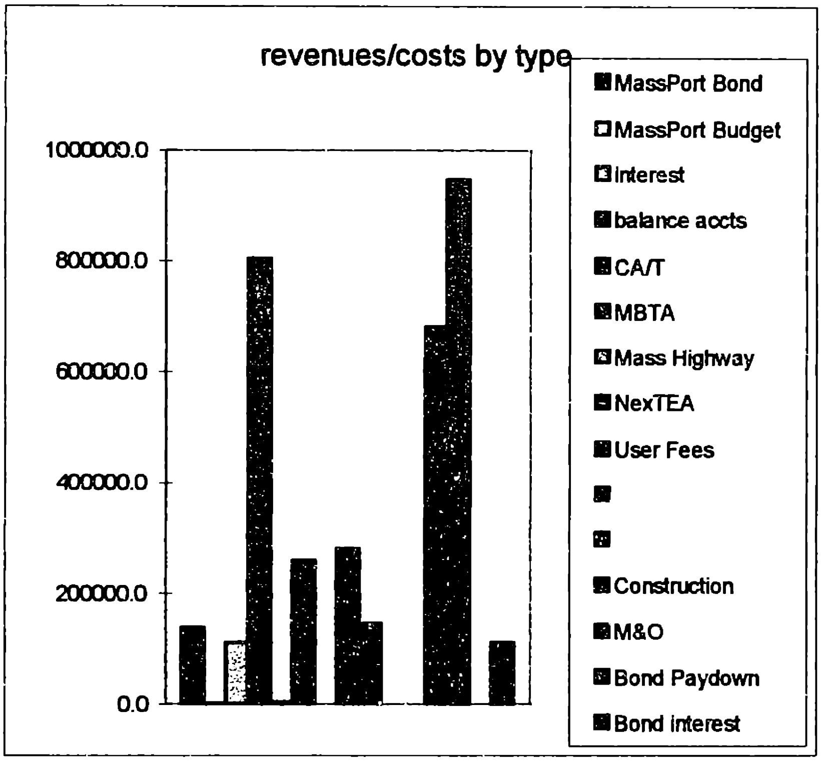
Figure 4-14 Possible Funding Commitments

Other fundamental assumptions included an inflation rate of 3%, a discount rate of 8% and a bond rate for Massport of 8%. These figures are felt to be representative of existing conditions and are most appropriate for this type of analysis. Maintenance and operation was based upon historical data suggesting necessary investment rates to ensure proper operation and prolonged system life. The investment required for each type of procurement varies, as each method places a different emphasis on life-cycle costing and is operated by different parties. The design-bid-build projects use 18% of construction costs as an annual requirement for maintenance and operation. Design-build uses 16.2% and design-build-operate uses only 15.5%. The build-operate transfer method would not cost the owner anything, but in turn, the owner would not receive any revenue from operation.

Revenues from the operation of each phase were also estimated. All estimates used a fare of $5 per trip to the airport. This figure represents approximately ½ the present taxi fare from downtown to the terminals. Phase I estimates are somewhat less accurate as they are based upon 100% recovery of operational costs, yet only assume 133 daily riders during the initial quarter of operation. This number increases to approximately 150 riders per day at the end of Phase I. The projections for Phase II are similarly conservative with daily ridership ranging from 500 to 800 during the ten year operational period. Phase III ridership projections are based upon Massport data regarding present airport access mode shares and projected numbers of passengers in the year 2010.[15] Presently 6% of all passengers arrive by rail transit. The total number of passengers presently is approximately 24 million. This number is expected to rise to approximately 45 million by the year 2010. Phase III ridership assumes that 15% of all passengers arriving in the year 2010 will arrive by rail transit. This number equates to 6.75 million passengers, or nearly 18,500 daily riders. These numbers are dependent both upon increased demand for air travel and the existence of a completed, high quality Intermodal Transit Connector that would connect the terminals with downtown Boston.

4.5.3.2 Financial Analysis Results

The CHOICES Model produced a financial pro-forma for the entire IMTC project. The results indicate that even if funding can be arranged for construction costs, the costs of operation of the system will be substantial. The model converted all the quarterly data using net present value analysis and calculated the present value of all the revenue and cost components of the project. The following graph (Figure 4-15) visually represents these financial components and the sources of funding on a net present value basis.



Class	
MassPort Bond	136613.5
MassPort Budget	998.8
interest	110883.7
balance accts	803863.2
CA/T	2576.3
MBTA	257898.8
Mass Highway	0.0
NexTEA	279918.0
User Fees	144843.5
Subtotal revenues	1739595.9

Construction	[illegible]
M&O	[illegible]
Bond Paydown	[illegible]
Bond interest	[illegible]
Subtotal Costs	[illegible]

Figure 4-15 CHOICES: Massport Revenues and Costs

The figures to the right are the actual present values that the graph is based upon. Construction costs are high, but over the life of the system included in the analysis, the operation of the system becomes a more important factor. The present model assumes that the majority of operational funding would come directly from Massport. The important number to focus upon is what is termed balance accounts. This number represents the capital that Massport, or any other agency, would be required to provide in order to defray the operating deficit. The operation of the system will not provide sufficient revenues to cover all of the operating costs. This difference must be funded in some manner. The balance accounts figure represents this operating loss. The present value of the balance accounts figure is nearly $804 million. This substantial amount is probably more than Massport can support. An additional source of revenue would be probably more than Massport can support. An additional source of revenue would be required. The potential sources could include the MBTA, through cooperative, joint operation, the State of Massachusetts, the federal government through the Federal Transit Administration or more likely, through increased airport taxes or tariffs. Based upon the projected increase in air passengers through the year 2010, an additional per passenger ticket charge could be assessed that would adequately cover this deficit. A minimal increase of $1 - $4 would be sufficient, yet would probably not adversely affect overall passenger volume as it is minimal compared to the present cost of air travel. It is also possible that additional Massport budget funding could be allocated to defray these costs. The present assumed investment in the IMTC by Massport is primarily limited to bond market funding.

Another useful graph is presented in Figure 4-16. This illustrates when additional funding will be required. Based upon the model and the previous assumptions regarding construction funding, substantial operational deficits and corresponding balance accounts will not be realized until operation of the full build system in approximately 2012.

Additional data from the analysis concerning individual contract data is attached in appendix B.

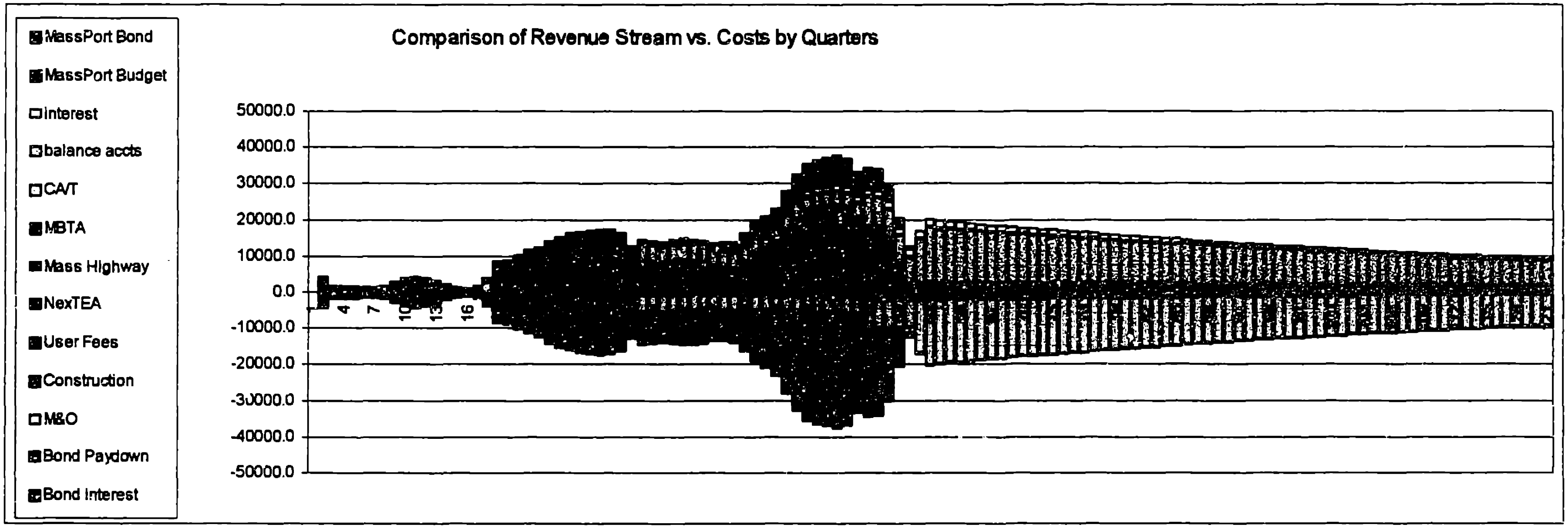


Figure 4-16 CHOICES: Massport Quarterly Data

4.6 Conclusions

The proposed IMTC package and the associated portfolio of projects illustrates the potential feasibility of such a system. Although many obstacles exist that prohibit the immediate commencement of the project, it may be possible to assemble the pieces in a manner that allows for completion of the project. The use of portfolio analysis is particularly helpful in its ability to separate individual aspects of the project. This compartmentalization allows for the inclusion of several non-Massport funding sources. It also should allow for the maximization of benefits for the entire system through the utilization of multiple delivery methods.

4.6.1 Potential Problems

The proposed system developed by the Infrastructure Development Research Group is certainly preliminary and based upon the need for more effective movement of people at Logan airport coupled with existing conditions in and around Boston. As presently envisioned, a number of hurdles exist that would need to be cleared before the project could be realized.

4.6.1.1 Funding

Perhaps the most important issue is that of funding. Without sufficient resources for design and construction, the system could never be completed. Maybe just as is important however is ensuring the availability of funding for operation. Because the revenues from operation cannot fully fund the entire project, a complete Build-Operate-Transfer contract strategy is not practical. The uncertainty surrounding future revenues is one of the major reasons that a phased approach is recommended. Each successive phase will demonstrate the ability, or lack there of, to construct the system with heavy reliance upon operational income. Another benefit of the phased approach is to provide additional time to explore outside capital sources. Primarily this would include the use of Federal Transit Administration funding, but would also include local agency participation. Through the use of financial analysis, including various assumptions regarding funding, it can be shown that the possibility of completion exists. Whether the proposed sources can commit the capital and negotiate the manner in which they will be involved remains as the central issue.

4.6.1.2 Technical Issues

A number of substantial technical issues remain that could prevent completion of the project. The ramifications of the full build system, including an additional tunnel under the harbor are not fully understood. The impact that this system would have on the environment, local communities and regional transportation cannot be accurately predicted without additional study and modeling. The system as proposed is bound to have some associated non-financial costs. Understanding and mitigating these costs will be challenging and time consuming.

In order to construct the proposed system with a phased approach, a number of specific technical issues will need to be addressed. Phase II operation requires that the buses to and from the airport operate inside the newly opened Transitway. Although dimensionally possible, the ventilation system may not permit any fossil fuel vehicle systems. Either the ventilation will need to be upgraded, or an alternative form of vehicle must be utilized that is capable of dual-mode operation.

Other design related areas will require substantial deliberation. Regarding the airport itself, the layout of the airport does not easily facilitate a people mover system that provides quick, effective access to all the existing terminals. At terminals A and E, design changes could be accommodated through planned renovations, but the remaining terminals provide particular challenge. Should the system be installed above ground in an elevated fashion, or would placing the system underground be more prudent? Construction would certainly provide additional challenges, but it might preserve options for later development. The system must be able to deliver passengers as close to the arrival and departure gates as possible, but it should also serve other functions. Two particular services that should be accommodated include the rental cars and existing hotels. Incorporation of these other services into the system will make it more viable and user friendly.

The final area of concern is how it will interface with existing MBTA systems around Boston. The viability of the entire system depends upon its place in the overall regional transportation system. The MBTA connections, the Blue line to the north and the Red line to the west, are especially critical as they provide direct access to downtown Boston. Assuming all these technical interface issues can be properly addressed, one of the associated agencies will have to assume operational control of the system.

4.6.1.3 Interface among agencies

The complete system, and to a lesser extent the first two phases, is dependent upon cooperation among all the local agencies that have transportation responsibilities. Regardless of the combination of funding sources, success of the project will require input from Massport, the Massachusetts Bay Transportation Authority, the Massachusetts Highway Department and the Central Artery/Tunnel project. Control of the final installation will be especially important. The operation of the system subsequent to construction completion will necessitate joint operation or a clear understanding of where responsibilities lie and an acceptance of those responsibilities. It is clear that should any of these local entities be unwilling or unable to participate in the planning, construction and operation of the project, it is unlikely that it would be completed. Traditionally these agencies have all been autonomous and rather unwilling to work cooperatively. As total capital resources continue to dwindle, the need to be more interactive may become more apparent. Hopefully external pressures will induce them to be creative and supportive of the overall goal - completion of the Intermodal Transit Connector.

4.6.2 Portfolio Feasibility

Systematic analysis of the overall project as a portfolio of individual projects allows a number of things to occur. The ability to inspect each portion and understand its sensitivity to changes provides a clearer picture. This closer inspection allows for the most appropriate assignment or risks and selection of the most appropriate procurement method in relation to the overall system procurement. Perhaps most importantly, in a situation such as the IMTC, where the owner does not possess the financial ability to completely fund the project, the use of portfolio planning allows for greater flexibility. The ability to involve other investors, from both the public and private sectors, may be crucial to the success of the project. The pieces of the portfolio can be combined in a manner that makes certain portions attractive to outside investment, while other parts can be completed by the owner. The owner is able to bundle risk and reward so that it is manageable for a variety of parties. The IMTC case exemplifies this potential through the utilization of MBTA, Central Artery, Massachusetts Highway Department, Federal Transit Administration, Massport and potential private sector capital.

5. Results and Conclusions

5.1 Issues

Through review of these two projects and knowledge of the various procurement strategies, it becomes obvious that any selection process requires careful analysis of the issues surrounding a project. While the availability of capital is extremely important, it is not the only concern and in many cases may not be the issue that requires the most attention. Each of these issues plays an important role in the ultimate success or failure of the project. They are often inter-dependent and must not be addressed individually, but rather dynamically as a system or variables.

5.1.1 Life Cycle Costing

The importance placed upon life cycle costing plays a tremendous role in the selection process. To truly achieve effective influence on design, the operations must be included with design. Even so, if the operational period is not sufficient in length, the degree of influence afforded operations in the design will be minimized. This relationship among contractual entities needs to be addressed not only in desire, but must be backed up through the terms of the contract. The incentives that are to be built into the contract must be consistent and provide ample economic stimulus to encourage life cycle costing if it is in fact a high priority. A desire to reap the benefits of this interaction is not enough. The desire must be fully understood and properly articulated to achieve any tangible results.

5.1.2 Relationships

The role played by relationships created through the contractual form can provide beneficial results if addressed as a priority. Alternatively if potential problems regarding these relationships are not adequately explored, the consequences can prove disastrous. It is not imperative that the relationships be leveraged to the maximum extent, but if they are ignored other benefits may be offset. Contractual forms that stem from other priorities need to also address the manner in which these relationships can develop. Tren Urbano offers an example of how these relationships may not be working to the advantage of the owner. The primary concerns were elsewhere and the issues regarding these relationships appear to have been predominantly viewed as either unimportant or of secondary concern. The net result is that the incentives built into any contract must be support and promote these relationships and their impact on the project.

5.1.3 Time

One of the benefits of emerging delivery methods is the ability to get projects completed quickly. This is true not just in the construction process, but often more importantly in the design and procurement stages. Owners must learn to be careful when attempting to optimize this variable. If this is seen as the only concern, other aspects will tend to be neglected and unexpected problems may develop. These may surface in the functionality of the relationships, the cost or quality or the project or in the owner's ability to create the project that was envisioned. Time may well be the most important factor in the selection process, but it is only one of many factors that contribute to the success of the project.

5.1.4 Costs, Revenues & Funding

Although the selection process contains many variables, financing will continue to play a dominant role. The availability of capital for the various stages of an infrastructure development project is tantamount. Without funding for each step of the process, from conceptual design to long term operation, any project will be destined for failure. The source and timing of this capital may be the key component that allows flexibility. Alternative delivery strategies are dependent upon sources of capital and cash flows that differ from historical patterns. Prediction of revenues and costs becomes crucial in the selection process. Because certain strategies, in particular build-operate-transfer, are dependent upon viable, steady revenue streams, an understanding of future revenues, costs and their variability, is imperative. Demonstration of financial viability will be an important step in attracting private sector involvement.

5.1.5 Flexibility

Owner requirements play a vital role in the development of a project. The amount of control required by the owner is a crucial variable. For instance, a goal of high quality service may conflict with a goal of greater access for the those with restricted income. This difference in priorities may require that the owner retain control, rather than allow profitability to be the determinant. Because each delivery method allows vary degrees of control and owner interaction throughout the development and construction process, the issue of flexibility becomes important. Conscious decisions regarding control and ability to make changes must be made early in the selection process. The ability of the private sector to make design decisions that may not increase profit is questionable. The reverse of this concern relates to the ability of a potential design-builder or franchisee to impact the actual design. Early decisions may limit the range of future options, including technology employed, and thus decrease the possibility of creating the optimal system. The control vs. innovation dilemma will not disappear, but rather become more important to address as the pace of technology development quickens.

5.1.6 Private Sector Involvement

Recently the private sector has expressed its willingness to take a more complex and involved role in the entire construction process. Undoubtedly this stems from the realization that additional work, and theoretically additional profit is available. With dwindling capital resources, the public sector will need to become increasingly more reliant upon private sector investment. The willingness of the private sector to participate should be seen as an opportunity. It is important however to recognize the degree to which additional participants will remain interested. This to a discussion of risk and associated reward. As always, those that are best able to handle a certain risk, should also be responsible for that risk. If this axiom is assumed to be correct, then it is logical to understand the private sector's perception. These new participants are willing to accept risks, but are becoming increasingly cognizant of how risks are associated with reward and how they can be controlled. They are therefore not willing to accept risk just because the potential reward is great. As alternative delivery methods become more prevalent, they will need to be packaged in a manner that allows those involved to control their own risks. This will include to a large degree, risks associated with future revenues. Because the ability to control these risks may not exist, certain minimum revenue guarantees will need to be provided to make the project attractive to the private sector. This assumption of risk by the owner is appropriate, as the success of the entire project may depend upon revenues. The public sector owners will need to be able to recognize this and other risks to properly package their projects.

5.2 Preferred Strategy

Through the continued use of traditional and non-traditional procurement strategies, it is apparent that they can all be useful. The utilization of these methods depends upon the local conditions and the requirements of the owner. These strategies can be viewed as an additional resource to push the frontier of infrastructure development.

5.2.1 Options Are Best

Because construction and infrastructure development is based upon projects with tremendous variability, it would be unreasonable to assume that a single procurement strategy is best suited for all projects. Each project is "one away" in that it has unique characteristics. Even a nearly identical system to be installed in two locations to serve similar needs and capacities will have different geographical and political constraints. It is thus impossible to perfect a single strategy that can be applied carte blanche to all construction.

Each basic strategy has the potential to be a viable method for delivering infrastructure. The methods need to be applied judiciously to be effective. As the advantages and disadvantages are explored for a particular project, one or more of the methods should become an obvious choice. Other methods will likewise become less attractive. A technique that continually re-examines the consequences of previous decisions produces a more in depth understanding of the process and potential outcomes. It is this iterative process that explores various combinations and their associated strengths and weaknesses that is essential for the proper application of each method. To exclude one or more methods just because they are rarely used would not be prudent. In fact, it may be the occasional utilization of the more systemized strategies that will allow a greater number of projects to be completed. If the overall goal is to meet present and future infrastructure demands, these alternative delivery vehicles cannot be ignored.

5.2.2 Use of the Entire Range of Strategies

Large infrastructure problems provide additional opportunity for the use of non-traditional procurement strategies. This does not imply that such projects should be packaged in a manner that does not properly bundle risk and reward. The real opportunity lies in the ability to view these large projects as a portfolio of smaller, more manageable projects. This approach allows for the use of numerous strategies within the context of a single large project. Individual requirements can be developed for each project within the portfolio and an associated procurement method can be selected. Project planning through this portfolio method may allow for the use of more systemized strategies for parts and parcels of the overall project. This is especially true where a steady stream revenue can be expected from the operation of the final system or project, yet the costs of the entire system are too great to entice qualified private sector interest. When each project can be appropriately packaged, it will be possible to attract additional capital investors. Access to new sources of capital will provide greater flexibility throughout the planning and project development process. This in turn should allow for an increase in the number of projects that can be undertaken.

5.2.3 The Growth of Portfolio Strategies

The use of alternative delivery methods and portfolio planning will allow for more creative solutions and ultimately make private sector investment in public infrastructure projects more attractive. With the decreasing availability of public capital to meet present and future requirements, the opportunity to involve additional participants should not be overlooked. The emergence and proven viability of alternative delivery methods provides a tool to make this happen.

Appendix A: CHOICES Data - Tren Urbano

CHOICES Data - Tren Urbano - Increased Maintenance

Project #	1	Bayamon	DB	PRHTA Bond		25536.1
Project #	1	Bayamon	DB	PRHTA Budget		15625.6
Project #	1	Bayamon	DB	interest		21642.4
Project #	1	Bayamon	DB	balance accts		59649.3
Project #	1	Bayamon	DB	ISTEA		19638.4
Project #	1	Bayamon	DB			0.0
Project #	1	Bayamon	DB		0	0.0
Project #	1	Bayamon	DB			0.0
Project #	1	Bayamon	DB	User Fees		0.0
Project #	1	Bayamon	DB	Subtotal revenues		142091.9
Project #	1	Bayamon	DB	Construction		60800.1
Project #	1	Bayamon	DB	M&O		56566.5
Project #	1	Bayamon	DB	Bond Paydown		3082.8
Project #	1	Bayamon	DB	Bond interest		21642.4
Project #	1	Bayamon	DB	Subtotal Costs		142091.9
Project #	2	Rio Bayamon	DB	PRHTA Bond		13894.6
Project #	2	Rio Bayamon	DB	PRHTA Budget		8502.2
Project #	2	Rio Bayamon	DB	interest		11776.0
Project #	2	Rio Bayamon	DB	balance accts		32456.3
Project #	2	Rio Bayamon	DB	ISTEA		10685.6
Project #	2	Rio Bayamon	DB			0.0
Project #	2	Rio Bayamon	DB			0.0
Project #	2	Rio Bayamon	DB			0.0
Project #	2	Rio Bayamon	DB	User Fees		0.0
Project #	2	Rio Bayamon	DB	Subtotal revenues		77314.7
Project #	2	Rio Bayamon	DB	Construction		33082.4
Project #	2	Rio Bayamon	DB	M&O		30778.9
Project #	2	Rio Bayamon	DB	Bond Paydown		1677.4
Project #	2	Rio Bayamon	DB	Bond interest		11776.0
Project #	2	Rio Bayamon	DB	Subtotal Costs		77314.7
Project #	3	STTT	DBO	PRHTA Bond		188336.6
Project #	3	STTT	DBO	PRHTA Budget		115244.0
Project #	3	STTT	DBO	interest		158446.6
Project #	3	STTT	DBO	balance accts		971660.1
Project #	3	STTT	DBO	ISTEA		144839.8
Project #	3	STTT	DBO			0.0
Project #	3	STTT	DBO			0.0
Project #	3	STTT	DBO			0.0
Project #	3	STTT	DBO	User Fees		154137.4
Project #	3	STTT	DBO	Subtotal revenues		1732664.5
Project #	3	STTT	DBO	Construction		448420.4
Project #	3	STTT	DBO	M&O		1103156.8
Project #	3	STTT	DBO	Bond Paydown		22640.8
Project #	3	STTT	DBO	Bond interest		158446.6
Project #	3	STTT	DBO	Subtotal Costs		1732664.5

Project #	4	Centro Medico	DB	PRHTA Bond	27038.2
Project #	4	Centro Medico	DB	PRHTA Budget	16544.8
Project #	4	Centro Medico	DB	interest	22915.5
Project #	4	Centro Medico	DB	balance accts	63158.1
Project #	4	Centro Medico	DB	ISTEA	20793.6
Project #	4	Centro Medico	DB		0.0
Project #	4	Centro Medico	DB		0.0
Project #	4	Centro Medico	DB		0.0
Project #	4	Centro Medico	DB	User Fees	0.0
Project #	4	Centro Medico	DB	Subtotal revenues	150450.2
Project #	4	Centro Medico	DB	Construction	64376.6
Project #	4	Centro Medico	DB	M&O	59894.0
Project #	4	Centro Medico	DB	Bond Paydown	3264.1
Project #	4	Centro Medico	DB	Bond interest	22915.5
Project #	4	Centro Medico	DB	Subtotal Costs	150450.2
Project #	5	Villa Nevarez	DB	PRHTA Bond	27038.2
Project #	5	Villa Nevarez	DB	PRHTA Budget	16544.8
Project #	5	Villa Nevarez	DB	interest	23679.3
Project #	5	Villa Nevarez	DB	balance accts	63158.1
Project #	5	Villa Nevarez	DB	ISTEA	20793.6
Project #	5	Villa Nevarez	DB		0.0
Project #	5	Villa Nevarez	DB		0.0
Project #	5	Villa Nevarez	DB		0.0
Project #	5	Villa Nevarez	DB	User Fees	0.0
Project #	5	Villa Nevarez	DB	Subtotal revenues	151214.1
Project #	5	Villa Nevarez	DB	Construction	64376.6
Project #	5	Villa Nevarez	DB	M&O	59894.0
Project #	5	Villa Nevarez	DB	Bond Paydown	3264.1
Project #	5	Villa Nevarez	DB	Bond interest	23679.3
Project #	5	Villa Nevarez	DB	Subtotal Costs	151214.1
Project #	6	Rio Piedras	DB	PRHTA Bond	84869.8
Project #	6	Rio Piedras	DB	PRHTA Budget	51932.3
Project #	6	Rio Piedras	DB	interest	74326.8
Project #	6	Rio Piedras	DB	balance accts	198246.3
Project #	6	Rio Piedras	DB	ISTEA	65269.0
Project #	6	Rio Piedras	DB		0.0
Project #	6	Rio Piedras	DB		0.0
Project #	6	Rio Piedras	DB		0.0
Project #	6	Rio Piedras	DB	User Fees	0.0
Project #	6	Rio Piedras	DB	Subtotal revenues	474644.2
Project #	6	Rio Piedras	DB	Construction	202071.1
Project #	6	Rio Piedras	DB	M&O	188000.6
Project #	6	Rio Piedras	DB	Bond Paydown	10245.7
Project #	6	Rio Piedras	DB	Bond interest	74326.8
Project #	6	Rio Piedras	DB	Subtotal Costs	474644.2

Project #	7	Hato Rey	DB	PRHTA Bond	43937.0
Project #	7	Hato Rey	DB	PRHTA Budget	26885.3
Project #	7	Hato Rey	DB	interest	38478.9
Project #	7	Hato Rey	DB	balance accts	102631.9
Project #	7	Hato Rey	DB	ISTEA	33789.7
Project #	7	Hato Rey	DB		0.0
Project #	7	Hato Rey	DB		0.0
Project #	7	Hato Rey	DB		0.0
Project #	7	Hato Rey	DB	User Fees	0.0
Project #	7	Hato Rey	DB	Subtotal revenues	245722.9
Project #	7	Hato Rey	DB	Construction	104612.0
Project #	7	Hato Rey	DB	M&O	97327.7
Project #	7	Hato Rey	DB	Bond Paydown	5304.2
Project #	7	Hato Rey	DB	Bond interest	38478.9
Project #	7	Hato Rey	DB	Subtotal Costs	245722.9
Project #	8	GMAEC	DB	PRHTA Bond	28089.2
Project #	8	GMAEC	DB	PRHTA Budget	17187.9
Project #	8	GMAEC	DB	interest	24589.2
Project #	8	GMAEC	DB	balance accts	3207.2
Project #	8	GMAEC	DB	ISTEA	21602.0
Project #	8	GMAEC	DB		0.0
Project #	8	GMAEC	DB		0.0
Project #	8	GMAEC	DB		0.0
Project #	8	GMAEC	DB	User Fees	0.0
Project #	8	GMAEC	DB	Subtotal revenues	94675.5
Project #	8	GMAEC	DB	Construction	66879.1
Project #	8	GMAEC	DB	M&O	0.0
Project #	8	GMAEC	DB	Bond Paydown	3207.2
Project #	8	GMAEC	DB	Bond interest	24589.2
Project #	8	GMAEC	DB	Subtotal Costs	94675.5

CHOICES Data - Tren Urbano - Low M&O

Project #	1	Bayamon	DB	PRHTA Bond		25536.1
Project #	1	Bayamon	DB	PRHTA Budget		15625.6
Project #	1	Bayamon	DB	interest		21642.4
Project #	1	Bayamon	DB	balance accts		3082.8
Project #	1	Bayamon	DB	ISTEA		19638.4
Project #	1	Bayamon	DB			0.0
Project #	1	Bayamon	DB		0	0.0
Project #	1	Bayamon	DB			0.0
Project #	1	Bayamon	DB	User Fees		0.0
Project #	1	Bayamon	DB	Subtotal revenues		85525.3
Project #	1	Bayamon	DB	Construction		60800.1
Project #	1	Bayamon	DB	M&O		0.0
Project #	1	Bayamon	DB	Bond Paydown		3082.8
Project #	1	Bayamon	DB	Bond interest		21642.4
Project #	1	Bayamon	DB	Subtotal Costs		85525.3
Project #	2	Rio Bayamon	DB	PRHTA Bond		13894.6
Project #	2	Rio Bayamon	DB	PRHTA Budget		8502.2
Project #	2	Rio Bayamon	DB	interest		11776.0
Project #	2	Rio Bayamon	DB	balance accts		1677.4
Project #	2	Rio Bayamon	DB	ISTEA		10685.6
Project #	2	Rio Bayamon	DB			0.0
Project #	2	Rio Bayamon	DB			0.0
Project #	2	Rio Bayamon	DB			0.0
Project #	2	Rio Bayamon	DB	User Fees		0.0
Project #	2	Rio Bayamon	DB	Subtotal revenues		46535.8
Project #	2	Rio Bayamon	DB	Construction		33082.4
Project #	2	Rio Bayamon	DB	M&O		0.0
Project #	2	Rio Bayamon	DB	Bond Paydown		1677.4
Project #	2	Rio Bayamon	DB	Bond interest		11776.0
Project #	2	Rio Bayamon	DB	Subtotal Costs		46535.8
Project #	3	STTT	DBO	PRHTA Bond		188336.6
Project #	3	STTT	DBO	PRHTA Budget		115244.0
Project #	3	STTT	DBO	interest		158446.6
Project #	3	STTT	DBO	balance accts		1048630.2
Project #	3	STTT	DBO	ISTEA		144839.8
Project #	3	STTT	DBO			0.0
Project #	3	STTT	DBO			0.0
Project #	3	STTT	DBO			0.0
Project #	3	STTT	DBO	User Fees		169994.5
Project #	3	STTT	DBO	Subtotal revenues		1825491.7
Project #	3	STTT	DBO	Construction		448420.4
Project #	3	STTT	DBO	M&O		1195983.9
Project #	3	STTT	DBO	Bond Paydown		22640.8
Project #	3	STTT	DBO	Bond interest		158446.6
Project #	3	STTT	DBO	Subtotal Costs		1825491.7

Project #	4	Centro Medico	DB	PRHTA Bond	27038.2
Project #	4	Centro Medico	DB	PRHTA Budget	16544.8
Project #	4	Centro Medico	DB	interest	22915.5
Project #	4	Centro Medico	DB	balance accts	3264.1
Project #	4	Centro Medico	DB	ISTEA	20793.6
Project #	4	Centro Medico	DB		0.0
Project #	4	Centro Medico	DB		0.0
Project #	4	Centro Medico	DB		0.0
Project #	4	Centro Medico	DB	User Fees	0.0
Project #	4	Centro Medico	DB	Subtotal revenues	90556.2
Project #	4	Centro Medico	DB	Construction	64376.6
Project #	4	Centro Medico	DB	M&O	0.0
Project #	4	Centro Medico	DB	Bond Paydown	3264.1
Project #	4	Centro Medico	DB	Bond interest	22915.5
Project #	4	Centro Medico	DB	Subtotal Costs	90556.2
Project #	5	Villa Nevarez	DB	PRHTA Bond	27038.2
Project #	5	Villa Nevarez	DB	PRHTA Budget	16544.8
Project #	5	Villa Nevarez	DB	interest	23679.3
Project #	5	Villa Nevarez	DB	balance accts	3264.1
Project #	5	Villa Nevarez	DB	ISTEA	20793.6
Project #	5	Villa Nevarez	DB		0.0
Project #	5	Villa Nevarez	DB		0.0
Project #	5	Villa Nevarez	DB		0.0
Project #	5	Villa Nevarez	DB	User Fees	0.0
Project #	5	Villa Nevarez	DB	Subtotal revenues	91320.1
Project #	5	Villa Nevarez	DB	Construction	64376.6
Project #	5	Villa Nevarez	DB	M&O	0.0
Project #	5	Villa Nevarez	DB	Bond Paydown	3264.1
Project #	5	Villa Nevarez	DB	Bond interest	23679.3
Project #	5	Villa Nevarez	DB	Subtotal Costs	91320.1
Project #	6	Rio Piedras	DB	PRHTA Bond	84869.8
Project #	6	Rio Piedras	DB	PRHTA Budget	51932.3
Project #	6	Rio Piedras	DB	interest	74326.8
Project #	6	Rio Piedras	DB	balance accts	10245.7
Project #	6	Rio Piedras	DB	ISTEA	65269.0
Project #	6	Rio Piedras	DB		0.0
Project #	6	Rio Piedras	DB		0.0
Project #	6	Rio Piedras	DB		0.0
Project #	6	Rio Piedras	DB	User Fees	0.0
Project #	6	Rio Piedras	DB	Subtotal revenues	286643.6
Project #	6	Rio Piedras	DB	Construction	202071.1
Project #	6	Rio Piedras	DB	M&O	0.0
Project #	6	Rio Piedras	DB	Bond Paydown	10245.7
Project #	6	Rio Piedras	DB	Bond interest	74326.8
Project #	6	Rio Piedras	DB	Subtotal Costs	286643.6

Project #	7	Hato Rey	DB	PRHTA Bond	43937.0
Project #	7	Hato Rey	DB	PRHTA Budget	26885.3
Project #	7	Hato Rey	DB	interest	38478.9
Project #	7	Hato Rey	DB	balance accts	5304.2
Project #	7	Hato Rey	DB	ISTEA	33789.7
Project #	7	Hato Rey	DB		0.0
Project #	7	Hato Rey	DB		0.0
Project #	7	Hato Rey	DB		0.0
Project #	7	Hato Rey	DB	User Fees	0.0
Project #	7	Hato Rey	DB	Subtotal revenues	148395.1
Project #	7	Hato Rey	DB	Construction	104612.0
Project #	7	Hato Rey	DB	M&O	0.0
Project #	7	Hato Rey	DB	Bond Paydown	5304.2
Project #	7	Hato Rey	DB	Bond interest	38478.9
Project #	7	Hato Rey	DB	Subtotal Costs	148395.1
Project #	8	GMAEC	DB	PRHTA Bond	28089.2
Project #	8	GMAEC	DB	PRHTA Budget	17187.9
Project #	8	GMAEC	DB	interest	24589.2
Project #	8	GMAEC	DB	balance accts	3207.2
Project #	8	GMAEC	DB	ISTEA	21602.0
Project #	8	GMAEC	DB		0.0
Project #	8	GMAEC	DB		0.0
Project #	8	GMAEC	DB		0.0
Project #	8	GMAEC	DB	User Fees	0.0
Project #	8	GMAEC	DB	Subtotal revenues	94675.5
Project #	8	GMAEC	DB	Construction	66879.1
Project #	8	GMAEC	DB	M&O	0.0
Project #	8	GMAEC	DB	Bond Paydown	3207.2
Project #	8	GMAEC	DB	Bond interest	24589.2
Project #	8	GMAEC	DB	Subtotal Costs	94675.5

Appendix B: Breakdown of IMTC Costs

Logan International Airport Intermodal Transit Connector

Description	Unit	Unit Cost	Quantity	Cost
Phase 1 1997-2002				
Smart Bus Acquisition	ea	300,000	5	1,500,000
Technology upgrade to existing buses	ea	10,000	6	60,000
Bus Maintenance Facility Contract	$/yr.	800,000	4.5yrs.	3,600,000
Smart Technology Displays at stops	ls	1,240,000		1,240,000
WTC Airportbound Tunnel Access Road/Ramp	ls	3,000,000		3,000,000
Total Cost Phase I				9,400,000
Phase II 2002-2012				
Addition Smart Bus Acquisitions	ea	300,000	8	2,400,000
Bus Maintenance Facility Contract	$/yr.	800,000	10 yrs.	8,000,000
Additional Smart Technology Display at Wood Island	ls	200,000		200,000
Total Cost Phase II				10,600,000

Phase III-Elevated Alignment at Terminals 2012				5,400,000
ALTERNATE A				
Stations				
Boylston-South St. Transitway Station and Track Conv.	ls	152,811,259		152,811,259
Hyatt/Water Shuttle	ls	5,370,000		5,370,000
Car Rental Consolidation Station	ls	5,370,000		5,370,000
Terminal A/B Station	ls	5,370,000		5,370,000
Terminal C Station	ls	5,370,000		5,370,000
Terminal E	ls	5,370,000		5,370,000
Wood Island Station improvements	ls	10,000,000		10,000,000
Total Station Costs				189,661,259
Systems				
Vehicles	ea	1,815,000	9	16,335,000
Guideway Equipment	ls	65,956,000		65,956,000
Power Distribution	ls	56,724,000		56,724,000
Command Control Communications	ls	56,896,000		56,896,000
Station Equipment	ls	6,696,000		6,696,000
Maintenance Equipment and Supplies	ls	24,580,000		24,580,000
Supplier Proj. Management & Design	ls	104,676,000		104,676,000
Subtotal				331,863,000
Vendor contingency	%	10%		33,186,300
Sub-Stations	ea(min)	460,000	16	7,360,000
Total System Cost				372,409,300
Guideway Systems-Full length dual lane				
Maintenance Facility	ls(min)	5,000,000		5,000,000
Elevated Guideway	lane-ft	4,046	5000	20,230,000
At Grade Guideway	lane-ft	2,700	6200	16,740,000
Guideway From WTC thru Tube	lane-ft	4,046	5700	23,062,200
Guideway Extension in Transitway btwn WTC & S. Sta.	lane-ft	4,046	5280	21,362,880
Subtotal				86,395,080
Mobilization	%	4%		3,455,803
M&PT	%	6%		5,183,705
Utility Relocation	%	12%		10,367,410
MBTA Track Support/Protection	Allow.	1,000,000		1,000,000
Landscape	%	3%		2,591,852
Cross Bay Tube	ls	180,000,000		180,000,000
Total Guideway cost, including Maint. Fac. & Tube				288,993,850
Total Phase III Cost				851,064,409

Phase III-Underground Alignment at Terminals 2012

ALTERNATE B

Stations				
Boylston-South St. Transitway Station and Track Conv.	ls	152,811,259		152,811,259
Hyatt/Water Shuttle	ls	5,370,000		5,370,000
Car Rental Consolidation Station	ls	5,370,000		5,370,000
Terminal A/B Station	ls	29,400,000		29,400,000
Terminal C Station	ls	29,400,000		29,400,000
Terminal E	ls	29,400,000		29,400,000
Wood Island Station improvements	ls	10,000,000		10,000,000
Total Station Costs				261,751,259
Systems				
Vehicles	ea	1,815,000	9	16,335,000
Guideway Equipment	ls	65,956,000		65,956,000
Power Distribution	ls	56,724,000		56,724,000
Command Control Communications	ls	56,896,000		56,896,000
Station Equipment	ls	6,696,000		6,696,000
Maintenance Equipment and Supplies	ls	24,580,000		24,580,000
Supplier Proj. Management & Design	ls	104,676,000		104,676,000
Subtotal				331,863,000
Vendor contingency	%	10%		33,186,300
Sub-Stations	ea(min)	460,000	16	7,360,000
Total System Cost				372,409,300
Guideway Systems-Full length dual lane				
Maintenance Facility	ls(min)	5,000,000		5,000,000
Underground Guideway-At Terminals	lane-ft	16,593	2160	35,840,880
At Grade Guideway	lane-ft	2,700	6200	16,740,000
Guideway From WTC thru Tube	lane-ft	4,046	7100	28,726,600
Guideway Extension in Transitway btwn WTC & S. Sta.	lane-ft	4,046	5280	21,362,880
Subtotal				107,670,360
Mobilization	%	4%		4,306,814
M&PT	%	6%		6,460,222
Utility Relocation	%	12%		12,920,443
MBTA Track Support/Protection	Allow.	1,000,000		1,000,000
Landscape	%	3%		3,230,111
Cross Bay Tube	ls	250,000,000		250,000,000
Total Guideway cost, including Maint. Fac. & Tube				385,587,950
Total Phase III Cost				1,019,748,509

Key to Information Source:	MPA	Massport Documents
	MBTA	MBTA Documents
	JBM	John B. Miller estimate

Appendix C: CHOICES Data - Massport

Project #	1	Phase I - Smart Bus Acquisition	DBB	Massport Bond	0.0
Project #	1	Phase I - Smart Bus Acquisition	DBB	Massport Budget	298.1
Project #	1	Phase I - Smart Bus Acquisition	DBB	interest	0.0
Project #	1	Phase I - Smart Bus Acquisition	DBB	balance accts	0.0
Project #	1	Phase I - Smart Bus Acquisition	DBB	CA/T	0.0
Project #	1	Phase I - Smart Bus Acquisition	DBB	MBTA	0.0
Project #	1	Phase I - Smart Bus Acquisition	DBB	Mass Highway	0.0
Project #	1	Phase I - Smart Bus Acquisition	DBB	ISTEA	1192.3
Project #	1	Phase I - Smart Bus Acquisition	DBB	User Fees	920.2
Project #	1	Phase I - Smart Bus Acquisition	DBB	Subtotal revenues	2410.6
Project #	1	Phase I - Smart Bus Acquisition	DBB	Construction	1490.4
Project #	1	Phase I - Smart Bus Acquisition	DBB	M&O	920.2
Project #	1	Phase I - Smart Bus Acquisition	DBB	Bond Paydown	0.0
Project #	1	Phase I - Smart Bus Acquisition	DBB	Bond interest	0.0
Project #	1	Phase I - Smart Bus Acquisition	DBB	Subtotal Costs	2410.6
Project #	2	Phase I - Smart Tech. Displays	DB	Massport Bond	0.0
Project #	2	Phase I - Smart Tech. Displays	DB	Massport Budget	248.0
Project #	2	Phase I - Smart Tech. Displays	DB	interest	0.0
Project #	2	Phase I - Smart Tech. Displays	DB	balance accts	765.5
Project #	2	Phase I - Smart Tech. Displays	DB	CA/T	0.0
Project #	2	Phase I - Smart Tech. Displays	DB	MBTA	0.0
Project #	2	Phase I - Smart Tech. Displays	DB	Mass Highway	0.0
Project #	2	Phase I - Smart Tech. Displays	DB	ISTEA	992.0
Project #	2	Phase I - Smart Tech. Displays	DB	User Fees	0.0
Project #	2	Phase I - Smart Tech. Displays	DB	Subtotal revenues	2005.4
Project #	2	Phase I - Smart Tech. Displays	DB	Construction	1240.0
Project #	2	Phase I - Smart Tech. Displays	DB	M&O	765.5
Project #	2	Phase I - Smart Tech. Displays	DB	Bond Paydown	0.0
Project #	2	Phase I - Smart Tech. Displays	DB	Bond interest	0.0
Project #	2	Phase I - Smart Tech. Displays	DB	Subtotal Costs	2005.4
Project #	3	Phase I - Bus Maintenance Facility	0	Massport Bond	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	Massport Budget	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	interest	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	balance accts	3251.0
Project #	3	Phase I - Bus Maintenance Facility	0	CA/T	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	MBTA	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	Mass Highway	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	ISTEA	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	User Fees	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	Subtotal revenues	3251.0
Project #	3	Phase I - Bus Maintenance Facility	0	Construction	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	M&O	3251.0
Project #	3	Phase I - Bus Maintenance Facility	0	Bond Paydown	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	Bond interest	0.0
Project #	3	Phase I - Bus Maintenance Facility	0	Subtotal Costs	3251.0

Project #	4	WTC Tunnel Access	DBB	Massport Bond	0.0
Project #	4	WTC Tunnel Access	DBB	Massport Budget	0.0
Project #	4	WTC Tunnel Access	DBB	interest	0.0
Project #	4	WTC Tunnel Access	DBB	balance accts	0.0
Project #	4	WTC Tunnel Access	DBB	CA/T	2576.3
Project #	4	WTC Tunnel Access	DBB	MBTA	0.0
Project #	4	WTC Tunnel Access	DBB	Mass Highway	0.0
Project #	4	WTC Tunnel Access	DBB	ISTEA	0.0
Project #	4	WTC Tunnel Access	DBB	User Fees	0.0
Project #	4	WTC Tunnel Access	DBB	Subtotal revenues	2576.3
Project #	4	WTC Tunnel Access	DBB	Construction	2576.3
Project #	4	WTC Tunnel Access	DBB	M&O	0.0
Project #	4	WTC Tunnel Access	DBB	Bond Paydown	0.0
Project #	4	WTC Tunnel Access	DBB	Bond interest	0.0
Project #	4	WTC Tunnel Access	DBB	Subtotal Costs	2576.3
Project #	5	Phase II - Additional Buses	DBB	Massport Bond	0.0
Project #	5	Phase II - Additional Buses	DBB	Massport Budget	416.3
Project #	5	Phase II - Additional Buses	DBB	interest	0.0
Project #	5	Phase II - Additional Buses	DBB	balance accts	0.0
Project #	5	Phase II - Additional Buses	DBB	CA/T	0.0
Project #	5	Phase II - Additional Buses	DBB	MBTA	0.0
Project #	5	Phase II - Additional Buses	DBB	Mass Highway	0.0
Project #	5	Phase II - Additional Buses	DBB	ISTEA	1665.2
Project #	5	Phase II - Additional Buses	DBB	User Fees	6069.0
Project #	5	Phase II - Additional Buses	DBB	Subtotal revenues	8150.6
Project #	5	Phase II - Additional Buses	DBB	Construction	2081.6
Project #	5	Phase II - Additional Buses	DBB	M&O	2427.6
Project #	5	Phase II - Additional Buses	DBB	Bond Paydown	0.0
Project #	5	Phase II - Additional Buses	DBB	Bond interest	0.0
Project #	5	Phase II - Additional Buses	DBB	Subtotal Costs	4509.2
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	Massport Bond	0.0
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	Massport Budget	36.4
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	interest	0.0
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	balance accts	203.6
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	CA/T	0.0
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	MBTA	0.0
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	Mass Highway	0.0
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	ISTEA	145.5
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	User Fees	0.0
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	Subtotal revenues	385.4
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	Construction	181.9
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	M&O	203.6
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	Bond Paydown	0.0
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	Bond interest	0.0
Project #	6	Phase II - Smart Tech. - Wood Island	DBB	Subtotal Costs	385.4

Project #	7	Phase II - Bus Maintenance Operation	DBB	Massport Bond	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	Massport Budget	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	interest	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	balance accts	5089.4
Project #	7	Phase II - Bus Maintenance Operation	DBB	CA/T	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	MBTA	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	Mass Highway	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	ISTEA	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	User Fees	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	Subtotal revenues	5089.4
Project #	7	Phase II - Bus Maintenance Operation	DBB	Construction	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	M&O	5089.4
Project #	7	Phase II - Bus Maintenance Operation	DBB	Bond Paydown	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	Bond interest	0.0
Project #	7	Phase II - Bus Maintenance Operation	DBB	Subtotal Costs	5089.4
Project #	8	Transitway Extension	DBB	Massport Bond	0.0
Project #	8	Transitway Extension	DBB	Massport Budget	0.0
Project #	8	Transitway Extension	DBB	interest	0.0
Project #	8	Transitway Extension	DBB	balance accts	0.0
Project #	8	Transitway Extension	DBB	CA/T	0.0
Project #	8	Transitway Extension	DBB	MBTA	120589.4
Project #	8	Transitway Extension	DBB	Mass Highway	0.0
Project #	8	Transitway Extension	DBB	ISTEA	0.0
Project #	8	Transitway Extension	DBB	User Fees	0.0
Project #	8	Transitway Extension	DBB	Subtotal revenues	120589.4
Project #	8	Transitway Extension	DBB	Construction	120589.4
Project #	8	Transitway Extension	DBB	M&O	0.0
Project #	8	Transitway Extension	DBB	Bond Paydown	0.0
Project #	8	Transitway Extension	DBB	Bond interest	0.0
Project #	8	Transitway Extension	DBB	Subtotal Costs	120589.4
Project #	9	Phase III - Guideway	DB	Massport Bond	29790.2
Project #	9	Phase III - Guideway	DB	Massport Budget	0.0
Project #	9	Phase III - Guideway	DB	interest	23674.5
Project #	9	Phase III - Guideway	DB	balance accts	197196.1
Project #	9	Phase III - Guideway	DB	CA/T	0.0
Project #	9	Phase III - Guideway	DB	MBTA	29790.2
Project #	9	Phase III - Guideway	DB	Mass Highway	0.0
Project #	9	Phase III - Guideway	DB	ISTEA	59580.4
Project #	9	Phase III - Guideway	DB	User Fees	0.0
Project #	9	Phase III - Guideway	DB	Subtotal revenues	340031.4
Project #	9	Phase III - Guideway	DB	Construction	119160.8
Project #	9	Phase III - Guideway	DB	M&O	197196.1
Project #	9	Phase III - Guideway	DB	Bond Paydown	0.0
Project #	9	Phase III - Guideway	DB	Bond interest	23674.5
Project #	9	Phase III - Guideway	DB	Subtotal Costs	340031.4

Project #	10	Fourth Harbor Tunnel	DB	Massport Bond	34476.9
Project #	10	Fourth Harbor Tunnel	DB	Massport Budget	0.0
Project #	10	Fourth Harbor Tunnel	DB	interest	30142.2
Project #	10	Fourth Harbor Tunnel	DB	balance accts	270433.0
Project #	10	Fourth Harbor Tunnel	DB	CA/T	0.0
Project #	10	Fourth Harbor Tunnel	DB	MBTA	34476.9
Project #	10	Fourth Harbor Tunnel	DB	Mass Highway	0.0
Project #	10	Fourth Harbor Tunnel	DB	ISTEA	68953.8
Project #	10	Fourth Harbor Tunnel	DB	User Fees	0.0
Project #	10	Fourth Harbor Tunnel	DB	Subtotal revenues	438482.8
Project #	10	Fourth Harbor Tunnel	DB	Construction	137907.6
Project #	10	Fourth Harbor Tunnel	DB	M&O	270433.0
Project #	10	Fourth Harbor Tunnel	DB	Bond Paydown	0.0
Project #	10	Fourth Harbor Tunnel	DB	Bond interest	30142.2
Project #	10	Fourth Harbor Tunnel	DB	Subtotal Costs	438482.8
Project #	11	Phase III - Stations	DBO	Massport Bond	24474.9
Project #	11	Phase III - Stations	DBO	Massport Budget	0.0
Project #	11	Phase III - Stations	DBO	interest	18704.2
Project #	11	Phase III - Stations	DBO	balance accts	137917.3
Project #	11	Phase III - Stations	DBO	CA/T	0.0
Project #	11	Phase III - Stations	DBO	MBTA	24474.9
Project #	11	Phase III - Stations	DBO	Mass Highway	0.0
Project #	11	Phase III - Stations	DBO	ISTEA	48949.9
Project #	11	Phase III - Stations	DBO	User Fees	15324.1
Project #	11	Phase III - Stations	DBO	Subtotal revenues	269845.3
Project #	11	Phase III - Stations	DBO	Construction	97899.8
Project #	11	Phase III - Stations	DBO	M&O	153241.4
Project #	11	Phase III - Stations	DBO	Bond Paydown	0.0
Project #	11	Phase III - Stations	DBO	Bond interest	18704.2
Project #	11	Phase III - Stations	DBO	Subtotal Costs	269845.3
Project #	12	Phase III - Maintenance Facility	DBO	Massport Bond	1304.1
Project #	12	Phase III - Maintenance Facility	DBO	Massport Budget	0.0
Project #	12	Phase III - Maintenance Facility	DBO	interest	1003.2
Project #	12	Phase III - Maintenance Facility	DBO	balance accts	4127.3
Project #	12	Phase III - Maintenance Facility	DBO	CA/T	0.0
Project #	12	Phase III - Maintenance Facility	DBO	MBTA	0.0
Project #	12	Phase III - Maintenance Facility	DBO	Mass Highway	0.0
Project #	12	Phase III - Maintenance Facility	DBO	ISTEA	1304.1
Project #	12	Phase III - Maintenance Facility	DBO	User Fees	0.0
Project #	12	Phase III - Maintenance Facility	DBO	Subtotal revenues	7738.8
Project #	12	Phase III - Maintenance Facility	DBO	Construction	2608.3
Project #	12	Phase III - Maintenance Facility	DBO	M&O	4127.3
Project #	12	Phase III - Maintenance Facility	DBO	Bond Paydown	0.0
Project #	12	Phase III - Maintenance Facility	DBO	Bond interest	1003.2
Project #	12	Phase III - Maintenance Facility	DBO	Subtotal Costs	7738.8

Project #	13	Phase III - Systems	DBO	Massport Bond	48567.4
Project #	13	Phase III - Systems	DBO	Massport Budget	0.0
Project #	13	Phase III - Systems	DBO	interest	37359.6
Project #	13	Phase III - Systems	DBO	balance accts	184880.1
Project #	13	Phase III - Systems	DBO	CA/T	0.0
Project #	13	Phase III - Systems	DBO	MBTA	48567.4
Project #	13	Phase III - Systems	DBO	Mass Highway	0.0
Project #	13	Phase III - Systems	DBO	ISTEA	97134.7
Project #	13	Phase III - Systems	DBO	User Fees	122530.2
Project #	13	Phase III - Systems	DBO	Subtotal revenues	539039.4
Project #	13	Phase III - Systems	DBO	Construction	194269.4
Project #	13	Phase III - Systems	DBO	M&O	307410.3
Project #	13	Phase III - Systems	DBO	Bond Paydown	0.0
Project #	13	Phase III - Systems	DBO	Bond interest	37359.6
Project #	13	Phase III - Systems	DBO	Subtotal Costs	539039.4

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